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FACTORY SANITATION AND LABOR PROTECTION.

BY C. F. W. DOEHRING, PH. D.

INTRODUCTION.

The welfare of the laboring class has always been a subject of the greatest importance and most far-reaching influence socially and politically. The miserable hygienic conditions existing in the working places in some industries, for example, are unjust to the working classes, and sometimes react with frightful results upon the public. The aspiration of the working classes to improve their condition in respect to sanitation is not only perfectly justifiable, but by all means should be encouraged. With the multiplication of factories the improvement in the lot of the laboring man has become a vital question of the day. Statistics and clear thinking convince him of the dangers to which he is exposed by the conditions of his employment.

Under the influence of long-continued work under insanitary conditions the physiques of the workmen, and especially those employed in factories, often show more or less characteristic marks. The height is usually below medium, the body, weak and thin, is poorly nourished and of sickly paleness. This condition is called lymphatic or anæmic. The spiritual and moral life may likewise become inactive and apathetic. Even the strongest factory workers under such conditions become more or less exhausted before they reach 55 or 60 years of age. Often they are completely wasted and utterly unfit for work at that age. Many of those who work in spinning mills, cloth-printing establishments, and in general in plants where there is a high temperature and lack of pure air, are cut off prematurely. Women suffer even more than men from the stress of such circumstances, and more readily

degenerate. A woman's body is unable to withstand strains, fatigues, and privations as well as a man's. This makes her condition all the worse, because her earnings are correspondingly smaller.

The diseases which most frequently afflict the working class are disturbances of the nutritive and blood-forming processes. Weavers, spinners, and workmen employed in branches of industry, where work is done in close, poorly ventilated, cold, or hot rooms, are especially subject to such diseases. Among the diseases to which workmen in such occupations are most often subject are the so-called inanition, scrofula, rachitis, pulmonary consumption, dropsy, also rheumatic troubles, pleurisy, typhoid fever, gangrene, and the various skin diseases.

Every epidemic, be it typhoid, smallpox, scarlet fever, dysentery, cholera, etc., draws its greatest army of victims from this class. For every death that occurs among the richer and higher classes there are many in the working class. It is the workmen engaged in unhealthy factories first of all who fill the hospitals and their death chambers. Again it is more often the workingwoman who suffers from female troubles, and even cancer. The reasons for the high mortality and shortness of life among the working class can easily be perceived from the foregoing facts. These two evils are always proportionate to the danger and the insanitary conditions existing in the industry.

Loss of health and the shortening of life are looked upon as the severest evils that can be inflicted upon the individual. The working classes themselves often call their condition white slavery, and their factories and workshops slaughterhouses.

All the harmful influences which affect the workingman in his various callings must therefore be thoroughly studied and earnest effort made toward their amelioration or removal, not only that the interests and the health of the weaker members of society may be protected, but also because the health of society in general is both directly and indirectly menaced by insanitary conditions in any industry.

When we go back to those causes to which the nations of the present day owe their advance in culture and social conditions, we find that one of the most important and essential causes of this undeniable advance lies in the deeper recognition of those natural conditions upon which depend the life and well-being of the individual and the prosperous development of society.

The sciences alone would have aided but little in any real elevation of the general conditions of well-being. Science, at times, had to descend from its lofty regions to meet the necessary demands of daily life. It had to make the laws and needs of human existence the object of its most comprehensive researches. It had to bring to light their relation to and connection with the external conditions of life. It is only by means of these that more rational rules of life can be formu-

lated. It is in the manifold transgressions of these laws, in the unreasonable gratifications of certain needs, in the almost criminal ignorance and disregard of injurious influences, that the causes and sources of many evils are to be found. Such evils are especially prevalent in the conditions which surround industrial establishments and their workers.

To understand the evils which threaten the industrial classes and to search for their remedy, is one of the pressing needs of the day. To obtain the correct point of view for the solution of these important questions, an unprejudiced and searching investigation is first of all necessary.

The attention of foreign countries has been for a long time directed to the economic traits of character of the American people, and especially to those industrial traits which aim at the improvement and extension of the methods of production. Nothing is neglected which may protect and raise the interests of industry. But hitherto too little attention has been given to those insanitary factory conditions which imperil the lives and health of the workers. These conditions have arisen largely as the result of the continuous increase of population in manufacturing towns, and they affect not only the workingmen, but also the manufacturers and the whole nation.

The present concentration of population in large manufacturing cities is not in the interest of public hygienic and economic principles in such a measure as might easily be assumed. The characteristic increase of the industries in American cities is nothing if not remarkable. The factory is the symbol of the day, and steam and electricity are the rulers of the present. Our age has learned to utilize the forces of nature and thus has made gigantic steps forward. The more attention is paid to the improvement of the conditions of health of the working class the more surely will those favorable economic results be obtained for which the American strives.

The successful development of factory sanitation and the protection of the workers in factories require—

1. Systematic education in respect to the many dangers which, in certain industries, threaten the workman and the public.

2. The institution of technical preventive measures based upon a sound practical as well as theoretical foundation, and whose aim shall be to remove the causes of all existing evils that injure the health.

Public sentiment is more favorably inclined toward such a problem than at any previous time. There is now in the industrial occupations little of that medieval seclusion which made the discovery of natural laws the closely kept secret of a guild or school, and which always strongly opposed the adoption of new discoveries. The great value of open intercommunication and instruction, in so far as they concern factory sanitation, labor protection, and the preservation of life, is recognized. The exertions and attainments of the individual

under these conditions are thus of greater value to the country at large. They smooth the way for those who aim at similar results and make their attainment more certain.

The inhalation of pure, moderately warm air containing a certain amount of moisture must be considered one of the first conditions for the preservation of the health of the human body. Even the external air varies in its temperature and degree of humidity according to the season of the year and atmospheric conditions. In factory rooms the air suffers many alterations injurious to the workingman. Sometimes these alterations are due to the peculiarity of the industry and the materials consumed. Usually, however, they coincide with the deterioration caused by the exhalations and expectoration of the workmen, and, in winter especially, are hastened by the gas or petroleum illumination. But the air is vitiated not only by the above-mentioned factors, but also by the dust which develops in the various industries and methods of manufacture. The latter may seriously impair the health of the workman and directly or indirectly endanger or shorten his life.

The list below shows the great number of varieties of dust having a more or less injurious influence upon the health. Just as numerous are the gases, which exert their dangerous influence upon the workman, especially in the chemical industry.

The elimination of these dangers involves many very important technical problems. The manner in which these may be best dealt with will be more clearly presented by describing for certain selected industries the preventive measures which should be established and which are representative of the best methods of preventing or overcoming the dangers in other industries. These, with the recognition of the technical variations in the different plants, can easily be applied and adapted to other industries.

In the first place, we must concern ourselves with (*a*) the knowledge of the essence and injurious properties of the dust particles from various sources; (*b*) the arrangements for the removal of these varieties of dust; (*c*) the arrangements for the removal of noxious gases; (*d*) the arrangements for a complete prevention of the generation or diffusion of noxious gases. This must be carried out in quite a different and more practical manner than has hitherto been done either at home or abroad.

An explanatory description of the industry should also be given, so that not only the manufacturer, but the workman as well, may understand the import of these attempts and propositions and see how the defects can be practically removed.

The injurious varieties of dust are the following:

1. Needle-grinding dust (pure steel).
2. Carding dust: (*a*) From a carding factory; (*b*) from a cotton mill.

3. Iron dust arising in emery grinding.
4. Needle-grinding dust (steel and emery).
5. Casting-cleaning dust (taken from the air).
6. Dust from a foundry.
7. Dust rubbed off from the lead weights of Jacquard looms.
8. Bronze dust from lithographic establishments.
9. Granite dust.
10. Marble dust from a sculptor's studio.
11. Syenite dust from a sculptor's studio.
12. Sandstone dust from a stonecutter's establishment.
13. Sandstone dust produced by scraping.
14. Stone dust produced in the construction of millstones.
15. Limestone dust from a stone quarry.
16. Meerschaum dust.
17. Slate dust.
18. Quartose-sand dust in the blast of an enamelled sheet-glass factory.
19. Glass dust in wood-turning dust.
20. Glass and flint dust in a sand-paper factory.
21. Brick dust or crockery dust.
22. Cement dust.
23. Gypsum dust.
24. Basic-slag dust.
25. Mineral-wool dust.
26. Linden-wood dust from a band saw.
27. Cutter's dust from thoroughly dried oak wood.
28. Grinding dust from pine wood.
29. Grinding dust from beech wood.
30. Grinding dust from boxwood.
31. Coal dust.
32. Charcoal dust.
33. Dust from a flax-heckling factory.
34. Hemp-carding dust.
35. Dust from the slubs in hemp spinning.
36. Horsehair dust in balling.
37. Horsehair dust from the mixing machine.
38. Horsehair dust from the air.

Injurious varieties of gas are met with in all chemical and in other industries but it is possible to remove them easily and practically. Of the manifold arrangements for the removal of noxious gases that, for instance, in the etching room of a European metal-ware factory is especially efficient. Openings are made in the walls behind the kettles at a level with the latter's surface and lead to a perpendicular canal from which the noxious gases are sucked by means of a strong fan.

Those arrangements whose purpose is to avoid completely the generation and diffusion of noxious gases do not really belong to the subject of ventilation, for they make special ventilation unnecessary. However, in respect to their effects they can be placed side by side with the improvements which are to be obtained by the way of ventilation. Among these belongs the substitution of plates, heated by

a mixture of air and illuminating gas, for the coal arrangement in silk finishing. The generation of carbon monoxide in the coal scuttles used in drying the foundry form is prevented and diminished by the introduction of air through a system of pipes. This brings about at the same time a complete combustion and a diminution of the smoke.

Abroad, extensive studies have been made in the ventilation and humidification of air in cotton mills. The system employed is probably one of the best that has been introduced in this industry. It makes it possible both in summer and in winter to keep the temperature of the air at the desired point—59° to 63° F. It removes the dust, makes the degree of humidity from 55 to 66 per cent, and completely renews the air of all the working rooms at least three times per hour.

The facts above given indicate how some of the injurious conditions can be removed. The task is to make known and available the experience which has already been gained.

A scheme for the systematic treatment and elaboration of technical preventive measures against the vitiation of the air in any industry should consider:

A. The sources of the contamination of air—

(1) Human transelementation of matter;
(2) The development of carbon dioxide;
(3) The development of aqueous vapor;
(4) Gas illumination;
(5) Other impurities.

B. Quantities of admixtures in air—

(1) Carbon dioxide;
(2) Aqueous vapor;
(3) Dust-forming admixtures.

C. The remedying of the contaminations of the air—

First. By the elimination of noxious gases, fumes, and dust before they can mingle with the respired air;

Second. By rarefaction—

(a) Requisite rarefaction;
(b) The amount of the interchange of air—(1) the ascertainment of the necessary interchange of air, (2) determination of the air supply, (3) necessary quantities of air;
(c) Influence of ventilation upon the humidity—(1) aqueous vapor contents, (2) sweating of the walls, etc., (3) humidification and dehumidification of the air;
(d) Measures for humidifying the air—(1) regulation of the humidification, (2) apparatus for humidification, (3) self-regulating humidification apparatus;
(e) Measures for drying the air.

Third. By introducing fresh air and eliminating vitiated air—

(a) Accidental ventilation—(1) draft, (2) accidental agitation of the air, (3) porosity and permeability of the walls, etc., (4) difference in tensions, (5) difference in temperature, (6) wind;

(b) Artificial ventilation—(1) ventilating openings, (2) the use of windows, (3) the introduction of warm air, (4) the introduction of cold air from below, (5) the introduction of cold air from above, (6) the location of openings for instreaming air, (7) winter and summer ventilation;

(c) The sources of supply of fresh air.

INFLUENCE OF CERTAIN VOCATIONS UPON LENGTH OF LIFE.

The influence of certain vocations upon the length of life of workmen has been the subject of statistical investigations, the results of which are given by Dr. J. Uffelmann, substantially as stated in the succeeding 7 pages, in Eulenburg's Real-Encyclopädie der gesammten Heilkunde, under the heading "Arbeiterhygiene."

The following table shows for each occupation or class the number of deaths out of every hundred deaths of persons over 20 years of age falling within the several ten-year periods of life up to 50 years, and those of persons over 50 years:

PER CENT OF DEATHS OF PERSONS OVER 20 YEARS OF AGE IN EACH SPECIFIED AGE PERIOD.

Occupations and classes of population.	20 to 30 years.	30 to 40 years.	40 to 50 years.	Over 50 years.
Grinders (Solingen, Lennep, and Mettmann)	31.6	26.9	23.4	18.1
Grinders (Sheffield)	28.4	35.1	23.9	12.6
Iron workers (Solingen, etc.)	20.1	16.6	17.4	45.9
Total male population of Solingen, exclusive of metal workers	15.5	12.1	14.0	58.4
Total male population	18.5	15.0	15.9	50.6
Male population in Sheffield	18.4	16.8	16.0	48.8
Male population in the Rhineland, 1816–1860	13.9	11.0	12.9	62.2
Male population in Berlin	18.9	18.4	18.8	45.8
Male population in Prussia, 1816–1860	12.6	11.9	14.6	60.9
Male population in Canton of Geneva	11.5	12.0	13.6	62.9

From the above it can be seen that in certain vocations death occurs much earlier than among the population generally. Among the grinders a very small percentage pass the fiftieth year.

Similar results will be found if the average length of life in other vocations is investigated. Rohé ascertained the average length of life in Massachusetts to be as shown in the following statement:

	Years.
Factory workers	36.3
Craftsmen	50.8
Workingmen (without any definite vocation)	47.4
Farmers	65.3

Hirt computes the average length of life of persons in various occupations as follows:

	Years.
Stonecutters	36.3
Diamond cutters	35.5
Glass grinders	42.5
Agate grinders	45–48
Cotton workers	47–50
Potters	53.1
Gilders	53.8
Printers	54.3
Masons	55.6
Hairdressers	57.9

Oldendorff found the average length of life, of the total mortality, to be as follows:

	Years.
Grinders (Solingen, etc.)	41.4
Dry grinders	40.7
Wet grinders	43.3–44.1
Grinders (Sheffield, 1832)	34
Dry grinders	29–35
Wet grinders	35–38
Grinders (Sheffield, 1876)	46.5–46
Iron workers (Solingen, etc.)	45.8
Smiths (Geneva, 1796–1830)	54.5
Locksmiths (Geneva, 1796–1830)	47.2
Braziers (Geneva, 1796–1830)	52.4
Men over 16 years of age (Geneva, 1796–1830)	55
Locksmiths and blacksmiths (Lübeck)	48.9
Blacksmiths [a]	55.1
Locksmiths [a]	49.1

The average length of life of those who died after the age of 20 years was:

	Years.
Grinders (Solingen, etc.)	42.8
Dry grinders	42
Wet grinders	45.5–46.2
Iron workers (Solingen, etc.)	47.8
Iron workers in a narrower sense	48.4
File cutters	43.8
Filers	46.3
Locksmiths and blacksmiths (Frankfort on the Main, 1820–1852)	46.3
Men in Solingen, etc. (1850–1874)	51.1
Men in Solingen, etc. (1850–1874), exclusive of metal workers	54.4
Men in Westphalia (1816–1860)	55.5
Men in Rhineland (1816–1860)	55.4
Men in Prussia (1316–1860)	54.8
Men in Berlin (1843–1860)	47.8
Men in Frankfort on the Main (1846–1848)	51.7
Men in Canton of Geneva (1838–1855)	58.4

[a] Hirt.

Very characteristic are the following statements obtained from English sources relating to English conditions. In England the average length of life among the higher classes is forty-four years; among the middle classes, twenty-five years; and among the laboring classes, twenty-two years.

The infant mortality among the higher classes is 1 death to every 4½ births; among the middle classes, 1 death to every 2½ births, and among the laboring classes, 1 death to every 2 births.

The mortality in general shows for the whole country (England) 22 out of every 1,000; for the residences of the higher classes, 17 out of every 1,000; for the laboring districts, 36 out of every 1,000.

Ogle calculates that in England the death rate among all men from 25 to 45 years is 10.1. According to occupations it is as follows:

Clergymen	4.6	Typesetters	11.1
Gardeners	5.5	Chimney sweeps	13.7
Bakers	8.7	Brewers	13.9
Locksmiths	9.1	File cutters	15.3
Workers in cotton mills	9.9	Innkeepers and servants	18.0

Very instructive also are the following figures of Ogle, taken from recent calculations. If the mortality among the clergymen is considered as the minimum or equal to 100, then that among other occupations is as follows:

Gardeners	108	Printers	193
Agricultural laborers	126	Bookbinders	210
Fishermen	143	Quarrymen	202
Carpenters	148	Lead workers, painters, glazers	216
Shoemakers	166	Cutlers	235
Bakers and millers	172	Coachmen	267
Masons	174	Brewers	245
Cabinetmakers	173	File cutters	300
Workers in wool manufactures	186	Potters	313
Workers in cotton manufactures	196	Inn servants	397

From these figures the great importance of labor protection from a social as well as an economic point of view is seen. This is especially true when we consider how large a portion of the total population is included in the laboring classes.

Ramazzini, the first to attempt a systematic investigation of industrial diseases (1713), divided the resulting injuries and disturbances of health, according to their causes, into two categories. The one includes those whose causes must be sought in the material employed; the other those which result from the movements, positions of the body, and exertions customary in the work. Both can be considered as the immediate result of employment in certain occupations, or may be called occupational injuries and diseases. To these two may be added a third group, in which the causes of the injurious influences upon the health are found to be due to the unhealthy and unsatisfactory condition of the working room or place of occupation.

As a hygienic precaution the material should be examined from two points of view, (a) whether it is of such a nature that its use gives occasion for the development of dust; (b) whether it is poisonous and in itself consists of substances injurious to the health.

The question of dust generation is of first importance because of the great number of diseases caused by its inhalation. Catarrhs of the respiratory organs are usually the immediate and first result of the inhalation of dust-laden air. These may lead to broncho-blennorrhea, and, subsequently, to pulmonary phthisis. Other disease processes, chronic pneumonia, for example, may also result from long-continued exposure to dust inhalation.

According to Oldendorff, of the total males above 20 years of age in the eight communities of the districts of Solingen, Lennep, and Mettmann, 46 per cent died of pulmonary consumption; among the ironworkers, 59.1 per cent; and among the grinders, 78.3 per cent.

According to Hirt, of 100 diseased workingmen suffering from phthisis, 28 were exposed to metallic dust, 25.2 to mineral dust, 13.3 to vegetable dust, 20.8 to animal dust, 22.6 to mixed dust, and 11.1 to no dust.

Perlen reported that of 1,425 consumptives treated at the Munich Polyclinic, 30 per cent had been exposed to metallic dust, 18 per cent to mineral dust, 26 per cent to vegetable dust, 17 per cent to mixed dust, and 8 per cent to animal dust. This shows that the men exposed to the inhalation of strongly irritating dust contributed the largest percentage of consumptives. Of the flint-stone workers, 80 per cent, and of the millstone workers 40 per cent were attacked by tuberculosis, while of the millers only 10 per cent suffered from it.

It should, however, be stated that dust alone, as such, is not the cause of pulmonary phthisis. Coal dust, for instance, may fill the lungs in masses and even enter into internal organs, such as the liver, spleen, etc., without necessitating any alteration of the tissues or inflammatory conditions. Another cause is directly responsible for the development of tuberculosis, namely, specific infection—bacillus infection. The foreign bodies which enter the lungs in the form of dust may occasion irritation and lead to little erosions. They may even pass through the entire lymphatic and blood circulations without causing tuberculosis. Tuberculosis must not be conceived as caused by these corpuscular elements, though they may be indirectly the occasion for the development of tuberculosis in that they prepare the ground, facilitate the entrance of the bearer of infection—the bacillus tuberculosis—and frequently are themselves the vehicle by means of which the bacillus is introduced into the lungs. Different kinds of dust are not equal in their effects. For the development of pulmonary tuberculosis mineral and especially metallic dusts are the most dangerous, while

that of flour is the least dangerous. This variation probably depends upon the greater or less power of the dust to irritate the mucous membrane and to produce little erosions, but chiefly upon the source of the dust and the opportunities it has of lading itself with infection bearers. Besides, not every chronic affection of the lungs of the industrial workingman which has the symptoms of phthisis is a case of true pulmonary tuberculosis—i. e., a disease depending on the rapid multiplication of the tuberculosis bacillus. This must be especially emphasized, as phthisis and tuberculosis are often considered identical.

A fine fibrous vegetable dust plays a large rôle in the origin of the various catarrhs on account of the ease with which it causes them and the obstinacy of affections of the mucous membrane.

Late investigations seem to point to a connection between dust inhalation and the formation of tumors. In the cobalt mines of Schneeberg, sarcomatous degenerations of the bronchial glands and lungs are said to be the cause of the miners' sickness (*Bergkrankheit*) which reigns there. From an ætiological standpoint, however, the question has not yet been decided.

Besides these common results of dust inhalation, a whole series of other affections of the lungs are due to the entrance of certain particular kinds of dust into the tissues. They usually present the pathological and anatomical symptoms of pneumonoconiosis.

Pneumonoconiosis represents a class of diseases which owe their origin to the inhalation of certain definite kinds of dust, not dust in general. Thus there are the following special forms:

Coal miners' phthisis (*Anthracosis*), lodgings of coal and charcoal dust, soot, or graphite.

Iron phthisis (*Siderosis*), deposits of metallic dust in the lungs in the form of (*a*) ferric oxide, (*b*) magnetic oxide of iron, (*c*) phosphoric oxide of iron, and (*d*) grinding dust (a mixture of steel and sandstone).

Flint phthisis (*Chalicosis*), lodgings of stone dust.

Clay phthisis (*Aluminosis*), lodgings of argillaceous earth dust.

Tobacco phthisis (*Tabacosis*).

Cotton phthisis (*Pneumonia cotoneuse, Byssinosis pulmonum*), lodgings of cotton dust.

It must be mentioned further that the inhalation of dust contained in basic slag, quicklime, various lime salts, and ferrous oxide, induces inflammations of the pulmonary tissues, which run their course with the symptoms of acute or subacute pneumonia.

Yet the respiratory organs do not afford the only means by which the various kinds of dust may exert their injurious effects. Not infrequently the dust particles, which likewise are the bearers of pathogenetic microparasites, gain access to the system through very slight injuries of the skin and cause general diseases (malignant pustules, rag-pickers' diseases, glanders). Finally, the eyes are more or less

exposed to the influences of dust. Often blepharœtidia, conjunctivitis, xerosis, and even severe diseases of the eyes are due to its influences.

The following categories of workmen are those who by the exercise of their vocation may be exposed to the various kinds of dust:

1. Metallic dust.—Brass founders, braziers, coppersmiths, cutlers, dyers, engravers, file cutters, gilders, grinders, lacquer workers, lithographers, locksmiths, molders, nail makers, needle grinders, needle makers, painters, printers, sieve makers, smiths, tinmen, tool smiths, typefounders, watchmakers, zinc white workers.

2. Mineral dust.—Carpenters; cement, diamond, and flint workers; masons, millstone workers, painters, porcelain workers, potters, stonecutters, workers in basic-slag mills.

3. Vegetable dust.—Bakers, candy makers, chimney sweeps, cigar makers, coal dealers, etc., joiners, millers, rope makers, weavers, wheelwrights.

4. Animal dust.—Brush makers, button makers, cloth makers, furriers, hairdressers, hat makers, paperers, saddlers, turners.

5. Mixtures of dust.—Day laborers, glass grinders, glaziers, street cleaners.

A consideration of material which is in itself poisonous is important because of the possibility of its occasioning industrial poisoning. Beyond the immediate injury to health induced by the poison, a greater predisposition to other diseases is caused by the poisonous effects of these materials and the resulting diminished power of resistance of the workman. It is said, for instance, that there is a special susceptibility to tuberculosis among the lead and mercury workers.

Chemical poisons affect the human organism in three forms—the powdered, gaseous, and soluble state. The absorption of the poison into the body occurs in various ways. In the gaseous and powdered condition it usually occurs through the respiratory organs or the alimentary canal, but may occur through the skin, especially if wounds or erosions are present and if the poisons are rubbed in.

The gaseous substances are divided into those which are only irritating to the respiratory organs and produce on sudden inhalation the phenomena of suffocation, and those which are poisonous in themselves and affect the whole organism without causing specific lesions of the respiratory organs. The former produce severe reactions on the respiratory passages, and gradually bring about chronic affections of the mouth and throat cavities, the larynx, and the bronchi. The latter also produce sudden attacks of suffocation, but more often the symptoms of severe nutritive disturbances, chronic poisoning, etc., are displayed. Finally both the described properties may be contained in one gas.

Below is given a list of the several poisons which enter into manufacturing at the present day and the several branches of industry in which they are used. It must be said, though, that the continued advances of industry work frequent changes in these groups, partly because of the introduction of new poisons, partly because of the substitution of other materials for the poisons in use.

The list of poisons and the occupations or industries in which they are used is as follows:

Ether fumes.—Among photographers.

Ammonia fumes.—Tanners, tobacco workers, tin-plate workers, sugar refiners, cesspool workers.

Aniline fumes.—In aniline factories and among dyers.

Arsenic.—Among taxidermists, in tanning and finishing felt, in extracting the oil from raw wool, in fuchsine factories, in the production of arsenic, among glass workers, in coloring wall paper, flowers, and textiles green, in the preparation of bronze colors, among painters, seamstresses, the producers of artificial stones, and zinc smelters.

Benzene fumes.—In aniline factories and in the finishing of cloth.

Lead.—Among lead smelters, lead miners, workers in white-lead factories, printers and typesetters, brush makers, enamel workers, glass, gold, silver, and patent leather workers, painters, tailors, seamstresses, seamen, lace workers, wall-paper workers, joiners, potters, gilders, lead platers in sulphite and cellulose factories, weavers, and brickmakers.

Carbolic acid.—In paraffin factories.

Hydrochloric and nitric acid fumes.—Among workers in chemical works, the lead platers of materials and papers, damask workers, tin-plate workers, and washerwomen.

Chromatic acid and yellow chromate of potassium.—In the preparation of chromatic salts.

Hydrocyanic-acid fumes.—In Prussian-blue factories, in the production of fulminate of mercury, in galvanic gold and silver plating, and among photographers.

Denaturized (*denaturirter*) spirit (which contains pyridin bases and wood alcohol).—Among joiners, turners, gilders, hat makers, and dyers.

Dinitro-benzole.—Among the workers in aniline factories.

Hydrofluoric acid.—In the etching of glass.

Fire damp.—In coal mines.

Iodine (bromine).—In chemical factories.

Carbon monoxide gas.—Ironers, cooks, worsted spinners, illuminating-gas factories, hydrogen-gas factories, metal foundries, and coal mines.

Carbon dioxide.—Among operators and workers with compressed air, in the manufacture of beer and wines, worsted spinning, in glue manufacture, in paper factories, in fumigating, in cleaning sink holes, in coal mines, and in sugar refineries.

Carburetted hydrogen.—In coal mines.

Copper.—Among bronzers, coppersmiths, filers and founders, and watchmakers, and in copper mines.

Illuminating gas.—In gas factories, among illuminating gas workers.

Methyl alcohol fumes.—Among operators with silk materials and felt hats, and the lacquerers of furniture.

Nitro-benzol.—Among workers in aniline factories.

Organic fumes.—Among brush makers and horsehair washers, cocoon reelers, gut-string makers, tanners, rag pickers, butchers, glue boilers, soap boilers, sink-hole cleaners, washerwomen, and sugar refiners.

Petroleum fumes.—Among petroleum workers.

Phosphorus.—Among phosphorus workers, friction-match workers.

Mercury.—Among mercury foilers, taxidermists, bronzers, dyers of artificial flowers, fireworks makers, gold and silver workers, hat makers, photographers, and finishers of anatomical preparations.

Sulphurous acid fumes.—Among bleachers of bristles and of guts for strings, lime burners, in sulphuric-acid factories, in sulphurizing hops, and in bleaching straw hats and wool.

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Bisulphide of carbon fumes.—Among india-rubber workers, wool washers, and workers in oil factories which employ bisulphide of carbon.

Sulphide of hydrogen.—In chemical factories, bronzing, among cesspool workers and sink-hole cleaners.

Turpentine fumes.—Among varnishers, painters, and workers in match factories.

Zinc.—Among zinc workers.

As it is impossible in the limits of this article to make an exhaustive study of all the dangerous dusts and poisons mentioned in the foregoing extract from Eulenburg's Encyclopedia, three groups of industries have been chosen for investigation, to show the dangers which threaten the factory workers and the public, and the methods which may be employed to ameliorate the insanitary and dangerous conditions. The industries chosen are (1) the manufacture of white lead, paint, etc.; (2) the manufacture of linseed oil, oilcloth, and linoleum, and (3) the manufacture of tallow, fertilizers, etc. A study of these industries should indicate the problems to be met and the methods to be employed in solving them.

As preliminary to the study of factories engaged in the turning out of white lead, paints, and various lead-containing products an examination of some of the processes and occupations in which these poisonous substances are employed and a general examination of the subject of lead poisoning seems necessary. By such means a better estimate of the value of measures for the prevention, or at least the diminution, of lead poisoning can be obtained.

THE LEAD INDUSTRY.

INDUSTRIAL LEAD POISONING.

Metallic lead occurs in nature in many combinations, as with sulphur, phosphorus, arsenic, carbonic acid, etc. It is usually prepared from sulphide of lead, commonly known as galena, which after being separated from the dead stone by hammers, is assorted by hand, disintegrated, and washed. The essence of the whole process is to get rid of the superfluous sulphur. The galena is melted with scrap iron in furnaces, during which process it disintegrates and forms sulphide of iron and melted lead. This is the iron-reduction process. By another method the crude material is roasted in the so-called flame roasting tubes, sometimes even in the open air. This transforms some of the sulphide of lead into lead oxide, and some into lead sulphate. The half-roasted mass is then melted, which causes both the lead oxide and lead sulphate to react upon the still undecomposed lead sulphide, and under the generation of sulphuric acid anhydrous metallic lead is produced.

Those workingmen employed in the production, spreading, and disintegration of lead (ore pounders, sieve setters, stampers, etc.) are but in a slight degree endangered by the lead-containing dust, and seldom

suffer from any of the lead diseases. Those who are engaged in the working off of the lead ore (precipitators, roasters, and smelters) are subject to serious illnesses, because, in addition to the lead-containing dust encountered in the filling of furnaces, they are exposed to the gaseous products of combustion (carbon monoxide, carbonic acid, etc.) and to the little particles of lead oxide which are carried along mixed with the lead fumes. These influences have the power to poison extensively the surrounding air, especially in the disturbances occasioned by looking into the furnaces. The absorption of the deleterious products, which is chiefly done by the respiratory organs, is favored by the high temperature and the great physical exertions under which the work is done.

This gives an explanation why the workingmen employed at the furnaces make up such a large percentage of those suffering from lead poisoning.

According to Hirt, out of 1,000 men employed in the lead mines of Freiburg 870 were treated for lead diseases in a period of ten years (1862–1872). According to the statistics of the lead mine and smelting works at Mechernich, which the company physician, Dr. Kollendonk, furnished the author, 27 cases of lead poisoning in all occurred among the 2,000 workmen in the year 1887. These cases were confined to the smelters, of whom there were 350, while among those men employed in mining the lead not a single case of lead intoxication took place.

In respect to the frequency of attacks the workmen employed in cleaning out the often still warm furnaces and in repairing the walls come next because they are brought into contact with lead fumes and dust. After these come those workmen engaged in fritting the lead oxide and its purifications from other metallic impurities. They have to fear the volatilization of the lead oxide in smelting. Those men employed in connection with the separation of silver (by cupellation or pattinsonization) from silver-containing lead ores are exposed especially to the inhalation of lead fumes and lead-containing dust.

Accordingly, there are dangers in all establishments in which lead is won. They arise both from the scattering of dust from the crude as well as the roasted ores and the generation of lead fumes. The constitution and the dangerous qualities of the poisonous substance naturally vary according to the ores, the apparatus used, the fireplaces and furnaces, and the processes by which they are produced. Despite the fact that a consideration of these differences is of the greatest importance in the framing of sanitary laws, it would be overstepping the bounds of this short study to treat them in full detail. It must be sufficient, therefore, to describe the most important methods and operations and the dangers which they involve.

The extracted metal, which is worked into pig, sheet, and rolled lead,

is very extensively used in manufacture on account of its softness and malleability. Partly by melting, but mostly by rolling and pressing, it is employed in the manufacture of gas and water pipes, sheets for covering the roofs of houses, mirror frames, lead polishers, and very many other articles. The temperature required for melting is such that lead fumes are not generated, and, besides, the surface of the molten metal is usually covered with a layer of fat to prevent the oxidation and the volatilization of the lead. From this it can be seen that in the employment of metallic lead usually the only danger is from the generally unimportant lead dust, and the latter is introduced only through the lack of cleanliness of the workmen who refuse to wash their hands before meals and thus transfer the dust and dirt to their food. In all these branches of industry, therefore, cases of poisoning are very rare, and can be entirely prevented by a strict demand for the most exacting cleanliness.

The manufacture of shot is dangerous to the workman. The molten lead, mixed with particles of arsenic, is usually passed through a sieve at the top of a high tower, whence it falls in little spheres into vessels of water below. This finished shot is then polished in drums, which are filled with powdered graphite and turned about their axes. Apart from the generation of arsenic fumes, the appearance of which could be prevented with slight care during the melting process, the lead dust driven off in passing it through sieves and that generated in the sorting of the grains of shot endanger the workmen.

Occasionally cases of poisoning induced by frequent contact with metallic lead have occurred in branches of industry and trades where they would be least expected. Mannkoff observed cases of lead poisoning among railroad and customs officials who had the habit of holding the lead seal between their lips while sealing the boxes. Fleury reported five cases of poisoning among telegraph inspectors, who neglected to clean their hands before eating after handling batteries. Interesting also are the cases of lead intoxication among the Jacquard loom weavers, reported by Schuller and others. Through the friction of the lead weights of the weaving chairs, hanging on cotton threads, little particles of the metal were worn off and impelled through the air as a fine lead dust, which caused numerous and severe cases of sickness among the workingmen.

The cases of lead poisoning among the file cutters and amber workers have the same origin. The former in sharpening the file, the latter in cutting and working the amber, use as a base a leaden block, which often is the cause of the severest intoxication. A part of the lead is freed by the work and inhaled as dust. The dust also gets into the mouth by means of the fingers. Cases of poisoning cease to appear as soon as a wooden block is substituted for that of lead.

Napias found cases of poisoning in sheet-metal workers and tinsmiths who used the lead in soldering and modeling. The method of transmission is similar to that described above.

In polishing, cannons and shells are pressed against rotating lead disks. Workmen engaged in this occupation frequently become ill on account of the inhalation of the lead dust which is generated and the transference of little particles of lead upon food.

Of the lead alloys, type metal, consisting of 75 parts lead, 20 parts antimony, and 5 parts tin, is of much interest from a sanitary point of view because of its fatal influence upon the health of a large number of workmen (type founders and typesetters). Even the casting of type is not without danger, because in melting the alloy the temperature rises so high that lead fumes are generated and, especially in poorly constructed casting machines, may escape into the factory rooms. Still more dangerous, on account of the dust that is developed, are the occupations of breaking off of the feeding head, smoothing the foundry seams, and dressing, planing, and polishing the type.

Poisoning occurs less frequently among the typesetters than it does among the type founders, because the manipulation of the type does not develop much dust. The diseases are usually due to the carelessness of the workingmen; for instance, if they hold the type between their lips, and if they take their meals without washing their hands, etc. The fact, however, must not be overlooked that the lead contained in the letters can be taken into the organism by mere contact with the hands, and all the more so because erosions and wounds brought about by cleaning the letters with lye are often found on the hands of the printer and facilitate the absorption of the poisonous metal. The ratio of the number of cases of poisoning among type founders to that among typesetters was noted by Tanquerel in his statistical lists as being 96 of the founders to 24 of the typesetters. According to Hirt, out of 100 type founders 35 to 40 exhibited symptoms of poisoning, while out of the same number of typesetters under observation during the same period there were only 8 to 10 cases.

Other alloys, as hard and soft solder, cliche, and sheet-metal alloy, etc., which serve for the greatest variety of purposes and are employed in the production of a great variety of objects (organ pipes, tin soldiers, artificial leaves, fruits, insects, etc.), of course make lead poisoning possible for the men in those occupations, but it is an unusual occurrence.

Relatively the rarest sufferers are braziers and tin-plate makers. The harmful influences upon the workman engaged in these occupations rest entirely upon the inhalation of the loosened dust and its entrance into the alimentary canal by the way of dirty hands and food.

The lead combinations require attention in a much higher degree than metallic lead. They are distinguished as oxides and lead salts. Lead unites with oxygen in three relations and forms: (1) Suboxide of

lead; (2) oxide of lead (impure litharge and massicot); (3) superoxide of lead; there is also an oxygen combination, which, however, is not considered as a special gradation of oxidation but as a combination of lead oxide and lead superoxide.

Suboxide of lead is of very little interest. Oxide of lead (impure litharge and massicot) is extracted either as a furnace product in the separation of silver from argentiferous lead or by the oxidation of metallic lead when air is admitted to the roasting tubes in such factories as employ lead oxide. It is used in the manufacture of red oxide of lead and sugar of lead, and for other purposes.

These occupations endanger the workman, principally through poor chimneys, lead-containing emanations, and frequent contact with the very dusty oxide. The most dangerous operations in the process seem to be the grinding, sifting, and packing of the litharge. These operations, unless the greatest care is observed, cause a tremendous generation of dust.

While massicot as such is of almost no importance, litharge is a frequently used industrial lead preparation. Its property to combine easily, in a molten condition, with silica and the silicates has led to its introduction in the glass industries. It serves in the production of strass (pellucid flint glass used in artificial gems), crystal glass, optical glasses, and in the manufacture of enameled sheet glass and in stained glass. The men employed in these branches often work in an atmosphere impregnated with lead fumes arising from the melting masses. They also work under the influence of lead-containing dust, which is generated very extensively in present-day grinding of glass, and particularly in the production of enameled sheet glass.

Worthy of especial attention is the use of litharge in the pottery industry, where it is often the cause of a very destructive variety of lead poisoning—potter's sickness. Most pottery is covered with a glazing, which, beside other mineral substances, contains a large percentage of impure litharge (also sulphate of lead). The materials necessary for this glazing are either run together in nature, or melted over fires where continual stirring is required. This forms a kind of glass which, after stamping, is called "glazing cake." After these glazing cakes have been powdered in mortars and stirred with water to a fluid paste, they are taken to the glazing mill where they are again ground finely and diluted with water. The baked pottery is then either dipped into the liquid or the latter is poured over it. It seldom happens that the glazing is produced by dusting. These operations expose not only the glazers themselves to the danger of lead fumes as well as to the poisonous dust, but also endanger all other men employed in the rooms. This explains why such a large number of men in the pottery industry are found to be suffering from lead poisoning. The lead diseases of those who are engaged in the enameling of

ironware as well as those employed in putting the glazing on the enamel labels of chemical and pharmaceutical vessels, depend on the same causes as those of the pottery workers, because they are engaged in the production, melting, and application of the lead-containing enamel.

Impure litharge is also used in varnish factories and in the production of lacquers. In France the latter are employed to give to furniture an antique appearance. The lacquer mass, which contains much lead oxide (50 per cent), is applied to the wood. The latter is then dried and afterwards polished with rough sandpaper and pumice stone. Part of the dust generated by this process is inhaled by the workman and results in lead poisoning. To color horsehair black, hair and brush workers use a decoction of litharge, vinegar, and water. Lead acetate forms and is transformed by the sulphur in the hair into black lead sulphate. It is the latter that colors the hair. The danger of coloring hair by direct contact with dissolved lead salts is not important, yet the greatest dangers arise in the cleaning and further use of the hair. The cleaning is accomplished by means of drums set with sharp wire points revolving within a similarly studded mantel. Naturally lead dust is generated. Even saddlers are exposed to the dangers in upholstering and other employment of hair thus colored.

The third combination of lead, the superoxide of lead, is employed in the manufacture of friction matches and plays a large rôle in the industry. It is produced partly by treating red oxide of lead with diluted sulphuric acid, partly by boiling a mixture of sugar of lead, litharge, red oxide of lead, and chloride of lime solution. According to Hirt, neither the manufacture nor employment of this preparation in the match industry has any particularly detrimental influence upon the health of the workman.

Of all the oxides, red oxide of lead is of the greatest importance in the industries. Its preparation consists in transforming metallic lead into lead oxide in frame tubes with the addition of air, grinding the oxide thus obtained with water, separating the unchanged remnants of lead by means of sieves, and drying the mass. Then it is ground again and put through sieves. Finally the free oxide is heated in iron vessels and is dry-ground and sifted once more. The product thus prepared is then packed. That this branch of industry exposes the workmen to great dangers is evident. The oxidation of the glowing lead masses in the hot furnace, the frequent handling of the product and emptying of the furnaces, particularly in deficient furnace plants, impregnate the atmosphere of the factory room with lead fumes as well as with lead dust. Further, the continued contact with the poison after it leaves the furnaces, and especially with the dust produced in the grinding, sifting, bolting, and packing of the powdered material, leads almost always to severe cases of poisoning, every workman being

affected after a longer or shorter period of employment. The employment of red oxide of lead in the technical sciences is similar to that of litharge. Sometimes they are used together; sometimes one is substituted for the other. The consumption of the red lead in the industries offers similar dangers to the workman as litharge.

Sugar of lead (acetate of lead) is produced by dissolving litharge in vinegar and letting it crystallize. The manufacture of this preparation, by the wet method, with a little care and cleanliness, is almost without danger, if the lead fumes are kept in check by tightly closed vessels. Nevertheless, the manipulation of the finished preparation, the emptying, sifting, and packing, is dangerous on account of the dust. The industrial employment of sugar of lead may also injure the dyers, who use it in enormous quantities in their industry. Further, sugar of lead is used in the production of wall-paper colors and in the manufacture of the acetates and varnish (in the place of litharge). It is also used in the silk industries to increase the weight of the silk.

Those dangers resulting from the industrial consumption of the poisonous material depend chiefly upon the dispersion of dust, which is either inhaled or brought into the system by the way of unclean fingers and food. Furthermore, in the preparation of sugar of lead by the wet process the development of lead fumes and their inhalation as well as absorption through the skin through erosions and wounds is possible, though only in a very moderate degree. Among seamstresses who use lead-containing silk the biting off and tapering of the thread probably offers the best chance to induce poisoning.

Of great importance, from a sanitary point of view, are the lead chromates, made by the use of lead acetate. These are (1) the neutral lead chromate (chrome yellow), (2) the basic lead chromate (chrome red), and (3) a mixture of both (chrome orange). They are insoluble in water, but have corrosive effects in the stomach. Cases of poisoning are very rare in the manufacture of the chrome colors, because they are prepared by the wet method. Yet the packing of the finished products and the use, even the consumption, of materials colored with them (yarn cotton) may injure the health of the employees to a large extent on account of the unpreventable scattering of dust. Many fatal cases of poisoning are known as results of the above-mentioned color dust. Thus Leopold reports a case of severe lead poisoning in a weaver's family which had worked with yarn dyed in chromate of lead. To a 9-weeks-old child, which was exposed to the influence of the dust in the room in which the yarn was used, the poisoning was fatal. Considerable danger also threatens those employed in the manufacture and consumption of the other yellow lead colors, as cassel yellow (yellow oxychloride of lead), and naphs yellow (antimonate of lead), which, however, since the introduction of chromate of lead plays but a small part in the industries.

The most important lead combination, from a sanitary as well as from a technical point of view, is lead carbonate (white lead). Its preparation is carried on by various methods, the aim of all of which is to decompose the vinegar of lead obtained from various sources by means of carbonic acid. In the Dutch method vinegar is permitted to rest upon lead plates, in vessels surrounded by horse manure, tan bark, etc. The organic substances generate the necessary carbonic acid and warmth. In the German method, the acetic acid fumes, mingled with carbonic acid, are led to chambers in which lead plates are stored. In the French method a solution of basic acetate of lead, obtained by dissolving litharge in wood vinegar, is decomposed by means of the introduction of carbon dioxide. During the chemical process the workmen are not subject to any injurious influence. The real dangers begin only in the further manipulation and industrial consumption of the crude white-lead material that has been extracted.

In the first place, the emptying of the oxidation vessels, and especially the chambers, is very dangerous, because it is almost impossible to avoid the scattering of dust from the crude material, no matter how much it is moistened.

Because the lead plates are never entirely transformed into white lead, the latter must be separated from the remnants of metallic lead. Fortunately, this separation is now nearly always accomplished by the wet method in the so-called sack drums, instead of beating and scraping the plate with the hands as in former times. The loosened white lead falls from the drum upon a fine sieve and then into a vessel standing below, while the remnants of lead fall out of the lower end of the sifting chamber. The material thus obtained is then subjected to the wet grinding and washing process in continually circulating water. It is pressed between cloths, dried, and again, this time in a dry condition, carried to the mills to be ground fine. Afterwards it is sifted, bolted, and packed in barrels as a finished product.

It is evident that in these manipulations the workmen are exposed to great dangers. In the wet production of white lead sufficient care and cleanliness on their part can largely prevent absorption through the skin and introduction into the mouth. There is great danger, however, in the dry operations of grinding, bolting, sifting, and packing, in which a great deal of dust is produced, because preventive measures and arrangements are as yet far from efficient.

The owner of a German white-lead factory, who kept the records of the number of cases of lead poisoning among the employees during a series of years found that wherever the men came in contact with dry white lead numerous cases of lead poisoning occurred, while in the wet process during four years not a single case of sickness occurred. Similar conditions appear in other white-lead factories. Their cause is due to the fact that in every manipulation the dry, finely pulverized

mass whirls up a cloud of dust, which impregnates the atmosphere of the working rooms, so that with every breath a number of poisonous particles are taken into the organism.

During an investigation of a white-lead factory it was observed that the floor and the beams were covered with a thin layer of red oxide of lead and white-lead dust. There was nothing to indicate in these rooms that work was done with such a dangerous poison. The men worked quite unconcernedly around the dry-grinding mill and in the back rooms, in which the atmosphere was partly filled with a visible dust. The respirator was usually not over the mouth and nose, but for the sake of convenience was drawn down over the neck. It need hardly be said that under these circumstances a good many more cases of poisoning occurred here than in the other branches of the industry.

According to Tanquerel, out of 2,161 cases of lead poisoning, taken from 30 branches of the lead industry, 691, or almost one-third, were among white-lead workers. According to statistics taken during a period of ten years (1870–1880) in a large white-lead and red-lead factory, which is said to have paid especial attention and care to the health of the workingman, out of 488 workingmen, 174, or almost 36 per cent, were affected with lead poisoning.

The statistics of the aforementioned German factory, as well as other statistics whose details are contained in the yearly reports of factory inspectors, confirm the assumption in regard to the age and constitution of the workmen, namely, that the powers of resistance to the influence of the poison is increased by strong manhood and good nourishment.

In the English list of one hundred dangerous occupations prepared for a work on occupational mortality, thirteen were selected as showing unmistakable evidence of plumbism. These occupations are as follows, the figures representing the comparative mortality figures from lead poisoning in the several trades:

COMPARATIVE MORTALITY FROM LEAD POISONING IN VARIOUS OCCUPATIONS, ENGLAND

Occupations.	Comparative mortality.	Occupations.	Comparative mortality.
Leadworkers	211	Coach makers	7
File makers	75	Gas fitters locksmiths	6
Plumbers	25	Lead makers	5
Painters and glaziers	18	Printers	3
Potters	17	Cutters	3
Glass makers	8	Wool manufacturers	3
Copper workers	8	Occupied males	1

The above occupations are arranged according to their mortality from lead poisoning, as shown in the tables. A little consideration, however, will show that these figures indicate very imperfectly the relative damage sustained by the operatives as a result of their occupations. If, for example, we compare the mortality figure of lead-

workers with that of potters, it will appear by the table that the former workers suffer from plumbism more than twelve times as much as do the latter. But on closer examination we find that while all leadworkers are constantly in contact with lead as a necessary condition of labor, not more than a twelfth part of the potters are so circumstanced.

It is the dippers and the glost placers who are the chief if not the only serious sufferers from lead poisoning among potters; but as these workers are not distinguished in the census returns from the other potters a false impression is conveyed as to the amount of mischief done by absorption of lead in those branches of the industry where the workers are actually exposed to contact with this metal. Again, when the figures for painters and glaziers are compared with the figures for file cutters a great disparity becomes evident, the file cutters apparently showing more than four times as many cases of plumbism as do the painters and glaziers; but on inquiry we find that while on the one hand file cutters handle lead continuously in the course of their work, on the other hand painters and glaziers are by no means so constantly exposed to this danger, much of their time being spent on labor which does not involve contact with lead or inhalation of fumes or dust of that metal. If the death rates of potters and painters engaged in those processes which are continuously subject to lead poisoning could be separately ascertained, there is no reason to doubt that they would show results quite as unsatisfactory as those experienced by leadworkers.

Although leadworking is known to be a very unhealthy trade, it is evidently impossible to deduce from the vital statistics of only 2,000 workers more than very general conclusions. Speaking generally, however, the mortality returns warrant the statement that in the main working period of life these operatives sustain a mortality which, on the average, is about 90 per cent above that of other workers.

Their comparative mortality from all causes is nearly three times that of agriculturists. Of the total deaths occurring among leadworkers, one-third are from "pulmonary diseases," i. e., from tubercular phthisis and diseases of the respiratory system taken together, and one-eighth are from lead poisoning. As compared with the standard for employed males, the mortality among leadworkers is excessive from diseases of the urinary, nervous, circulatory, and digestive systems, in addition to the causes above specified.

The following fact drawn from the sickness records of a factory is also interesting. New men usually suffer from an attack of lead colic soon after they have entered upon their occupation, while those who have been employed for a long time very seldom become ill. It must not be considered as a slowly and gradually formed immunity due to habituation to the poison, but must be accounted for solely by the fact that the men in time learn to better avoid the dangers of their occupation and to prevent the absorption of lead. Immediately upon

employment they should be instructed in the dangers and how to avoid them.

The use of white lead in industries is exceedingly varied and the cases of poisoning depending on it for a cause are unfortunately still quite numerous. Painters, artists, lacquer workers, colorists, and sign painters, and workers in stained and glazed paper, as well as playing and visiting card factory workers, suffer from the effects of the poisonous material, which is used as a color in their branches of industry on account of its remarkable covering and protecting qualities. The absorption of poison is caused usually by the mixing of the colors, at which operation the dust of the finely powdered dry white lead is inhaled, or the poison is directly introduced into the alimentary canal by way of the hands, brush, etc., as well as by food and drink.

The careless spattering of the clothes with mixed colors which subsequently dry and scatter as dust can under circumstances induce poisoning. The danger is especially great in solutions in which the color masses are mixed with water, gum, glue, etc. If the color is mixed inside, the other people in the house are also exposed to the danger of poisoning. Almost the same is true of the gilders, who before they apply the gold cover the vessels about to be gilded with a paste, which is made by mixing white lead and litharge with glue and oil of turpentine. The preparation of putty, for which white lead is peculiarly adapted, may endanger the glazier, but poisoning from this cause is very rare and due only to gross uncleanliness.

White lead is also still quite frequently used in certain of the lace industries, partly to cover the laces with dust to make them white and heavier, and partly to stamp patterns upon dark materials. In these cases lead intoxication is usually caused by the absorption of dust through inhalation. The same is true of the use of white-lead powder in leather finishing, as among tanners and glove makers, and in straw-hat factories by the brushing of the hats with white-lead powder. Finally, the cosmetics containing white lead, especially the so-called white rouge, which consists of almost pure white lead, have caused cases of poisoning, both among the producers and the consumers.

The other lead preparations, lead cyanide, lead chloride, lead oxychloride, and finally lead nitrate and iodide of lead, the last two of which are used in calico printing, play but a small rôle in the industries and are seldom the cause of poisoning, except through the inhalation of lead-containing dust.

EFFECTS AND SYMPTOMS OF LEAD POISONING.

The salts of lead, more especially the soluble ones, are strongly poisonous. Since lead is a cumulative poison its salts and compounds, such as the oxide and carbonate, produce serious results if taken into the system even in minute quantities for any length of time. One of

the forms in which lead is introduced into the system is by the use of drinking waters, some varieties of which easily attack the lead of the pipes used for conveying the water. Again, the working people engaged in the manufacture of lead and lead compounds, more especially white lead, are liable to suffer from lead poisoning. It is a regrettable fact that lead as a metal, as well as in its combinations, is a poison to the human organism, the more to be dreaded because its influence is stealthy and treacherous. The symptoms of poisoning generally are not immediately apparent, but only after the poison has remained in the organism for some time. In course of time the disease becomes chronic, and the symptoms are pain in the stomach and abdomen, constipation, loss of appetite, thirst, and nervous prostration (known as lead palsy), epileptic fits, and total paralysis. One of the signs of chronic lead poisoning is a blue line at the edges of the gums due to the deposition of lead sulphide. This line is frequently seen in painters and decorators, who are liable to this form of poisoning, because of the white lead used in making paint. The blue line is also observed in workmen engaged in the manufacture of white lead or in manufactures in which this compound is employed. A portion of the lead taken into the system is excreted by the kidneys. In cases of chronic lead poisoning it is stated that the administration of potassium iodide aids in the elimination of lead from the system. The distribution of the compounds of this metal in the different organs of the body is shown in the following quotation from Dr. Thomas Oliver's work on Dangerous Trades (p. 310) giving the results of examinations of the bodies of lead workers who succumbed to lead poisoning:

In most of my own fatal cases, lead was detected in the liver, kidneys, muscles, and brain, etc. To the fact that lead has been found in the brain, and has probably formed some complex chemical compound with it, may be attributed the convulsive seizures, insanity, and possibly, too, death. At the most it has always been a very minute quantity of lead that has been found in the brain after death. In one of my patients Professor Bedson found on chemical analysis only 0.779 grain in a brain and cerebellum that together weighed 51.5 ounces; while from another brain and cerebellum that weighed 48 ounces, he obtained only 0.634 grain of lead. From another brain Professor Bedson removed 4.04 milligrams [0.062 grain] of lead, while in a case reported by Mr. Wynter Blyth there were 99.7 milligrams [1.538 grains] of sulphate of lead found in the brain and 17.4 [0.268 grain] in the cerebellum.

It is scarcely possible to discover all the cases in which poisoning is induced by means of this widely used substance. They usually occur where least expected. Many objects used in housekeeping or as playthings cause more or less serious illnesses. In consideration of this fact the employment of lead and its combinations in the arts,

industries, and housekeeping is of very considerable consequence from a hygienic standpoint. This is especially true, as several of the lead combinations are indispensable and because up to the present time no satisfactory substitutes have been found.

Cases of lead poisoning due to chance or accident, considering their frequency and the seriousness of the symptoms, are of little importance as compared with cases of industrial lead poisoning occurring among those laborers or factory hands whose occupations compel them to be exposed daily to metallic lead or its combinations.

There is no such immunity or gradual habituation to the poisonous lead as Gruber assumes, yet the severity of the effects is not in direct proportion to the quantity of poison absorbed. While a given quantity of poison in one individual may cause him no inconvenience whatever, in another the same quantity may cause serious conditions of illness. The reasons for the difference in the power of resisting the effects of the poisonous lead and its combinations in different persons must be sought not only in individual differences, but in manifold internal and external circumstances. In the first place, age is an important factor. It is well known that the power of resistance of the childish organism against anything of harmful moment is small. It is evident, therefore, that children and youthful individuals in whom the development and maturity of the most important organs have not been completed more easily succumb to the disastrous effects of the poison than adults. On the contrary, however, the stronger and more perfectly nourished the individual is the longer he can withstand the disturbances caused by the poison. Almost all the causes which diminish the activity of the vital functions and the energy and capability of the organism, as hunger, exhaustion, chronic diseases, alcoholism, etc., at the same time favor the action of the poison. Thus Trourreau mentions cases in which the disposition toward lead poisoning was increased by the use of absinthe during a period of many years.

RELATION OF SEX TO LEAD POISONING.

Sex also seems of importance as regards susceptibility to the poison. Although statistics of lead factories do not certainly prove such an influence, yet it may be assumed that women, who, as is known from experience, are more susceptible to external influences, especially poison (mercury, for example), than men will be more easily affected by lead than the latter. This is also confirmed by the observation of Labrosse and Hirt.

English investigations as to the influence of lead on women have given the following results: After a few weeks or, at the most, a few months of regular employment in a lead factory, particularly if much of the time is spent in stripping the white beds or emptying

the stoves, young women would suffer severely from lead poisoning. It is stated by English experts that young women who were strong and healthy when they entered a white-lead factory have died from saturnine poisoning within three months. In one instance a young woman had worked only forty days, during a period of nine weeks, when she succumbed to lead poisoning. Young women, especially, according to observations of Dr. Thomas Oliver in England, are much more susceptible to plumbism than men. The predisposition to lead poisoning is in both sexes spread over all periods of life, but in so far as occupational exposure to lead is concerned, it is believed (1) that women are more susceptible than men; (2) that while liability in the case of women is greatest between the ages of 18 and 23 years, that of men is later; (3) that while females rapidly break down in health under the influence of lead, men can work a longer time in the factory without suffering, their resistance apparently being greater. In addition to a sexual susceptibility to plumbism there is also an individual and a family tendency as well. It is difficult to explain this susceptibility of certain persons to lead poisoning; as to the fact, however, there is no doubt. It is partly a constitutional, and it may be partly a temporary and accidental condition. We find illustrations of constitutional predisposition to certain maladies in the greater liability of some people, for instance, to contract infectious diseases than others; in the readiness, for example, with which they contract typhoid fever and suffer severely from it. We have similar illustrations of the influence of age. The early years of adult life are those in which enteric fever is most severe. As an indication of how susceptibility to plumbism may be accidentally and temporarily developed, Oliver instances the influence of poverty, which, by preventing the purchase of wholesome and abundant food, allows the gastric juice probably to dissolve out more of the lead that has been swallowed. No doubt the greater prevalence of plumbism hitherto observed in women who have worked in white-lead factories is explained, to a great extent, by the fact that they have until recently worked in larger numbers than the men in the dangerous processes, for since June, 1898, the date in which the English law required that male should replace female labor in these processes, the number of cases has increased among men and correspondingly decreased among women, as will be seen from the table below.

According to the annual report of the British Chief Inspector of Factories for 1897, there were 370 cases of plumbism reported as having occurred during 1897 in white-lead works. The average number of persons employed in such works in 1896 was 2,499, and of these some were engaged in the manufacture of red and yellow lead. One person out of seven of those employed in white-lead works suffered from plumbism during that year. For 1898 the statistics, as indicated

below, did not show any abatement—a circumstance which led to a communication from the home secretary to the manufacturers as to the desirability of replacing the old stoves by others of newer design, and the introduction of other mechanical and structural arrangements with effectual precautions. Since the introduction of new stoves for drying and other methods of mixing white lead plumbism has considerably decreased. The cases of poisoning reported in 1898, by months, were as follows:

CASES OF LEAD POISONING IN BRITISH WHITE-LEAD WORKS DURING 1898.

Month.	Male.	Female.	Total.	Month.	Male.	Female.	Total.
January	14	31	45	July	28	9	37
February	22	14	36	August	31	5	36
March	13	24	37	September	67	1	68
April	14	19	33	October	38	2	40
May	18	28	46	November	34	1	35
June	21	9	30	December	46	1	47

Lead exerts a most dangerous influence in the course of pregnancy. It is a fact based on statistical investigation that abortions are unusually frequent among women employed in lead factories. According to Paul, out of 141 pregnant lead workers 82 women aborted, 4 gave premature birth to stillborn children, and 5 to stillborn children at the regular time. Other physicians who have made observations report practically the same result. Not only is pregnancy interfered with, to a high degree, by the lead, but the harmful influences of the poison are transmitted to those children that are born alive. Usually the latter are poorly developed and weakly individuals who soon succumb. According to Paul, of 50 children born of women employed in lead-works 20 died during the first year, 15 the second year, and only 4 reached their fourth year. The influence of the season of the year must also not be underestimated.

The following statement from Dangerous Trades, by Dr. Thomas Oliver, will give proof of the high mortality among lead workers' children:

Where the two sexes are as far as possible equally exposed to the influence of lead, women probably suffer more rapidly, certainly more severely, than men. To a certain extent the reason is to be found in the fact that lead exercises an injurious influence upon the reproductive functions of women. It deranges menstruation. Usually there is an excessive loss at the monthly periods, which causes women to become anæmic; in a few instances, on the other hand, the loss is scanty. It is upon pregnant women that the metal exercises its worst effects. The ecbolic or abortifacient action of lead is beyond dispute. It is knowledge of this fact that has caused women of the lower classes when pregnant to resort to diachylon pills, which contain a small quantity of lead, for the purpose of producing miscarriage. When a white-lead worker becomes pregnant it is almost impossible for her to

go to the end of term if she continues to follow her employment. As a rule, she miscarries, but if, perchance, she goes to term, the child is either born dead or dies shortly after birth from convulsions. In the liver and kidneys of stillborn children of female lead workers that I submitted to Professor Bedson for chemical analysis, there were found minute quantities of lead. Chemical analysis, therefore, confirms clinical experience as regards the cause of death in these children. As to the injurious influence of lead upon maternity, I shall give a few illustrations taken from my own and others' experience. Mrs. H., aged 35, worked in a white-lead factory for six years, before which she had 4 children born at full time. Since going to the lead works she has had 9 miscarriages in succession and no living child. Mrs. M., aged 30, has had 7 children and 3 miscarriages. The last 2 children were born and all the miscarriages took place after entering the lead factory. Mrs. F. has had 3 miscarriages since taking up lead work. Mrs. K., aged 34, had 4 living children before going into the lead factory and 2 living children afterwards. Still following her occupation, she had 6 miscarriages in succession, became the subject of plumbism, and was under my care in the infirmary for a few months on account of colic and paralysis; she made a good recovery, but did not return to the lead factory; next pregnancy she went to term and had a living child, which survived. If additional medical testimony were required to support the opinion I have put forward as to the pernicious influence of lead upon maternity, it is to be found in that of M. Constantin Paul, a French physician, who has published in detail his experience of 15 pregnancies of 4 women working in a type foundry. Ten of these pregnancies ended in abortion, 2 in premature labor, 1 in a stillbirth, and 1 in a living child, who died a few hours after birth. * * * Constantin Paul, grouping together a large number of pregnancies, viz, 123, found that of these, 64 ended in abortion, 4 in premature confinement, 5 children were born dead, and 20 of the infants died within the first twelve months. Of 1,000 pregnancies reported by Tardien, 609 ended in abortion. (Poisons Industriels, Office du Travail, Paris, 1901, p. 5.) In the potteries, Miss Paterson and Miss Deane, two of His Majesty's inspectors of factories, found that "out of the 77 married women reported as suffering from lead poisoning during this period (the year ended March 31, 1897) 15 have been childless and have had no miscarriages; 8 have had 21 stillborn children; 35 have had 90 miscarriages, and of these 15 have had no child born; 36 have had 101 living children, of whom 61 are still alive. The great majority of the 40 who are dead succumbed to convulsions in infancy." Dr. J. F. Arlidge, certifying surgeon for Stoke, has published his experience of 239 married women working in lead processes in the china and earthenware industry. Of the children born before the mothers worked in lead 40.4 per cent died. Of each 100 pregnancies there were 7 miscarriages, while, during or after lead employment, of the children born only 36.5 per cent died, and the percentage of miscarriages was 11.8. Of the 239 women there were 71 who had had no children prior to working in lead. These 71 women had subsequently 302 children (of whom 114 died) and 38 miscarriages; that is, for every 100 children born 37.7 died, and 11.1 of every 100 pregnancies resulted in miscarriage. Dr. J. F. Arlidge's statistics show that in female pottery workers employed in lead processes the percentage of miscarriages is higher than in those engaged

in other departments, but neither is this nor the death rate of children born under these circumstances so great as M. Paul, Tardien, and I have found.

If lead exercises a prejudicial effect upon the reproductive powers of women, it is also capable, although to a less degree, of diminishing the virility of men. Children of female lead workers almost invariably die of convulsions shortly after birth or during the first twelve months. If a child is the offspring of parents, both of whom are lead workers, it is puny and ill nourished, and is either born dead, or dies a few hours after birth. The power of lead not only to kill the offspring, but to destroy for the time being the child-bearing powers of women, is remarkable, and it is this circumstance, along with the fact that women suffer more readily and severely from lead poisoning, that are the main arguments for keeping them out of the dangerous processes in any industry in which lead compounds are used. * * * Roques (*Mouvement Médical*, 1872) is of the opinion that a mother working in lead conveys through her milk to the child she is suckling the metallic poison, and that there is produced a slow and progressive deterioration of the infant's constitution. Professor Bedson has analyzed for me the milk of suckling lead workers without finding any trace of lead therein. Whether or not lead is only occasionally present in the mammary secretion, it is undesirable that women who have an infant at the breast should work in the dangerous process.

VARIOUS WAYS OF CONTRACTING LEAD POISONING.

Tanquerel des Planches, to whom are due the most valuable accounts of industrial lead poisoning, found that the cases of poisoning occur most frequently in May, June, July, and August (46.7 per cent, against 27.77 per cent from January to April and 25.47 per cent from September to December), and in some workingmen they occurred annually at this period. Archambault has made similar observations. Even if some of the cases of sickness during the hot months can be explained by the fact that more men are employed in lead industries during the summer, others can, without doubt, be blamed on the heat, which, by causing frequent drinking as well as increased perspiration, favors the solution and absorption of the lead products. Some of the French authors consider this increased lead absorption as due to the higher nervous susceptibility superinduced by the heat; others claim that it is due to the increased amount of wine drunk in France during the summer. This wine is clarified by means of metallic lead, or stored in lead-containing vessels, and therefore frequently has additions of lead. It must also be mentioned that, with the first attack, lead workers acquire a predisposition to further attacks. Very often relapses occur even when the individual has remained absent from his work for a long time and has not been in contact with lead. Heubel, as well as Mayer, are inclined to account for the recurrence by the assumption that the lead, which had been passively stored in certain organs, after a time again gets into circulation and induces a new succession of symptoms.

The poison enters the organism through the skin, and the respiratory and digestive organs.

Tanquerel declares that lead poison is not absorbed through the skin. Entirely negative results were obtained by Mounereaus in his experiments with rabbits whose skin had been shaved. In these experiments absorption by the way of the digestive tract had been prevented, and the animals were able to dwell in lead-containing places without any injurious effects. Notwithstanding this the following facts will prove the possibility of the absorption of lead products through the skin.

Orifila and others report several cases of poisoning through the use of lead-containing cosmetics; Schotten and Crocker through lead-containing hair dyes. According to Professor Schulz the use of lead-water poultices upon the skin has resulted in lead poisoning. A deep-seated discoloration of the skin has several times been observed after the accidental external use of soluble lead preparations and sulphur baths. Naturally the danger of poisoning is greater where there are abrasion and wounds on the epidermis. The poison is doubtless absorbed by the skin glands after it has been transformed by their secretions into a soluble and absorbable condition.

That lead and its combinations are most easily absorbed by the mucous membrane of the digestive apparatus and that the latter is the most frequent path of introduction is evident and does not require further proof. The introduction of lead into the blood also may be accomplished easily through the respiratory apparatus, as the large surface area and the rich supply of blood to that organ furnish favorable occasion for absorption. The respired lead is dissolved and made absorbable by means of the secretions in the bronchial branches. It is immaterial whether it is introduced as dust from white lead, red oxide of lead, etc., or in the form of fumes. The observations of Lepioi-Chioti made on animals prove that the absorption of lead products very easily takes place in the respiratory apparatus.

The assumption of Chevalier that metallic lead is insoluble in the secretions of the body and consequently not poisonous in its effects is erroneous, as at every place of application it may be changed into an absorbable condition. To this end the skin furnishes the sweat, the stomach its juice, and the bronchi their secretions, etc. Though a large lead sphere, such as a good-sized bullet, is but little attacked by the digestive apparatus, and the effects are not especially injurious, the same can not be said of the little grains of shot whose relatively larger surface gives a greater field of action to the working of the digestive fluids, and from them poisonous effects have repeatedly occurred. Ruva observed a severe case of lead colic after the swallowing of 10 grains of shot; Bronvin, as the result of a shotgun wound. Of all the lead combinations rhodan lead, according to Eulenburg, is the only one which is not poisonous to the animal organism.

The process of absorption is very much the same in all surfaces of absorption. No matter in what form it offers itself for absorption, the lead must be transformed into a soluble compound, and this occurs under the coincident influence of the secretions and albumen. The lead albuminates are formed which in contact with diluted acids (gastric juice, perspiration) or alkaline fluids (blood, chyle, lymph) become absorbable. They get into the circulation from different parts of the body chiefly by means of the chyle and lymph, and are carried to the various organs where they are deposited. Between the lead and the albuminoids of the parenchyma chemical combinations are formed which are thrown off very slowly and only with the greatest difficulty through excrement, urine, milk, and in many cases through the skin.

Traces of lead have been found in the tissues of persons months and years after they have recovered from lead poisoning, and during all which time they had had no further opportunity for the absorption of the poison. In chronic lead poisoning the distribution of the poison to the several organs is not equal, but certain organs take a relatively large amount of lead as compared with others. According to Heubel's investigations on dogs fed with lead preparations, the greatest percentage of lead was found in the bony tissues, the parenchyma of the kidneys, and the liver. The relative quantity of lead in the spinal cord and the brain was small, and still less was found in the muscle substance. Only traces of the metal were found in the other organs. Above all, only very small amounts were found in the blood, and these always relatively smaller than those in the organs investigated.

As has already been shown, all lead products (except the nonpoisonous rhodan lead) possess the power to produce in the body a characteristic series of symptoms, which, as they usually arise from the sum total of smaller effects, take a slow and chronic course. No matter what lead product causes the poisoning, the series of symptoms is always the same. As the very first symptoms an increased vascular tension exists for some time, after which a loss of appetite and a general emaciation occur, accompanied by an earthy color of the skin, a loss of strength (sometimes after a relatively short exposure to the poison), and a manifest loss of weight.

The victim experiences a certain dryness of the mouth and a disagreeable sweetish, metallic taste. The tongue, especially the posterior portion, is covered with a whitish layer. The breath becomes offensive. A bluish-gray seam of sulphide of lead shows at the edge of the gums. The latter are often loosened, reddish blue, and partly shrunken, so that the teeth, which frequently display diseased alterations, appear longer.

At the same time there is more or less severe anæmia. The intensity of the symptoms in different individuals, as well as in the same individual at different periods of time, varies.

EFFECT OF LEAD POISONING UPON VARIOUS ORGANS OF THE BODY.

Parallel to these general symptoms, more or less evident affections of the other organs are running their course. The stomach and intestines present the symptoms of chronic dyspepsia, want of appetite, vomiting, hiccough, etc. Especially in severe cases there is a gray covering of the mucous membrane (deposits of sulphide of lead, precipitated out by the sulphuretted hydrogen (H_2S) formed in digestion). This settles in the interstices between the connective tissue texture and produces a shrinking and degeneration of the mucous membrane.

Of especial importance and interest are the nervous conditions of the intestinal canal, whose aggregate has been contracted into the words "lead colic." These symptoms occur at intervals of various length. To the many precursory symptoms (like strong navicular contraction of the abdomen, which may become as hard as a board, and severe nausea with vomiting of bile) an active feeling of thirst, a weak voice, a hard, diminished, thread-like pulse, increased respiration (asthma saturninum), and drawing pains of varying intensity in the abdomen, are added. They trouble the victim, and often are the cause of the most unnatural positions adopted to allay the pains, which can sometimes be made bearable by pressure on the abdomen. The seat of the pain is usually in the region of the navel, from which it radiates to other parts. In addition, there are localized constipation existing for days, often ischuria, neuralgic pains in the region of the genito-urinary system, and pains in the limbs. Lead colic may reappear with severe pains and drag through weeks and even months. On the other hand, it may end in a few days with complete recovery. It is seldom fatal. Of Tanquerel's 1,217 patients only 9 died; of Andrali's 500 only 5 died.

Of the other vegetative organs the liver is sometimes attacked (Heubel, Hitzig, and Aubry), so that a genuine case of icterus, a deposition of bile particles in the tissues and excretion of the same through the urine, results. Of especial value are the phenomena of reaction which occur in the kidneys. As it is the task of the kidneys to eliminate a part of the lead from the organism, they are exposed to the harmful influence of the poison in almost every case. Yet no great alterations ought to be produced in their parenchyma.

A diminution of the diuresis almost always occurs, the urine is often albumenous and shows the same characteristics (Bartels) as are caused by the ordinary atrophied kidney. In many cases such an atrophy has been pointed out, mostly in the form of the red granular atrophy (Leyden).

Cicatricial atrophy of the interstitial tissue, with atrophy of the glomeruli and hyaline degeneration of vessels and processes limited to a small scar, sometimes occurs. So also, especially on the part

of English authors (Garrod), the lead kidney is brought in conjunction with the true gout kidney and lead poisoning is set up as a poison-generating cause. The changes of the diuresis are looked upon by some as the principal cause of the symptoms occurring in the vascular system. The pressure of blood and vascular tension rises and causes the pulse to have a characteristic, hard, thread-like character. Not rarely hypertrophy of the left ventricle has been observed. The alterations of the diuresis superinduced by the kidney affections is considered by many authors, following the precedent of Traube, as the cause of the frequent brain affections—encephalopathia saturnina—and that because of its similarity to uræmia.

The English have made extensive investigations in this respect and the following quotation from the work on Dangerous Trades by Dr. Thomas Oliver, pages 308 and 309, shows some of the results obtained:

The question of insanity in lead workers has been ably dealt with by Dr. Robert Jones,[a] the medical superintendent of the London County Asylum, Claybury, Essex. Taking the proportion of 1 lead worker, in the broad sense of the word, to every 58 of the adult population, there ought to be in Claybury 18 male patients belonging to that class. As a matter of fact, however, out of 1,050 males in the asylum, there are 35 who have been lead workers, plumbers, painters, and glaziers, but excluding pottery workers and miners. In examining the histories of 3,500 male patients admitted into Claybury, Dr. Jones found that of these 133 were artisans, who in their trade had possibly become impregnated with lead; their occupations were as follows:

Painters	75
Decorators	13
Plumbers	18
Gasfitters	13
Laborers in lead works	6
Grainers	3
Gasmeter makers	2
Color grinder	1
File cutter	1
Tea-lead roller	1
Total	133

Of these 19 had signs of lead poisoning upon admission, such as paralysis, colic, and blue line on gums, while in 22 there was a history of convulsions (encephalopathy), headache, giddiness, and paralysis. Of the 133 cases the following is the analysis of their mental condition:

Mania	37
Melancholia	33
Dementia	19
Dementia with epilepsy	10
Dementia with general paralysis	24
(?) General paralysis	7
Alcoholic mania	3
Total	133

[a] British Medical Journal, September 22, 1900.

"The proportion of general paralytics among these possible lead cases is 18 per cent; the average yearly percentage of general paralytics to the total average number of male patients admitted into asylums for the five years 1893–1897 was 13.1, and it appears to me there is a strong presumptive evidence that lead may be a factor in the cause of general paralysis of the insane." Elsewhere [a] I have drawn attention to the association of lead poisoning and general paralysis, and indicated that as there is in the plumbic form a larger percentage of recoveries than in general paralysis proper, the probability is that the malady is not exactly of the same nature, but is rather a pseudo-general paralysis. Dr. Jones summarizes his conclusions thus:

1. That lead poisoning is a contributory factor to insanity.
2. That the mental symptoms may be grouped among one or other of the following varieties:

(*a*) Toxæmia, with sensory disturbances, which tend to get well.
(*b*) Hallucinations of sight and hearing, usually chronic and irrecoverable.
(*c*) General paralysis with tremors, increased knee jerks, incoordination, listlessness, and dementia, which tend to get well.

There are several other theories besides these concerning the nature and diagnosis of encephalopathia. Rosenbaum and Heubel assume that the brain anæmia resulting from the effects of lead is the cause of the brain diseases. Harnach believes them to be due to the direct influence of lead on the various brain centers. The latter view is probably the correct one in most cases. The brain affections induced by lead may run a manifold course and range from the mildest to the most severe cases. Many nervous symptoms figure often as forerunners. Then headaches, a feeling of dizziness, and a series of cerebral phenomena occur. The latter consist of a varying combination, partly quiet, partly raving delirium, comatose conditions, and epileptic-like convulsions. These three groups of symptoms sometimes alternate often and rapidly, and combine with several others (aphonia, etc.), and make the whole very complicated.

Of particular interest are the symptoms occurring along the several nerve tracts, which often present themselves in the most typical manner. Thus there sometimes arise, to begin only with the higher organs of sense, sudden disturbances of a serious character, such as amblyopia and even complete amaurosis, with pupil enlargement and suspended reaction. These conditions, among which objectively no anomalies can be proved, disappear usually after a few days.

Very similar attacks have been observed in the auditory organs and in isolated cases in all the organs of sense. Often they are observed in the peripheral nerve endings, where they produce a series of interesting symptoms in the sphere of the sensory nerves. Among these is the so-called arthralgia saturnina and the appearance of severe pains in the limbs and joints, such as frequently accompany lead

[a] Oliver, in Allbutt's System of Medicine, Vol. II, "Lead Poisoning."

colic. As precursory symptoms, trembling of the hands and weakness of the limbs occur, and then sets in the real neuralgia, which is the severest at night. The latter bears a certain resemblance to gout, which gives additional strength to the view that there is a close relationship between gout and lead poisoning. Garrod claims to have found lead-containing uric acid in the blood. Pedell claims to have found, besides hypertrophy of the left ventricle and lead atrophy, deposits of urates in the various joints of the lower extremities and in the kidneys.

According to Garrod one-fourth of all those suffering from gout are said to be painters and workers in lead. According to Bucquoy, attacks of gout are a common occurrence among painters. Arthralgia also does not continue without intermission, but often has remissions, during which formication, light drawing pains, etc., remain. The group of lead symptoms, which usually make their appearance last, are the paralysis of motor nerve tracts. They are the lead paralysis that usually occur in one nerve, the radial. The cause of the paralysis is probably the occurrence of alterations in the anterior gray cells of the spinal cord (degeneration and atrophy of the ganglion cells). (Vulpian and Opperm.) They cause the nerve paralysis, and secondly degenerate alteration in nerves and muscles, even if these changes of the spinal cord can not always be found.

The paralysis usually begins in the extensors of the third and fourth fingers. This, first of all, makes the extension of the first phalanges of the third and fourth fingers impossible. The end phalanges can still be extended by the interossei muscles. Then it seizes the other extensors of the forearm, while the supinators usually remain unaffected. At this period a characteristic position of the hand known as drop-wrist is obtained in that it hangs down loosely, at right angles, in the position of ulnar abduction.

It is evident that the utility of the hand as well as its strength has been seriously impaired. The paralysis may now extend to the region of the triceps and deltoid muscles, in which process the other regions of the arm also do not remain intact. Other nerve tracts seldom present the symptoms of lead paralysis. In rare cases, after the extensors of the upper extremities have been attacked those of the foot and toes are attacked in their turn. Still later certain of the trunk muscles and the diaphragm may become paralyzed. Paralysis may even reach the muscles of the larynx and produce complete aphonia. Paralysis of sensory nerves may also accompany the motor paralysis.

As already pointed out, degeneration takes place in those nerves and muscles attacked. As resulting symptoms of this degenerate atrophy, beside the characteristic position of the arm, emaciation, inutility, and electric degenerative reaction make their appearance.

AN INVESTIGATION OF LEAD WORKS.

MANUFACTURE OF WHITE LEAD, PAINTS, ETC.

In the prosecution of this investigation, study was made of several factories engaged in two dangerous branches of the lead industry. These included two white-lead and paint works and one establishment for smelting and refining lead and zinc. The larger of the white-lead factories will first be taken up, and its processes, condition, and the effect of the employment upon the workmen described. This will be followed by a like description of the smelting and refining works. Finally, a statement will be given of the results of employment in lead factories and the preventive measures necessary to guard against lead poisoning.

In the investigation of the larger plant visited engaged in the manufacture of white lead, paints, etc., the detailed facts (from a hygienic standpoint) could not be ascertained. The reason for this was the continued absence of the superintendent, and the technical director could not, on account of lack of time, be spared from the main office as much as was desirable. However, with his aid the accompanying short description was made possible.

Some unwillingness to give information at the beginning was due to the absence of the director and the belief that the investigation was connected with the accidental death of a workman who fell into a vertical crushing mill. This could not have occurred if the tank in which the white-lead mass is mixed had been surrounded with a railing, through which the men could have added the material. Several months have passed since the death of the workman, and the same possibility exists that a similar fate may overtake the new man employed in his place. This could very easily occur because of the elevated floor and the slipperiness of the material. The surrounding of this crusher mill with a railing has probably been neglected because from the factory director's point of view it would hinder the work. A railing could be easily constructed which would not hinder the work, but would protect the workman from falling into the mixing tank.

Occupying several acres of ground, the factory stands isolated from other large factories, so that the neighborhood is not menaced in any way whatsoever. Entering the office of the factory, one sees a force of clerks comfortably situated in well lighted and ventilated rooms, with sanitary arrangements for their convenience. On the second floor is the superintendent's office and anteroom for dining purposes, etc. In the manufacturing department is a network of buildings devoted to the industry in which the firm is engaged. Each of the numerous buildings plays its part in producing the finished product. In the yard hundreds of tons of pig lead are stacked, ready for the casting

kettles which are located at a convenient point adjacent to the corroding houses. The casting house is isolated from the other buildings, and is amply ventilated by large open doors. The fumes from the kettles are carried off in large flues intended for that purpose. It is here that the manufacture of white lead is begun. The process begins with the "buckle," which is formed by allowing the molten lead to run on an endless chain, from which the buckle assumes its shape.

From the casting house the buckles are carried to the stacks or corroding houses, where they are subjected to the chemical processes necessary for their transformation into white lead and so arranged as to give the best practical results. On a bed of tan bark 6 to 8 inches in depth is set a row of porous earthenware pots, in the bottom of each of which is placed sufficient dilute acetic acid and a number of buckles, which by the action of the acid and the fermentation of the tan bark produce white lead. Upon a complete tier of pots a floor of lumber is used as a cover to prevent the tan bark from coming in contact with the white-lead formation and as a foundation for the next layer. The process of corrosion requires from one hundred to one hundred and forty days in this "old Dutch process," and the process can be regulated by a system of flues, which are necessary for the regulation of the heat generated in the process. The acetic acid attacks the lead buckle almost immediately, forming acetate of lead. The fermentation of the tan bark incidentally generates carbonic-acid gas, which by its action transforms the acetate of lead into the commercial carbonate of lead.

When the corroding process has been completed, the stacks are discharged and the lead is carried to the mill house, just outside of which is a bin into which it is dumped. From this point until the finished product is made there is no necessity for the lead to be handled again. Falling into the powerful crushers, the scrap, or uncorroded metal, as it is sometimes called, is separated from the carbonate of lead formed in the process of corrosion by machinery, being closed so that no dust can escape during the separating process. However, as a precautionary measure, blowers and ventilators are installed for the purpose of collecting any dust which may be produced. These carry such dust to the "dust house," a small building located outside the mill house and erected especially for this purpose.

The crushing and separating process having been completed, the lead is sent through a long series of washing and floating tanks, where all traces of acid are eliminated. Two floors of this large mill house are devoted to this part of the process. In all the departments the workmen are instructed to use respirators, in order to prevent the inhalation of lead dust, and signs in various languages, distributed throughout the works, warn the laborers of the danger from working in lead, and every assistance for their protection against it is afforded.

When the lead has been thoroughly washed, it is passed to the steam-heated copper drying pans, and when it has been thoroughly dried it is either stored in bins, to be subsequently mixed and ground with linseed oil, or marketed as dry white lead.

In the erection of this mill house the comfort of the workmen has been properly looked after. There is ample accommodation for those who desire to remain in the factory during lunch hours, and suitable arrangements for cleanliness are provided for all those employed in the white lead as well as in the other departments. Employees are provided with means for preventing lead poisoning; and cleanliness is always observed. Some of the employees frequently indulge in a drink of very dilute sulphuric acid, a well-known remedy for lead poisoning.

On the second floor, directly under the drying pans, is the chasing department. Here the lead is mixed with the linseed oil by powerful chasers, which consist simply of a large iron wheel made to revolve in a circular pan set in the floor. From the chasing apparatus the lead is passed into mixers, which are intended to more thoroughly incorporate the linseed oil with the white lead, and from here it is sent to the water-cooled mills to be finely ground and packed in kegs or cans by automatic machinery.

Adjoining the grinding rooms is a building for the storage of empty packages as well as filled stocks. From here orders are shipped to the trade.

Whatever scrap or uncorroded metal remains after the earlier process is sent to the oxide department, where red lead, litharge, and orange mineral are manufactured. In this department there are practically but two operations, first the burning, which is done in furnaces built especially for the purpose, and secondly the grinding and packing. There are over twenty furnaces arranged systematically in a long, well ventilated room, each furnace being provided with flues for the escaping gases. The furnace tenders, whose duty it is to regulate the heat and to watch the degree of oxidation, are men of experience. Red lead and litharge are made from the scrap metal or pig lead as it is received from the smelter. Orange mineral is produced by burning the carbonate or white lead.

Adjoining the furnace rooms is the washing and grinding department, where the various oxides are treated mechanically with water for the purpose of separating any metal which has not been duly oxidized in the furnace room. This operation having been completed, the red lead is ground and collected in screen boxes tightly sealed, so as to keep the rooms used for this operation as free from dust as possible. As in the case of the white-lead department, suitable quarters, with all conveniences, are ready for the use of the workmen and those employed in this department.

The flaxseed used in the manufacture of linseed oil is unloaded from the cars into a long box through which an endless chain passes. This carries it to the linseed-oil mill located at a point beyond. The seed is crushed and heated before being placed in the presses, and the process is so simple as to need no explanation.

On the first floor, which is devoted to the weighing and filtering of the oil, is the electrical department, which supplies the light for the entire plant, and in an adjoining room is a bath for the pressmen. Numerous surrounding buildings are for the storage of linseed oil, none of which is marketed until it has been allowed to settle for a considerable period of time.

Passing from the oil mill, there are the carpenter shop, machine shop, empty-barrel house, and numerous other buildings devoted to storage, and finally the color-making department, a long four-story brick building recently erected for this purpose. On the top floor are the various tanks used for dissolving necessary chemicals and ingredients used in the manufacture of colors, which empty into still larger tanks where the colors are precipitated and again washed before passing to the filter presses located on the first floor. In a room separated from the one devoted to the filtering, the colors are dried and then taken to another building in which they are ground dry or mixed in various vehicles, as the demand of the trade may indicate. The color-grinding building is also of four stories, well lighted, and painted white in order to assist nature in affording the workman the best light. Because of its cleanliness and excellent ventilation there is little or no danger to those who are occupied in the color-manufacturing department. The top floor is devoted to storage purposes, the third floor to the mixing department, the second to the grinding, which is done in water-cooled mills especially adapted to the purpose. The first floor is devoted to the packing and shipping department. For those colors which contain lead or other poisonous ingredients bins have been erected, and as the colors are kept under cover when not being handled, but little dust is produced. As a safeguard, however, ventilators have been installed, and so far no ill effects from working in this department have become apparent. An adjacent building is devoted to the advertising department, where at times from 40 to 50 persons are employed. Sufficient light and ventilation are afforded those occupied here, and the long tables stand in readiness for luncheon purposes during the noon hour. In this building also is the chemical laboratory, with scientific appointments, as well as apparatus for practical testing purposes. On the third floor are toilet rooms for girls and women employed in the advertising department. In connection with the color manufacturing there are a number of buildings in which large quantities of raw materials are stored. All of these are kept in good order by men whose business it is to look

after stock. Passing over the large area of this factory, one is impressed with the well-painted buildings and the clean walks leading to and from them, and the absence of refuse so often noticed in large manufacturing plants. Men are employed whose sole duty it is to look after the cleanliness of the buildings and the surrounding yard, and each department is under strict orders to maintain a cleanly appearance at all times.

Another white-lead factory was also investigated, but it is not necessary to enter into the details of description here, as it does not differ to any considerable extent from the one already described.

SMELTING AND REFINING OF LEAD AND ZINC.

Further study of lead-working employments was made in a factory occupied only with smelting lead and zinc. Eight kilns were in use, employing 24 men night and day. No protection against heat, smoke, or gases was provided. The material employed consists of refuse coming from tube works and smelting furnaces, deposits of smelting works smoke (75 per cent lead), and zinc ore from Joplin, Mo.

The metallic fumes which develop in the smelting of lead and zinc have a very harmful effect upon the workmen, and at the same time annoy the vicinity within a large radius. At a neighboring factory sulphuric acid fumes were very heavy. In this manufacturing process sulphurous acids are developed. The lead fumes are precipitated on the chimney and flue walls as a loose whitish deposit which consists of lead oxide, the carbonates and sulphides of lead, antimony oxide, arsenic acid, zinc oxide, carbonate of lime, silicic acid, and clay. The smoke, impregnated with a mixture of all these oxides, acids, metals, carbonates, and sulphides, issues from the top of the iron chimney of the factory and is deposited upon men, animals, and neighboring grounds, where it necessarily must exert its injurious influences.

From these constituents of the smoke powder-like substances similar to any other dust are produced. If they contain anhydrous sulphuric acids their caustic effects come into consideration, in that under the influence of mist and dew concentrated solutions are given.

The gases are especially injurious to vegetation, because it is almost impossible to condense them completely, and they are diffused over wide regions. Sulphurous acid, which acts so disastrously upon men, animals, and plants if the air contains more than 0.004 per cent and at the same time is full of mist or moisture, is the most important of these. In clear or rainy weather its influence is greatly diminished.

Besides the smelting of lead, which is done by a primitive manufacturing process, there is the dangerous zinc smelting. In this process, in which refuse is also employed, very injurious acids are developed. The workmen are subjected to great heat. Much dust arises

which, in the employment of arsenical blend, contains a large proportion of arsenic. A strong current of air carries the dust through the roof, but this causes frequent cold drafts on account of the high temperature.

On the whole, this establishment must be considered insanitary. The workmen suffer from catarrhs of the respiratory organs and from digestive troubles. The latter are perhaps due to a direct influence of the zinc combinations upon the stomach. Perhaps they are the result of a general deterioration of the whole constitution. The usual coincident dirty gray, pale color of the skin was not noticeable in this factory, as only colored men are employed, probably for very evident reasons. After several years' occupation in such a factory diseases of the spinal cord, and especially its lower divisions, may occur. In smelting the lead dust (containing 75 per cent lead) chronic lead poisoning among the workmen necessarily occurs. From the escape of sulphurous acids and zinc oxide dust it is evident that the neighborhood is very much in danger. Very poisonous dust is raised in pulverizing and sifting the various kinds of zinc dust.

Lead melts at 633.2° F., boils with an active white heat, and evaporates. Therefore, if it is heated as much as is necessary in the present industry, it gives off poisonous fumes. Because refuse is almost exclusively used here in extracting the metallic lead, the heat is considerably higher than in the ordinary smelting of lead. As a result the dangers to which the workmen are exposed in standing before the eight furnaces are very great.

The workmen themselves have no conception of the danger of their occupation, and in this factory it was impossible to gain any information concerning cases of illness, because they purposely avoided every meeting.

The only proper measure of improvement would be the complete suppression of the entire factory, because its location and the construction of the plant produce extensive annoyances and dangers to the immediate neighborhood, as well as to the public at large. Such industries should not be carried on within city limits, but in the open country. Should the dilapidated old factory building be rebuilt, provisions should be made for the condensation of the lead fumes, similar to those made in large lead works. The method of condensation of lead fumes in such works is as follows:

In consequence of the volatility of lead at high temperature, a certain portion of the metal and some of its compounds is carried away by the heated gases in the operations of smelting, refining, reducing, etc. To prevent the loss and minimize the nuisance which would arise from allowing the gases produced in these various operations to pass directly into the chimney, the furnaces are connected with a

series of flues or condensing chambers in which the gases are cooled, and so deposit some of the solid matter held in suspension before they issue from the chimney. These flues are cleaned out at stated intervals, and the "fume" is collected. Lead exists in the fume chiefly in the form of sulphates and oxide, and is recovered by roasting and smelting it, alone or mixed with ores and slags. A certain proportion of silver is always found in lead fume, the amount being considerably less than that obtained directly from the ores from which the fume was produced.

The method of fume condensation most commonly relied on, and the one said to be most efficient, is simply to connect the various smelting and other furnaces in the works with a series of long flues of large transverse area. In some establishments the flues used for this purpose have an aggregate length varying from 3 to 5 miles, and a cross section of from 6 by 7 feet to 8 by 9 feet. Jets of steam and water have in some cases been introduced at different points in the flues for the purpose of facilitating the fume deposition. Lead smelters differ in opinion as to the advantages gained by the use of either steam or water. Various devices have been proposed to effect the condensation of lead fumes without the necessity of constructing long flues or large condensing chambers.

The Stagg condenser consists of a large rectangular chamber divided by partitions extending alternately from the top and bottom of this chamber, leaving free spaces above and below. The lower part of the chamber is filled with water, so that the gases pass first down one side of a partition, through the water, and rising in the next compartment pass over the next partition and down again to the water. The gases are drawn through the chamber by means of air pumps attached to the exit flue. The fume is, in its passage through the condenser, thus drawn through water and the greater portion of the solid particles removed. The solid matter collecting in the water is drawn off from time to time into tanks.

In Stokes's method of condensing, the gases are drawn off from a flue by means of a fan, and are then forced into the condenser, which consists of two chambers placed side by side. The chambers are divided into several compartments by partitions, which alternately extend from the top, and dip below the surface of the water at the bottom of the chambers. Each chamber is divided horizontally by two floors made of open joists, upon which fagots are laid, thus forming filtering beds, which are washed by a fine spray of water falling from a cistern on the top of the condenser. The gases drawn from the flue by the fan are forced through a series of compartments of the condenser, and meet in their passage with the fine spray of water, and must also pass several times through the filtering bed, where the fume

as it collects is washed away with the water which accumulates in the lower part of the chamber. When the water has reached a certain height it is drawn off into tanks, and here the solid matter collected by the water gradually separates out.

In 1878 Messrs. Wilson and French patented a condenser, which has been adopted at the Sheffield Smelting Company's works and also by Messrs. Bewick and partners, Limited, Helburn-on-Tyne. At the Bewick works the gases from the ore house, slag house, and reverberatory furnaces pass first into a long tube, which ascends the ballast hill at the back of the works, and, after making a circuit around the top of the hill, the gases are drawn off from the tube down a series of narrow flues to the condensers. In this way the gases are thoroughly cooled before they reach the condenser, and a certain portion of the solid matter in them is deposited in the flues, which are cleaned out from time to time. The remainder of the solids is obtained in the condenser, which consists of a wooden box having a shelving bottom, where the solid matter arrested collects, and an opening at the lowest point by which the contents of the condenser are run off from time to time. The gases are forced into the box by a fan along a pipe, which opens into a chamber formed by a partition running parallel with the side of the box. Below, this chamber opens into a series of triangular tubes running across the box. These tubes are perforated above, and through these fine openings the gases are forced into the water with which the box is partially filled. Near the surface of the water a series of three or four copper-wire screens or screens made of wickerwork are fixed and held in position by support. The gases pass out finally by a pipe in the top of the box and are conducted by flues to the chimney. By this arrangement the gases are forced through a layer of water of a given depth, and further intimate contact between the water and the particles of the fume, etc., is insured by the wickerwork or copper-wire screens. The fume, etc., arrested by the water collects in the lower part of the box and is drawn off into settling tanks, and, after the greater portion of the water has been removed, the fume is dried and smelted. With three-wire gauge screens and a depth of 8½ inches of water it is stated that at the Sheffield Smelting Company's works the quantity of lead and silver arrested amounts to from 95 to 98 per cent of that contained in the smoke as it leaves the furnace.

The following analyses, taken from Dr. Percy's work on The Metallurgy of Lead (p. 451), will serve as examples of the composition of lead fume. The samples analyzed were collected from the flues of the lead-smelting works at Bagill's, and represent the fume from reverberatory furnaces and slag hearths.

ANALYSIS OF SAMPLES OF LEAD FUME.

Composition of lead fume.	Sample I.	Sample II.	Sample III.
	Per cent.	*Per cent.*	*Per cent.*
Protoxide of lead	46.54	62.26	46.88
Sulphide of lead	4.87	1.05	.....
Sesquioxide of iron and alumina	4.16	3.00	10.00
Oxide of zinc	1.60	1.60	4.14
Lime	6.07	3.77	6.73
Sulphuric acid	26.51	25.78	14.15
Insoluble residue	10.12	1.97	14.40
Carbonaceous matter	.....	.....	3.37
Total	99.87	99.43	99.67

RESULTS OF EMPLOYMENT IN LEAD FACTORIES.

In the investigation of the white-lead factories the sickly appearance of the workmen was everywhere noticeable, the result of the absorption of lead in all possible forms—gaseous, powdered, and dissolved. In like manner sufficient protection for the workmen by means of efficient ventilation, conducting away of the poison, and personal protection was everywhere lacking. Rooms are too small, too low, and insufficiently clean and moist. If protective and preventive arrangements are present they are inefficient. Dust and lead laden gases and fumes not only enter the various working rooms, but also escape from the windows and skylights, so that even from the street the roof can be seen covered with a fine white-lead dust. Exhausters are placed at the entrance to prevent the dust from scattering in the working rooms, and from escaping to the external air. They are far from fulfilling this purpose, especially in such operations as dry grinding, packing, and the like. It must be admitted that from our present knowledge it is very difficult to perfect arrangements by which the factory rooms in this industry can be satisfactorily protected from lead dust, gases, and fumes. Still it is possible to separate them from the other rooms, so as to prevent the spreading of the above-mentioned material in the latter.

In the preparation of lead colors, especially by the wet method, it frequently happens that the clothes of the workmen are exposed to the lead-containing liquid. It is evident that there is great danger in the continued use of such clothing.

Respirators have been procured by many employers for the use of workmen who are engaged in dust-developing occupations. The workmen refuse to wear them. If the employers insist upon their being worn, it is done unwillingly, and the men work without them in the poisonous atmosphere whenever possible. From this it is evident that up to a certain point protection against poisoning can be obtained by strict regulations. Beyond this point, however, one is powerless, unless the workman of his own free will concerns himself with the utmost cleanliness and the use of protective measures.

The thoughtlessness of the workman is very great. Men eat their lunches with unwashed hands in the factory itself, when a dining room is provided for their special use. Implements covered with white lead are held in the mouth, because they are too indolent to lay them down. Hands covered with white lead are used in filling pipes and cutting off chewing tobacco. Here is one place for reform. The workman must be educated up to a realization of the danger of his occupation, and should know the use and purpose of all preventive measures against poisoning. Besides, very strict orders as to conduct should be given, and implicit obedience should be demanded. It is evident that there is no protective method which can permanently prevent the disastrous influences of lead in long-continued employment of the men unless they have a clear conception of the whole subject. Propositions for such precautions, regulations, and general preventive measures in color and sugar of lead factories are fully given below. They correspond with the prescribed methods that are used in the German Empire, and have stood the practical test of experience. It is self-evident that from time to time they have to be extended as advances and improvements are made in the method of manufacture. Nevertheless, these prophylactic measures are the foundation upon which these extensions have to be based. Only this much can be here indicated—that it is necessary to have all plants inspected by an expert, from a technical and hygienic standpoint. A uniform system of inspection should be established and satisfactory instruction given in this system. In this manner all arbitrary judgment in the investigation of dangerous conditions can be done away with.

As the result of personal observations, investigations, and examinations of workmen by the author, it was discovered that a certain amount of lead gets into the stomach, from which it is transmitted to the fluids of the body. The symptoms are usually catarrh of the stomach, sickness, vomiting, and cramps. The diseases of lead poisoning are caused, as in all white-lead factories, through the inhalation of lead-containing dust and the contamination of food and drink with lead.

Lead apparently has never been found to cause acute cases of poisoning among the workmen. On the contrary, it is a slow and stealthy poison, which in this way makes doubly sure of its victims and scarcely ever permits them to escape. The forms in which lead is dangerous are essentially the same. The metallic fumes are condensed, enter the mouth, and are swallowed with the saliva. In other instances the lead dust is introduced into the stomachs of the workmen when they partake of their meals with unwashed hands. Lead dust is also inhaled and from the lungs absorbed by the body. The effects of the dust taken into the system in the latter manner are less marked. It is remarkable that the workmen in white-lead factories care but little for the danger lurking in the material to which they are exposed,

and carefully endeavor to conceal the diseases which have been caused by white-lead poisoning. A foreman, for example, told the writer that he had followed his occupation in a white-lead factory for more than a decade, and positively insisted that he had never been ill, and even now did not feel any evil effects. Even at a distance it could be seen that the lead had completely undermined his health. His pale complexion and whole appearance indicated that his body and constitution had suffered extensively from the stealthy and treacherous influence of the poison, and that it had been present in his organism for a long time. It will not be long until this man will succumb to the poison unless he gives up his occupation. In this investigation it was ascertained that those who have once recovered from the disease are very susceptible to it on a subsequent exposure.

Concerning these two ways by which lead is so rapidly absorbed by the body no differences of opinion exist or are possible. While the possibility of the direct cutaneous absorption of lead is denied by some and affirmed by others, the results of the author's investigations leave little doubt that lead poisoning may be induced in this manner. The almost indescribable carelessness of the white-lead workers must be taken into consideration.

The investigations of the diseases from which lead workers suffer indicate a disturbance of the whole organism, even long before a really severe illness occurs and compels them to lay down their work. These symptoms display themselves sooner or later, depending largely upon individual susceptibility. One workman had been employed scarcely three weeks in the drying chamber of a white-lead factory. His duties were to cut furrows through the warm and wet white lead in order to accelerate the drying process. Even after this short period, judging from his appearance and answers, he was evidently suffering from the first symptoms of lead colic. Another workman would resist the poisonous influence much longer. From these facts it is evident that the individuality of a person plays a large part in the absorption of the poison. From those workmen, whose outward appearance indicates a more or less advanced case of poisoning, it is ascertained that there is always a consequent loss of weight. In white-lead factories the workmen ought to be weighed at definite intervals and conclusions drawn from the result. This is a simple method of investigation and is not expensive. The growing decrease in weight indicates to both employer and employee that care must be exercised and the dangerous occupation suspended for a time.

In one case of lead poisoning observed in this investigation the symptoms were chiefly a peculiar coloring of the entire skin of the body. The gums were slate colored and formed a bluish girdle about the brown and almost black teeth. This bluish color was scattered in spots over the whole mucous membrane of the mouth; the mouth was

parched; the appetite had diminished, and thirst had increased for a long time. While eating there was a sweetish taste, a shriveling sensation in the mouth, and the breath had a peculiarly disagreeable odor. The conjunctiva of the eye was of a dirty dark color. The face was thin and sunken. The stool had been retarded for a long time and was dry and hard; the urine had steadily decreased. Despite these symptoms of lead poisoning, the man continued at his work, and could not be induced to give it up. He should have been compelled to do so.

In every kind of work concerned with the manufacture of lead it has been found that, in addition to the above symptoms, abdominal pains occur. At their incipiency they are mild and wandering. Sometimes, however, they are violent and localized. Sometimes they occur spasmodically and at various periods, especially at night, when they become so violent as to necessitate a convulsive contraction of the abdomen. Intestinal gases give the latter a bloated appearance.

If we take into consideration that from such symptoms it is only a short distance to fatal and dangerous lead poisoning, it is almost impossible to decide who is more culpable, the workman who with such an evident case of poisoning continues his work until he finally has to give it up, or the employer who permits him to work in such a condition. If in such cases of lead poisoning the usual fainting spells, impeded respiration, and decreased pulsation appear, it becomes more and more difficult to effect a cure. Such a case may easily develop into the so-called lead palsy. Lead palsy proper usually attacks the extensor muscles of the arm, less frequently those of the legs, and is allied to contractions of the limbs or separate fingers. The patient is unable to extend the limb spontaneously, but it can sometimes be used with comparative ease. This paralysis appears either slowly or after an attack of the much-dreaded lead colic. It finally induces a complete degeneration of the paralyzed muscle. In the more severe cases epileptic convulsions (the so-called lead epilepsy), mental aberration, conditions of deafness, and various disorders of the mind occur.

These mental alienations are usually indicated by long-continued dizziness, headaches, melancholia, and weakness of mind. After a long subjection to lead poisoning, the so-called lead anæmia occurs. This causes death through increasing emaciation of the body and through dropsy. Lead poisoning thus runs its course in the body of a workman unless he takes early preventive measures against the influence of the poison. To this end he must give up his occupation, or at least take the greatest care and maintain the most exacting cleanliness, besides obeying all measures adopted for his protection.

If the workman is suffering from chronic lead poisoning (we are not concerned with acute cases), he should employ mucilaginous, fatty, and nourishing foods and drinks (milk, for example). Frequent baths and clean clothes as well as the greatest cleanliness should be carefully

looked to. Warm clothing should be worn. He should keep to his bed as conditions require, and live in a warm and dry house. Of external measures, especially in lead colic, oily and irritating clysters, warm cloths on the abdomen, and warm baths are very serviceable. In all cases of lead poisoning, and especially in chronic cases, the so-called sulphur baths are very valuable. In lead paralysis the electric current is recognized as efficient.

The above is to be considered only as a general statement, and not as a course of treatment of lead poisoning to be undertaken without the aid of a physician. The latter should be consulted under all circumstances and the necessary course of treatment with regard to internal remedies followed.

Among those workmen who have come under the observation of the writer lead is absorbed in two forms, either as fumes or as dust. Experience has shown that the most severe cases of lead poisoning are almost without exception caused by the absorption of the metal in a powdered condition.

From our knowledge of the method of lead absorption into the organism of the workman it may be assumed that the condition of the absorbable poison is irrelevant. The indicated differences in its effect seem to be entirely due to the absorption of different quantities of lead. The most frequent and severe cases of lead poisoning are contracted in white-lead factories, where large quantities of the poison are always able to exert their evil influence. From the latest researches it is not improbable that the poison which is directly introduced into the stomach is absorbed more rapidly and in larger quantities than that which enters by the way of respiration. This is chiefly in the form of dust. This fact readily gives an explanation for the difference in the effects of lead dust and the fumes. Much more difficult is the question of the ætiology and pathology of lead poisoning. Ætiology is concerned with the causes of disease. Pathology theoretically treats of the knowledge of diseases and the exact manner in which they and their symptoms are brought about. All early and late observations in this respect agree, (1) that the occurrence of lead poisoning, lead colic especially, is periodical and in certain places takes a true epidemic form; (2) that individual circumstances, as far as susceptibility is concerned, play a large part in lead poisoning, while in other respects, such as constitution, age, and temperament, the individuality is of no importance whatever.

In details the various observers diverge. The reason for this is probably that their conclusions are drawn from an insufficient number of cases. There is no doubt that investigators in this line will find causes and corresponding effects and reduce everything to order and regularity as soon as they draw their conclusions from a sufficient body of statistics. What appears to be mere chance or extraordinary

circumstance is only the extreme of the ordinary and familiar. These phenomena occur according to definite laws, and even in the most abnormal cases there is a repetition of the same symptoms.

These so-called extraordinary cases must not be considered as alone and isolated, but should be studied in their relations to the ordinary and familiar cases. To ascertain this important relation it is necessary to study the greatest possible number of cases that can be obtained. The result will avoid wrong impressions which might be derived from a small number of cases.

Autumn and spring are the seasons in which lead colic periodically occurs. The heavier atmospheric conditions, especially on the coast, during these seasons prevent the escape of the lead fumes. Stagnation of the atmosphere containing lead fumes in the usually ill-ventilated working rooms admits of their absorption by the body. In addition to the above, the humidity of spring and autumn causes attacks in persons susceptible to such influences and to diseases of a catarrhal nature. This condition of the atmosphere also readily causes new attacks of lead poisoning in those individuals who are predisposed to it. It has been found that these cases occur when only very small quantities of poison have been absorbed and even when no new exposure to lead has taken place.

The periodical occurrence of lead colic in spring and autumn and the causes of this phenomenon are the hints on which more extended investigation must be based in order that technical protective measures may be secured which will be perfectly satisfactory.

Another important question which has already been touched upon is the dependence of the effects of lead poison on the individuality of the workman exposed to the influence of the poison. The investigation of the author in factories proves that everybody is not equally susceptible to the influence of lead poisoning. It is true that every person exposed to lead, even under the most favorable circumstances, is likely to suffer from lead poisoning. Notwithstanding, it is a fact that in a table of mortality and sickness submitted by a foreman, there was a large number of workmen who had been exposed daily to the noxious inhalation of lead fumes for a period of from ten to twenty-five years who had never complained of the more severe symptoms of poisoning. From the foregoing it seems possible that immunity against the poison occurs in certain families, while on the other hand others are particularly susceptible to it.

Through questioning workmen it was ascertained that up to a certain limit it is possible to become habituated to lead poisoning, and that age is without influence. Persons who begin working with lead at an advanced age are more susceptible to lead intoxication than younger people. Three young persons, ranging from 20 to 27 years of age, who had been employed in a white-lead factory for a number

of years evinced not the slightest trace of lead poisoning in their appearance, and according to their statement had never been ill. It is not necessary to give a list of the symptoms of lead colic, as they are observed in detail. It is customary to divide lead colic into three degrees—the first or the severe form, which formerly often resulted in death, the medium, and the light form. The hitherto sharp distinction between these several forms is not sanctioned by bedside observation and practice. Transitions from the light to the severe cases, and vice versa, frequently occur.

The severity of the disease is not in the violence of the pains, for they are as a rule easily combatted by present methods of treatment, but in the manifold complications which occur even in the lightest attack of lead colic. They lead to a disease which in its incipiency appears very innocent, but often ends fatally. Workmen who have had lead colic have stated that in the beginning it was always in conjunction with dyspeptic troubles and slight cardialgia. Frequent cases in which there was cardialgia without dyspepsia were also described to the author. These resulted either in the recovery of the patient in one or two days or developed into enteralgia, with all the symptoms of lead colic. It is impossible, therefore, to prove the rarity of cardialgia without any auxiliary symptom. A large number of workmen who claimed to have had lead colic described the symptoms in such a manner that it was impossible to diagnose them except as gastralgia. In many cases one or more attacks occurred, which, however, ran their course in the usual and familiar manner. Another peculiar phenomenon was discovered, which probably has also been carefully observed by others, namely, that the symptoms of poisoning occur in a cycle in those individuals with whom it has not become chronic. After the disease has run its course it may disappear for months and even years. Such a patient is taken ill several times in succession for a longer or shorter period of time, sometimes violently, sometimes less violently. After recovery from these attacks he sometimes lives for years in the best of health.

Finally, attention should be directed to another symptom, which has not been mentioned elsewhere, and yet from the assertion of the workmen is one of the most frequent and obstinate. It is the pain during the first days of an attack of lead colic around the region of the lower lumbar vertebræ. Most sufferers complain of this, and it lingers after all other pains have disappeared. It is said that sometimes it is very severe, and completely obscures all other symptoms. Usually, however, it is not observed by the sufferers until the abdominal pains have disappeared. They suffer from it all the more because their power of resistance has been reduced.

The complications which have been mentioned as occurring either immediately after the attack or later, during the course of lead colic,

may entirely obscure the symptoms. There are three which are worthy of especial note—vomiting, icterus, and urinal troubles.

Vomiting may be purely symptomatic, depending on aggravated dyspepsia, and is of minor importance, although of the greatest annoyance to the patient. On the other hand, it may be caused by reflex action, especially from the urinary organs, and then is an exceedingly obstinate, and therefore severe, symptom. In the latter case it may combine with an equally obstinate hiccough, which greatly exhausts the strength of the patient. Icterus in light form is a well known and frequent symptom in the beginning of lead colic, and results in dyspepsia, combined with duodenal catarrh. The most serious complications in lead colic are the diseases of the urinary organs. Finally, complete paralysis of the bladder, which may cause death, has been observed.

PREVENTIVE MEASURES AGAINST INDUSTRIAL LEAD POISONING.

Lead in its various forms is used in many branches of industry. The hazards to which workmen are exposed are equally numerous, and many thousands are in danger of lead poisoning. Consequently preventive measures against this danger of poisoning are especially needed. These can be efficacious only if principles are observed which can be carried out not only from a sanitary but also from a technical and economic standpoint. In other words, they must do justice both to the workman and to the business; to the former, in that health and life are protected, to the latter in that the business is not made impossible. Thus it is possible to diminish the large number of fatal cases of poisoning, and eventually to prevent them entirely. So far it has been impossible to find an individual immunity from lead poisoning. However, it is certain that the individuality of a person plays a very important part in the absorption of the poison.

If the factories are thoroughly investigated, and attention especially directed to the technical methods of manufacture, certain conscientious and humane manufacturers are found who of their own accord endeavor to do away with the dangerous influences of the poison. Further, it must also be noted that the technical sciences have busied themselves with this important subject without, however, bringing about any material improvement in the dangerous industries. There are several reasons for this: First, a lack of hygienic and technical experience, as well as ignorance of really satisfactory remedies; and, secondly, the regrettable fact that the introduction of preventive rules never had sufficient administrative authority.

The chief problem, therefore, must be to oppose this evil of industrial life with measures which have practical value.

The following is an outline of protective measures which should be employed in factories, and is based upon the dangers to the workers and upon the technical processes of manufacture.

PROTECTIVE MEASURES TO BE APPLIED IN LEAD COLOR AND SUGAR OF LEAD FACTORIES.

1. All the working rooms of factories of this kind in which lead colors or sugar of lead is manufactured must be roomy and high, well ventilated, and kept moist and clean. The entrance of lead dust, gases, and fumes must be prevented by means of suitable arrangements.

2. Dust-generating apparatus must be covered at all joints with thick layers of felt, wool, or equally effective material, so that the entrance of dust into the working room is prevented.

Apparatus of this kind must be so constructed that a tension of the air can not occur in it and must not be opened until the generated dust has settled and has fully cooled.

3. In dry grinding, packing, shipping, the emptying of lead scum (impure litharge) and red lead ovens, the boiling of red lead, and in other operations in which dust is produced which might enter the workroom, catchers and conduits must be established at the entrance to prevent the spreading of dust into the working room.

4. Those working rooms which the above-mentioned arrangements can not entirely protect against the entrance of lead dust or gases and fumes must be closed against the other rooms, in order not to taint the air in the other rooms.

The inner surfaces of the oxidizing and drying rooms must be constructed as smooth and as tight as possible. The oxidizing chambers must be kept moist during the process of storing and emptying their contents. After the end of the oxidation process, before the chambers are entered for the purpose of emptying them, they must be thoroughly moistened and kept thus during the process of emptying.

6. In the transformation and the preparation of lead colors, especially in washing and wet grinding, manual labor must be replaced by mechanical arrangements as far as it is possible, in order to avoid the soiling of the hands and clothes of the workmen.

The pressing of the lead mass must be undertaken only after the soluble lead salts in it have been removed.

7. The employment and occupation of young persons must not be permitted in those plants in which lead colors are produced. Women must be admitted only to those rooms and occupations in which contact with the lead products is unnecessary.

8. To those rooms in which lead color and sugar of lead are produced and packed the employers must admit only such persons as have a

medical certificate stating that they are neither weak nor suffering from pulmonary, kidney, or stomach troubles; these certificates must be filed and open to the inspection of the factory inspector.

9. Those workmen employed in connection with and who come in direct contact with lead products must not remain at work more than twelve hours out of every twenty-four.

10. The employers must furnish all those workmen who come in direct contact with lead materials and products with a fully protective suit of working clothes, including a cap.

11. In those occupations in which dust is generated without being immediately removed by mechanical means the mouth and nose of the workman must be covered with a respirator or wet sponge.

12. Those occupations in which direct contact with dissolved lead salts occurs must be carried on only by men who have been supplied with impermeable gloves or whose hands have been greased with fat.

13. The employer must supply the workmen with individual outfits of clothes, respirators, sponges, and gloves as above. There must be a sufficient number of them and their efficiency must be beyond question. He must take care that each separate article of clothing is used only by that workman to whom it has been assigned. At stated intervals the working clothes, respirators, sponges, and gloves must be cleaned; the former at least once a week. While in use the separate objects must be stored in their individual lockers.

14. A bath and dressing room, and separated from it a dining room, must be established in some part of the plant where there is no dust.

Both rooms must be kept clean and free from dust. During the cold seasons they must be heated. The bath and dressing room must be supplied with soap and towels and with vessels for the purpose of rinsing the mouth. A sufficient number of lockers must be provided for the storage of those articles of clothing which are put off before the beginning of work. In the dining room or at some other suitable location arrangements must be made for heating the food.

The employers must give their employees the opportunity of taking a warm bath at least once a week.

15. The employer must see that the health of the employees is watched over by a physician who has been reported in writing to the inspecting officer. There must be a monthly examination of the workmen. Every case of disease ascertained must be reported to the employer and chief inspector. Those workmen in whom the symptoms of a lead disease have been discovered must be discharged and not reemployed at occupations requiring direct contact with lead material until they have fully recovered.

16. It is the duty of the employer to keep a record of all cases of illness or to have one kept by one of his officials, who is personally

responsible for the completeness and correctness of the records of the examining physician. This record must contain—

(*a*) The name of the one who keeps the record.

(*b*) The name of the physician whose duty it is to watch over the health of the workmen.

(*c*) The name of the sick workman and his previous occupation.

(*d*) The kind of disease.

(*e*) The date of its beginning.

(*f*) The date of recovery, or, if the workman does not return to his occupation, the date of his discharge. This record is to be submitted to the inspecting officer upon demand.

17. The employer must issue regulations, which, besides hints as to the use and employment of the articles mentioned in paragraphs 10, 11, 12, must contain the following provisions:

(*a*) The workman must not be permitted to bring whisky, beer, or other spirituous liquors into the factory.

(*b*) The workman must be prohibited from taking articles of food into the working room, and must leave them in the dining room. The taking of meals, in so far as it does not occur outside of the factory, must be permitted only in the dining room.

(*c*) The working clothes, respirators, sponges for the mouth, and gloves must be used only in those rooms and in those occupations for which they have been prescribed by the employer.

(*d*) The workmen must not enter the dining room, take meals, or leave the factory unless they have previously taken off their working clothes, cleansed their hair of dust, carefully washed hands and faces, cleansed their noses, and rinsed their mouths.

Furthermore, provision must be made that disobedience on the part of the workmen in respect to any of these regulations can be punished—by deduction from their wages, for instance.

The manufacturer is responsible for the enforcement of these regulations, and it is his duty to discharge men who repeatedly transgress them.

18. Plants for the production of lead products can be built only after their proposed construction has been reported to the inspecting officer and the department of building inspection has given its consent. The officers of inspection must, as soon as possible after the receipt of the plans, make a personal examination and decide whether they conform to the required regulations.

19. In cases of disobedience to the prescribed regulations the department of inspection must have power to demand a suspension of the industry until arrangements have been made which satisfy the prescribed conditions.

HARMLESS SUBSTITUTES FOR LEAD.

But even if all manufacturing could be carried on under such conditions as have been specified, many dangers are inevitable. The use of poisonous material in the arts, trades, industries, and household should be limited as far as possible, if not entirely suppressed. This limitation and suppression is possible because the poisonous lead preparations, white lead, for instance, can be replaced, to some extent at least, by harmless substances. How this can be done in the industry of painting is evident from the following methods, in which it is shown that a white paint can be produced without the aid of white lead, from the use of which so many painters suffer lead poisoning. All these substitutes for lead have been used to some extent, and more or less successfully, in European countries, notably France and Germany.

1. In the first method the following is the course of procedure: First, the wall or woodwork is given a coating of zinc oxide diluted with glue water. If this has dried within two hours, a coating of zinc chloride diluted with glue water follows. The zinc oxide unites chemically with the zinc chloride and forms a hard, glossy, and exceedingly smooth surface. By mixing the colors with glue water any desired consistency can be obtained. This zinc coating previous to the oil coating offers the advantages of extraordinary durability, very rapid drying, and a more than 50 per cent cheaper method of production. Of the disagreeable odor of fresh oil coatings there is not the slightest trace in this zinc coating.

Zinc chloride is obtained by dissolving metallic zinc in hydrochloric acid, or most advantageously as a by-product in soda and sulphuric acid manufactories. The superfluous and often almost valueless hydrochloric acid while still warm is permitted to react on ground zinc blende (sulphide of zinc, false galena, black jack, or black blende), and the escaping sulphide of hydrogen is immediately burned and turned into sulphurous acid and water and again used in the production of sulphuric acid. The resulting solution is heated until it has the consistency of sirup. In the employment of this paint no white lead is used. Its value and practicability are indicated by the fact that the French Government paid the inventor a reward of 20,000 francs ($3,860) in order that the invention might be employed in benefiting the masses.

2. A second method to supply the place of white lead is as follows: To 150 parts water add 50 parts of glue and 2 of caustic soda and boil for some time. The resulting flocculent precipitations can be used. After cooling, 50 parts of ordinary silicious solution are added to the above. Stir this mixture and add sufficient zinc oxide to make a thin and easily spread solution. To give this mixture an equal consistency, pass it through a color mill or rub it on a grinding stone. With the mixture obtained as above indicated (which must always be prepared

fresh), woodwork, metal, or masonry is coated once or twice, and after the coating is perfectly dry it is covered with a 10 per cent solution of zinc chloride. It is only through this last coating that the paint obtains a beautiful smoothness and great power of resistance. By the addition of earth colors, manganese, umber, etc., to the zinc oxide any desired shade of color may be obtained.

This second substitute for white lead is more worthy of recommendation than the first, as it furnishes more satisfactory results.

3. The third method is also a wet preparation of colors. It can be prepared rapidly, cheaply, easily, and without the aid of machinery. A harmless oil color made of zinc white as well as lead colors (white lead and red lead), and a likewise harmless black, can be prepared by this method. It is done as follows. This direction is especially valuable for painters who prepare their own color. First, a thin and homogeneous paste is prepared by mixing a quantity of one of the following finely powdered substances with water:

To 1,000 grams white zinc oxide, 300–350–400 grams water.

To 1,000 grams gray zinc oxide, 150–180 grams water.

To 1,000 grams white lead, 150–180 grams water.

To 1,000 grams red oxide of lead, 50–60 grams water.

To 1,000 grams lampblack, about 1,000 grams water.

The first two produce harmless metallic colors (white and gray); the last a harmless flash color; the other two are lead colors, which, however, are prepared by the wet method, and in such a manner that the workman does not come in personal contact with any of the material.

To the above water mixture, linseed oil is added in sufficient quantity to produce a consistent color, rather too little than too much. Stir several minutes with a spatula, which causes the oil to unite with the metallic oxides. Pour off the perfectly clear water which collects on the surface and knead the sediment as butter is kneaded, in order to expel all the water. Finally a greasy mass is left, which to be used is diluted with oil to such a consistency that it can readily be spread with the brush.

Zinc white, gray zinc oxide, oxide of lead, red oxides of lead, lemon yellow, and lampblack are the only colors which so far have given satisfactory results. The color is, as the separation of the water proves, a real chemical combination and has all the appearance of one.

Should other mineral substances, viz, ocher, earth colors, copper combinations, etc., be treated in the indicated manner, no water would separate, and, despite stirring and kneading, no matter how long, only a mixture of the three original substances (color material, water, oil) would remain. A chemical combination is formed only by the use of white and gray zinc oxide, white lead, red oxide of lead, chrome yellow, and lampblack. This accounts for the preference given these colors, as practice has proved their value as a protective covering for

wood and metal. The method of preparation for such oil colors for painting, either on a large or small scale, is as follows:

Red oxide of lead, zinc white, gray zinc oxide, white lead, or chrome yellow, in the powdered commercial state, are worked into a paste by the addition of water. This paste is diluted by the addition of more water till it is of milk-like consistency, and is then strained through a silk cloth. The amount of water used is immaterial. It may be quite large in order to make the paste fluid enough to pass rapidly through the sieve. Upon this a small amount of the color (about one-tenth per cent), which was not powdered finely enough, remains. This can be put aside for the next operation. Besides this, all other foreign substances, little pieces of wood, paper, metal, etc., remain and the color is cleansed of them. This is an advantage which can not be obtained either in a roller mill or a grinding mill with runners. The color paste can be put in any vessel and left until the color has settled entirely. For this several hours and even several days may be necessary. The water which has collected over the color material is poured off. A sufficient amount of oil is then added, as already noted, rather too little than too much.

The mixture is stirred for several minutes. The combination between the coloring material and the oil continues until the paste collects and sinks to the bottom of the vessel. The water which has collected is poured off and the paste is kneaded to expel all the remaining water.

For further use the color is preserved in cylindrical vessels, similar to those customarily used by indoor painters and whitewashers. Immediately before using the color paste is mixed with a sufficient quantity of oil and drier, and forms a homogeneously grained oil color.

Steam roller mills produce at the most only 220 pounds of ready-made oil color daily. With a grinding stone a workman can produce at the most only one-twentieth of this amount in the same time. In both cases the result is imperfect. By employing the above-described method a single workman can produce in two hours and almost without any tools over 220 pounds of faultless oil color.

The gray zinc blende paste must be dried and powdered, and worked through the sieve in the latter state. The reason for this is that continued contact with water would cause its complete oxidation and the formation of a hard mass almost insoluble in oil would form. Lampblack stands in the closest affinity with dry oil, and forms a paste which separates as completely from water as those formed by the metallic oxides. To make this substance combine with water it is necessary to mix with it a small amount of water containing about 10 per cent alcohol. A poor grade of whisky or wine would answer the same purpose. The lampblack is stirred with the alcoholic liquid by means of a trowel until the mixture is of such a consistency as to unite very readily with water. It can then be passed through the silk sieve,

so that the impurities remain behind. It is then left standing, and when the color paste has settled the water is poured off. The color is then treated with oil, as has been described in the treatment of the metallic oxides. It collects and the water contained in it separates out.

None of the foregoing substitutes is in all respects equal to the dangerous white lead, but in many cases the harmless substitute is entirely satisfactory. Researches in this direction will doubtless be continued and the treasures of chemistry may be further drawn upon.

LEAD POISONING IN INDUSTRIES USING LEAD PRODUCTS.

The pottery industry is one of the principal industries in which the substitution of harmless substances for the dangerous lead seems highly desirable. Earthenware is shaped, air dried, and then glazed. One substance for glazing is lead glaze; another is enamel of lead, which consists chiefly of fine galena (pottery ore), clay, and sand. The materials are ground and mixed in a handmill with stones, similar to a grain mill. While the pottery ore is roasted sulphur escapes as sulphurous acid, and the oxide of lead produced by roasting combines with the silica and argillaceous earth and forms aluminium lead silicate. On account of the great quantity of ferric oxide contained in clay and sand this glazing is always colored.

The glazing of air-dried material is done in three ways—by immersion, sprinkling, or powdering. By immersion cooled earthenware can be glazed, but this is hazardous to the workman, for his hands come in direct contact with the lead-containing glaze, consequently the second method, or that of sprinkling, is most frequently employed in glazing earthenware. If the third method, or that of powdering, is employed in glazing crockery, the latter is first immersed in a mass of fatty earth and then covered with finely ground glazing material. This method is also of the greatest disadvantage to the workman, because the inhalation of little pieces of lead can not be prevented.

If the lead oxide has been mingled in right proportions with the silica of the clay, then the enamel of lead is insoluble in the ordinary organic acids that are used in housekeeping. But if a part of the lead oxide has not thoroughly combined with the silica some of the lead may be dissolved in hot vinegar. The use of earthenware glazed thus is evidently not without danger.

After it has been proved that every kind of earthenware can be produced without the use of lead, because glazings in which no lead is used have been successfully introduced in German factories and compete very well with those containing it, the best rule to be given is to prohibit entirely any glazing containing lead and to find a transgression of this prohibition a deliberate injury to health. The prohibition would be the best protection against lead poisoning in the

pottery industry. The workmen are extensively exposed, as by rubbing litharge and suboxide of lead in the production of the glazing, in touching the glazing with the hands during the course of production, through inhaling the dust during the drying of the ware, and by putting the article in and taking it out of the oven.

It is also worthy of mention that the rubber respirators which have been used abroad for the protection of workmen against lead poisoning have proved inefficient. They are easily deranged and are also annoying to the workmen. This protection, therefore, is entirely out of the question. If respirators are worn in those factories in which lead-free glazings have not been introduced, the following simple method is efficacious: Take cloths which have been moistened with ammonium sulphide and tie them over the mouth. The lead fumes produce with this insoluble sulphide of lead. It is also to be noted that the cleanliness of the workman is the best protection against lead poisoning. To this end free baths ought to be instituted in all factories for the benefit of the employees. Food and drink should not be consumed in the working rooms. In all rooms in which there is a great amount of dust, and especially in those in which the material is stored, there should be sufficient ventilation, and the dust should be removed by means of water, as, for instance, in the dry grinding of certain objects.

The following statement as to the manufacture of glass tiles in Germany is quoted from Oliver:[a]

During the manufacture, at Velten, in Brandenburg, of glass tiles for making earthenware stoves, there recently occurred a considerable amount of lead poisoning among the operatives, due to the glazing of tiles with oxide of lead. * * * The glazing material is made, first, by firing together lead oxide and tin in the proportion of three to one. To the compound thus obtained there are added feldspar, marine salt, and quartz. These are mixed together, and subsequently exposed to a great heat so as to form a fritt. The vitrified material thus obtained is crushed, finely pulverized, and mixed with water, while the thick liquid is applied to the surface of the tiles, which are afterwards heated in a special furnace. During these operations there are many opportunities for the workmen to become poisoned by lead. In the act of crushing, a considerable amount of dust rich in lead salts rises into the atmosphere. Rasch caused some of the air to pass through cotton wool, and he thus arrested the dust. The lead in this he estimated as sulphide. The quantity found by him in 100 liters [about 3½ cubic yards] of air varied between 0.0012 and 0.0066 gram [0.02 and 0.1 grain], which was equivalent to an amount of lead oxide entering into the lungs during the twelve hours' work in the factory of 0.05 to 0.6 gram [0.8 to 9.3 grains]. Upon the clothes of the workmen he obtained as much as 3 to 4.8 grams [46.3 to 74.1 grains]. It was found that all the lead in the fritt had not been converted into an insoluble form. There was at least one-hundredth part in the form

[a] Dangerous Trades, by Thomas Oliver, page 368.

of lead oxide, a circumstance which rendered the glaze harmful to those who dipped the tiles, and also to those who handled them after dipping. It is needless to say that where this industry is carried on, precautions should be taken similar to those in use in the potteries, care being taken to have the fritting of the lead carried on in well-ventilated places, and the grinding of the fritt done in inclosed machinery.

What has been said about lead poisoning in the earthenware and pottery industry is true also of the enameling of cast-iron ware as well as of all other branches of industry in which lead or its products are used.

Enamel originally denoted a mass of glass which in its production, both colorless and colored, had been made nontransparent by zinc oxide. According to a certain formula, enamel is prepared in this manner: An alloy consisting of 15 to 18 parts of tin and 100 parts of lead is oxidized by means of hot air. The oxide is powdered and skimmed. The resulting mixture of tin oxide, with lead oxide (lead stannate), is now fritted with a mass of glass. An enamel-like substance is also produced by arsenical acids, silver chloride, calcium phosphate, kryolite, feldspar, sodium aluminate, and precipitated barium sulphate. It is customary to enamel the inner surface of cast-iron ware to protect it against rust and weak acids. This is done by removing the oxide with dilute sulphuric acid. A glazing material is then whirled about in the vessel, and a fine powder of a metallic oxide or other material is then scattered upon the moist surface. The ware is then heated in a muffle until the glazing mass melts. Here also the use of lead-containing substance in making cooking and eating vessels ought to be positively prohibited. Any transgression of this prohibition ought to be severely punished, as it would mean an intentional injury to health, viz, through lead poisoning. Obedience in this respect to prescribed regulations is the easier, because there are a sufficient number of methods by which glazings which are free from lead can be successfully produced.

In the manufacture of gloves white lead is used to polish them. In the place of this poisonous material a harmless one can be used with equally satisfactory results—talc, for instance. Talc is a mineral which is related to meerschaum (sepiolite) and soapstone (steatite). Soapstone is also commonly called talc, because there is only a very slight difference between them. Talc is used in the manufacture of the so-called Spanish chalk, rouge, and the like.

From what has been said it can be seen that simply by a satisfactory substitution of a harmless material for a poisonous one many cases of poisoning among the workmen can be prevented. The workmen ought to be acquainted with these facts, and the various means ought to be taught them by word, example, and writing.

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File cutters and workmen engaged in the manufacture of amber articles employ a soft bed of poisonous metallic lead. This danger to the workman can be removed if, in place of the lead bed, tin is chosen. Files can be cut both by hand and by machinery, but file-cutting by machinery is usually carried on in modern and well-ventilated factories, and no lead is used in the process.

It is otherwise with file cutting by hand. Seated on a stock, the hand file cutter has in front of him a stone block into the center of which a small piece of bar steel, called a stiddy, is inserted, and on this stiddy is placed a piece of metallic lead, called the bed. The file about to be cut is strapped onto the bed. The lines as seen on a file are made by means of a chisel and hammer, each line representing a blow. The reason for using the lead bed to strike the file on is that there may be as little recoil as possible, and yet sufficient resistance to develop the line in its entirety as a result of the blow given by the hammer and chisel. As a consequence of constantly striking files of uniform size, a groove is formed on the lead bed, into which succeeding files easily fit. When he has cut one face of the file the workman rubs that side with charcoal, turns it over, and then proceeds to cut the other side, after which both faces are briskly rubbed. The file cutter grips the chisel between the index finger and thumb of the left hand, and in order to get a good grip of the chisel he often moistens his finger with his tongue. The steel hammer used by a cutter generally weighs from 7½ to 9 pounds, and each line on a file represents one stroke of the hammer. There are often on large files as many as 3,800 lines.

File cutting by hand is generally regarded as a dangerous industry. As a consequence of hammering and brushing the files a considerable amount of dust is created, some of which must be inhaled, as the man or woman—for both sexes follow the occupation—bends closely over the stock. In several samples of dust removed from the stocks and rafters of the shops lead was found, the other constituents of the dust being particles of iron, charcoal, and chalk. Dust from rafters contained 2.64 per cent metallic lead; from top of stock, 14.82 and 22.28 per cent; from floor under the stock, 2.63 and 4.37 per cent.

As a consequence of the usually diminished vital resistance and the practice of eating his food with unwashed hands, the moistening of his fingers while at work, and inhalation of dust, the file cutter in course of time becomes the victim of lead poisoning. It is metallic lead dust that is given off during the blows with the hammer and chisel upon the file. Lead in this form is certainly much less harmful than when in such a soluble combination as the oxide or carbonate, but oxidation of the surface of the lead is constantly taking place, thereby rendering the metal more or less absorbable.

In addition to the ill health caused by lead poisoning, pulmonary

consumption carries off a large number of file cutters. All the workers look anæmic. Many whom Oliver examined had suffered from colic; several were completely disabled on account of paralysis of the extensor muscles of the fingers and wrists. Out of 100 file cutters examined by Dr. White, 74 had a blue line on the gums, 28 had lead colic, and 20 paralysis of the wrists and fingers. The trade is characterized by a high mortality, the figures being 316 file cutters against 123 occupied males in general. Only cutters of handmade files suffer from lead poisoning.

Lately machines for making files have been introduced in the use of which lead poisoning can not occur. The manufacture of handmade files, therefore, should be prohibited unless a bed of tin or other harmless material is used instead of one of lead. Besides tin, there are also many other materials which can be employed for the same purpose.

Lead poisoning will disappear among the weavers who use the Jacquard loom if iron weights are substituted on the warps for those of lead. Through friction these weights produce a dust which contains by analysis 56.80 per cent lead, and consequently exerts a direct poisonous influence upon the workman.

In polishing cannons and shells a rotating lead dish is used which could just as well be replaced by one made of tin or a harmless alloy.

Typesetters, who frequently come in contact with lead, very often suffer from lead poisoning. The present substitute for lead, which consists of copper aluminum, is not practical on account of its high price.

All that therefore can be done at present in the manufacture of those articles which are cast from molten lead is to get rid of the lead fumes and dust as far as possible. In order to prevent lead fumes in the smelting rooms of type foundries, the following method is employed: Hoods are fastened over the smelting kettles in the foundries. These hoods can be made of sheet metal, can be moved vertically, and are connected with the chimney by pipes. When lead or type material is melted, the hoods are let down so that they cover the smelting kettle. There are small doors for the introduction of more metal, so it is impossible for fumes to escape into the working room. Especially hazardous is the dry grinding of the type. Much lead dust is produced, which leads sometimes to lead intoxication and sometimes to pulmonary consumption. The only rule which can be recommended in this case is a prohibition of dry grinding. The operation can without doubt be replaced by wet grinding, which is much less dangerous. (Type metal consists of 75 parts lead, 20 parts antimony, and 5 parts tin.)

Those workmen who are annoyed by lead dust in composing rooms have to fear not only direct poisoning from the metal, but also pulmonary consumption, with which many of them are threatened. The dust

of composing rooms contains much lead. On this account the rooms should be efficiently ventilated and the dangerous operation of cleaning the type boxes should be carried on in the open air and not in the working room, as is usually done. The most satisfactory method is with a pair of bellows.

In the manufacture of shot the arsenic-containing lead alloys are prepared as follows: The lead is melted in cast-iron kettles, and the surface is covered with a layer of charcoal dust. In the center of this the arsenic-containing substance (arsenious acid, metallic arsenic, or realgar) is placed. This is very injurious to the health. On stirring the molten mass, lead and arsenious fumes, which are directly poisonous, are given off.

As a preventive, a hood similar to that described in the foregoing should be placed over the smelting kettle, the arsenious substances should be added only in a well-ventilated room, and the workmen should be furnished with respirators.

As it is impossible to prevent contact with the poisons used in the lead industry at the present time and the hazardous work itself can not be done away with, improvements should be introduced by which the danger of working with lead and its pigments is reduced to a minimum. To deal properly with this problem employees in the lead industries should be protected by preventive arrangements, and laws should be passed which will protect not only the men working in the factory, but also their families from harmful influences. In Germany, for instance, the Government superintends the most dangerous branches of the lead industry, viz, the manufacture of lead colors and sugar of lead. The Government regulations, which deserve the most careful consideration in all lead industries, are able to diminish the danger of intoxication to a very large extent. Their enforcement must be as strict as the danger of working with lead and lead substances demands.

The indolence, ignorance, thoughtlessness, and indifference of the workman often make such regulations a mere farce. Because the workmen are so accustomed to the old careless method and consider this or that regulation as uncomfortable, and because they do not feel any injury from their carelessness, they refuse to take the proper precautions. This evil must be eradicated by strict and careful supervision and control. It is a necessary condition, therefore, that the sanitary regulation must not be based on the good will of the employees. The workman should be thoroughly informed of the danger of this work and the means of prevention. Then his obedience to these regulations must be procured by special measures; he might, for instance, be threatened not only with a fine, but with loss of position. The responsibility for the observance of such regulations on the part of the workmen can be intrusted by the employers to their managers and supervisors. These must be held accountable for the results

of a lax execution of the sanitary regulations, as well as for all cases of sickness, etc. Only in this manner is there a guaranty that the regulations passed by the Government are not at the mercy of the workman's whim, but are really carried out. In places where the health of hundreds is threatened by dangers of such consequence great requirements must be demanded of the employees.

The extent of the employer's responsibility depends on circumstances and has to be carefully considered, as also the various questions of administrative details. Inspectors should have a professional aptitude and especially a technical education to enable them to carry out the laws with success and tact. Their duties ought to be not merely a form and they must not hesitate to demand strict and energetic obedience to the law. In order to do this they must be completely independent.

The exact regulations in regard to this matter which have already been adopted abroad enforce (1) the necessity of frequent careful cleansing of the mouth, face, hands, even the whole body, clothes, and utensils; (2) the strictest prohibition against bringing food and drink into the working rooms, and against partaking of it with unwashed hands.

In England, where investigations have been made, preventive measures have been adopted. The chief inspector of factories issued special rules for white-lead works, which were an advance upon those of previous years, and which have undoubtedly diminished plumbism in this industry. It is unnecessary to reproduce these rules here, but the main points included in them are that plans for new works or structural alterations of old factories must be submitted to the chief inspector of factories; white-lead beds must be watered when being emptied; drying stoves must be ventilated, and no person is allowed to draw a Dutch stove on more than two days in any week; no woman is allowed to work in the white beds, rollers, wash becks, or stoves, or in any place where dry white lead is packed, or in other work exposing her to white-lead dust; there must be weekly medical examinations of every person employed in the lead process, with suspension in the case of illness and medical reexaminations before returning to work; suitable respirators, overalls, and head coverings must be provided by the occupiers; adequate washing appliances are required, with cessation of work ten minutes before each mealtime and the end of the day's work for the purpose of washing. The duties of persons employed are similarly defined, and any person obtaining employment under an assumed name or on any false pretense is liable to a penalty. It is enacted, too (factory and workshop act of 1891, secs. 9 and 11), that the rules shall be kept posted in conspicuous places in the factory, so that they can be conveniently read by the persons employed. Any person who is bound to observe the rules and fails to do so, or

acts in contravention of them, is liable to a penalty. In such cases the occupier also is liable to a penalty unless he proves that he has taken all reasonable means of publishing and to the best of his power enforcing the rules to prevent contravention or noncompliance. Great importance is attached to extreme temperance in the use of alcohol and to a weekly or fortnightly alteration of employment for the work people in the factory.

Regulations of this kind should be introduced not only in the lead color and sugar of lead industry, but among all trades that use lead or lead products in any form, such as lead works, shot factories, type foundries, and printing establishments. Further, age, sex, and general condition of health play an exceedingly important part in lead poisoning. It is only strong and thoroughly healthy people who can withstand the dangerous influences of the work without extensive injury. Consequently only those workmen who have a physician's certificate to the effect that their age, development, strength, and state of health enable them to work without special danger should be permitted to work in those industries in which there is an extensive development of fumes and dust, as in lead works and sugar of lead factories.

The Government regulations should fully explain the above, as well as be explicit in regard to the length of the working day, the employment of women, the supervision of the men's health by a physician, the management of the infirmary, etc. In this respect it is worth while to look to the Germans, from whom in the present case something new and better can be learned. From a physician's standpoint it would seem valuable to point out means which by increasing the efficiency of the organism would likewise increase its power of resistance against the influence of the poison. First among these means is as good, strong, and efficient nutriment for the workmen as is possible. Experience has shown that either from thrift or real need the workmen use unhealthy, indigestible, and poor food in the preparation of their meals. As a result their strength and assimilative powers decrease, and favor the action of the poisonous influence. The use of bacon and fatty foods generally is considered of great value. Some even claim them as a specific against lead poisoning. The use of milk is even more satisfactory (a quart or more a day per person). Its favorable action is due to its nutritive and gently laxative properties. The latter is of importance to lead workers because they have a tendency toward constipation.

Besides good and efficient nourishment for the lead workers, healthful dwellings are of next importance. They, however, should not be in close proximity to the factories, but at a distance of from one-half to one mile. This is to compel the workmen to be exposed every morning and evening, even if only for a short time, to the open air, and to give them exercise, which increases respiration. Time and

opportunity should also be given the workmen to frequently cleanse the mouth, hands, etc. Further, in the most dangerous occupations, such as the washing of ores, the emptying of the oxide vessels, and the dry grinding, bagging, straining, and packing of the dusty lead preparations, workmen ought to relieve each other frequently. Attention to these details would greatly aid in improving the general state of health.

Obedience to such regulations has done much abroad to decrease the number of cases of industrial lead poisoning, yet in all establishments where lead is employed other methods are needed to decrease its harmful effects. The chief obstruction in the work, as has been shown, is the lead-containing dust which is developed in all manipulations of this industry. In the first place, then, it is evident that in all establishments measures should be adopted against this pernicious dust. To successfully combat it, three conditions are necessary:

1. To prevent its development and spread in the working rooms.
2. To separate the workmen from it if it does form.
3. To get rid of it as soon as possible.

In respect to first condition, one of the most satisfactory methods of preventing the development of dust in the use or preparation of the dust-producing material consists in moistening the material sufficiently. The directors of lead mines and works should therefore exert the greatest care to moisten the lead ores sufficiently when crushing. In potteries, if lead-containing glazings are still used, care should be taken to apply them only in a wet state by immersion or sprinkling, never by powdering. The danger of dry grinding in the manufacture of type could be removed by wet grinding.

Lead colors, as well as all dusty lead combinations, if it is in any way possible without great injury to the industry, should be prepared wet, or with a stronger moistening. This is especially the case with the easily powdered and dangerous white lead. In order to protect the workmen—painters, varnishers, workers in colored and glazed paper manufacturies, fan painters, gilders, glazers—who use white lead in their trade, and to free the factory works from the pernicious effects of dust, it is necessary to insist that white lead must not be dried, but that immediately after skimming it in a half dry state it should be mixed with oil and put on the market in the form of a paste. This process, which makes the most dangerous operations, like drying, pulverizing, sifting, bolting, and packing, superfluous, has been proved entirely satisfactory. The dry preparation of white lead should be used only where it is impossible to use it except in the dry form. The objection that the paste form, on account of its rapid drying, is not suitable for shipping is without value, as drying can be prevented by putting the paste in hermetically sealed vessels.

Finally, there are methods by which it is possible to absorb large quantities of lead dust, or at least to prevent its flying about in the

rooms, as, for instance, the introduction of regular and efficient water sprayers in the factory rooms as well as the frequent mopping of the floors, which should be as smooth as possible and free from cracks. Specific methods of moistening and arrangement of the most dangerous factory rooms, viz, the oxidation and drying rooms of white-lead factories, can be found in the German governmental provisions. Concerning the prevention of the spread of dust through the working rooms, it is recommended that all apparatus by which dust is developed should be entirely separated from the working room. All open mills and apparatus by the use of which it is impossible to granulate lead without the production of the fatal dry dust should be separated forever from the lead color factories. This is especially easy, as roller mills have been introduced which are entirely closed and prevent any lead dust from escaping into the factory rooms. They are very satisfactory and grind exceedingly fine. The only place in this mill through which the dust could possibly escape, viz, its ore funnel, can be closed by keeping it continually filled with the mineral to be ground, and thus cutting off every avenue of escape.

In one of the largest foreign lead factories this object is attained by a container which is immediately above the ore funnel, and is filled with the material. It is operated mechanically by the mill, and keeps the ore funnel always filled. The dangers from bolting, sifting, and emptying the material can be efficiently diminished and even entirely prevented by such an arrangement. The ground material as it is emitted from the roller system is directly carried on to the other machine by means of a dust-proof arrangement, thence in like manner to the collection box, and thence to the packing room, doing away entirely with the spreading of dust in transportation.

To still further prevent the diffusion of dust in the factory rooms air-tight inclosures and casings should be put in connection with exhausters such as have been introduced into many factories, in order to remove the lead dust by suction as soon as it is formed. Wherever dust is developed and there is danger of its entering the working room an apparatus of this kind should be used. The best arrangement, and a very simple and cheap one, especially where steam power is present, is constructed as follows: A long main tube supplied with a strong exhauster, sends branches to the packing and grinding rooms, etc., as the case may be. These are funnel shaped at the lower end, and possess movable telescopic socket pieces. In packing, which is now done by means of a shaking apparatus and not by treading, the movable funnel of the branch tube is opened and placed immediately over the empty vessels. This sucks up the developing dust at once, and prevents it from escaping into the working rooms. Such an exhaust plant has been used with great success not only in the packing and grinding rooms, but also in the manufacture of red lead in one of the largest factories abroad. In emptying the coloring oven in red-

lead making, a dust-receiving box or funnel is placed over the emptying wagon and connected with one of the branch tubes of the exhaust plant.

In another dust-consuming arrangement the very fine white-lead dust is sucked up, and by mechanical means carried ultimately to two boxes. These are diagonally divided into two parts by means of a flannel partition. The latter gathers up the dust, but permits the air to pass through. Every time the boxes are disconnected from the exhaust plant a mechanical beating apparatus frees the flannel from dust. This drops into a receiving vessel beneath.

Attention should be given to the disposal of lead fumes, which are a very important factor and exert a disastrous influence upon the workmen if they escape into the factories. In all establishments where lead fumes are developed (smelting works, furnaces, shot manufactories, type foundries) they should be held in check by means of efficient flues. The fumes could be sucked up by mantle-like casings fastened over the openings of the furnaces and smelting kettles. After they have been rendered harmless it would be easy to conduct them to the open air. In a foreign type foundry the escape of fumes is prevented by means of a fume destroyer which is placed above the smelting kettle and in connection with a strongly drawing flue.

Through the above-mentioned protective measures for the immediate suppression and interception of lead dust and fumes the dangers of lead poisoning have been greatly diminished, yet from experience it is known that it is impossible entirely to prevent the scattering of poisonous lead products in the factories. The best protective measure is as perfect ventilation as possible, and the replacement of the dust and fume-laden atmosphere of the workrooms with clean and fresh air. The choice of the ventilation system depends entirely upon the size of the plant. In so far as any system is cheap, simple, convenient, and efficient, to that extent it is preferable to any other.

Such operations as the packing of lead colors, where a great amount of dust is produced, should be carried on only in the open air, as is almost entirely done abroad. There are certain cases in which the peculiarity of the labor makes it impossible to prevent the extensive formation of dust and fumes, and which compel the laborer to inhale with every breath a large number of poisonous particles. These occupations require the strictest supervision, and all who are employed should be required to tie wet sponges or efficient respirators over mouth and nose. These permit the passage of air in breathing, but retain the greatest number of lead particles.

One of the best arrangements for this purpose which is in vogue abroad is a respirator made of light plate. By means of rubber cushions it is made close fitting. In inspiration the lead-contaminated air passes through absorbent cotton moistened with glycerin or some other neutralizing substance. In expiration the vitiated air is expelled

by means of valves. More perfect but less convenient are those arrangements which permit the workman, while he is at work, to inspire air entirely free of dust from without.

The absorption of lead in its soluble form is less frequent and can be diminished by obeying principles of cleanliness and practical regulations. Despite the numberless safeguards for the protection of the workman it has been impossible to prevent the occurrence of lead poisoning. Consequently attempts have been made to find a prophylactic method in the science of medicine which would counteract the disastrous influences of absorption of poison into the organism. As it is a well-known fact that lead forms almost insoluble combinations with various elements, several physicians have proposed to employ these chemical elements as prophylactics. These elements uniting and forming insoluble combinations with lead can thus be eliminated from the body. The chief elements used for this purpose are iodine and sulphur in their various forms. It is not known how much lead is absorbed by the several workmen in the several manipulations. The use of iodine and sulphur preparations for many months is evidently irrational, as the organism is not indifferent to them. The results of their continued use lead to indigestion and a general diminution of strength and assimilative powers, which especially favor lead intoxication. There is no objection to the use of gargles which contain small amounts of sulphur and iodide of potassium. On the contrary, frequent washing of the mouth and gargling is to be most strongly recommended. The employment of sulphur and ordinary warm baths also greatly lessens the danger.

Finally, education, an already indicated prophylactic measure, is of greatest importance. This is especially the case in those industries and trades in which the workmen are left to themselves, and handle lead and its products without supervision. Even though laws and preventive measures are frequently unheeded on account of the carelessness of the workman, yet experience teaches that lead poisoning often occurs only as a result of ignorance on the part of the employee. It is therefore very important that the workman as well as the public in general be informed of the danger of lead poisoning. This is to be accomplished by popular articles, lectures before associations, the publication of disastrous cases of lead poisoning, and by word and example.

OILCLOTH AND LINOLEUM INDUSTRY.

PROCESSES OF MANUFACTURE.

In order that the public at large, and especially the workman, may gain an understanding of the injurious conditions in this industry, a short explanation of the process of manufacture seems necessary. From this should be gained the understanding necessary for forming

a correct judgment of the case, and for developing those preventive measures which should be adopted for obviating these injurious influences and thus protecting both the workman and the public at large.

Two establishments were studied, both engaged in the manufacture of oilcloth and linoleum. The first was a plant employing about 300 persons and comprising over 40 separate buildings.

The linoleum as manufactured consists of a layer several millimeters in thickness. This is a mixture of oxidized linseed oil, resin, and ground cork, and is spread over and applied to a rough ground texture of cloth. The latter is varnished on its lower surface. The covering layer is, in consequence of the imbedding of the oxidized linseed oil in the porous cork particles, absolutely impermeable to water. The surface is completely closed and free from pores. It can therefore easily be cleaned with water without injury to the floor. The poor heat-conducting property of the cork particles also diminishes that of the oxidized linseed oil and decreases its inflammability.

Fresh linoleum, in proportion to the completeness of the oxidation of the linseed oil employed in its preparation, has a more or less perceptible odor. On exposure to the air this odor diminishes, and finally, when by the combination with oxygen the oxidation of the oil has been completed, it disappears. A floor covered with linoleum does not possess the disagreeable coldness of varnish or oilcloth. Linoleum is made either plain, in one color, or in patterns. The patterns are produced in three ways: (1) By the application upon the ground texture of a mixture of covering masses of different colors and grain; (2) by the juxtaposition and fastening of differently colored and arranged patterns upon the ground texture; (3) by printing the plain linoleum with oil colors. The resulting products are known by the names of grain, inlaid, and printed linoleum.

The crude material for the production of ground and powdered cork consists almost exclusively of the waste of cork industry, and is used extensively in the manufacture of linoleum. This waste consists of pieces of cork up to a cubic inch in size. The comminution, accompanied by a great generation of dust, is carried on by degrees. As a preliminary step machines divide the material into small pieces. The second step is grinding them in mills into a fine powder or flour. This work is not without danger, because the cork dust is easily inflammable and, if lighted, explodes with great force. The scraps of iron which frequently are among the particles of cork often cause explosion by producing sparks in passing through the mills. The parts of the machines which cut the cork into little particles are rapidly revolving adjustable rollers or plates studded with cutting teeth.

The pulverization of the particles of cork thus obtained is accomplished by two methods. According to the older method with rasps consisting of large, rapidly revolving drums studded with saw teeth,

against which the material is pressed by two slowly revolving feeder rollers. In the newer method flat stone mills are used, whose whole construction is very similar to the ordinary flour-grinding mills. The cork flour is passed through the mills several times until all the particles possess the required fineness. During these several passages the ground material is separated into various classes by means of drum sieves containing about 1,000 meshes to every square inch.

As a result of this process, in which not even exhausters are efficient, it can easily be seen that the workman and the neighborhood are exposed to great annoyances because of the very fine consistency and exceeding small specific weight of the ground cork. This finely ground cork dust is carried away by the slightest disturbances of the air and transported for long distances. It is very injurious to the respiratory organs.

The second factor annoying to the workman and to the neighborhood is the oxidation of the linseed oil. Of the various vegetable oils used in the manufacture of oilcloth and linoleum up to the present time linseed oil is the only one that is employed to any large extent. Not all the linseed oil of commerce is equally adapted to the manufacture of linoleum. A high degree of purity is of great importance in manufacturing, and on this account these manufacturers usually make their own linseed oil.

As with other vegetable oils that dry, the oxygen of the air induces a chemical change in the linseed oil. It dries when exposed to the air in a thin layer and forms a transparent resin-like mass, which is more or less elastic. By the absorption of oxygen and the setting free of carbonic acid and water the transformation of linolein into linoxyn occurs. The other constituents are transformed into the acids of palmitin, myricine, and elain, which oxidize on long exposure to drying influences. Linoxyn is the most important basis in all linseed oil colors, and also forms that product of the oxidation of linseed oil which is used in the manufacture of linoleum.

The quantity of oxygen which is absorbed is far greater than that of the carbon and hydrogen which are liberated during the process of oxidation. Consequently this process is accompanied by an increase in the weight of the material, sometimes amounting to more than 7 per cent.

The boiling of the linseed oil, either alone or with oxidizing substances (litharge, sugar of lead, oxide of zinc, superoxide of manganese, and the like), as is done in varnish factories, for the purposes of linoleum manufacture, increases the energy of the oxygen during the process of oxidation and decreases the time required for oxidation. The same result is obtained if it is sprayed in a lighted and heated room which has a continuous supply of fresh air.

There are two methods for the oxidation of linseed oil. According to the older method the oil, in which the oxidation has already been begun by boiling it in sugar of lead and by the introduction of a spray of warm air, is spread in thin layers upon the extended texture and exposed to the influence of continually changing air heated to about 86° F.

According to the other method, the oxidation process is completed by introducing a stream of compressed air into the hot oil.

The products of these two processes which, as linoxyn is the chief constituent, are in short called linoxyn, are essentially different in their physical properties. In the one process the mass is completely homogeneous, not sticky, but similar to india rubber, like it very elastic, but not nearly so ductile and less resistant to tearing. On account of its lesser viscidity the mass can be ground in a mortar to a yellowish white powder. This linoxyn has an odor similar to that of fresh linseed oil. It remains dry under the influence of heat.

Linoxyn prepared by the other method is essentially different from that which has been described. It forms a tough, sticky mass of a dark brown color, which easily adheres to any object and can be drawn out into short threads. In very thin layers the color is yellowish white like the first kind, yet not nearly so pure. The odor is weakly acid, similar to that of freshly boiled linseed oil varnish, but not so strong. These circumstances indicate that the process of manufacture and oxidation has not advanced as far as in the first case.

The boiling of linseed oil with oxidizing substances is carried on in vessels, open or covered with a hood, hung over an open furnace fire. The flame either simply plays around the bottom of the kettle or is carried along its side by walled flues. As a result of this direct system of heating it is easier to carry on the boiling at a temperature (about 392° to 464° F.) considerably above the boiling point of linseed oil. Experience teaches that this greatly diminishes the duration of boiling. The objection to it, however, is that a frequent stirring of the contents of the kettle is necessary in order to prevent the excessive heating of the oil on its walls and to equally distribute the oxidizing materials in the liquid.

Another method of preparing linseed oil for more rapid oxidation is to expose heated linseed-oil dust to the influence of a weak current of air. There are a number of other methods of transforming the linseed oil into linoxyn or, in other words, of oxidizing its elements.

The linoleum covering mass consists chiefly of an intimate mixture of oxidized linseed oil (linoxyn) with finely ground cork meal.

In order to increase the speed of drying, and to produce the hardness and elasticity various drying materials (sulphurous manganese, red lead, and others) and resins (colophonium, cowrie gum, and the

like) are added to the original components. For coloring purposes various mineral colors are added. Linseed oil is also entirely or in part replaced by other thick vegetable oils, as, for instance, the pitch-like residues arising from the distillation of palm, cotton seed, and other oils. In the place of cork, wood flour, pulverized peat, finely cut fiber, and the like are sometimes used. The proportion between the plastic and nonplastic materials in the different mixtures which are customarily used is almost the same. To a hundred parts by weight of oxidized linseed oil, thirty-eight parts of resin (colophonium) and thirteen parts of cowrie gum are added. They are mixed in a pan heated by steam and a suitable coloring material (venetian red, ocher, etc.) is added. This mass is thoroughly mixed with an equal weight of cork meal, in mixing machines.

Every manufacturer works according to his own process, and by his varying proportion, and by the addition of turpentine and naphtha (benzine) he increases the plasticity of the mass and diminishes its brittleness. For the purpose of boiling it down linseed oil is cooked for several days at a temperature of 500° F., until on cooling it congeals into a mass of india-rubber-like consistency.

The pitches of cotton seed and palm oil in equal proportions are also mixed with oxidized linseed oil between heated rollers. In this method drying materials amounting to about one-sixteenth the weight of the pitch and oil mixture and slight quantities of coloponium and cowrie gum are added. This mass is then kneaded with an almost equal weight of cork meal, and sometimes cow's hair is added to give it greater strength. Cowrie, or New Zealand gum, comes from the cowrie tree (*Pinus kauri* or *Damarra australis*). In color it ranges from a milky white to a dark brown; sometimes it is colorless and transparent. For the protection of the workman the following property of the gum must be noted: It is very easily inflammable and burns without dropping, with a bright flame. After careful melting and congealing it forms a hard mass similar to shellac, and, like it, is soluble in alcohol.

Usually a steam-heated vessel, with a stirrer, serves in the preparation of linoxyn for its mixing with the other materials. The vessel is a recumbent cylinder, into which the unprepared material is introduced. The casements which serve as the heads of the cylinder are double walled. Into the hollow space between the latter steam is led, and the contents of the cylinder are heated to such a degree that the linoxyn is transformed into a plastic mass. The process of mixing this with the resins is accomplished by means of a stirrer within the cylinder. The axis of the former passes through one head wall, and has a driving wheel on the outside. After the mixing has been accomplished the vessel is emptied by means of a canal, which during the

active process is closed by a slide. The mass is either led into forms, in which it is congealed into cakes of a specified weight, or it is emptied into another double-walled cylinder, which is heated so that the contents remain plastic.

The application of the linoleum-covering mass to the ground texture and the process of making it adhere is accomplished without the use of any especial binding material. At a temperature of 284° to 302° F. the mass itself has such plasticity and adhesiveness that under strong pressure it clings tightly to the texture. The coating of the lower surface of a ground texture, by means of a lake as protection against moisture, is sometimes done before, sometimes after, the application of the linoleum mass. The drying of the color coating is carried on in rooms heated by hot air or steam. Previous to the application of the linoleum-covering mass to the ground texture the former must be thoroughly mixed in the roller works. The mass comes from these machines in the form of thin sheets, which are either folded and used to cover the texture immediately, or are run through rapidly revolving rollers and transformed into a coarse powder. The latter method can be used to especial advantage in spreading the mass over the texture before its introduction into the press. The finished product possesses as a result a great uniformity. The hot presses used in the application of the linoxyn cork mass to the ground texture are partly plate presses and partly roller presses (calenders). The plates or rollers of the presses are cast hollow and heated by steam under a tension of several atmospheres.

The other processes are the cooling of the mass on cold rollers and the drying of the linoleum.

The linoleum-covering mass, which consists chiefly of linoxyn, cork meal, and the various resins, is always used in a highly heated condition. By heating it gains the plasticity necessary for shaping it, as well as the adhesiveness required for uniting the little particles to each other and to the supporting ground texture.

In addition, the mass also develops that penetrating odor which is noticeable in the oxidation of the oil. This very circumstance shows that the oxidation of the linseed oil was not completed, and that in deodorization a continuation of the process of oxidation takes place.

The drying of the linoleum is a continuation and completion of the process of oxidation. This is accomplished by exposing the product to the influence of currents of warm air. In proportion as this decreases the development of odors it increases the solidity and elasticity of the manufactured products, and in a limited degree the weight, because of its continued absorption of oxygen. The fact that a linoleum-covering mass which lay in a warm and dark room for 155 days increased 1.76 per cent in weight proves this.

The proportion between the odor and fluidity is direct and permits

a conclusion concerning the development of the oxidation and drying process. It must also be noted that changes in the properties of fluidity depend not only upon the length of the drying process, but also upon the condition of the linoxyn, obtained during the oxidation of the oil. The changes are produced much more rapidly in correctly constructed drying houses, the temperature in which is kept constantly at from 77° to 86° F. by heating apparatus, and in which there is a constant renewal of air.

The drying process itself, in the drying houses, is accomplished by the difference in weight between hot and cold air and the consequent continual upward draw, assisted by ventilatory openings. The linoleum is hung over rods and in many folds, as is done in the textile and paper industries, so that the air may pass along the perpendicular fiber.

Finally the work of printing and finishing the linoleum must be mentioned. The printing is done with oil colors and by means of forms of wood or metal upon printing presses or machines. After having been printed the linoleum is taken into the drying house, where it remains several weeks. After it has completely dried it is cut, the upper surface is washed, and it is wound on rolls.

MEASURES FOR THE PROTECTION OF THE WORKMAN AND THE PUBLIC.

From the preceding explanation it is evident that the comminution of the cork gives rise to great clouds of dust and also gives occasion for the production of sparks. Further, the cork dust is easily inflammable, and its ignition produces a disastrous explosion. To remove this danger it might prove efficient to pass the pieces of cork through a magnetic separator in order to remove the particles of iron before they have a chance to get into the comminuting machine.

The boiling of the linseed oil with oxidizing substances demands a continuous stirring of the contents of the vessel in order to prevent the overheating of the oil in immediate contact with the walls of the vessel and to completely intermingle the oxidizing substances with the liquid. The workmen accomplish this by hand, continually moving a ladle in the boiling mass. This procedure is carried on by direct heating and at a temperature (about 392° to 464° F.) considerably in excess of the boiling point of linseed oil. In this process dense, injurious fumes escape from the frequently opened vessel and come in contact with the workman. The steam dome over the vessel does not offer sufficient protection, as will be shown.

If mechanical stirrers were used they would make the continual movement of the oil mass possible, and would be a great protection to the workman, who now is exposed to unbearable heat and irregularly escaping oil gases, but hardly dares move during the boiling and generating process, because of the easy ignition of the dangerous oil.

The vessel hanging down into the fire requires only to be covered with the usual kettle dome, pierced at the apex by a stirring ladle. The lower end of this ladle is located in a groove at the bottom of the vessel. The frame-like wings of the ladle moving through the mass are revolved by means of a bevel pinion. Appliances for filling, emptying, and watching can easily be introduced into the vessel or domes. This arrangement is very cheap and practical. It would also aid considerably in diminishing the great annoyance caused by the heat and the disagreeable odors generated in boiling. For the complete removal from the working room of disagreeable gases arising in cooking and boiling down the oil other measures are necessary.

From the description of the process of manufacture it is evident that linseed oil possesses the property of gradually drying and changing into a tough transparent mass on exposure to the air. This is brought about very slowly and incompletely. The property is much more apparent if the oil has been for some time exposed to the air under a higher temperature and with the addition of certain oxidizing substances.

The drying of the oil varnish is not brought about by evaporation alone, as the public and workman assume, but by the circumstance that the varnish absorbs oxygen and chemically changes into a solid substance. The more rapidly the process of oxidation goes on the better the varnish. Experience has taught that oxidation is accomplished more rapidly in proportion as a greater quantity of oxygen is introduced. This is done by the addition of litharge, sulphate of lead, zinc oxide, manganese, etc. From experiments and practical experience it has been found that linseed oil absorbs half its weight of oxygen.

The drying of linoleum is essentially nothing more than a continuation of the oxidation of linseed oil, which naturally causes an evaporation. The latter can be prevented and the rate of drying increased by adding pure oxygen to the warm air that is introduced in the drying house. By this the evaporation is brought to a minimum and, under careful operation, is scarcely worth mentioning.

The annoyance to the public and to the workmen of neighboring establishments, as well as to those who are engaged in this occupation, is caused by the inefficient removal of the fumes which escape from the oil kettles. It is immaterial whether the linseed oil is cooked or boiled down with or without chemical addition, but it is a fact that, though the customary hoods have been built over the kettles, the escaping fumes are removed neither rapidly nor efficiently. The hoods are joined to a collecting tube, which receives the gases gathered up by the former. The collecting tube carries the gases and fumes to an iron chimney.

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As proof of the statement that the gases, carried into the chimney as above described, are not first made harmless, we might point out the annoyances from which the neighboring plants suffer. Further, it is due to technical defects in the plant that odoriferous and vaporous gases can not be led into and escape from the chimney with sufficient rapidity because of the lack of draft. A proof of the defective construction is that a fire is kept burning at the foot of the chimney to obviate this deficiency. The fire is supposed to create a draft, but the trouble is not and can not be satisfactorily removed by this method.

The measures which should be introduced here for the purpose of remedying the evil are as follows: The collecting tube must enter the chimney at an inclination, not horizontally, and must be of a larger diameter than at present. The gases which are caught by the hoods of the oil boilers must be made harmless by burning before they enter the chimney. The assumption that the fire which is now continually kept burning at the foot of the chimney accomplishes this rests upon complete ignorance of a physical law; for this fire acts only as a so-called decoy fire, as will be seen from the following:

As the air within the chimney, on account of its circumscribed position, is of a different temperature than the air without, the equilibrium of the column of air, which can be imagined as standing on the bottom of the chimney, is destroyed. If the bottom of the chimney were closed the equalization between the inner and outer air could be accomplished only by the power of expansion and by diffusion, which in this case would be of no importance. If, however, an opening is made at the bottom of the chimney, then the equalization of the temperatures of the internal and external air will induce a current to pass through the chimney. This current of air is from below upward, because the air being heated at the lower opening of the chimney becomes lighter than the external air, and rises. The heated space below then draws a new supply of air from without to replace that which has been lost. This is heated in its turn and rises. Thus a continuous circuit of air through the chimney from below upward is produced.

Smoke and dense vapors are not always lighter than the atmospheric air, but have the power to partake of the movements of those atmospheric layers into which they are thrown. In the open chimney it is therefore not the smoke, oil vapors, and varnish fumes which strive to rise upward and escape, but it is the current of air in the interior of the chimney which must drag the smoke and varnish fumes that enter from the collecting tube upward and along with itself. This effect can be produced only when the current of air is strong enough to include the smoke and odoriferous fumes. This, however, is not true in the present case, as the facts prove.

The chimney, in short, is too low to generate a sufficiently strong current of air. All that would be necessary to remove the evil would

be a chimney of greater height and a satisfactory introduction of a collecting tube into the same.

Direct dangers for the workman in this manufacturing process are caused mostly by the exceedingly penetrating and evil-smelling fumes which arise from the cooking and boiling down of the linseed oil. These fumes make the boiling of oil and varnish an operation much to be dreaded. The danger rests in the severe irritation of the mucous membranes, the eyes, and the nose.

Further, in the customary method of boiling the oil product is likely to boil over on the open fire and cause severe burns to the workman. If litharge or similar chemicals are added to the oils, as is usually the case, the danger of lead poisoning is also present.

If resins are added to the oil, they develop volatile substances which have a very injurious influence upon the respiratory organs. The ether oil which forms produces headaches and nausea, sometimes complete stupor. The irritation of the respiratory organs may develop, according to Eulenburg, into hæmoptysis. As already said, the combustion of the fumes is the best way to prevent the vitiation of the atmosphere of the whole neighborhood.

The most radical measure and the only correct one in the building of new plants of this kind, which on account of their location, or the defects of the establishment might bring about dangers and annoyances to the inhabitants of the vicinity or the public at large, is to forbid them entirely within city limits. If they are built outside of city limits a satisfactory and permanent supervision of the industry must be required, and must aim especially at the protection of the workman.

METHOD OF DRYING IN A LINOLEUM FACTORY.

The second factory investigated in this industry comprised 25 buildings and occupied an area of several acres. The buildings were chiefly constructed of brick. About 250 persons are employed, and each of these, according to a statement of the bookkeeper, works 55 hours a week. The factory has founded a beneficial association which in the case of sickness or accident aids its members, and youthful persons are not employed.

The purpose of the drying methods used in this establishment is to dry the material covered with a linoleum covering mass as rapidly as possible and to decrease the time allowed for the exhalation of the odors. This is an important factor, as has already been sufficiently indicated in the discussion of another linoleum factory, where the process of drying has been explained. The description of the details of the former factory applies more or less also to this factory, with the difference, however, that no linseed oil is manufactured here.

In the description of the former factory it was shown how the drying process can be hastened by the introduction of a spray of air to the hanging linoleum, and how the spreading of the odors over the surrounding country can be prevented.

Here an attempt has been made to obtain the same results by means of a mechanical draft. The odor which spread over a large territory about the other factory was not at all, or only very slightly, perceptible here.

The drying apparatus consists of five compartments, technically known as stoves. Each of these compartments is about 100 feet long, 11 feet 6 inches wide, and 56 feet high, with the exception of the outside one, which is about 50 per cent wider than the others, and is intended to be used as a drying room for extra wide linoleum and oilcloth.

In the manufacture of goods of this kind several things are necessary: (1) The ability to maintain a high temperature equally distributed; (2) the ability to change the air frequently, so that sufficient oxygen may be obtained to properly cure the manufactured goods, which contain a large amount of linseed oil, and (3) after the process has reached the proper stage, to clear the space of objectionable odors and gases quickly, and to reduce the temperature rapidly, so that the workmen may enter the room and remove the material in comfort.

Under the system installed the circulation and temperature are under complete control. The air is admitted at a low velocity at the floor, and naturally tends to rise. The return ducts are so arranged that the air may be taken back at a level of about one-third of the height of the room, at two-thirds of the height of the room, or quite at the top of the room. It can also, by means of suitable dampers, be taken in part from any one of the three points mentioned, which makes the control of temperature absolutely positive, and it will be readily seen that when the goods are sufficiently cured it is simply necessary to shut off the steam from the heater and circulate cold air through the stove, and the temperature is reduced very rapidly to any desired degree.

The apparatus used in connection with this work is the well-known Sturtevant system, consisting of a heating coil, together with a blower having a directly connected engine. The apparatus is very similar to that used for many kinds of work, the principal variation in this case being its especial adaptation to this industry.

In this case it has been successful, for the reason that it is very compact in form, very positive in variation, and thoroughly controllable under any and all conditions, atmospheric or otherwise, and can be so quickly adjusted for wide ranges of temperature as to meet any sudden or unexpected demand.

This method supersedes the more antiquated one of putting steam pipes around the room to raise the temperature to the requisite height. They do not supply the necessary amount of air, and, furthermore, have a tendency to overheat those goods near them and to underheat those farther away.

LINSEED OIL MANUFACTURE.

Linseed oil is the most important and most commonly used drying oil. It is met with in commerce as raw, refined, artists', and boiled oil. Raw oil is obtained by pressure from the seeds. Refined oil is obtained by agitating the raw oil with 1 per cent of strong sulphuric acid in lead-lined tanks, after which it is boiled with water or treated with steam and the water and sediment drawn off into settle tanks. Artists' linseed oil is that oil which has been allowed to stand for weeks or months, then treated with litharge, and finally bleached by exposure. Other processes of refining are also used. Raw linseed oil possesses great drying powers, which are considerably enhanced by the operation of boiling. Boiled oil is therefore a most important article to the painter. The drying power of boiled oils is still greater if litharge or some other dryer has been added during the operation of boiling. The dryer appears to act as a carrier of oxygen to the oil, and a definite chemical compound of the metallic oxide with linoleic acid is formed. Both raw and boiled linseed oil are used in the manufacture of ordinary paints, while for the more delicate colors used in the fine arts refined and artists' oil are preferred.

The process of manufacture in the factory investigated is as follows:

The crude material is linseed. It is first carried to the second story and passed through a sieve. It is then carried below and crushed between nine sets of rollers. By means of elevators and conveyors this crushed material is carried to four heaters, and after it is sufficiently prepared is ready for the extraction of the oil. To this end it is put in hydraulic presses, 20 of which are placed side by side, and the hot crushed seed is submitted to 3,500 pounds pressure. The oil that is extracted is led to tanks in the cellar. After filtration it is pumped into storage tanks.

Outside of the factory building are nine iron oil tanks, which have a capacity of about 700,000 to 800,000 gallons of oil. The oil is pumped into these tanks by means of an engine of about 250 horsepower. The entire factory makes a very favorable impression upon the visitor. In the dirty and oily occupation a praiseworthy cleanliness is observed which is worthy of imitation. But what is even more worthy of recognition are the provisions for the workman in the hot press rooms, where efficient protection has been introduced. The temperature here rises to 125° F., and is caused by the hot mashed linseed and its introduction into the presses.

For the protection of the workmen blowers have been arranged beside the presses and places of work. They lead compressed air from a central air shaft to the workmen in a very efficient manner, so that they in no manner suffer from the heat. Only one thing might be here desired, namely, that the air be purified and disinfected before it is led to the workman. This would be especially desirable here because the whole vicinity as well as the immediate environment of the factory is surrounded with an atmosphere vitiated by a neighboring fertilizer factory.

How the disinfection of this pestilential air can be accomplished has been explained in another place.

The following is an outline of the protective measures that should be applied to varnish and lacquer manufacture as well as to oilcloth and linoleum factories:

PROTECTIVE MEASURES FOR VARNISH AND LACQUER MANUFACTURE, ESPECIALLY FOR OILCLOTH AND LINOLEUM FACTORIES.

1. In new plants those buildings which are to serve in the production of lacquers and varnishes must be removed from other buildings at quite a distance, or at least separated from them by fireproof walls.

2. In new plants the walls, ceilings, and floors must be constructed of fireproof materials.

3. The doors must be fireproof, set in iron or stone grooves, and open outwardly.

4. The windows must be supplied with iron shutters, which can be locked if there is any danger of fire from neighboring buildings.

5. Where transportable varnish boilers and furnaces are present, care must be taken that the oil which boils over can not come in contact with the fire.

6. In varnish boilers which are heated directly over the fire, the lowest point of the liquid must be at least 3¼ inches above the highest point reached by the fire. There must also be a mark in the kettle to indicate how far it can be filled.

7. The varnish boilers must be filled to only two-thirds of their capacity and supplied with an overflow channel to catch any oil which might boil over.

8. In the immediate vicinity of the boiling rooms of lacquer and varnish factories a sufficient quantity of sand must always be present to smother the fire if necessary.

9. Vessels of more than 10 pounds capacity must not be raised from the fire with the hands. In the case of larger vessels, mechanical arrangements, such as stove trucks, windlasses, portable pans, and the like, must be used to raise and transport them.

10. Those vessels employed in boiling lacquer and varnish, in melting and dissolving resins and the like, must be furnished with arrangements which lead the generated vapors either to the external air or make it possible to render them harmless either by condensing or burning them. In burning the gases and vapors an arrangement must be made to prevent the reflux of the flame and an explosion which might result from it.

11. The openings, which are in the covers of the boilers to permit stirring and looking into them, must be fitted with irremovable slide valves, trap valves, little doors, stoppers, or the like, which must be opened only when necessary.

12. If no other vents are present, a hood must be placed over the boiler in order to carry into the chimney the vapors that escape during the temporary opening.

13. The addition of easily inflammable substances to the molten resins and the like, in movable boilers, must not be carried on in the melting room or the vicinity of fires, unless an apparatus for carrying away the generated vapors is present and accomplishes this without permitting them to escape into the working room. Otherwise these operations must be carried on in a separate room or in the open air where the generated vapors can be led away. Before the addition of the easily inflammable substances the draft must be shut off and the molten resins sufficiently cooled. The crude materials must not be stored in the boiling rooms.

14. The working and store rooms in which easily inflammable materials, such as alcohol, ether, benzine, etc., are handled must be lighted by an isolated internal or external lighting plant. They must be entered only by men provided with safety lamps.

15. The heating of these rooms must be accomplished by steam, hot water, or stoves fed from without.

16. In those operations in which the eyes of the employees are liable to be injured through the scattering of hot and caustic liquids the men must be supplied with protective glasses and required to use them.

17. Smoking in the manufacturing and store rooms must be prohibited.

18. In lifting the lacquer and varnish kettles from the fire the damper must be shut, and the openings upon which the kettles have stood must be closed with tight-fitting covers.

19. In the boiling rooms of varnish factories no fluids of any kind, not even the so-called chemical extinguishers, must be used, but only the sand mentioned in section 8.

20. The covers of the boilers must be kept open only as long as is absolutely necessary.

21. The handling of combustible liquids which may develop inflam-

mable gases and vapors must be forbidden in the vicinity of the fireplaces.

22. The cleaning of melting kettles in the working room is forbidden.

23. The shoes of the employees must be such as to offer sufficient protection against hot liquid.

THE MANUFACTURE OF TALLOW.

The term "tallow" is principally applied to the mixture of olein and stearin obtained by rendering beef or mutton fat. Various vegetable fats, the grease obtained by boiling or steaming bones, the solids obtained by the expressing of whale and fish oil, and certain other solid fats, however, are also known as varieties of tallow. Inferior kinds of animal tallow used for soap making are known as melted stuff, rough stuff, and town tallow, the latter being also known as kitchen stuff or pot grease and consisting of the waste obtained in cooking operations. Varieties whose names depend on the places of export are known as River Plata, North American, and Western tallow. So important is the tallow industry that in South America and Australia immense numbers of cattle were formerly slaughtered and boiled down for their tallow alone.

The arrangement employed for rendering fat consists of a strong iron cylinder, having a charging hole, a manhole near the bottom for discharging the refuse, taps for drawing off the fats, water-supply valves, steam-supply valves, and a waste valve. The charge is heated by steam supplied at 60 to 80 pounds pressure which circulates through the coil beneath a perforated false bottom supporting the fat, and water is supplied when necessary. After six to eight hours the tallow is drawn off, alone or with water, by opening the upper or lower tap.

There are a series of cylinders of 1,200 to 1,500 gallons capacity employed in rendering the fats when the tissues are not required in a condition otherwise than is suitable for manure. The cylinders are filled above a false bottom with the crude fat, and steam is admitted by a foot valve and perforated pipe at 50 pounds or even as high as 100 pounds pressure. A cock is opened to allow escape of condensed water when spurting occurs on opening a try cock. After ten to fifteen hours the steam is cut off and the cock and safety valves are opened, and, after settling, the layer of tallow is drawn off through a series of cocks. The cover of a discharge hole in the bottom of the cylinder is then raised by a rod, and the residue falls into the tub beneath.

To remove the last traces of tissue it is necessary for the tallow to be washed, melted, and strained. This process extracts more tallow from the fat than any other. Sometimes the fat is rendered at the

atmospheric pressure by boiling a mixture of the fat with one-fourth its bulk of water containing 2 to 3 per cent of sulphuric acid.

The quality of tallow varies with the species, age, and sex of the animal, and with the part of the body from which it is obtained. Animals fed on brewery refuse usually yield a tallow containing a lower proportion of stearin. Mutton tallow contains the largest proportion of stearin, and is whiter than beef tallow.

Tallow consists principally of stearin, olein, and palmitin, the two former largely predominating. Pure tallow is white and almost tasteless, but the commercial product is usually yellowish. When saponified it yields about 94 to 95 per cent of fatty acids. Tallow melts between 100° to 120° F., the best varieties melting at about 110°. It may be distilled in vacuo, but is decomposed when distilled with superheated steam into oleic, stearic, and palmitic acids, with separation of glycerin.

Commercial tallow frequently contains a considerable quantity of free fatty acid and is often adulterated with cotton-seed stearin, bone fat, the distilled fatty acids from wool grease, and other fats more easily melted than stearin. Starch, china clay, and whiting are also used as adulterants.

Several processes are in use for bleaching and purifying tallow and stearin in addition to the mechanical methods of subsidence and filtration under pressure from a head of the liquefied tallow. By one process tallow for soap making is bleached by driving air through it in finely divided streams while heated to from 180° to 200° F. With ordinary tallow this process requires from ten to fifteen hours.

The tallow is sometimes agitated with potassium carbonate and allowed to settle before treatment. It may also be bleached by boiling with a solution of bleaching powder in the proportion of 1 per cent, or of potassium chlorate in the proportion of less than 0.3 per cent of the tallow, with addition of hydrochloric or sulphuric acid. A mixture of manganese dioxide and hydrochloric or sulphuric acid may also be used.

Tallow is said to be largely bleached by the following process: It is partly saponified by heating with soda and salt solution, and the upper and lower saponified layers are drawn off for making curd soap; the middle, unsaponified portion being filtered through linen, heated to boiling with a 2½ to 3 per cent solution of alum for fifteen minutes, and left for three to five hours. It is then again heated to from 338° to 392° F. to complete the bleaching, care being taken to arrest the heat if any unpleasant smell is observed. The fat treated by this process should not be rancid, neither should it be too fresh.

There is also a method of purifying in which the melted fat is agitated at 150° to 212° with a solution of potassium permanganate and sufficient dilute sulphuric acid to render the whole distinctly acid.

After an hour the liquid is settled and the fat is drawn off and remelted in water.

Stearic acid may be bleached by agitation with 5 per cent of sulphuric acid diluted with 10 per cent of water. After settling and removal of the acid water with the aid of washing, purification may be completed by stirring in water containing the whites of 25 eggs to each 100 pounds of stearin and heating by steam. The albumen rises as a scum, containing most of the chemical impurities.

The tallow factory studied in connection with this investigation is chiefly concerned in the consumption of meat offal and bones. These materials are collected in the city where the factory is located and taken to the factory in wagons.

In this factory the following unsanitary conditions were found: Everyone doubtless has noticed the horrible stench which remains when a wagon loaded with the materials used in such factories passes along the street. That emitted in unloading such a wagon in the factory is almost indescribable. When the factory was visited such wagons were being unloaded. After the larger bones have been assorted, the stinking mass of flesh, consisting mostly of small particles, is loaded on carts and taken to the second story by an elevator. There it is put in the four large digesters and passes through the boiling process, which, on the average, lasts three hours. After the contents are removed they are pressed and then spread on the floor for drying. The oil and fat is stored in barrels and transported in them. The residue is used in the manufacture of fertilizers.

In the first place the collection of the stinking meat offal and bones on the public streets and its transportation on the same ought to be prohibited. This can only be brought about if the offal is stored in hermetically sealed cans and hauled to the factory in the latter. These cans may be made similar to those in which human excrement is transported through the streets.

The employment of this method has the advantage that in unloading the wagons the workmen are no longer compelled to inhale noxious organic odors of putrefying masses of meat, which without any question are injurious to the health. Moreover, it is possible by means of these hermetically sealed cans to bring the stinking masses directly to the second story and empty their contents into the digesters. In this way the stench on the street and during transportation to the factory rooms is prevented. If it is necessary that the collected meat offal and the bones be assorted in the factory before they are further used, a place of collection should be built, entirely separated from all other buildings. This place should be connected with the factory chimney by means of a flue. The latter would consume a large portion of the gaseous odors of the organic and decomposing mass, and the

remainder would be carried high in the air, where they would be scattered by atmospheric disturbances and thus not cause any annoyance.

It would be still better to burn the organic fumes before carrying them to the chimney. This could be accomplished by the introduction of a special furnace between the chimney and the storage room. The gas-impregnated air could be introduced into the furnace by means of a steam-jet injector or ventilator, and thence passed into the chimney. This arrangement would accomplish a further purpose in removing the great swarms of flies and preventing their settling, and also decrease the annoyance which the workmen suffer from them now.

It is true that an arrangement for the removal of the fumes during the boiling and emptying process has been introduced in the factory, but it does not serve its purpose. It would be of great sanitary benefit, too, if the masses of already heated bone which lie on the factory floors were stored in distinct barrels, supplied with a similar ventilating apparatus. On the whole, the entire factory should be supplied with a permanent, thoroughly efficient system of ventilation.

It is also to be noted that the workmen freely handle the offal in order to assort those parts which seem unsuited for use. The danger of blood poisoning is very great, but it can be prevented if in such work the men are supplied with gloves.

THE FERTILIZER INDUSTRY.

THE MANUFACTURE OF FERTILIZERS.

A description of the process of the manufacture of fertilizers and of the materials used will give a sufficient basis for a consideration of the defects of the plants engaged in their manufacture, as well as for efficient propositions for removing such defects.

Manures are sometimes classed as general and special. The former class embraces those which answer most of the requirements of a crop. They can thus be used alone and admit a pretty general application. Special manures, on the other hand, supply few—occasionally but one—of the elements of plant food, and are applied in certain cases only, but most frequently used in mixture with other manures. The principal artificial manures having a claim to be considered general are seaweed, fish manure, and oil cakes.

Seaweed is largely used in some localities near the sea. When quite fresh seaweed contains about 80 per cent of water. Its composition varies a good deal. The proportion of nitrogen and potash in fresh seaweed is thus very similar to that in farmyard manure, while the phosphoric acid is deficient.

The application of fish not suited for other purposes to the fields as manure has been practiced in certain parts of the country for a number of years. In many districts on the seacoast, where fishing is the

chief industry, the only way of disposing of a superabundant catch of herrings, for example, has been to utilize them as a manure. From such a practice has sprung up what is now an important and ever-increasing industry, viz, the manufacture of fish guano.

This guano varies considerably in quality, according to the nature of the process employed and as to whether made from whole fish or merely from fish offal. The latter process is the common one. The manufacture is carried on at the fish-curing stations, and the quality of the guano made from this source is somewhat different from that made from whole fish, for a large portion of the fish offal is made up of bones and heads. The best quality of this guano may contain as much as 10 per cent of nitrogen, but as a rule it is nearer 8 per cent. A very considerable variation occurs in the amount of phosphoric acid, owing to the fact that the guano made from fish scrap is naturally much richer in this ingredient than whole-fish guano. The phosphoric acid may be said to range from 4 to 15 per cent, besides there is present a small quantity of potash. Guano is also manufactured from the carcasses of whales. Such guano contains from 7½ to 8½ per cent of nitrogen and about 13½ per cent of phosphoric acid.

A fish guano is manufactured to a considerable extent from a coarse variety of herring. This fish is caught for its oil, which is extracted by boiling. The residue is manufactured into guano after pressing. That fish guano is a valuable manure there can be no doubt. What impairs its value is the fact that, as a rule, it contains a certain amount of oil. The effect of the oil is to retard fermentation and decomposition when the guano is applied to the soil, and this renders its action slower than would otherwise be the case. It is mixed with farmyard manure and also with superphosphate of lime.

For many years guano occupied the first place among our commercial manures. The best and largest deposits are now exhausted, although a considerable quantity still remains.

Guano has been formed from the excrement and carcasses of sea-fowl. The fresh excrement is highly nitrogenous, and consists chiefly of acid and calcium phosphate. If the climate is hot and dry, the excrements are quickly dried and the nitrogenous matter preserved. This has been the case for instance on the rainless coast of Peru. In a moist climate the nitrogenous matter is quickly converted into ammonia and dissipated by evaporation or drainage, and a phosphatic guano practically destitute of nitrogen remains.

In a dry Peruvian guano the nitrogen chiefly occurs as uric acid and water, and a smaller proportion as ammonia salts. A damp guano contains more ammonia and smells strongly of ammonium carbonate.

Some of the Peruvian guanos contain distinct amounts of nitrates. The phosphoric acid exists chiefly as finely divided calcium phosphate;

besides this, some is present as ammonium phosphate, and as phosphates of other alkalis. A portion of the phosphate is readily soluble in water. Guano is an extremely valuable manure, supplying to larger or smaller degree all the essential constituents of plant food in a condition readily assimilated by the plant, or acquiring that condition very soon after admixture with the soil.

Guano is treated generally with 25 to 30 per cent of sulphuric acid by which means the ammonium carbonate is neutralized, the urates largely converted into ammonium salts, and the calcium phosphate rendered soluble. This process is of considerable advantage in the case of damp guanos. Besides Peruvian, the only other nitrogenous guanos imported are from South Africa and Patagonia. The South African guanos originally found were phosphatic; these have been removed and a fresh deposit of the birds is now annually collected from several islands opposite the west and south coast of Africa. These guanos being fresh deposits are generally rich in nitrogen and comparatively poor in phosphates. The small deposits found in the islands off the California coast may be considered as intermediate between the two classes of nitrogenous and phosphatic guanos.

The ancient deposits of guano occurring in climates in which rain is frequent have lost almost all of their nitrogenous matter. They are, when freed from sand or rock, of great value as phosphatic manures and have been much used for the manufacture of high-class superphosphates. Some of these guanos have been considerably altered by the action of water and other natural chemical agents. One common result of this action is the formation of "crusts," consisting largely of calcium phosphate containing considerably less calcium than tricalcic phosphate, and therefore of special value as manure. Gypsum is also present in some cases to a considerable extent.

Cheap or damaged oil cakes or cakes unfit for food (as castor) are employed to a small extent as manure. They contain 4 to 7 per cent of nitrogen, 1.5 to 3 per cent phosphoric anhydride, and 1 to 2 per cent potash.

Large quantities of nitrate of soda and sulphate of ammonia are found in stock rooms. Their nature and characteristics as a manure may be briefly summed up as follows: Nitrate of soda is a whitish, crystalline salt, extremely soluble, and is quickly diffused in the soil. It contains 95 per cent of pure nitrate of soda—i. e., 15½ per cent of nitrogen, equal to about 19 per cent of ammonia. Next to sulphate of ammonia it is the most concentrated nitrogenous manure. The relative quantity of nitrogen in these two manures is as 3 is to 4. Nitrate of soda contains nitrogen in the most valuable and readily assimilable form. It is, as nitric acid, the form into which all nitrogen must first be converted before it becomes available for plant use.

The oldest and still the chief sources of sulphate of ammonia are the

gas works, where it is obtained as a by-product. It is also obtained to a lesser extent from shale, iron, coke, and carbonizing works and from bones, horn, leather, and certain other animal substances rich in nitrogen, when subjected to dry distillation, as is the case in certain manufactures, such as bone charcoal (used in sugar refineries). The distillation of horn, etc., and the manufacture of prussiate of potash also constitute less abundant sources.

The coal used in gas works contains on an average from a half to one and a half per cent of nitrogen. When it is subjected to dry distillation, as is done in the gas works, the nitrogen is chiefly converted into ammonia, and in the process of purification is removed with the gas liquor, which contains about 1 per cent of ammonia. The ammonia recovered from this liquor by distillation is then absorbed in sulphuric acid. It may be pointed out that not nearly all the nitrogen contained in the coal is recovered as sulphate of ammonia.

Next to the gas works the shale works form the chief source for this valuable manure. In these works the ammonia is obtained in distilling the paraffin shale by a method somewhat similar to that in use in the gas works. Recently ammonia has been recovered from the blast-furnace gases in iron works. Thousands of tons are annually obtained in this way. From coke and carbonizing works the annual production is about half that obtained from iron works.

Pure sulphate of ammonia is a whitish, crystalline salt, extremely soluble in water. The commercial article, however, is generally grayish or brownish in color, owing to the presence of slight quantities of impurities. The pure salt contains 25.75 per cent of ammonia; the commercial article about 24.5 per cent. The chief impurities which it is likely to contain are an excess of moisture, free acid, or insoluble matter. Some samples contain small quantities of ammonium sulphocyanate, a substance extremely poisonous to plants. Sulphate of ammonia is thus the most concentrated of all nitrogenous manures in common use, and is for that reason the most expensive.

Hoofs and horns form a regular source of artificial nitrogenous manure, the latter being obtained as a by-product in the manufacture of combs and other articles. They are stored in the form of a fine powder, and in order to increase their rate of action, which is very slow, they are often composted with horse manure before use. They have also been composted with slacked lime. There can be no doubt that such treatment increases their value considerably. The percentage of nitrogen seems to vary much according to the animal from which they are derived. In nine samples of horn the nitrogen was found to vary from 7½ to 14¼ per cent, giving an average of 11⅛ per cent. The nitrogen seems rarely to exceed 15 per cent. The amount of phosphoric acid has been found by various investigators to range from 6 to 10 per cent.

Also, torrefied horn has been used. This is a horn which has been subjected to the action of steam. The nitrogen in this material is considered to be more active than in ordinary horn.

Ground hoof is very similar in composition to horn and contains about 14 to 15 per cent of nitrogen. Considerable quantities are now used. It must be remembered, however, that horns, hoofs, hair, bristles, etc., although rich in nitrogen, possess a comparatively low value as manure.

Dried blood is a very valuable manure, its nitrogenous matter becoming readily available to the crop after mixing it with the soil. Perfectly dry blood contains 16 per cent nitrogen and 4 per cent ash, of which one-half is common salt. The commercial-article contains 9 to 12 per cent nitrogen; 10.3 per cent is about the average.

Leather has also been used as a manure. Its nitrogen ranges from 4 to 6 per cent, and it may safely be called the least valuable of the nitrogenous manures. Leather is from its very nature admirably adapted to resist decomposition when applied to the soil, and unless it is reduced to a very fine condition it will remain undecomposed for a long period. Torrefied leather, however, is probably of greater value. It is obtained in the same way as the torrefied horn, already referred to—namely, by treatment with steam. The grease and fatty matters which so largely aid it in resisting decomposition being extracted, it is much better suited for purposes of manure than ordinary leather. Torrefied leather contains from 5 to 8 per cent of nitrogen.

What is called meat-meal guano is generally that made from the carcasses of cattle after they have been treated for their meat extract. The meat meal is used both for feeding and manuring purposes. Considerable quantities are imported. It is a valuable manure, especially so for its nitrogen, which varies from 4 to 8 per cent, while it contains from 13 to 20 per cent phosphoric acid. Some meat-meal guanos contain as much as 11 per cent of nitrogen.

In some parts of the world, more especially in Germany, the carcasses of horses, as well as cattle, dogs, pigs, etc., which have died of disease, are converted into guano. They are subjected to treatment by steam in digesters. By this means the fat and gelatin are separated and utilized, while the remaining portion of the animal is converted into guano. Other processes are also employed. The resulting manure contains from 6 to 10 per cent of nitrogen and from 6 to 14 per cent of phosphoric acid.

Meat-meal guano is a valuable nitrogenous manure. The same general remarks apply to it as to fish guano, although it ferments very much more quickly than the latter and is undoubtedly a more valuable manure.

Manure made from waste wool products is a material extensively manufactured and was formerly much used as a manure. There are

three qualities—the first containing 8 to 12 per cent of nitrogen, the second 6 to 8 per cent, and the third 5 to 8 per cent. Shoddy is by no means a very valuable manure. Woolen waste products were formerly much richer in nitrogen than is now the case. This is owing to the now prevalent adulteration of wool with cotton. Pure woolen rags should contain 17 to 18 per cent of nitrogen. It has been recommended to treat woolen waste with caustic alkali before using it as a manure. This renders the nitrogen more available and has other advantages to recommend it.

Soot obtained in the usual way generally contains about 3 per cent of nitrogen. This is chiefly in the form of sulphate of ammonia and small quantities of potash and phosphates. A varying proportion of nitrogen is present in the form of ammonia salts, and this undoubtedly confers upon soot its value as manure. It has long been used as a top dressing for young grain and grass, and has been applied at the rate of from 40 to 60 bushels per acre. It has an indirect value as a slug destroyer.

Bones are still used in a variety of conditions, such as in the raw or green state, bruised, boiled, steamed, fermented, burnt, dissolved, and broken, or they are ground to various degrees of fineness, to which the names of ½-inch bones, ¼-inch bones, bone meal, bone dust, and floated bones are given.

In the early methods bones were fermented before being used in order to render their action more speedy when applied to the soil. This fermentation was often effected simply by mixing the bones with water and allowing them to lie for a week or two. In other cases the bones were mixed with urine or other refuse matter. The most general method is to pour sulphuric acid on them.

The composition of bone tissue varies considerably, and depends on the age and kind of animal to which it belongs, as well as on the part of the animal it is taken from. Bones are made up of an organic and an inorganic part. By steeping a piece of bone in dilute acid the inorganic portion of the bone is dissolved out and the organic portion, which fills the framework of the bone, is left. On the other hand, by submitting a bone to the action of great heat the organic portion of the bone is driven off and all that remains is a quantity of ash.

The proportion of the organic to the inorganic matter varies considerably in different bones. The bones of young animals contain more organic matter than those of old animals. In compact bones the inorganic matter is greater than in spongy bones. The thigh bone contains most inorganic matter. The short bones which have to bear the greatest strain are richest in inorganic matter. Of the bones of animals, fish bones exhibit the greatest variety of composition, some being almost entirely made up of organic matter, while others are similar in their composition to the bones of quadrupeds.

The organic portion of bones is almost entirely made up of a substance to which the name ossein has been given and which, when boiled for a long time, is converted into gelatin. This ossein, which forms on an average from 25 to 30 per cent of the weight of bones, is extremely rich in nitrogen, containing over 18 per cent.

The inorganic portion, which forms about 70 per cent, is made up chiefly of phosphate of lime. The dry leg bones of oxen and sheep have the following composition:

	Per cent.
Phosphate of lime	58 to 63
Carbonate of lime	6 to 7
Phosphate of magnesia	1 to 2
Fluoride of calcium	2
Organic matter	25 to 30

Raw bones contain 6¼ per cent of nitrogen and 8 per cent of water. Bones are used for the manufacture of glue and gelatin. These are extracted by steaming the bones. The bones after this treatment are used as manure. The fat present in raw bones retards their decomposition in the soil. Probably it forms along with lime an insoluble soap, which prevents the mineral matter in the bone from being dissolved by the carbonic acid of the soil. In the process of boiling or steaming a certain loss of nitrogen takes place, greater or less, according to the length of time they are boiled or steamed, and the pressure applied. A more economical method for extracting the fat has been introduced by using benzine. This process is not used to any extent. The loss of nitrogen in the former case is more than compensated for by their more speedy action as a manure when applied to the soil. Bone meal of good quality contains from 45 to 55 per cent of phosphate of lime and 3½ per cent of nitrogen.

It is well known that bones are a slow-acting manure. They may be said to possess both a mechanical and chemical action when applied to the soil. When they putrefy their nitrogen is slowly converted into ammonia, and carbonic acid as well as various organic acids are formed, which, acting upon the insoluble mineral matter in the bones, render it available for plant uses. Bones, when applied in large quantities, may act not merely as direct suppliers of plant food, but in the course of their putrefaction they may act upon a certain amount of the inert fertilizing matter of the soil, and render it available. The more readily, then, that bones putrefy the more speedy will be their effect.

As already pointed out, bones, in order to increase their efficiency, are often fermented before application. The removal of the fat is another means of increasing the rate of their action, but the fineness to which they are ground determines this more than anything else.

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Much ingenuity has been expended in perfecting machinery for grinding bones. At one time in Germany they were pounded in stamps similar to those used for ore.

In this country what has been called "floated bone" has been prepared. This bone is so fine that it actually floats in the air like flour dust, and is made by whirling the bones against one another in machines. The action of bones prepared in this way is, of course, very speedy, but the difficulty of applying a manure in such a fine state of division to the soil is great. The expense of the process is also considerable. The ease with which finely ground bones putrefy is evinced by the fact that bone flour has to be salted in order to preserve it. Fermentation, as already seen, requires a plentiful supply of air and a certain amount, but not too much, of moisture.

In view, therefore, of what has just been said, it might seem best to use bones in the form in which they are most speedily available or as dissolved bones. This would be so if the bones were the only source we possessed for the manufacture of superphosphate of lime; but we now have in the various abundant mineral phosphates much more abundant and cheaper sources for this valuable manure. Another reason against dissolving bones is to be found in the difficulty experienced in dissolving their phosphates. Bones, especially when raw, are not easily acted upon by acids.

Dissolved bones, however, are still manufactured. Formerly the manure called dissolved bone was often a mixture of mineral superphosphate and undissolved bone meal. The composition of dissolved bones varies somewhat, the percentage of soluble phosphate being about 20 to 23 per cent, the insoluble amounting to from 9 to 10 per cent, and the nitrogen from 2½ to 3½ per cent.

The bone ash which is left after burning bones was once an article of considerable importance as a manure. It is still imported from South America and is now used chiefly in the pottery industry. It is still used occasionally in the manufacture of high-class superphosphates and is extremely rich in phosphate of lime, of which it contains between 70 and 80 per cent. It is devoid of nitrogen. Bone ash is best used in a dissolved form, as it possesses no characteristic action such as bones possess.

When heated in a closed retort bones are not converted into bone ash, but into a body called bone char. This body is similar in composition to bone ash, except for a certain percentage of charcoal, amounting on an average to 10 per cent. It contains but little nitrogen or other organic matter.

In the manufacture of steel by the basic process, there is a large percentage of waste product, which is known as basic slag. This slag contains about 50 per cent lime, 4 per cent magnesia, 2 per cent alumina, 14 per cent iron oxide, 5 per cent manganese oxide, 10 to 25

per cent phosphoric pentoxide (average 17 per cent), and 8 per cent silica. The process has been adopted to a very large extent.

For several years the slag was regarded as valueless. The large amount of iron present led agricultural chemists to believe that the phosphoric anhydride would not prove available to plants, while the ferrous oxide would probably be injurious. It is now known that the phosphoric anhydride in the slag is almost wholly combined with calcium, and that this calcium phosphate is easily disintegrated, rendered soluble in the soil, and that no ill effects arise from the presence of the ferrous oxide. Tetra-calcic phosphate is apparently the combination in which most of the phosphorus occurs. About 1.5 per cent of the total phosphorus exists as iron phosphide, which is changed into phosphate in the soil. The phosphate in the slag is not soluble in water. It is dissolved to a considerable extent by a solution of ammonium citrate.

To be effective the slag must be very finely ground. It should pass through a sieve having 10,000 meshes to the square inch. The grinding requires special machinery. It is advisable to break it first under stamps, to further reduce it between rollers, then to place it between separate pieces of iron by passing over slanting sieves, and, finally, to grind it between millstones.

Phosphatic minerals which are unsuitable for the manufacture of superphosphate, either from their poverty in phosphates or from the presence of an objectionable amount of iron oxide or alumina, are sometimes treated with acid. The calcium phosphate is dissolved out and then recovered by precipitation. By a previous calcination the ferric oxide and alumina of the mineral may frequently be rendered more insoluble. By the use of cold or weak acid many of these objectionable ingredients may be left undissolved.

The solution in acid is then precipitated in lime, chalk, or solution of calcium sulphydrate, prepared by acting on alkali waste with a solution of hydrogen sulphide. If the addition of the neutralizing base is stopped while the solution is still acid, the precipitate will consist chiefly of dicalcic phosphate. A solution of calcium sulphydrate is the best precipitant. Its addition should cease as soon as a dark color indicates the formation of some iron sulphide.

The phosphates previously mentioned may be applied directly to the soil with good effect if in the condition of fine powder. Many phosphatic deposits are, however, too hard and insoluble to be used economically in this manner. They are treated with sulphuric acid and converted into superphosphates.

The phosphate to be employed is first thoroughly dried and then reduced to an extremely fine powder. Considerable improvements have been effected lately, both in respect to economy in the grinding and in the degree of fineness attained. When the material is in masses

it is first broken into small pieces by a stone crusher. It is then transferred to a mill and ground by edge stones on a revolving bed. The dust is separated from the product by a fan and the grit fed to ordinary horizontal millstones. A separator is of great use in removing the fine dust from partly ground products, thus enabling the remaining grit to be reduced to powder with a smaller consumption of power. The Sturtevant (centrifugal) mill is also employed for reducing phosphates to powder. The finer the powder obtained the more complete will be the action of the sulphuric acid.

The sulphuric acid employed has a specific gravity of 1.57. Acid of this strength is, of course, preferred on the ground of economy. It is essential, however, that the acid contain water, as the dryness of the product is determined by the formation of gypsum. The proportion of water necessarily depends on the composition of the materials and the nature of the reaction. If free phosphoric acid and gypsum are the result of the reaction the sulphuric acid used should have 1.65 as its maximum specific gravity. If hydrated monocalcic phosphate is the product formed the maximum specific gravity of the sulphuric acid will be 1.55. If the material contains calcium carbonate or fluoride, these constituents will require acid of 1.78 specific gravity for their conversion into gypsum. In practice the weak chamber acid answers well. Some water is lost as steam during the mixing, and a certain proportion of moisture does not injure the texture of the superphosphate if it contains a sufficient amount of gypsum. It is clear, however, that when dealing with a phosphate containing much carbonate or fluoride, an acid somewhat stronger than ordinary chamber acid is to be preferred.

The proportion of sulphuric acid to be used depends, of course, on the composition of the phosphatic material. Theoretically, 100 parts of tricalcic phosphate will require 94 of sulphuric acid, specific gravity 1.6, or 100 of sulphuric acid, specific gravity 1.55, if monocalcic phosphate is to be produced. One-half more acid must be used to produce phosphoric acid. The proportion of sulphuric acid used in practice is usually as large a one as can be employed without endangering the dryness of the product. It is generally somewhat in excess of that needed to produce monocalcic phosphate, but is considerably below that required to yield only phosphoric acid. For South Carolina river phosphate (the phosphate most largely used) the ordinary proportion is 90 per cent of sulphuric acid, specific gravity 1.57.

The excess of lime present in the material (as carbonate or fluoride) is the principal factor in determining the quantity of sulphuric acid to be employed. One hundred parts of lime will require 260 parts of acid, specific gravity 1.6, or 277 parts of acid, specific gravity 1.55, to produce calcium phosphate. Phosphates containing a considerable excess of lime will yield a poorer phosphate than their percentage of

phosphoric acid would seem to warrant, owing to the large proportion of sulphuric acid which they require. Siliceous matter is the least harmful impurity in a mineral phosphate, as it consumes no sulphuric acid. To prepare a mineral superphosphate the only ingredients required are the powdered phosphate and sulphuric acid. When turnip manure or other manures containing a little nitrogen are prepared, crushed bones, powdered hoof and horn, shoddy, or ammonium salts are added in mixing the ingredients. Superphosphate is very seldom made from bone alone, as it is difficult to obtain a dry product, and the proportion of soluble phosphate yielded is but small. So-called dissolved bone is usually prepared from a mixture of mineral phosphate, bone, and some concentrated nitrogenous matter. The mixer in which the reaction takes place stands on a platform over an empty chamber known as the pit. It consists of a wooden cylinder, sometimes nearly horizontal, sometimes vertical, furnished in the center with a revolving shaft, carrying arms set on screw wires. Into this mixer the charge of weighed dust is emptied, bag by bag, while at the same time a measured quantity of sulphuric acid is run in from a tank. When the charge is completed it is agitated for two minutes; a valve is then opened, and the whole contents of the mixer (about 16 hundredweight) are allowed to fall into the pit below. Ten charges can be easily worked in one hour. The pit below is usually built of brick or concrete on three sides. The fourth side consists of a wooden boarding which is taken down when the pit is being emptied. A pit will hold about 140 tons. The fluid material which enters the pit rapidly reaches a temperature considerably exceeding 100°, and then becomes solid. In a day or two it is dug out with pickaxes.

The gases given off during the reaction, both from mixer and pit, are particularly offensive, especially when the phosphate contains fluorides. Both mixer and pit are provided with flues connected with a fan, by which all the gases are removed, made harmless in a scrubber, and then conducted to a tall chimney.

Superphosphates are porous. They are reduced to powder by being passed through disintegrators, and if mixed manures are to be made, the other ingredients are added during this process. Corn, grass, mangel, and potato manure are produced by the addition of ammonium sulphate or other nitrogenous material, with or without potash salts. Sodium nitrate can not safely be added to superphosphate, unless the latter is very dry. If this precaution is neglected, free nitric acid is produced, the manure bags are destroyed, and serious troubles may occur. To employ ammonium sulphate and sodium nitrate together is still more objectionable, as ammonium nitrate is formed. Even when it does not defer decomposition it ruins the manure by its tendency to become liquid.

It was formerly supposed that the soluble phosphate produced consisted almost entirely of monocalcic phosphate. It is now recognized that often a large part of the soluble phosphate consists of free phosphoric acid. In the first stage of the reaction phosphoric acid alone is probably produced, and this afterwards reacts on the remaining undecomposed phosphate. The proportion of free phosphoric acid in the resulting manure is greater when strong sulphuric acid has been employed, because the total soluble acid has been diminished. When superphosphates are dried at 100°, a loss of soluble phosphoric acid occurs. This loss becomes much greater when a higher temperature is employed. Monocalcic phosphate can, in fact, exist only when in union with water. A further reaction which is of great practical moment to the manufacturer of superphosphate is the loss of soluble phosphate while the material is stored. The regenerated insoluble phosphate is known as reverted phosphate. This deterioration during storage is not observed in superphosphate prepared from finely ground mineral phosphate which contains no appreciable quantity of iron or aluminium, but it is observed only when ferric oxide or alumina is present. In few of the phosphates employed is any considerable amount of the phosphoric acid combined with iron or aluminium. In some phosphates, as Carolina river phosphate, the iron is apparently present as pyrites, or as ferrous silicate, and exercises no injurious influence. In many other phosphates the iron exists as ferric oxide.

Ordinary superphosphate is made from a mixture of phosphates, and contains 25 to 27 per cent of dissolved phosphate and 2 to 3 per cent of undissolved phosphate. Superphosphate containing 30 to 31 per cent dissolved phosphate can be produced from good Carolina phosphate. Far richer superphosphates are obtained by various other processes. These superphosphates have a special value where manure has to be conveyed a long distance.

AN INVESTIGATION OF FERTILIZER FACTORIES.

The fertilizer factory first investigated diffuses its penetrating odors and gases over a wide extent of territory and causes great annoyance. All the buildings of the plant, which, according to the statements of the proprietors, are about 28 years old, consist mostly of dilapidated wooden structures.

The following products are manufactured in this factory: Two brands of potato manure; rectified phosphate; fishbone and potash; No. 1 bone phosphate; farmers' ammonia bone phosphate; grain and grass special; all crop phosphate; soluble bone and potash; special top dressing for grass; bone dust; special compounds.

The bone stock house is divided into several compartments by means of wooden partitions. Close by is the mill for the grinding of the

bones, which are stored in the bone stock house. After being ground they are carried to the second story by means of an elevator, sifted, and put into bags.

The establishment is further divided into stock rooms, mixing rooms, tank rooms, storage rooms, and storerooms for the crude material. A railroad switch leads into the building, by means of which various materials are taken in and out. The chimney, made of iron, is 52 feet high. Below the railroad track are tanks for the storage of low-grade (12 per cent) potash, city refuse, etc. The factory, according to the statement of the foreman, produces about 5,000 tons annually. The number of men employed varies with the time of the year and the demands of the trade. At the time of the investigation only 13 men were at work. The foreman who has been employed here had typhoid fever a number of years ago. On an examination of the men employed in the conversion of raw bones it was discovered that they had been employed only two or three years, and according to their statement had never been ill. To obtain a correct conception of the sources of the noxious odors it is necessary first of all to take into consideration all those substances and materials which are stored here and employed in production.

Dust, gas, and stench are diffused to an incredible extent by this factory. Defective transportation, filling, and repacking arrangements for the powdered crude material and end products aid greatly in this, as well as the entirely unnecessary handling of shovels, brooms, and spades. Besides, there is inefficient protection from the dust-generating apparatus and machines, and large quantities of harmful, even dangerous, dust are whirled about by every breath of air and by the continual traffic. The stairs which lead up to the acid mixers, which, by the way, are too narrow and too close to the driving belts of the machinery, are covered finger-thick with dirt and dust.

The greatest cleanliness should be insisted upon. The escape of the dust and gases generated during the acid process should be avoided as far as possible, and where this can not be done they should be conducted away so as not to vitiate the atmosphere of the working room.

The most efficient system of ventilation for the industry under consideration would seem to be a self-acting skylight ventilation. This object can be attained by means of the so-called ventilation valves on the roof of the factory and storehouse, or by chimney domes and suction heads.

The suggested arrangement itself would not entirely prevent the injuries to health that occur in the manufacture of the superphosphate and the grinding of the basic slag. Special care must be paid to acids—as, for instance, carbonic acid, hydrochloric acid, fluoric acid, and sulphurous and sulphuric acid—in order that they may not exert their harmful influence upon the health, as is the case at present.

Experience has shown that the workmen in all such superphosphate and artificial fertilizer factories are frequently affected with gastric and intestinal catarrh unless provision has been made for a satisfactory and efficient removal of the poisonous fumes. Hæmoptysis has also been observed in several cases.

In mixing the strongly acid superphosphate with saltpeter for the production of fertilizer compounds free nitrous and nitric acid may be set free. Direct cases of poisoning have been observed, due to these dangerous acids.

In the production of superphosphate either the natural phosphorites or the phosphatic guano, bones, ground bones, etc., are used as described in detail in the foregoing. In treating these materials containing tricalcium superphosphate, $Ca_3(PO_4)_2$, the latter is decomposed into monocalcium phosphate, $Ca(H_2PO_4)_2$, free phosphoric acid, and calcium sulphate. These materials must previously be well powdered.

In this process dangerous dust is generated, and therefore efficient protection and dust-preventive measures should be introduced in the grinding operation. The best preventives are good, dust-proof disintegrators, which transform the crude material into a powder and prevent all escape of dust.

The mixing of the powdered material with sulphuric acid generates carbonic, hydrochloric, hydrofluoric, sulphurous, and sulphuric acids. For the prevention of evil effects from noxious gases an excluding process may be carried on either by hand in lead vessels, walled pits, or mechanically; in the latter case by means of a suitably located cylinder, in which revolves a shaft with arms. Sometimes the mixing is done in tanks by means of a vertical shaft fitted with plow-like pieces of iron. The machine is constructed entirely of iron and steel. The tank is closed by means of a wood cover lined on the inside with lead in such a manner that the generated acid fumes can escape only by means of an exit pipe sunken in the cover. The fumes are most satisfactorily gotten rid of by conducting them to the factory chimney. If there is not sufficient draft, a ventilator must be introduced in the flue to suck the fumes out of the machine and push them on.

Another arrangement for the removal of the gases and fumes generated in this industry is especially effective. This can be introduced and constructed as follows: An elevated tank with sulphuric acid is placed beside the large mixing pan. From this tank the acid flows into a vessel standing on scales and thence into the mixing pan. By means of this simple arrangement the weighing of the acid is simplified and made safe for the workmen. Over the mixing pans there should be a hood of sufficient size. A steam jet ventilator opens in this hood. This receives its steam supply through a steam pipe. From this hood the gas is driven by the ventilators through a conduit to a furnace which serves exclusively for the burning of the gases. This furnace

must be connected with the factory chimney. It is an excellent method for destroying the poisonous gases. The whole arrangement prevents the diffusion of the gases through the factory rooms. Furthermore, the dust generated by the tightly inclosed shaking sieves and the disintegrators may be led to the same furnace and burned there. The combustion of this dust, consisting mostly of organic material, is very important.

The most dangerous products are the fumes which are always generated in the treatment of crude material containing fluorine with sulphuric acid. These can generally be made harmless by the following manipulation:

The poisonous fumes must be sucked out of the mixing room by means of a rotary fan. A dilution through superfluous air must be prevented as far as possible. The gas mixture must be moistened by the spent steam of the machine, which is always present, and led into a large chamber where the fluorine combinations are split up by means of an efficient sprayer and precipitated in combination with silicic acid. The remainder of the fumes is then filtered through a bed of moist pebble stones.

The dust generated in the grinding of basic slag has very harmful effects on the respiratory organs. In a factory which was mostly engaged in the manufacture of ground basic slag, thirteen cases of severe pulmonic diseases occurred in a short time. Besides, there were fatal cases of bronchial catarrh and pneumonia. The dust of this material to which the workmen are exposed consists of the phosphate of lime, iron, and magnesia, as well as quicklime and oxide of iron.

As an excellent dust preventive the use of rolling-ball grinding mills may be mentioned. The latter are well known, and great advance has been made in their construction. A very commendable construction is that in which the mill consists of several concentric drums that are successively separated by layers of balls, while the drums themselves furnish the grinding surface. In the front walls of the latter openings are made. The dustless feeding of the mill is accomplished through the opening of an antechamber closed on all sides and connected with the mill. The emptying of the ground material into the collecting vessel without raising dust is accomplished by means of a number of slits in the mantel, which completely surrounds the sifting drum and makes it dust proof.

Finally, if other kinds of grinding mills are used, exhausters and dust collectors must be employed to remove the harmful dust as soon as it is generated in the mill.

Attention should be called to the necessity of inclosing the bone stock house as completely as possible, and the introduction of an efficient system of ventilation by means of interconnecting canals between the several storerooms, and their final conduction to the chimney. This

brings about the removal of the stench caused by the decomposition of the particles of organic matter lodged on or in the bones. It is still better to lead this stench to a furnace similar to the one heretofore described and render it harmless by combustion. This can be easily and simply accomplished.

In the investigation of another fertilizer factory, which also had a flayer's yard in conjunction, the following was observed:

The three-story building in which the work is done is large and roomy. Almost all the materials just discussed in detail are employed in this factory. In addition to these there are the materials that are taken to the flayer's yard, such as blood and meat, mostly of horses, of which during the past year more than 2,400 were consumed.

The mill room is situated in the first story of the factory, and serves for grinding certain crude materials, consisting of Florida, South Carolina, and Tennessee rock, great quantities of which lie near the mill. Besides the mill room there are large rooms on this floor in which the ready-made fertilizer is stored in heaps that reach to the ceiling. In some compartments there are mixtures consisting of the dissolved animal matter and powdered rock. These stored materials are emptied from the upper story through the flooring by means of a very primitive arrangement. The bone mill, containing a disintegrator for the grinding of bones, is also located on the first floor, and the filling of the bags with the powdered material is done here. In another compartment there is stored, besides other materials, a so-called dryer substance. This consists of limestone, and is mixed with the fertilizer to hasten the drying process after it has been treated with sulphuric acid.

The second story is reached by means of a weak wooden stairway. Here all sorts of manure materials are stored, chief among which is bone phosphate, or bone fertilizer. They are all in a powdered condition.

The apparatus for mixing the powdered material with sulphuric acid occupies the third story. It consists of separate receptacles for the powdered rock and for the acid together with a stirring arrangement. When the material has been mixed, it is emptied through the floor into a receptacle below, known as the pen. After a short time it is taken out and dried. Mention should also be made of the fact that the acids are pumped to the third story by compressed air.

In the third story are also large stores of feathers, hair, and woolen materials, which are converted into fertilizers by means of the proper acid. Besides, there are also screens for sifting. The material is carried from below to the screens by means of a chain-belt arrangement.

In the manufacture of manure and the conversion of the material two large boilers and a steam engine are in continual operation.

On the same ground plot there is besides the factory a one-story

building in which the dead horses are treated. The manner of treatment is as follows: After being skinned they are boiled in vertical boilers. At the end of this operation the fat and bones are separated, while the meat and other refuse is taken directly to the main factory to be used in the production of fertilizer.

The insanitary conditions in this establishment are very evident and are similar to those found in the preceding factory. In addition great evils are originated in the flayer's yard which may be the direct or indirect source of the development of epidemics. It was impossible in the investigation to ascertain with certainty how far this is true, but several facts seem to indicate that isolated occurrences of typhoid are due to the disease-spreading miasma generated here.

A foreman in one of the near-by fertilizer factories, as well as a foreman in the tallow factory previously described, suffered from typhoid. In both cases the disease was due to putrid meat, offal, and bones. Further information in this respect could have been gained if the workmen had not been so taciturn and unresponsive. Colored men are employed preferably. Their external appearance makes it much more difficult to judge of the general state of health than it would be in the case of white men. Precautionary measures for doing away with the dust generated in mixing and grinding the several materials are not present. Only the screens on the third floor have a box-like casement over them. The reservoirs in which the sulphuric acid is weighed before it is introduced in the mixer are open and permit the escape of the irritating acid fumes which must be injurious to the men employed in this work. The storage of large quantities of fetid wool, feathers, hair, and other organic material creates a terrible stench. The stairways and floors, as far as the latter are open to passage, are covered with a layer of dust ranging in thickness from 1 to 2 inches. At every step large clouds of dust whirl up and make the atmosphere, already laden with stench and dust, still more dangerous to the workmen. In this establishment an examination of several workmen (colored men) showed that their labor, in the present state of the factory, had seriously affected them. Emaciation and idiotic expression were the general symptoms. It has already been observed abroad that unless the acid fumes which arise in the mixing process are entirely conveyed away hæmoptysis may finally result.

Those workmen who are employed in those processes which deal with the dead horses are exposed to the greatest dangers. At the time of the investigation the men were found in a room in which ten skinned carcasses lay, and work was just being begun on another. The process is as follows: First the skin is taken off and the hair of the tail and mane removed. After this the carcasses are cooked in a boiler, and the fat, bones, and flesh are used for further fertilizer production. In this work a pestilential stench is generated which

affects not only the workmen, but also the surrounding country. The evil especially affects the neighboring factories and the workmen employed in them. The stench arises chiefly from the opening of the carcasses and the putrefaction which sets in.

This primitive method of treatment is dangerous, not so much because no preventive measures for the leading away and counteraction of the noxious organic gases and miasmas have been adopted, but because of the danger that has been proved to lie in the swarms of flies that collect. They were observed in great numbers on the ten skinned carcasses, in the room, and in the neighboring rooms, in which bones, manure, and prepared flesh were stored, as well as throughout the whole neighborhood. They are of the largest kind and are popularly known as "strawberry heads." The dangers caused by these flies are extraordinary. It is well known that they poison men and animals. They cling very closely to the carcass with their feet, and in this lies their great danger to man. It has been proved that flies settling upon all surfaces and materials carry along small particles when they fly away and deposit them in other places. Should it happen that they are covered with a sticky poisonous substance, it annoys the insects themselves and they strip it off with their feet, as can readily be observed. This cleaning is done by alternately rubbing one pair of feet against the other. Sometimes the posterior part of the body is cleaned in the same way. These are the manipulations which are dangerous. The proof can be drawn from the following facts:

Lately investigations have been made in Vienna concerning smallpox and those suffering from it. Among other experiments the professor who was carrying on the investigation placed a vessel with glycerin at an open window. Soon the voracious flies were attracted by the sweetish liquid, and some of the sticky material stuck fast to them. In their efforts to free themselves they went through the already described manipulation and managed to get rid of all the foreign substance that clung to them. When the professor microscopically examined the previously chemically pure glycerin he found foreign cells in it, such as occur only on persons suffering from smallpox. Such an observation is of the greatest sanitary and hygienic value, and indicates the method by which such dangers must be met. If such diseased matter is conveyed by flies in such way as to reach the delicate mucous membrane, or any wound, the infection is completed. Protection in this case is impossible, as infection takes place without the slightest suspicion of it. Those who live near such dangerous factories as have been described must take every precaution to protect themselves during sleep from these not only disagreeable, but, under the circumstances, most dangerous insects. Little children must in no case be exposed to them. During the night the annoyance and

danger are not so great, especially for those who sleep without light, as for those who sleep during the day.

Near this place of occupation was a linseed-oil factory, of which an investigation was also made. Here an opportunity was furnished of making an observation of the dangerous results which the flies cause. The superintendent of the linseed-oil factory had been stung several weeks previous on the left cheek by one of the large redheaded flies, which continually carry contamination from the neighboring house, where dead horses are treated, and which, as in the present case, enter offices and dwellings. Immediately after he had been stung the face of the superintendent swelled in a critical manner, and in a few hours was in such a condition that he could scarcely see. Without doubt it was a case of blood poisoning, which might have had serious consequences for the victim if his constitution had not been so strong and his power of resistance unusually great. Serious results were also prevented by the fortunate circumstance that the victim chased the fly away as soon as he felt it. If the sting had introduced a greater amount of poison and it had gone into a blood vessel he might not have recovered so easily.

The above-described case proves how threatening are the dangers of poisoning and disease transmission through flies which come from such places and how easily an epidemic may be caused.

From the previous description of fertilizer and phosphate manufacture it is evident that the improvements needed in this case must be very nearly the same as those indicated in the discussion of the preceding factory and which apply to all industries of this kind. Naturally a great deal depends on local conditions, and although the end sought is always the same, the means must differ in the various cases.

In the present case, in order to do away with the described dangerous conditions, the following measures should be taken:

1. In the first place the collection of flies on the dead horse must be done away with, in order to prevent the spreading of disease-bearing germs. Care must also be taken against the spread of the organic and miasmatic odors which escape and exert a dangerous influence upon the health of the workmen, besides poisoning the air in the vicinity. Finally, the procedure of boiling such a large number of dead horses (2,400 during the last year) must be performed in such a manner that the escaping fumes can be deodorized and rendered not unhealthful to those who live in the neighborhood. Concerning the great numbers of flies that collect on the skinned horses, we must emphasize first of all that poisonous material is often already present in the dead horses; for instance, if they have died of malignant pustule, glanders, or some other contagious disease. In other cases putrefaction has already largely set in, or dangerous suppurations which hasten it.

As an efficient measure to prevent the transmission of the poison

the employment of compressed air and the combustion of the organic miasmas is proposed. The employment of compressed air is the simplest and the cheapest method. It can be introduced and employed in such establishments at very small expense. To accomplish this purpose a small air-compressing pump or suitable fan is necessary. This can be procured cheaply and run by the steam power, which is always present. The compressed air is conducted over the dead horses by means of tubes. This tubing is movable and laid beside the carcass on lightly constructed tripods. A number of the latter can be arranged side by side. The effect of this simple arrangement is that all flies are driven away by the strong current of air that passes over the dead horse and can not settle on it. At the same time the organic miasma and putrescent odors which arise from the carcasses are removed and the workman who does his work over and beside the bodies is protected from this harmful inhalation.

In addition to the above-mentioned arrangement the following apparatus should be added. Its purpose is to carry away and totally destroy, not only the putrid organic gases and odors which develop, but also the flies. For the accomplishment of this purpose large tubes of galvanized sheet metal ending in a funnel-like extension are placed over the dead body. The mouth must be at such a height as not to hinder the workmen in their occupation. As many tubes and mouths must be introduced as the size of the establishment and the sphere of activity of each single funnel demands. Local conditions must also be taken into consideration. The gases and organic fumes which escape from the bodies are carried to a furnace through these tubes into which a steam-jet ventilator draws them. This receives its steam supply from a steam conduit and is fastened in the funnel. The furnace is exclusively built for the combustion of these gases, and its flue must be in direct connection with the factory chimney. The compressed air, the pressure of which need be relatively small, creates a current of air; the steam-jet ventilator produces a vacuum. Between the pressure of the air on the one hand and the suction on the other the flies and all the gases and odors which escape from the dead horse are carried to the place of combustion. Those miasmas which collect along the ceiling should be collected and destroyed in a similar way. This complete arrangement is as simple and worthy of recommendation as it is sure of satisfactorily and safely accomplishing its purpose. The desired end can be reached in no other way than through combustion by fire. The employment of chemicals and disinfectants is impossible from the conditions of the case. The use of such remedies as sublimate, acids, etc., would under the circumstances expose the workmen to greater dangers than the evils they are supposed to obviate.

A very important source of danger in this industry is in the

procedure of cooking or boiling. The aim must be to prevent the resulting fumes and the generated stench from molesting the neighborhood. The boiling can be carried on by the application of a very important physical law which is remarkably well adapted to industries of this kind. It has the advantage that it can be introduced and worked cheaply on the one hand, and on the other hand the apparatus is very simple in construction. Furthermore, it recommends itself in that it saves fuel and increases the rate of production. It can also be used in small plants. The following may serve as an explanation: Under diminished pressure water boils at a low temperature, while increased pressure produces a corresponding rise in the temperature of boiling. The increased pressure may be caused not only by the air, but by the steam as well. This occurs when water is heated in a tightly-closed vessel, which can be made in the simplest way by fitting it with a tight screw cover. Such a vessel, on a small scale, is called a Papin's digester; on a large scale, a steam boiler. In it it is possible to heat water to a temperature of 392° F., and even still higher, while in an open vessel water can under no circumstances be heated higher than the boiling point, which at sea level is 212° F.

Such vessels are used to bring about the complete permeation of hard and dense bodies with water. For instance, water heated to 212° F. dissolves only a very small part of the bone gelatine, and that superficially, while water of from 230° to 248° F. permeates the bone completely and dissolves the gelatine stored in the innermost parts. The question is quite different in the boiling process respective to the boiling point of water under low pressure. The influence of pressure of air in boiling water and other liquids is very great, as can be seen from the following fact: If water is boiled while the mercury in the barometer is very low, even though the rise of temperature is very rapid, the thermometer will indicate only 210.2° F., while if the boiling takes place during clear weather, when the barometer stands very high, 213.8° F. will be indicated. As an illustration the following interesting and practical experiment will be sufficient: A flask half full of water is heated until active boiling sets in. It is then taken from the fire and quickly stopped up. Boiling will immediately cease, but begin again as soon as cold water is poured on the upper part of the flask. It is possible in this manner to cause water to seethe and boil even if it is only lukewarm. There is no air in the flask. It was expelled by the steam, and was prevented from reentering by the cork when the steam was cooled and condensed. There is then no pressure of air on the water, which in that condition boils at a temperature of 68° F. The vacuum in the flask contains only steam vapor, which at first weighs heavily upon the liquid within and prevents its boiling. When cold water is poured on the flask a part of the vapor condenses, causing a corresponding diminution of pressure, which is so large that a

part of the water can again be changed to vapor with the accompaniment of ebullition.

A low-pressure vessel constructed on the foregoing principle, in which evaporation takes place much easier and boiling occurs at a much lower temperature than under ordinary circumstances, can be employed in this branch of the industry with success. All that is needed is an iron tube of sufficient diameter, closed at one end and in the form of a boiler. After it is partly filled with water and the material, it is made air-tight. The air in the tube-like boiler is then exhausted. The contents boil very readily because of the vacuum which has been generated by the expulsion of all air. From the foregoing explanation it will be seen that boiling occurs at a temperature of 68° F. The boiler must be fitted with an arrangement either in the side or the cover by which the air can be exhausted. The air pump which supplies the room containing the dead horses with compressed air can be used in exhausting the air from the boiler. The whole construction is in itself very simple and does not require any further or more detailed explanation. The greatest attention must be given to the described method of construction by means of which the low-pressure space is produced and maintained.

In such an extensive industry as is under present consideration the introduction of a large number of boilers is desirable, so that the dead bodies may not collect, but be used immediately after they have been skinned. This would greatly lessen the amount of organic putrefaction.

Beside the room containing the dead bodies are the bone and dissolved-meat fertilizer magazines, from which the air could also be collected by the ventilation plant and purified by means of flues which are in direct communication with the chimney.

Finally, the small compressed-air plant (pump) can be employed by means of a hose and small respirators to furnish the workmen with fresh air, which would obviate the dangers of miasmatic gases and dust generation. The movements are, indeed, somewhat restrained by it, and such respiratories are to be recommended in this, as in other dangerous occupations, only when the workmen are not compelled to move around very much. In this investigation the attention of the foreman was directed to the dangers of the dust clouds, acid fume inhalation, and poisoning by means of flies, hereinbefore described in detail. Several men were examined, but it was impossible to ascertain how many and what workmen in this factory had suffered from diseases caused by this occupation. They were mostly colored men, and tried to evade every question.

An extensive superphosphate factory was visited, but a satisfactory investigation could not be made. The superintendent would not allow

it without a permit from the main office, situated in another city. Nevertheless it was made clear to him that the generation of dense dust in the factory was very detrimental to the workmen.

In order to accomplish this in the grinding establishment in the first story his attention was called to the fact that the generation of dust was such that the incandescent lights could scarcely be distinguished, and, further, that the workmen were not merely dusty but covered finger thick with it. The two grinding machines could not be distinguished, and it was even dangerous to get close enough to ascertain what their purpose was.

A more thorough investigation was impossible owing to the disinclination of the superintendent, and in consideration of the fact that he referred all requests to the main office. Nevertheless, in passing the bagging place especial attention was called to the lack of protection under which the men worked. This industry employed about 100 men in the comminution and grinding of Florida rock, bones, and other suitable material.

The preceding description of a fertilizer factory gives an account of how the work is done without any protective measures. All this shows how necessary legal measures are. Besides, it shows the need of an official inspector with legal authority to make his investigations at any time, day or night, in order to discover such insanitary conditions and to direct the attention of the factory officials or owners to them.

In order to accomplish at least something in the interests of the workmen, whose health is endangered to the utmost, it was made clear to the superintendent that the generated dust caused severe cases of pneumonia. The dust which the men inhale in grinding and packing consists of harmful phosphates and often results in fatal cases of bronchial catarrh and pneumonia. Further than that, workmen employed in such superphosphate and manure factories where there is an inefficient removal of the fumes are often affected with gastric and intestinal catarrh, and are even attacked by hæmoptysis. In the process of mixing strongly acid superphosphates with saltpeter for the production of fertilizing mixtures, nitric and nitrous acid fumes are set free, which often result in cases of direct poisoning.

According to the statement of the owner of the flayer yard, this plant consumes the organic manure material as well as almost all the products which have been described under the investigation of the fertilizer factory.

On account of the aforesaid reasons it was impossible to enter any other buildings except the hurriedly visited grinding mill. But there seems to be no doubt that the whole plant will prove equally dangerous as the mill in which the phosphate-bearing rocks are powdered and afterwards treated with sulphuric acid.

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The superintendent was asked to remain standing for some time in the dust in which the men beside the mill work. He was at least frank enough to declare that he could not stand it. He expressed a desire to do away with the generation of dust, and in the presence of the proprietor of the neighboring flayer's yard made a request to be informed in writing of the necessary improvements. This wish could not, of course, be fulfilled so long as a complete investigation of the whole plant and local circumstances was denied.

PROTECTIVE MEASURES FOR FERTILIZER FACTORIES, AND ESPECIALLY FLAYER AND BONE YARDS.

The following are the protective measures which ought to be applied to the factories in the fertilizer industry for the protection of the employees and the community:

1. The crude bones must, as far as possible, be stored in dry and well-ventilated rooms.

2. In transporting, sorting, and disintegrating the bones, men with open wounds on the hands must not be allowed to work. The sorting must be done only in an airy and well-lighted room. .

3. Crushing work must be so arranged that the machines can easily be put out of operation by the workmen, and must be secured against automatic starting.

4. In crushing works, rolling-ball grinding mills, and chain-pump works, the opening of the feeders must be inclosed or made safe in some other way. The path of the transporting vessels and feeding screws must be efficiently secured.

5. The disintegrators must, as a rule, be able to be stopped independently of all other operations. If the introduction of such an arrangement can not be accomplished on account of serious difficulties, it must at least be possible to give a signal to the engineer or to throw off the belt. The disintegrators and their loose pulleys must be protected against all endangering contact.

6. In stamping works the path of the lifting cogs must be inclosed wherever it comes within reach of the workmen.

7. In so far as the scoops of the running mill are not at least 3 feet above the floor they must be surrounded by a protective inclosure.

8. Every machine must have a stopping arrangement. Disturbances during the operation of the same, such as stopping up, pulling off the belt, and the like, must only be remedied while the machine is at rest.

9. The exhausters must be sufficiently protected against endangering contact by means of wire netting or by gratings.

10. Oiling, in so far as it is not done automatically, must be done only from a safe position, or while the machine is at rest.

11. The bone steamers, if they are constructed for low pressure, must be provided with safety valves, air cocks, steam pressure gauges,

controllers, or the introduction of a steam protection valve between the boiler and steamer. It is permissible that one safety valve may serve for several steamers or be placed on the same conduit.

12. The bone steamer must be tested before it is used, and from time to time thereafter. In this test the pressure must be one and a half times that of the highest steam pressure used, and exceed it by at least one atmosphere.

13. Bone steamer feeders must be so constructed that the workmen can not fall into them.

14. If sulphurous acids are used in the manufacture, ventilating arrangements must be introduced to prevent the escape of the fumes.

15. The injurious dust generated by the comminution and grinding of the bones must be removed as far as possible by suction at its place of production. In case it is impossible to accomplish this, the men must be supplied with respirators, sponges, mold cloths, or other efficient protectors, and their use must be required.

16. The tanks for treating the bones with sulphuric acid must be supplied with contrivances to prevent the escape of injurious and annoying gases and fumes. Crude materials which generate dangerous quantities of fluoric, hydrochloric, or nitric acid fumes must not be treated in open pits. Treatment of bones with nondenitrated acid wastes in open pits must be forbidden.

17. The introduction or addition of sulphuric acid must be so accomplished as to prevent the spilling and scattering of the acid as far as possible. In emptying the acid carboys, lifters for that purpose must be used.

Workmen whose eyes are threatened by the spattering of acids must be supplied with eye protectors, and be compelled to wear them.

18. In the extraction of fat and glue the open boilers must have a rim of at least 3 feet in height. Work around the open boilers from an elevated position must be permitted only when it is made firm and safe by means of a railing or similar protective contrivance.

If the fat is extracted with benzine, the following regulations must be observed:

19. The building for the extraction of fat, in new plants, must be at a sufficient distance from the other factory buildings, and parallel with the floor of the first story. The doors should open outwardly. In older plants in which the extracting building is connected with the other buildings, or even directly adjoining, the latter must be separated from it by high fireproof walls.

20. Doors and low windows which can be opened must not open toward kettle furnaces and other fireplaces, so as to obviate as far as possible the danger of explosion of the escaping benzine vapors. Flues which carry the benzine vapors into the open air must have their openings as high as possible.

21. By means of an inclined floor and a drain placed at its lowest level the overflowing benzine must be rapidly gotten rid of and led underground into a distant tightly closed pit.

22. There must be a special way of escape from the upper stories and the filling rooms.

23. The illumination must be accomplished either by incandescent electric lamps, whose main and branch wires are outside the building, or by lamps which are protected by a casing and excluded from the working room by strong tightly fitting window panes.

24. The use of open or loosely covered separation vessels in the extracting apparatus must be forbidden. The volume gauge on the benzine vessels must be protected against external injury.

25. Smoking and even the introduction of matches and similar articles must be entirely prohibited.

26. Entrance into the fat-extracting building with lanterns and open lights must be forbidden, and at night must be permitted in particular instances with safety lamps only.

27. The admittance of unauthorized persons into the extracting building must be positively prohibited.

28. The storage of benzine supplies must take place only in fireproof and isolated places.

Other fertilizer factories, including the Thomas slag mills in which bones are used, should adopt the following measures for the protection of the workman:

29. Should rolling-ball grinding mills be used, their belts must be carefully incased.

30. Each separate machine must have a disconnecting switch. Disturbances in its operation, such as stopping up, falling off of the belt, and similar accidents, must be remedied only when the machine is at rest.

31. Ground Thomas slag, or other rocks, must be stored only in bags or barrels, or if in bulk, only in closed rooms, which are supplied with mechanical dust suction.

32. The tanks for the sulphuric acid treatment must be supplied with contrivances to prevent the escape of injurious and annoying gases. The escaping gases must be made harmless.

33. Crude materials which generate fluoric, hydrochloric, and nitric acid fumes in injurious quantities must not be treated with sulphuric acid in open pits.

The use of denitrated acid wastes in the open-pit treatment must be forbidden.

34. In emptying the acid-treatment chamber, a strong and efficient system of ventilation must be employed.

35. The emptying of the acid-treatment chamber must be carried on with the greatest care. The undermining of the mass, if it is stored higher than 6 to 7 feet, must be prohibited inside of the chamber.

36. The introduction and addition of sulphuric acid must be accomplished so that the spilling and spattering of the acid is avoided as far as possible. In emptying the acid carboys lifters for that purpose must be used.

37. Materials must not be heaped up in the machine room and the hallways so as to endanger the people employed there.

38. The storage of materials against the buildings and surrounding walls is permissible only so far as the detrimental effects of their pressure is prevented by the resisting power of the walls.

39. The undermining of the stored, half-finished, or finished superphosphate masses, when they reach a greater depth than 6 or 7 feet, must be prohibited. In digging it away a precipitation of the mass must be prevented by digging terraces of not more than 6 feet or some other method.

40. Piles of bags must be built with corners of the outer layer in the cross-bond manner. They must be at least 2 feet removed from the nearest rail of the track. The piles must be placed upon hard and level ground. They must be at suitable distances from the free-running transporting machines, belts, and machine parts, so that the workman can not come in contact with the moving parts.

The removal of the bags must be accomplished by means of steps of four bags each. In no case must bags be drawn from any part of the heap or opened. If inclined planes are used, care must be taken that the workmen are not struck by the sliding bags.

THE NECESSITY OF PURE AIR IN WORKROOMS.

Pure air is among the first of the indispensable necessities of man. The hygienic investigations of the last few years, and especially under the complicated conditions of the overcrowded cities, weighed down with all sorts of disease and illness, have shown the great importance of pure air and its far-reaching influence upon humanity. The extent of this influence depends not only upon the quantity, but also upon the composition of the air and upon the manner in which it is led into houses, dwellings, and working rooms. As water and earth, as dwellings, as the manner of life and the spiritual and moral conditions of men exert their influence, so also does the air which we breathe have its potent powers. This is a power which, according to its properties, promotes health, domestic happiness, and general well-being, or brings countless ills and manifold disasters upon whole generations. The beneficent influences of the air have been shown with the greatest exactness. Its harmful contents have been proved without the slightest doubt, and we know how the latter exert their injurious influences upon the various bodily organs or functions as well as upon a great part of our domestic and industrial activities. Science has spoken loudly and insistently in this respect, yet proportionately little has

been done to bring about an acceptance of its teachings and its warnings from a hygienic standpoint. Numbers, even of those who otherwise watch over their health with hypochondriacal timidity, expose themselves carelessly or inadvertently to the influence of poison-impregnated air. In most of our populous cities an active and fearless fight is carried on against epidemics, local diseases, and a whole series of pulmonary ills, whose cause ought to be sought primarily in the poor condition of the air and its defective distribution in buildings.

The factories of the country are a most depressing instance in this respect, though on the other hand they are the foci of remarkable intelligence and advance. Statistics also give proof of the regrettable hygienic conditions of our factories, regarding which people are still in a state of childish unconcern. Statistics show that improvement of the air in factory sanitation is one of the most pressing demands of private and public life.

In most factories there is an indescribable recklessness. The air supply is used as it is found in the rooms without any previous test. It is evident that the air, exposed to the most varied influence of its environment, must take up substances which can produce the most manifold ills and disturbances in the human organism. Why then is it that, despite the constitution of the air, so much less attention is paid to it than to many other substances which influence life?

It is customary to offer without hesitation to the internal organs those common articles of food which display nothing offensive to the sight and are not disagreeable to the organs of taste and smell. It is true that the organs themselves rarely rebel immediately, and even the illnesses, troubles, and diseases which develop seldom indicate the real causes. The air is one of those substances which must always be suspected. The respective scientific, and especially hygienic, investigations have shown that this distrust and carefulness is, above all, advisable in large, populous, industrial cities because of the conditions peculiar to them.

In the first place increased care and a doubly exacting examination of the ruling influences become here an undeniable necessity because of the recurrence of distinctive contagions and epidemics and the overwhelming number of weakly and sensitive constitutions predisposed to all possible ailments and susceptible to all kinds of influences. In the second place these overcrowded localities, in which the air in itself is bad and where there is an army of harmful substances, make a certain community of life necessary. This latter, as is well known, increases all the injurious influences by that which is called the power of affinity.

In fact, as a result of a number of coincident experiences and observations, the air of many large cities, which with its good properties might have such advantageous influences upon the conditions of health, was found to be one of the most pernicious of influences. Would it

not be remarkable if the inhalation, for a period of many years, of air filled with pernicious substances had not a far-reaching detrimental influence on the population and in particular the factory workers and the weaker portion? Would it not be just as wonderful if it did not induce a susceptibility to disease and exert an intrinsic influence upon the generation and spread of dangerous diseases and epidemics?

Although the most recognized authorities in natural science and hygiene have frequently insisted upon and pointed out the detrimental influences of infected air, yet at the present time, unfortunately, a very exact knowledge as to the kind, degree, and certainly very harmful results of these influences is lacking. As already indicated, this work is as difficult as it is necessary, because of the never-absent coincidence of other harmful influences which make it almost impossible to separate a single one with satisfactory exactness. Yet lately, thanks to the laborious researches of hygienists, certain fundamental principles have been established. This was done in Europe, where the poverty of great masses and the consequent epidemics in densely populated manufacturing cities made exact investigations of the public conditions of health necessary.

THE DANGERS OF THE PRESENT SOURCES OF AIR FOR BUILDINGS.

We endeavor to purify the contaminated air in closed rooms by the introduction of external air. The supply of fresh air is drawn from the great ocean of air which is itself contaminated at various places and in various degrees. Thus the effectiveness of the supply of fresh air depends not only on its quantity but to a great degree on its quality; that is to say, upon the degree of the contamination of the source.

The impurities must be divided into those absolutely harmful and those which become harmful only on account of a certain degree of intensity. The first includes the germs of contagious diseases, which are as dangerous in small as well as in large quantities, and therefore are injurious in themselves. These impurities are characterized by this, that they are living organisms and possess the power of propagation.

Those impurities which are harmful only in certain quantities are:

1. The gases of putrefactions, i. e., carbonic acid gas, ammonia, and aqueous vapors.

Usually these exactly analyzable products do not occur in harmful quantities. With them certain not well known or entirely unknown decompositions occur, concerning whose influences we have no clear knowledge, but which most probably break the ground for diseases. We know that men exposed for any length of time to air thus infected become sick, yet we are unable to prove that these products of decomposition are the direct cause.

2. The products of transelementation in normal animal life which consist mostly of carbonic acid gas (carbon dioxide) and water, but probably also contain other harmful substances. The extensive researches of Pettenkofer into the impurities of respired air do not start with the assumption of the harmfulness of the carbon dioxide (CO_2), whose proportion can rise to 8 per cent without producing the slightest evil effects. Contrary to this generally false conception, Pettenkofer used the easily analyzable carbon dioxide only as a convenient standard of the degree of contamination, assuming that the amount of unknown harmful products or those analyzed with difficulty is proportional to it.

3. The chimney gases, which contain chiefly carbon dioxide and sulphurous acid, besides unconsumed coal and soot. The former is harmful, the latter eventually become so, especially to plants, when they have been oxidized to sulphuric acid.

Among the disturbing constituents of city air are those substances which originate in the chimneys of private houses and factories. Particles of soot, ashes, and also sulphuric, sulphurous, and hydrochloric acid are the products of combustion. In Manchester, upon a space of 1 square mile, 1,455 pounds of soot, 110 pounds of sulphuric acid, and 55 pounds of hydrochloric acid have been found to fall in three days. In London 6,391,000 tons of coal were consumed in 1889. In round numbers they produced 195,720 tons of sulphuric acid. Berlin annually consumes about 2½ million tons of coal.

Not only plants and trees suffer from the effects of this smoke, but also consumptives, asthmatics, and all persons with weak lungs.

4. Mechanical dust, which, though consisting of essentially harmless materials, may work most disastrously by irritating the lungs.

The impurities are scattered broadcast through the air that surrounds us by the agency of atmospheric disturbances and diffusion. They are destroyed by the oxygen or are absorbed as carbon dioxide—for instance, by plants—and thus a continual self-purification of the air is going on. From this it does not follow that air is everywhere equally pure. Air will always be most impure close to the places whence these impurities arise, and therefore such places must be avoided as bases of supply. There are three possibilities for source of supply:

1. Close over the surface of the earth, without doubt, the products of the decomposition of the organic constituents of the ground are most to be feared, even though they vary in different locations. In cities their amount depends largely on the construction of the pavements. The escape of ground gases is much easier through a porous and loose pavement than, for instance, through one of dense asphalt. It is true that a compact pavement prevents the entrance of impurities from above, but it also restrains the gases which are generated in the ground. The latter often find their way into the houses through the cellar,

whence there is usually an upward draft of air. In general, supplies of air taken from over good and clean pavements contain but few of the gases of putrefaction. The addition of dust is very great here, but because it is a coarse dust it can easily be thrown out again. The fine dust is met with in equally large quantities, even at very considerable heights. On the whole, those impurities which are close to the surface of the ground do not argue much against making it the source of supply, provided especially unfavorable locations, such as near cesspools, halting places of vehicles, and the like, are avoided. The most efficient source of supply is in the underbrush of a clean garden, under 6 feet above the ground.

2. At some distance (25 to 40 feet) above the ground the composition of the air depends largely upon the spontaneous ventilation of the buildings, especially, in this case, when the interchange is produced by means of air pressure. There the vitiated air escapes through the pores of the building, instead of escaping above, and thus is likely to cause an extensive contamination of the external air. This contamination depends on definite conditions; therefore in the consideration of the contamination of the external air it is not quite just to condemn this source of supply as absolutely untrustworthy.

3. In cities the diffusion of the impure air takes place above the roofs. Since all new air must finally come from this place, it has lately been demanded that here should be the source of supply. But this source is in the closest proximity to the chimney openings, which just as often belch forth smoke to either side, or even downward, as upward. It is true that the whole roof space has been used as a deposit chamber for the soot and dust, yet the combustion gases are carried in great quantities near the source of supply. Like smoke, the vitiated air is, as a rule, expelled over the roof. Usually closets and sewers have ventilation openings on the roof. During the hot summer the cooler temperature of the inner rooms frequently causes a flow of poisoned air upward. Thus, especially in this most dangerous season of the year, the entrance of bad air into the lower rooms can not be prevented. In the open, these gases also diffuse among the lower layers of air, but are then very much rarefied.

Consequently, here also there are reasons for and against the choices of this source of supply. As far as contamination of the air is concerned, there is no decisive reason for the adoption of any one of these three locations. The choice rather depends essentially upon an entirely different consideration, namely, the influence of the pressure of the wind upon the ventilation plant. With us this is about 31 pounds per square foot, while the pressure of the strongest blast machine can produce only about 5 pounds pressure, one operated by hand power only about 1 pound, and one depending on warm air for motive power only from 0.4 to 0.6 pound. The movement of the air in a ventilation

plant exposed to the wind depends almost entirely on the latter. Those arrangements for the prevention of the external pressure do away with the trouble only to a certain extent.

The pressure of the wind affects those openings at some height from the ground more strongly than others, because they can not be protected against the whirl of the often-interrupted but nevertheless powerfully moving streams of air. On the ground there is much efficacious protection on account of the great number of walls, bushes, and the like. There also the supply openings can be turned upward—a direction in which they are least influenced by the wind.

From the foregoing it is evident that none of the described locations are without drawbacks. Yet it can be seen that, in general, preference is given either to drawing the air supply from over the roof or from near the ground rather than from some intermediate height.

The choice of the source of supply should depend upon the individual and local conditions. For instance, drawing the supply of fresh air from the roofs of the clinic at Halle must be considered a grievous mistake, because often, probably, the germs of contagion are again taken into the rooms by the ventilating apparatus.

On the whole, hospitals should be compelled to purify the used air before its expulsion. Without doubt the impure air does as much harm as the drains of industrial establishments, upon which the Government places regulations, or even as the annoying smoke from factory chimneys.

During the last decades the closest attention has been paid to water supply. Even if water contains only slight and not very harmful impurities, it is considered unfit for use, and expensive plants are established for production of pure drinking water. The almost complete lack of attention in regard to the air seems a great injustice. It is now one of the most urgent duties of sanitary science to treat the purification of the air and its conduction to homes and factories with the same care as has already been devoted to water for many years.

IMPROVEMENT OF THE AIR SUPPLY OF FACTORIES BY PLANTING TREES IN THEIR VICINITY.

The sanitary and ethical importance of a garden-like and wooded environment of factories for its effect upon their fresh air supply must be emphasized. Science and experience, however much the question may still be debated, have shown that forests exert a climatic influence of the greatest importance. Moss is especially adapted to conduct along its roots little streams of water, and to lead it into the earth where it preserves the latter's dampness, or, in other words, its "dust freeness." A wooded environment of factories is therefore not only an ornament but also a factor protecting both strength and health. It is well known that where the forests disappear the climates become

irregular. Wind and electric storms become stronger, hailstorms and cloud bursts are more frequent, and the latter tend to make the ground bare and sandy. Vegetation, therefore, in its fullness is intimately connected with forests and dependent on them. Hand in hand with this influence of forests upon climate and the fertility of the soil goes the sanitary importance of a wooded environment of factories. From the remotest times it has been recognized that trees and fresh vegetation in the vicinity of human dwellings improve the air. Ever since the times of Priestly, when the atmosphere was first chemically investigated, the phenomenon of the improvement of air was ascribed to the increased amount of oxygen given off by the plants and the proportional decrease of the carbon dioxide.

Pettenkofer is also said to have published communications in which it is said that forests aid effectively in warding off cholera.

The following fact, warranted by a communication of Magistrate Giere, of Ruhla, speaks for the sanitary importance of forests. In the year 1852 the forest Reuter at Ruhla in Thuringia was felled, and since then pulmonary consumption, which previously was scarcely known, has reigned every year in this otherwise healthy place.

The planting of gardens and wooded promenades in and about cities, especially around factories, has the effect not only of beautifying the region but also of giving shade and coolness. The aim is at the same time to improve the air, which in these places is most contaminated. The forests, in view of this beneficent influence upon the health of human beings, should be drawn in toward the cities and factories.

A knowledge of the highly important influence of forests upon the health has existed for a long time, but only lately have beginnings been made looking toward a general and practical utilization of this knowledge.

The forests in the vicinity of large cities and factories should be treated with twofold care, and when ignorance and shortsightedness have destroyed them, trees should be planted. The forests laid out in certain German cities are daily visited by thousands of workingmen with their wives and children. The influence of these walks upon a better morality is remarkable and demonstrates that a forest as the factory environment of a workingman always speaks to his better nature and exerts a powerful influence upon his spiritual development and character.

DEFECTS IN FACTORY CONSTRUCTION.

In respect to the general construction of the factory, particular attention should be directed to the effects of currents of air. It has become clear from practical experiments that such currents usually permit contaminated air to pass through the ceilings between the different floors. The ceilings in most factory buildings are, as a matter

of fact, so constructed that contaminated air easily passes through them. The exhalations usually rise in winter, but in summer, when the external temperature is higher than the internal, they take the opposite direction.

This method of ceiling construction is a serious drawback from a hygienic standpoint. The ceilings should be further examined as to whether, between them and the floors above, breeding places for vermin and disease germs can be formed.

This drawback can be easily done away with and at the same time an efficient system of ventilation and supply of pure air can be introduced without much expense.

In respect to the construction of the floors, the introduction of the present system of factory construction and the adoption of asphalt and cement is much feared, especially in France. As the result of a very competent investigation it is said that the feet swell from the use of such floors. The sensation of cold is the same on stone as on asphalt and cement. The swelling of the feet is not rheumatic, but, according to the Society for Public Hygiene in Paris, it is the specific effect of the asphalt or cement.

The floors should be constructed of any fire and water proof material, but at the places where the workmen have to stand insertions of wood should be introduced. This is especially desirable in rooms in which typesetting is done.

It should be noted and emphasized that the unavoidable dropping of oil from machines forms fatty acids on the asphalt floors, the exhalations from which are known by experience to be injurious to the female organism.

The floors should be constructed of a material which will permit them to be scrubbed and washed with soda lye. The so-called Sinzig and Mettlach flagstones offer such a material.

Where a floor, impermeable to liquids, is to be constructed in factories, it should be made of a double layer of flagstones set in cement. The floor should then be furrowed by a sufficient number of cement drains, in order to prevent the stagnation of liquids. It is immaterial how the floor is constructed, but from a hygienic standpoint it should fulfill the following requirements:

(1) Absolute impermeability to fluids as well as air.

(2) The possibility of easy cleaning.

(3) It should be fireproof.

Further, in the investigation of factories it should be ascertained whether the stairways are laid out satisfactorily and meet various requirements demanded by an efficient labor protection, especially in the case of fire.

Finally, in the much-used passageways attention should be paid to the floors so that nothing smooth or slippery may develop on them, and thus cause accidents.

If factory rooms are situated immediately beneath the roof, some provision should be made to protect the workmen against the injurious influence of the heat. The roof should be isolated, simply and practically, so that the heat can not permeate it and enter the factory room.

Ceilings in factories as a rule have loose floors lying over them, and are powerful agents not only in the diffusion of dust and the contamination of air, but also in the transmission of disease germs. In the investigation of factories it was found that almost all of them, from a constructional standpoint, contain in themselves a source for the development of injurious dust and its transmission to the workman. This source is found in the defective construction of the ceilings and floors in factory buildings of more than one story.

A great number of factories have wooden beams. The beams are, usually, roughly cut, and have a thickness of from 2 to 3 inches, with a height of from 8 to 15 inches. The height and thickness depend upon the free bearing length of the beam. Upon this arrangement of beams there is, as a rule, a single floor constructed of flooring boards nailed directly on the beams.

It is clear that cracks will form between the boards and that they will gradually increase in size as the wood dries. Thus the dust formed on an upper floor is whirled up at every step of the workmen and penetrates through the cracks into the story below. There it is diffused in all directions and part of it is inhaled before it again settles. This phenomenon is the more serious in proportion as a strong draft or opening of the windows in the lower story causes the dust to whirl about. A window ventilation introduced with the best intentions often only increases the evil in that it forces the injurious dust into the respiratory organs, or at least brings it to them with increased speed.

But the penetration of the dust through the floors is not the only defect of the method of construction described. Loads of dust collect on the sides and lower surfaces of the beams. The beams are almost always cut with a large-toothed saw, so that the sides present rough, splintery surfaces which offer an excellent opportunity for the deposit of dust. The more irregular and the rougher such a surface is the more certainly the dust will adhere. If new dust permeates from the upper story through the cracks of the flooring, a large portion of it is thrown against the rough surface of the beams and loosely lodged in countless little indentations. In the course of time quite a deposit is formed here, which may even be increased by spider webs. Dust which is whirled up in cleaning and in window ventilation often rises as high as the ceiling and is lodged on the beams. Stronger drafts then loosen and carry it to the respiratory organs. In order to gain a clearer conception of the quantity of these deposits, the following calculation will suffice:

Take, for example, a comparatively small corner building, such as is frequently found in cities. Such a building may be assumed to be 100 feet long, 25 feet wide, and four stories high, excluding the basement. The beams, as a rule, are 15 inches wide and 3 inches thick and are separated from each other by a space of 16 inches. Each floor, then, contains 75 beams each 25 feet long. Each beam has a surface of 2 (1¼ feet by 25 feet)+(¼-foot by 25 feet)=68¾ square feet. As there are 75 beams, each ceiling shows 75 by 68¾ feet=5,156¼ square feet of rough surface for the lodging and collecting of dust. In the four stories there are, then, 5,156¼ square feet by 4=20,625 square feet of surface, upon which the dust, with all its dangerous contents, can collect and, after a sufficient deposit, be loosened again and exert all its injurious influences. This is exclusive of the under surface of the floor boards themselves.

From the conditions of the case sweeping the beams at regular intervals is impracticable. The deposition of dust is continuous and its rapidity depends upon the condition of the floor and the traffic upon the same. It is the latter which causes the dust to permeate through the cracks into the lower story. Even should the beams be swept frequently, the effect would be all out of proportion compared with the trouble, and unsatisfactory because this operation would injure those employed in this occupation, and directly convey the injurious contents of the dust to their respiratory organs.

The floor of the upper story is not alone the bearer of the dust which results in industrial operations—as, for instance, in cigar or tobacco factories and many other industries—but it is also the bearer of other substances which have turned into dust and are injurious to the organism or may be the direct cause of disease.

Of these injurious substances the most dangerous is the expectoration of persons having pulmonary consumption.

According to the generally recognized results of investigations all conditions of the lungs which are caused by the tuberculosis bacillus are designated as pulmonary tuberculosis. The expectorations of every man suffering from such a disease always contains the fatal bacillus tuberculosis and as soon as it has dried on the floor it mingles with the other dust. The first condition of pulmonary tuberculosis is the entrance of the tuberculosis bacillus into the lungs. It is evident, therefore, that with this arrangement of beams and loose flooring there is a veritable host of different infective substances. After the expectoration which contains the germs has dried, it collects on the floors, penetrates them, and impregnates the air below.

There is no radical remedy for pulmonary consumption. Medical science is able only to relieve the sufferings of the patient and to remove threatening symptoms. From this it is evident how important it is to find efficient protective measures against the fatal infec-

tion. On account of the frequency and malignity of pulmonary consumption (experience has shown that already one-seventh of the population is carried away by it) energetic protective measures are of the greatest importance, especially as effective measures against the spread of the infective substances are possible.

As preventive measures against the dangers from the described deposits of dust on beams, the following measures are suggested:

1. In the first place, the floors must be replaced by such as make the passage of the dangerous dust impossible and which, if possible, should at the same time be fireproof. Besides the hygienic floors, attention must also be paid to the ventilation. An efficient system can always be introduced easily, cheaply, and rapidly and is of as great importance as the change of the flooring.

2. The stable-like appearance of the factory rooms caused by wooden beams and the deposition of dust must not be permitted. It can be removed by covering them with a ceiling, which will give the factory room such a habitable character as human beings deserve.

THE ILLUMINATION OF FACTORY ROOMS.

Investigations in regard to the illumination of factories are always very difficult, because no definite standards have been set up. One branch of industry may require more light than another, and, on the other hand, the question of room is often a hindrance in large cities and the manufacturing industries are far from being established in faultless rooms, especially within city limits, where the factory rooms are in the lower stories.

From an official point of view, definite specifications can only be made in the case of new constructions or extensive repairs.

In the investigation of factories in respect to natural illumination the following fundamental principles should be observed:

The amount of light should be reckoned according to the proportion between the area of the wall and the area of the windows. This method has the advantage of simplicity over all others, because in it we deal with constants. The area of the windows should occupy about one-third of the wall area. Even less has been considered sufficient. Up to the present time one-fifth of wall area has been considered sufficient. In newly built factory rooms in Germany there is already 1 square yard of window area to 3.5 square yards wall area.

A hygienic authority (Popper) demands 1 square yard window area for every 30 cubic yards of space, so that there is at least 0.5 square yard per head. German reports show that such a demand has been taken into consideration only once. For the favorable approval of certain plants, among which cigar, lacquer, varnish, glue, chemical, artificial wool, and metal-consuming factories, and metal worsted yarn mills and color mills have been especially mentioned, a light

area of 8½ to 10¾ square feet has been demanded for every person employed.

This demand seems high, if we consider that according to Hirt 64½ square feet window area in a room containing 20 men, or, in other words, 3 square feet per man, is more than enough, and that employment in the factory must be forbidden only if there is less than 2 square feet per person.

It is immaterial from what side the light comes, but no glaring light should be allowed to enter which may injure the workman.

For artificial illumination no rules can be given stating how much petroleum or how many electric lights will suffice, for instance, for ten men. German authorities on hygiene (Hirt, Popper) demand one gas flame consuming about 5 to 6 cubic feet of gas per hour for every six or seven men.

In any judgment in this direction experience must be the only standard of authority. It is a well-known fact that a certain number of gas flames are counted to a system of gas pipes. If, then, at some time fewer flames are used, they are under higher pressure and burn unsteadily, and unconsumed gas escapes, which has injurious effects upon the workman.

To meet these two drawbacks, and especially the latter, all the pipes should be supplied with automatic pressure regulators, whose aim is to cause a steady light, no matter how many flames are burning at the same time.

In making a test as to whether the illumination of a factory room is satisfactory from a hygienic standpoint, or whether the necessary number of gas flames is present in a room to supply the demands of the eye, and that the eye may not be exposed to injurious exertion, the following table will furnish an approximate basis:

NUMBER OF NORMAL GAS FLAMES NECESSARY TO ILLUMINATE FACTORY ROOMS OF VARIOUS DIMENSIONS.

Dimensions of the room (feet).			Number of normal flames.	Height above the floor (feet).	Dimensions of the room (feet).			Number of normal flames.	Height above the floor (feet).
Length.	Width.	Height.			Length.	Width.	Height.		
15½	15½	12½	2–3	6½–7½	41	41	31½	25–30	11½–12½
18½	18½	14½	5–6	7½–7¾	52½	52½	41	40–45	13–14½
24½	24½	17½	9–12	8½–9½	62½	62½	46	60–70	15½–17½
32¾	32¾	22¾	16–20	9½–10½	72½	72½	52½	100–120	18½–20¾

In certain factory rooms, which must be strongly illuminated, the number of flames must be considerably increased. One normal gas flame must be counted for not less than 39¼ cubic yards of space. In rooms more than 32¾ feet in height it is a rule to establish the lights at about one-third of the height of the room, so that they may serve and not injure the eye.

As soon as a room more than 41 feet in its longest dimensions deviates so far from the square form that the proportion of the length to the breadth is greater than two to one, it is advisable to introduce chandeliers. The ground surface of the room is thus as far as possible divided into squares, each of which should contain the number of flames indicated in the foregoing table.

The argand flame, which consumes about 5.3 cubic feet gas per hour and is 15 candlepower in strength, is often called a normal gas flame. The specific consumption—that is, the consumption of a single candle—equals 0.35 cubic foot per hour. In the so-called incandescent gaslight this amount can be decreased to 0.018 cubic foot per hour. The standard of measure for light is, as has been said, the candlepower. It must be remarked that in Germany the unit of light is that amount of light given by a Hefner lamp, with a definite flame light and wick strength in a perpendicular direction and at the distance of 3 feet. The amount of illumination on a white surface at the distance of 1 meter immediately below a Hefner lamp is called a meter candlepower. This standard is tested in the Royal Physical-Technological Institute and is generally employed in Germany.

From a hygienic standpoint electrical illumination must be preferred to all other methods. Besides its excellent effects in that it comes nearest to natural sunlight it has the following advantages:

(*a*) It does not raise the temperature of the room in which it burns.

(*b*) It does not vitiate the air in it, as no carbon dioxide is produced.

As proof of this the following is given from *Zeitschrift fur die electrische Ausstellung in Wien:*

AQUEOUS VAPOR, ETC., GIVEN OFF IN ONE HOUR BY VARIOUS KINDS OF LIGHT IN THE PRODUCTION OF 100 CANDLEPOWER.

Kind of light.	Aqueous vapor (grains).	Carbon dioxide (cubic feet).	Units of heat.
Electric arc light			57
Incandescent lamp			290
Petroleum lamp	9,259	33.55	7,200
Gas argand burner	13,272	16.24	4,860
Lamp with beet oil	13,118	35.31	6,800
Paraffin candle	15,278	43.08	9,200
Tallow candle	16,204	51.21	9,700

The following comparative figures will show the further hygienic advantages of electric illumination:

AQUEOUS VAPOR, CARBON DIOXIDE, AND UNITS OF HEAT GIVEN OFF FROM VARIOUS SOURCES IN ONE HOUR.

Source.	Aqueous vapor (grains).	Carbon dioxide (cubic feet)	Units of heat.
Man	509	0.78	92
Candle consuming 154 grains per hour	170	.49	97
A gas flame (coal gas) with a consumption of 4.94 cubic feet per hour	2,407	2.90	878

In judging the value of electric illumination of a factory from a hygienic standpoint, its drawbacks must be considered. Because electric illumination has no effect on temperature, valuable effects on ventilation are lost. As a proof of this assertion the following fact, showing the importance of this loss, is given: While the amount of carbon dioxide generated by the respiration of the spectators in a German theater continually increased, yet with gas illumination it continually sank between acts, because, on account of the high temperature of the house, there was a continual interchange of air in opening and shutting the doors. With electric illumination this sinking between the acts did not occur, because of the decreased interchange of air owing to the lower temperature. In a full house with gas illumination the quantity of carbon dioxide observed was 2.3 per 1,000, with electric illumination 1.8 per 1,000.

It is true that the total carbon dioxide production was not so great, but it is also true that the ventilation advantages effected by the higher temperature were diminished. Therefore, if electric illumination is to be introduced into a factory, increased attention must be paid to ventilation.

But electric illumination must be recommended in industrial circles not only from a hygienic standpoint, but also from an economic one, as may be seen from the following instance: Electric illumination was introduced in a German planing establishment and sawmill in which about 20 men were employed. Previous to this an insurance company refused to insure the whole plant, valued at 400,000 marks, ($95,200) for less than 12 marks per 1,000; now they come down with their demands to 4 marks per 1,000.

In respect to the danger from fire, the following points of view must be taken into consideration in electric illumination. In the first place, fire may arise from the motors necessary for electric lighting. This is a small but nevertheless ever-present possibility. In the second place, little pieces of molten copper or glowing charcoal may fall from the lamps and cause fire. Consequently a support must be placed below the lamp. In the third place, defective insulation of the wires may be the cause of fire, or, owing to a wrong estimate of the capacity of the wire and the intensity of the current, the former may become hot and burn off the insulation. The electric incandescent lamp is very safe, because it is extinguished by the oxygen when the bulb breaks.

In judging a manufacturing plant in respect to electric illumination and the danger of fire, the following precautionary measures should be observed:

1. Complete insulation of the wires.
2. Repeated examinations of the same.
3. Metallic casings for the current and return current and avoidance of earth conduction.

4. An interval of at least 4 inches between the single wires and the breaking through the walls for the current and return current at points as far removed as possible.

5. The wires must be so thick as not to become overheated.

6. If arc lights are used, plates must be placed below to catch any glowing carbon that might drop off.

INJURIOUS SANITARY INFLUENCES DUE TO THE TEMPERATURE OF FACTORY ROOMS.

The temperature which causes trouble in factories oftenest is not cold, but heat. Sources of warmth are frequently found which must be considered very carefully, but which in purpose have nothing whatever to do with heating the rooms. That it is unhealthy to remain for hours in a room in which boilers and steam pipes create an unbearable radiation of heat is evident. This is especially true when one considers to what difference of temperature the men, and above all the stokers, are exposed when they leave the hot room.

Technical knowledge has supplied a remedy in this case which is invaluable to both parties, the employee as well as the employer. This consists of covering the pipes with a poor conductor of heat, which prevents the radiation and consequent loss of heat.

The qualities which such a covering should possess are as follows:

(1) It must be as poor a conductor of heat as possible.

(2) It must be able to withstand the incident temperatures.

(3) It must be elastic, so as not to be injured by the expansions of the pipes.

(4) It must, finally, present a pleasing external appearance.

The first condition is evidently fulfilled by all porous bodies, in which there are many little air spaces, so that its atmospheric contents may be considered at rest. On account of the second conditions animal and vegetable substances can frequently not be used in immediate contact with the pipes. The third condition, however, would make the employment of such substances very desirable.

The pipes in a water-heating system are covered with straw, wool, cotton, and silk wastes, cow and calves' hair, or a rough felt prepared from them, cork plates, etc. The immediate covering is incased in a board boxing in laths fastened together like barrel staves, screw-like rope coils, textures, etc., or the casings mentioned hereinafter are used. Should the above material be used in covering steam pipes, it would be advisable to first coat them with clay to which chopped straw, calves' hair, or the like has been added.

The so-called mineral wool can withstand all existing temperatures. It is, however, not very popular as a pipe covering, because it requires an individual casement for its own protection and frequently does not

hold well. The best of all mineral enveloping substances is infusorial earth (kiesel guhr) which has been prepared with a suitable binding material. A covering mass made chiefly of infusorial earth is therefore, on account of its poor conductivity of heat, convenient application, and relative cheapness, preferable to all others. If the coating is applied with care and then covered with oil paint, it leaves nothing to be desired in respect to an agreeable outward appearance.

The packing or filling in of boilers and pipes is also managed in another way. The pipe is surrounded with a covering of wire spirals. They are wound with felt and the latter is fastened by sewing linen about it. Thus the pipes are surrounded by a layer of air which is at rest and prevents the radiation of heat, because air is a very poor conductor of heat. In one establishment in which this kind of packing of pipes was employed the expenses for fuel sank over 17 per cent. This was not only an advantage to the health of the workman, but also a considerable profit to the manufacturer.

Concerning the danger of mineral wool in its manufacture and employment, the following facts must be given:

Its manufacture and employment is very injurious, and endangers the health and therefore the lives of the men who handle it. It consists of infinitely thin glass threads, and looks like natural white wool. It is obtained by introducing a jet of steam into liquid blast-furnace slag. This transforms the liquid slag into very fine threads, which carried by ordinary drafts unite in lumps and fall into a wire collecting vessel. During this process a great number of minute particles are torn loose and fly through the air into the various places of work. There they are deposited on the bared, hot, and perspiring parts of the body, the neck, face, hands, and feet, and are inhaled in great quantities. In the first case they cause a severe dermal itching; in the latter case a continual hacking cough. It is evident without further explanation that this injurious glass dust which enters the skin, larynx, and lungs must bring with it great danger to the health. In the manufacture of mineral wool it must further be mentioned that besides the porous pig iron the slag quantitatively is the most important product of the blast furnace. From the point of view of the technician this is an important indication of the working of the furnace. In cooling it should show a light color, and after cooling should be glassy and stony. It is used not only in the manufacture of mineral wool, but also in the production of artificial stones, street-construction material, and argillaceous earth preparations, and in the preparation of cement, as an addition to bottle glass and enameling, and as fertilizer material. It has also been attempted to utilize the phosphoric acid which, in addition to argillaceous earth, protoxide of iron, and the silicates of potassium, is contained in the slag in the form of phosphate of lime.

In a list of the last-mentioned heat-protecting measures the following results were obtained. At a steam temperature of 300.92° F., a naked pipe showed 267.98° F., while a covered pipe showed a temperature of only 97.88° F. Naked pipes condensed 205 pounds in four hours, while the condensation of those that were enveloped was only 61 pounds.

From this it is evident that the aforementioned nonconductors of heat furnish entire protection against the radiating of heat in steam pipes, and that they should generally be introduced.

Working rooms in which the temperature is very much increased not only by steam pipes, but also through the presence of many men and lights, should be provided with and cooled by a good system of ventilation.

THE COOPERATION OF THE MEDICAL AND TECHNICAL SCIENCES IN FACTORY CONSTRUCTION.

Those plants which supply our buildings with light and air, heat and water, should also answer hygienic demands.

Hygienic rules should be followed in all buildings which men inhabit. The observance of correct hygienic principles can alone prevent the many diseases which may be caused by defective construction of buildings and by industrial occupations.

The physician may find the injurious influences which are the causes of disease and prescribe remedies. It is the duty of the constructing technical engineer to solve the problems put by the physician. To accomplish this it is necessary that the technician should become acquainted with the injurious influences, and the physician with the fundamental principles of hygienic technology, so that they may rightly judge the problems encountered.

The physician must know what can and can not be done by the technical sciences and hygienic technology. This does not mean that it is necessary to command a knowledge of the whole large sphere of the technical sciences, but only of their powers and what they are able to do. This knowledge from the very nature of the case can and will pertain only to the elements of architectural technique. By this knowledge is not meant the ability to give a decisive judgment concerning the whole of a technical plan and its constructional details, but only sufficient intelligence as to whether the hygienic problem put by the physicians is technically solved if certain architectural conditions are respected.

In all hygienic technologic plants the medical hygienists to a certain extent put themselves under obligation to sketch the building programme. Architectural and technical sciences on the other hand, undertake to solve the problems put in this programme from a correct technical standpoint.

But it should never be considered the duty of the architect or technician to solve the problems put by the medical hygienists exclusively from a technical standpoint. In most cases local circumstances will necessitate modifications and changes in hygienic demands. In other words, medical hygienists and technicians should always consult each other. Therefore it is of especial advantage to both if on the one hand the medical hygienists know the elements of architecture, and especially hygienic technology, and the technicians and architects on the other hand are acquainted with the elements of hygiene. This warning must be given, namely, that the technician does not go far into the sphere of the medical hygienist, and that the latter in planning hygienic plants limits his judgment only so far as his knowledge goes.

THE IMPORTANCE OF HYGIENIC CONSTRUCTION.

The State requires, to a large extent, the aid of the science of hygienic technology. If it aims at the welfare of the people it must care for an efficient and, above all, sanitary laying out of cities, and must regulate the construction of private buildings so that they will not endanger the health of their inhabitants. It is therefore one of the most important duties of a State to secure the introduction of this most important science of hygienic technology, and more especially of factory and dwelling sanitation, by the spread of important facts concerning this subject and to superintend the execution of sanitary laws with care.

This should be done from an economic and hygienic point of view.

Public interest in this respect should be directed, first of all, to the sanitary construction of public and generally useful factories and buildings which should be built, fitted, and kept as examples worthy of imitation in private undertakings.

The same interest should be taken in private buildings and industrial establishments so that by obedience to hygienic principles the health and well-being of the individual and consequently of the general nation may be improved.

Thus the purposes of the legislative activities of the States and the supervision of hygienic technological principles are conditioned both by building inspection and economic considerations. Their whole tendency should be especially directed to a safe and healthy construction of buildings and to hygienic technological industrial regulations, so that a really efficient labor protection may result. This has especial reference to our industrial establishments and, in a narrow sense, to a sound factory sanitation and labor protection.

The general means for the attainment of these ends should be sought:

1. In the establishment of a special hygienic and technical supervision of all factory construction.

2. In the care for a sufficient instruction of the whole people by word, writing, and example in the chief and most important principles of hygienic factory sanitation and labor protection.

3. In a very careful, conscientious, and lasting inspection and control of all the sanitary arrangements in buildings.

All those measures which limit the constructive liberty of the owner, for the sake of the general good and the preservation of the health of the workman in factories which are about to be constructed, serve especially in reaching these sanitary ends. Especially, all plans of intended buildings and reconstructions should be carefully investigated before the building permit is granted, and should they not fulfill the demands of sanitary safety and order the permit should be refused.

In respect to those buildings which are already constructed such measures should be adopted as will anticipate or remove the dangers which threaten the general well-being.

AGREEMENTS BETWEEN EMPLOYERS AND EMPLOYEES.

[It is the purpose of this Department to publish from time to time important agreements made between large bodies of employers and employees with regard to wages, hours of labor, etc. The Department would be pleased to receive copies of such agreements whenever made.]

AGREEMENT BETWEEN HOCKING VALLEY BITUMINOUS COAL OPERATORS AND UNITED MINE WORKERS OF AMERICA.

DETAILED MINING SCALE FOR HOCKING VALLEY.

(SUBDISTRICT NO. 1 OF DISTRICT NO. 6.)

Effective during the scale year from April 1, 1900, to April 1, 1901; renewed and continued March 6, 1901, to be effective from April 1, 1901, to April 1, 1902; and by agreement entered into February 25–26, 1902, at Athens, Ohio, by and between the Ohio State officials of U. M. W. of A. and the operators of the said district by their duly authorized representatives, to be effective from April 1, 1902, to April 1, 1903.

Pick mining rate per ton of screened lump coal	$0.80
run of mine, $\frac{5}{7}$ lump price	.57$\frac{1}{7}$
Entries—Dry entries, per yard	2.00
Break-throughs in entries	2.00
Break-throughs in rooms	1.39
Room turning	3.03
Timber men, per day	2.28
Track layers, per day	2.28
Track layers' helpers, per day	2.10
Pipe men, per day	2.22
Trappers, per day	1.00
Cagers, drivers, machine haulers, water haulers, and all other inside day labor, per day	2.10
Dumpers and trimmers, per day	2.10

Couplers, greasers, slack haulers, firemen, engineers, carpenters, blacksmiths, cleaners, hostlers, and other outside day labor, special prices according to nature of work.

MACHINE.

Cutting, by Jeffrey styles of machine, in rooms, per ton	$0.09
Cutting, by Jeffrey styles of machine, in entries	.12$\frac{1}{2}$
Cutting, by punching machine, in rooms	.13$\frac{1}{2}$
Cutting, by punching machine, in entries	.14$\frac{3}{4}$

Loading, in rooms, per ton	.41
Loading, in rooms, with hand drilling, per ton	.44
Loading, in entries	.51½
Loading, in entries, with hand drilling	.54½
Loading break-throughs in entries (entry price).	
Loading break-throughs in rooms	.48½
Loading break-throughs in rooms with hand drilling	.51½
Drilling by hand	.03
Drilling by machine	.02½
Room turning, cutter and loader (entry price).	

RULES AND CONDITIONS GOVERNING THE HOCKING DISTRICT FROM APRIL 1, 1902, TO APRIL 1, 1903.

SECTION I.—*Turns.* There shall be no free turns allowed to either rooms or entries. The entries shall be driven as fast as operators desire or conditions permit, but in no case shall entry miners be allowed more cars per week than room miners, and at least once each week the turn shall be made uniform for the time previously worked. If, however, the regular turn will not allow cars enough to drive the entries as fast as desired, the operators shall increase the number of miners in each entry, so that, by giving to each the regular turn, the entries shall be driven as fast as two miners could do with full work. If, however, the room men decline to take their place in the entries when requested to do so by the operators, then the entry men shall have free turns until the entries are driven the required length; nothing in the foregoing to prevent fast turns.

SEC. II.—*Limit on mine cars.* No limit of weight shall be placed on loading mine cars, and in case of loss in transit the company shall not be held responsible, except where cars are broken by employees or where a wreck occurs, the average weight shall be made good by the company. In order that miners can not take advantage of this clause, the mine manager and committee of any mine where complaint is made of loading cars over their capacity shall mutually agree on a standard height of loading cars.

SEC. III.—*Check off.* The system of checking off for the United Mine Workers' organization remains in force and must be observed, same to be checked off by per cent of earnings. The above to include all dues and assessments for burial fund and United Mine Workers' organization.

SEC. IV.—*Clay veins.* Where clay veins, roll in bottom, or horsebacks exist, the price for removing same shall be determined between loader, mine boss, and mine committee.

SEC. V.—*Bottoms, sprags, etc.* All machines shall be fitted with front shoe not to exceed 2½ inches in thickness, and the machine men be required to cut coal level and close to bottom; and in no case shall thickness of bottom exceed 4 inches, except in case of pots or other extreme variations; and all machine men leaving more bottom than above must lift the same or it shall be lifted at their expense. Where the mine boss or superintendent orders left a greater thickness than 4 inches the company shall take care of it, and where the bottom is sulphurous and unmarketable the miner may call the attention of the mine boss to it and endeavor to arrive at an agreement for its removal or retention. If the mine boss and miner fail to reach an agreement

as to compensation or otherwise, the matter shall be submitted to the superintendent and mine committee for adjustment. In case of sprags being left by a machine man, he shall be notified by loader, and if he refuse to remove the same, the loader shall remove same and be allowed 50 cents for so doing; the said 50 cents to be deducted from machine runner. And when any machine runner leaves six or more sprags in any one pay he shall be removed from machine and his services be disposed of as deemed best by the general superintendent.

SEC. VI.—*Rooms.* All rooms shall be 30 feet wide, with two tracks in each room where practicable. Where rooms have to be cut 24 feet wide or under to 18 feet, same shall be paid 3 cents per ton extra. Not to affect pillars or entries. Each two men shall be given two rooms where practicable.

SEC. VII.—*Blacksmithing.* Machine loaders are not to be charged for blacksmithing.

SEC. VIII.—*Pick mine necks.* In opening rooms in pick mines where narrow work exceeds 18 feet before widening room, all in excess of 18 feet shall be paid for at entry price.

SEC. IX.—*Wet places.* Where the mine boss and miner fail to agree as to whether the working place is wet and entitled to extra pay, it shall be referred to the committee and mine boss or superintendent, and if adjudged wet, 3 cents per ton additional shall be paid.

SEC. X.—*Mine idle on account of idle men.* If four men are out of cutting or drilling at work time in the morning, and upon investigation by mine boss and committee it is found to be the fault of the company, the mine shall be laid idle the next day, at the discretion of the committee.

SEC. XI.—*Slate.* The company shall remove the slate from the working places of the miner; and if the company fails, after being notified, the miner shall be employed to remove such slate and be paid therefor at the price agreed upon between the mine boss and miner, based on the price of inside day labor.

SEC. XII.—*Double shift entries.* Twenty-five cents per yard shall be paid for driving double shift entries and break-throughs between entries.

SEC. XIII.—*Stops.* No stoppage shall take place at any mine on account of any grievance, except for violation of agreements or refusal of employers to pay on regular pay day without an explanation, until the matter has been presented to the mine boss and superintendent and an opportunity for adjustment permitted, and, failing to adjust, then the matter be referred to the officials and operators.

SEC. XIV.—*Clean coal.* No dock shall be taken for less than 100 pounds of dirt unless it is apparent that dirty coal has been loaded intentionally; then 300 pounds of good coal shall be taken for 100 pounds or less. For from 150 to 250 pounds of dirty coal, 700 pounds of good coal shall be taken. For 250 or more pounds of dirty coal, 1,000 pounds of good coal shall be taken. For the third dirty car of coal in the same day from the same working place, 1,500 pounds of good coal shall be taken, and if the man or men are found to have an average place by bank boss and committee, he or they shall be laid off for one day or more, at the discretion of the mine boss and committee. All good coal docked to be placed in the burial fund. Weigh offices to be so arranged that checkweighman can see chutes and railroad car.

SEC. XV.—*Lost coal.* If the company insist on the machine men cutting places, then the company shall pay for all coal lost by places falling in.

SEC. XVI.—*Break-throughs between rooms.* That all break-throughs between rooms be paid entry price for all coal over three cuts by a 6-foot machine.

SEC. XVII.—*Members' sons.* All things being equal, sons of members of the United Mine Workers of America, when becoming of proper age, shall be allowed the preference of going into the mine, same to be a part of this agreement.

For operators—
J. M. Roan.
E. B. Pedlow.
D. E. Ritchie.
D. C. Thomas.
C. G. Newton.

For miners—
W. H. Haskins.
D. H. Sullivan.
Michael Collins.
Thomas Cairns.
Joseph Richards.

Attest:
F. S. Brooks.

STATISTICS OF CITIES—ERRATA.

In BULLETIN No. 42, the issue of September, 1902, in the article on the statistics of cities, the following corrections should be noted:

On page 981 the legal borrowing limit of Providence, R. I., is, by a typographical error, given as 30 per cent; the statement should be 3 per cent.

At the time the statistics for Cleveland, Ohio, were secured the manuscript of the annual report relating to the financial affairs of the city, from which it was necessary to take much of the data, was in the hands of the printer, and use of it could be made only while in that condition and piecemeal, a method especially unsatisfactory in the case of a complex financial statement. In this way a number of errors have been allowed to appear in the statistics for Cleveland, several of them of a considerable amount.

Page 990, actual income for fiscal year from trust funds, interest, and dividends should be $189,328 instead of $289,070.

Page 992, actual income for fiscal year from loans (long-term bonds, two years or over) should be $1,367,594 instead of $1,267,852.

Page 1002, expenditures on account of construction and other capital outlay for police department should be $65,093 instead of $65,083.

Page 1004, total expenditures on account of construction and other capital outlay, exclusive of loans repaid, $3,939,137, should have note as follows: "Probably includes $160,200 paid by sinking fund commissioners into city treasury." Total expenditures on account of construction and other capital outlay, including loans repaid, should be $4,828,951 instead of $4,828,941.

Page 1015, expenditures for maintenance and operation of sewers should be $50,134 instead of $49,134; expenditures for maintenance and operation of street cleaning (and sprinkling) should be $209,364 instead of $62,263; other street expenditures for maintenance and operation should be $16,985 instead of $47,982.

Page 1016, expenditures for garbage removal should be $102,506 instead of $102,511.

Page 1017, expenditures for maintenance and operation of cemeteries should be $29,098 instead of $29,108; other expenditures for maintenance and operation should be $361,595 instead of $478,684.

Page 1052, per capita expenditures for street maintenance, except lighting, should be 58 cents instead of 28 cents; per capita expenditures for all other maintenance purposes should be $5.23 instead of $5.53.

RECENT REPORTS OF STATE BUREAUS OF LABOR STATISTICS.

KANSAS.

Bulletin of the Bureau of Labor and Industry for 1901. W. L. A. Johnson, Commissioner. 163 pp.

This bureau has issued annual reports since its organization, but the legislature of 1901 provided for biennial reports. The bulletin is issued as taking the place, in some degree, of the report for the year. Its contents are as follows: Strikes and labor difficulties, 17 pages; enforcement of labor laws, 18 pages; labor organizations, 14 pages; proceedings of the fourth annual convention of the State Society of Labor and Industry, 54 pages; statistics of manufactures, 52 pages.

STRIKES AND LABOR DIFFICULTIES.—Text accounts are given of the various troubles occurring between June 30, 1901, and May 1, 1902. These were 25 in number. Causes, cases of interposition by the commissioner, arbitration proceedings, contracts, terms of settlements, etc., are given in detail.

ENFORCEMENT OF LABOR LAWS.—Under this head are given court decisions, opinions of the attorney-general of the State, and brief accounts of cases arising under the laws of the State relating to labor.

LABOR ORGANIZATIONS.—This chapter presents reports from 105 labor organizations in the State, 99 of which report an average membership of 68.8. The same number of organizations report the average cost per member for maintaining the unions, aside from insurance features, at $6.75 per annum. The period of employment is reported by 99 organizations, the average being eleven months. Eighty-seven organizations report the hours of labor, which average 9.6. Railroad employees work from ten to fifteen hours daily, while in the building trades work is almost entirely on an eight-hour basis.

STATISTICS OF MANUFACTURES.—A brief review of the industrial development of the State is presented, together with statistics taken from the Twelfth Census of the United States.

MICHIGAN.

Nineteenth Annual Report of the Bureau of Labor and Industrial Statistics, including the Ninth Annual Report of the Inspection of Factories. 1902. Scott Griswold, Commissioner. xviii, 537 pp.

This report presents the following subjects: The beet-sugar industry, 12 pages; the Portland cement industry, 12 pages; the chicory industry, 2 pages; the flax industry, 3 pages; organized labor, 21 pages; coal mine inspector's report, 12 pages; manufactures, 5 pages; prominent industries, 16 pages; penal and reformatory institutions, 13 pages;

inspection of hotels and stores, 30 pages; strikes, 7 pages; suicides, 2 pages; boiler and other explosions, 6 pages; factory inspection, 368 pages; advantages and industrial resources of the State, 8 pages; laws relating to the bureau of labor, 15 pages.

BEET SUGAR.—This industry is of recent development in the State. Of the 13 factories in operation, 1 began business in 1898, 7 in 1899, 2 in 1900, 2 in 1901, and 1 in January, 1902. The cost of building the above plants was $5,776,332. The aggregate capital stock is $4,400,000. The capacity of the plants varies from 350 to 750 tons of beets daily. Ten of these factories were in operation during the season of 1900–01 and consumed an aggregate of 335,510 tons of beets. The total amount paid for beets was $1,702,877, or an average of somewhat over $5 per ton.

Coal and limestone are the other principal materials consumed in this industry, 64,349 tons of coal and 26,154 tons of limestone having been required during the year. These articles are obtained in the State, each factory burning its own lime. The total production of sugar was 64,616,358 pounds. The employees numbered 1,839 and received an average wage of $1.95 per day.

Five new factories, each of a capacity of 600 tons of beets per day, are reported as in process of construction, to be ready for the season of 1902–03. A general review of the industry, including a description of the processes of manufacture, detailed accounts of the various plants, the cost of raising beets, etc., is given.

PORTLAND CEMENT.—Of 16 factories built or in process of construction, 10 were in operation in 1901, the output for the year being estimated at 1,570,000 barrels. These factories employed 897 workmen, of whom 700 were laborers, at an average wage of $1.60 per day. Engineers and assistants earned $2.60; machinists, $2.42; millwrights, $2.53, and foremen, $2.60.

There is a general account of the industry and of the processes of manufacture, with descriptions of particular plants.

THE CHICORY INDUSTRY.—This, like the beet-sugar industry, unites agriculture and manufacture very closely, the 7 factories obtaining most of their supplies by contracting with farmers to furnish them the roots at a fixed price. About $175,000 is invested in this industry, and 120 men are employed for an average of one hundred days each season. The average daily wages are $1.65. Three of the 7 factories manufacture the finished product and run throughout the year. The consumption for 1901 was 31,500 tons of roots, produced on 3,500 acres of ground. Farmers received an average of $7 per ton for the roots.

FLAX.—Six mills, all under the control of one company, are engaged in this industry. They consume about 4,000 tons of flax annually, for which the farmer receives a contract price of $10 per ton. Two hundred employees have steady work and 600 others are employed during the season immediately following harvest. Wages range from $1.25 per day for laborers to $2 per day for machine tenders.

ORGANIZED LABOR.—A canvass by the bureau secured returns from 107 unions, of which 106 reported a total membership of 13,266. Twenty-four unions report strike benefits paid out during the year to the amount of $16,392, and 33 paid sick benefits amounting to $8,148. The average number of hours worked per day was 9.2 and the average working time was 9.7 months. Brief reports from the various unions are published, and a summary of suggestions as to desired legislation is presented.

COAL MINES.—Thirty mines were in operation for some portion of the year, employing an average of 1,838 persons. The average number of hours worked per day was 7.8, and of days per month 20.2. The average daily earnings of employees amounted to $2.44, the range being from $1.50 to $4.50. The amount of coal mined was 1,004,109 tons, at an average cost for mining of $1.41 per ton. The cost of mining in 1900 was $1.38 per ton.

Accounts are given of 24 accidents that occurred within the year.

MANUFACTURES.—Under this head are given the results of a canvass of 200 establishments, representing 58 industries. The principal statistics are given in the following table. Twenty-three industries are represented by single establishments, and are grouped as miscellaneous.

STATISTICS OF MANUFACTURES, 1901.

Industries.	Establishments.	Capital invested.	Cost of material.	Wages paid.	Value of product.
Furniture	25	$2,860,744	$2,391,906	$2,051,660	$5,238,196
Machinery	25	1,207,200	470,776	525,386	1,282,724
Vehicles	15	1,098,860	1,692,364	618,384	2,942,990
Fancy woodwork	15	580,445	379,990	373,443	978,255
Cigars	11	76,000	91,725	88,473	299,708
Women's wear	9	335,790	556,522	279,111	1,146,449
Boilers and engines	6	245,500	155,669	116,535	322,750
Pure food articles	5	222,250	190,249	43,407	430,806
Lager beer	4	657,000	101,258	36,087	269,011
Leather	4	443,870	616,310	76,989	801,322
Boots and shoes	4	380,000	311,097	77,856	480,715
Air rifles	4	167,500	133,328	114,084	312,000
Pumps	3	621,100	196,340	141,780	530,537
Printing and engraving	3	450,000	187,621	152,125	427,273
Land plaster	3	275,000	23,837	32,930	139,490
Confectionery	3	178,000	285,000	42,603	420,000
Agricultural implements	2	1,000,000	638,000	341,565	1,418,607
Refrigerators	2	450,000	145,046	148,068	432,664
Flour	2	294,662	1,116,769	34,328	1,228,785
Brick	2	149,500	13,291	13,986	58,000
Coffins and caskets	2	149,293	96,000	46,521	221,253
Cooperage	2	130,000	134,689	49,020	235,412
Dressed lumber	2	85,000	140,848	22,770	187,889
Clothing	2	60,000	115,000	56,250	248,000
Railway supplies	2	60,000	87,117	32,100	146,000
Furnaces	2	45,000	37,000	23,150	71,500
Mirror plates	2	42,200	87,000	35,604	171,000
Paper boxes	2	42,000	36,968	29,292	110,819
Shirts and collars	2	27,800	18,500	16,208	57,500
Excelsior	2	22,000	13,790	10,188	29,352
Mattresses	2	28,800	61,000	35,800	111,000
Extracts and perfumes	2	18,600	40,000	7,815	76,290
Brass goods	2	17,248	49,746	33,642	93,131
Stone and marble	2	11,000	7,400	13,860	30,860
Wooden shoes	2	900	535	1,650	2,660
Miscellaneous	23	2,263,224	2,198,964	788,354	4,149,806
Total	200	[a]14,688,486	[b]12,821,549	[c]6,511,329	[d]25,099,249

[a] Apparently this total should be $14,696,486; the figures are given as found in the original.
[b] Apparently this total should be $12,821,655; the figures are given as found in the original.
[c] Apparently this total should be $ 6,511,024; the figures are given as found in the original.
[d] Apparently this total should be $25,102,749; the figures are given as found in the original.

The aggregate number of employees was 16,263. Their average yearly earnings amounted to $400.38.

PROMINENT INDUSTRIES.—Under this head are given short descriptions of a number of individual establishments representing some of the prominent industries of the State.

STRIKES.—Brief accounts are given of the various labor troubles that occurred in the State in the year 1901. No summaries are given.

RECENT FOREIGN STATISTICAL PUBLICATIONS.

AUSTRIA.

Die Arbeitseinstellungen und Aussperrungen in Österreich während des Jahres 1900. Herausgegeben vom k. k. Arbeitsstatistischen Amte im Handelsministerium. 462 pp.

The seventh annual report on strikes and lockouts of the Austrian Labor Office is contained in this volume. As in the report for the preceding year, the information is contained in six tables, showing (1) strikes according to geographical distribution, (2) strikes according to industries, (3) general summary of strikes, (4) summary of strikes for the years 1894 to 1900, (5) a table showing in detail the facts for each strike in 1900, and (6) details for each lockout in 1900. An appendix gives information concerning economic conditions in 1900, the status of the labor movement for the same year, the amount of the contributions received by the trades union commission in aid of strikers, and documents relating to various phases of the more important strikes of the year.

STRIKES IN 1900.—During 1900 there was a slight decrease in the number of strikes and in the number of establishments affected as compared with 1899; on the other hand, the number of strikers shows a marked increase over 1899 and over any year of the period during which complete returns of strikes have been published by the Austrian Government. The increase in 1900 is due entirely to conflicts occurring in the mining industry. If mining be excluded, the year 1900 will show the smallest number of strikers of any year during the period for which statistical information is available.

During the year there were 303 strikes, which affected 1,003 establishments, and involved 105,128 strikers and 7,737 other employees who were thrown out of employment on account of strikes. The strikers represented 67.29 per cent of the total number of employees in the establishments affected. The average number of strikers in each strike was 347. Of the total strikers, 89.37 per cent were males and 10.63 per cent were females. After the strikes 97,564 strikers were reemployed and 4,346 new employees took places formerly occupied by strikers. Of the 303 strikes, 61, or 20.13 per cent, were successful; 136, or 44.89 per cent, were partly successful, and 106, or 34.98 per

cent, resulted in failure. The following table shows, by industries, the number of strikes, establishments affected, strikers and others thrown out of employment, etc., during the year 1900:

STRIKES, BY INDUSTRIES, 1900.

Industries.	Strikes.	Establishments.	Total employees.	Strikers.		Others thrown out of employment.	Strikers reemployed.	New employees after strikes.
				Number.	Per cent of total employees.			
Mining	40	272	105,578	78,791	74.63	3,817	74,575	2,400
Stone, glass, china, and earthen ware	19	31	1,251	574	45.88	37	427	74
Metals and metallic goods	26	91	3,724	1,977	53.09	248	1,858	59
Machinery and instruments	13	13	2,262	519	22.94	12	422	88
Wooden and caoutchouc goods	34	45	3,156	1,391	44.07	332	1,150	191
Leather, hides, brushes, and feathers	20	30	804	604	75.12	74	496	55
Textiles	56	73	22,694	12,010	52.92	2,130	10,655	540
Wearing apparel and millinery	27	192	2,875	1,644	57.18	593	1,288	188
Paper	9	11	1,320	1,004	76.06	19	1,001	2
Food products	8	43	554	229	41.34	2	78	141
Chemical products	2	2	86	83	96.51	3	70	.....
Building trades	23	158	7,907	4,849	61.33	399	4,152	574
Printing and publishing	17	17	397	204	51.39	45	155	28
Commerce	1	1	11	6	54.55	.....	.....	6
Transportation	2	2	606	546	90.10	20	546	.....
Other industries	6	22	3,012	697	23.14	6	691	.....
Total	303	1,003	156,237	105,128	67.29	7,737	97,564	4,346

Strikes in the textile trades were again more numerous than in any other group of industries, 56 strikes, involving 12,010 strikers, having occurred in that group. The mining industries, however, show by far the largest number of strikers, 78,791 of the 105,128 strikers for all industries having been involved in the 40 strikes which occurred in the mining group.

In the presentation of strikes by causes, the cause and not the strike is taken as the unit, and since several causes frequently operate to bring about one strike, the number of causes usually exceeds the number of strikes. Thus the 303 strikes of 1900 were produced by 379 causes.

The following table shows the causes of the strikes for 1900 by industries:

CAUSES OF STRIKES, BY INDUSTRIES, 1900.

Industries.	Against reduction of wages.	For increase of wages.	For change in method of payment.	For reduction of hours.	For discharge of foremen, workmen, etc.	Against obnoxious treatment.	Against discharge of employees.	Against obnoxious rules.	Other causes.	Total.
Mining	4	15	3	2	.....	.....	3	1	14	42
Stone, glass, china, and earthen ware	3	11	.....	3	.....	1	.....	1	2	21
Metals and metallic goods	3	3	.....	5	3	1	6	3	4	33
Machinery and instruments	2	4	.....	2	2	.....	1	2	4	17
Wooden and caoutchouc goods	4	13	.....	12	2	4	5	.....	3	43

CAUSES OF STRIKES, BY INDUSTRIES, 1900—Concluded.

Industries.	Against reduction of wages.	For increase of wages.	For change in method of payment.	For reduction of hours.	For discharge of foremen, workmen, etc.	Against obnoxious treatment.	Against discharge of employees.	Against obnoxious rules.	Other causes.	Total.
Leather, hides, brushes, and feathers	1	10	.....	12	1	.....	3	.....	3	30
Textiles	4	31	1	15	2	1	7	3	12	76
Wearing apparel and millinery	3	21	1	8	.....	.....	1	1	3	38
Paper	.....	4	.....	4	1	1	1	1	1	13
Food products	1	2	.....	2	.....	1	3	.....	.....	9
Chemical products	.....	2	.....	.....	.....	1	.....	.....	.....	3
Building trades	.....	19	.....	4	1	.....	1	.....	.....	25
Printing and publishing	.....	5	1	.....	1	.....	5	2	5	19
Commerce	.....	.....	.....	.....	.....	.....	.....	.....	1	1
Transportation	.....	2	.....	.....	.....	.....	.....	.....	.....	2
Other industries	1	5	.....	.....	.....	.....	.....	.....	1	7
Total	26	152	6	69	13	10	36	14	53	379

As in the previous year, the most frequent causes of strikes were the demands for increased wages and for reduction of hours, the former having been one of the causes of 50.2 per cent and the latter of 22.8 per cent of the strikes.

The following table shows the results of strikes by industries:

RESULTS OF STRIKES, BY INDUSTRIES, 1900.

Industries.	Strikes.				Strikers.			
	Succeeded.	Succeeded partly.	Failed.	Total.	Succeeded.	Succeeded partly.	Failed.	Total.
Mining	6	21	13	40	2,465	74,321	2,005	78,791
Stone, glass, china, and earthenware	5	6	8	19	156	243	175	574
Metals and metallic goods	7	10	9	26	132	663	1,182	1,977
Machinery and instruments	3	3	7	13	46	98	375	519
Wooden and caoutchouc goods	10	10	14	34	349	760	282	1,391
Leather, hides, brushes, and feathers	6	11	3	20	161	310	133	604
Textiles	5	35	16	56	223	8,192	3,595	12,010
Wearing apparel and millinery	3	21	3	27	75	1,485	84	1,644
Paper	3	4	2	9	122	876	6	1,004
Food products	.....	2	6	8	.....	86	143	229
Chemical products	.....	1	1	2	.....	62	21	83
Building trades	5	6	12	23	1,026	1,672	2,151	4,849
Printing and publishing	6	3	8	17	50	91	63	204
Commerce	.....	.....	1	1	.....	.....	6	6
Transportation	1	1	.....	2	36	510	.....	546
Other industries	1	2	3	6	50	552	95	697
Total	61	136	106	303	4,891	89,921	10,316	105,128

As usual, those strikes which are either successful or unsuccessful are not extensive in comparison with those which are partly successful. In 1900 over 85 per cent of the strikers were included in the latter class.

The following table shows the results of the strikes in 1900 according to their duration. It is seen that the greater number of strikes

were of short duration, 167, or over 55 per cent, having lasted only from one to five days. Thirty-five strikes lasted over thirty days.

RESULTS OF STRIKES, BY DURATION, 1900.

Days of duration.	Strikes.				Strikers.			
	Succeeded.	Succeeded partly.	Failed.	Total.	Succeeded.	Succeeded partly.	Failed.	Total.
1 to 5	36	57	74	167	4,120	10,168	5,076	19,364
6 to 10	16	29	11	56	372	5,187	1,096	6,655
11 to 15	3	10	4	17	104	1,859	107	2,070
16 to 20	1	5	3	9	11	631	727	1,369
21 to 25	.....	7	2	9	.....	710	889	1,599
26 to 30	2	4	4	10	90	1,267	42	1,399
31 to 35	1	.....	2	3	105	.....	908	1,013
36 to 40	1	3	1	5	72	1,452	409	1,933
41 to 50	.....	2	2	4	.....	174	351	525
51 to 100	.....	15	3	18	.....	67,789	711	68,500
101 or over	1	4	.....	5	17	684	.....	701
Total	61	136	106	303	4,891	89,921	10,316	105,128

STRIKES DURING SEVEN YEARS.—The following table shows the number and extent of the strikes in Austria for the period during which the ministry of commerce has published reports on strikes:

STRIKES, BY YEARS, 1894 TO 1900.

Year.	Strikes.	Establishments affected.	Strikers.	Per cent of strikers of total employees.	Days lost.
1894	172	2,542	67,061	69.47	795,416
1895	209	874	28,652	59.68	300,348
1896	305	1,499	66,234	65.72	899,939
1897	246	851	38,467	59.03	368,098
1898	255	885	39,658	59.86	323,619
1899	311	1,330	54,763	60.23	1,029,937
1900	303	1,003	105,128	67.29	3,483,963

The number of strikes and the number of strikers for each year of the seven-year period are shown, by industries, in the following two tables:

STRIKES, BY INDUSTRIES, 1894 TO 1900.

Year.	Mining.	Stone, glass, china, and earthen ware.	Metals and metallic goods.	Machinery and instruments.	Wooden and caoutchouc goods.	Textiles.	Building trades.	Other.	Total.
1894	13	22	23	7	23	34	11	39	172
1895	4	29	37	6	38	29	24	42	209
1896	11	29	33	14	55	43	42	78	305
1897	25	27	26	20	27	28	34	59	246
1898	29	27	26	13	28	28	49	55	255
1899	26	21	32	24	35	84	33	56	311
1900	40	19	26	13	34	56	23	92	303
Total	148	174	203	97	240	302	216	421	1,801

STRIKERS, BY INDUSTRIES, 1894 TO 1900.

Year.	Mining.	Stone, glass, china, and earthen ware.	Metals and metallic goods.	Machinery and instruments.	Wooden and caoutchouc goods.	Textiles.	Building trades.	Other.	Total.
1894.....	22,986	6,415	2,752	194	9,793	6,317	14,975	3,629	67,061
1895.....	626	9,943	3,694	253	2,336	4,085	5,361	2,354	28,652
1896.....	30,120	3,217	2,973	2,058	5,972	9,791	5,484	6,669	66,234
1897.....	3,632	3,053	1,568	4,689	1,372	11,275	4,995	7,883	38,467
1898.....	7,046	4,491	991	2,471	1,318	3,171	13,961	6,209	39,658
1899.....	3,477	2,112	2,459	1,356	3,198	30,249	7,842	4,070	54,763
1900.....	78,791	574	1,977	519	1,391	12,010	4,849	5,017	105,128
Total .	146,678	29,805	16,414	11,540	25,380	76,898	57,417	35,831	399,963

The causes of strikes for the seven-year period are shown in the following table, the cause and not the strike being made the unit:

CAUSES OF STRIKES, 1894 TO 1900.

Year.	Against reduction of wages.	For increase of wages.	For change in method of payment.	For reduction of hours.	For discharge of foremen, workmen, etc.	Against obnoxious treatment.	Against discharge of employees.	Against obnoxious rules.	Other causes.	Total.
1894	23	53	5	19	12	5	34	16	32	199
1895	19	89	6	31	22	2	31	8	37	245
1896	28	140	8	67	32	5	40	12	34	366
1897	26	116	7	47	26	13	32	18	45	330
1898	33	124	8	54	29	9	36	20	39	352
1899	29	148	5	73	17	5	40	18	40	370
1900	26	152	6	69	13	10	36	14	53	379
Total.	184	817	45	360	151	49	249	106	280	2,241

The following table shows, for both strikes and strikers, during each year of the period, the results expressed in percentages:

RESULTS OF STRIKES, 1894 TO 1900.

Year.	Strikes.				Strikers.			
	Number.	Per cent succeeded.	Per cent succeeded partly.	Per cent failed.	Number.	Per cent succeeded.	Per cent succeeded partly.	Per cent failed.
1894.....	172	25.00	27.91	47.09	67,061	9.15	37.31	53.54
1895.....	209	26.79	24.88	48.33	28,652	12.81	60.69	26.50
1896.....	305	20.98	36.40	42.62	66,234	4.60	62.80	32.60
1897.....	246	17.48	36.99	45.53	38,467	15.69	47.81	36.50
1898.....	255	18.82	41.18	40.00	39,658	8.36	66.46	25.18
1899.....	311	15.43	45.02	39.55	54,763	10.21	71.99	17.80
1900.....	303	20.13	44.89	34.98	105,128	4.65	85.54	9.81
Total	1,801	20.16	37.92	41.92	399,963	8.17	64.53	27.30

LOCKOUTS.—In the year 1900 there were 10 lockouts; the most frequent causes were the observance of Labor Day (May 1) and the protests of employers against strikes. The following table shows the number, etc., of the lockouts for the period 1894 to 1900:

LOCKOUTS, BY YEARS, 1894 TO 1900.[1]

Year.	Lockouts.	Establishments involved.	Persons locked out.	Per cent of persons locked out of total employees.	Persons locked out and reemployed.
1894					
1895	8	17	2,317	51.25	2,183
1896	10	211	5,445	79.52	4,589
1897	11	12	1,712	54.40	1,647
1898					
1899	5	38	3,457	60.96	3,448
1900	10	58	4,036	75.81	3,708

FINLAND.

Industri-Statistik, 17. År 1900. Senare delen. Fabriker och Handtverkerier. Bidrag till Finlands Officiela Statistik, XVIII. ix, 150 pp.

The seventeenth annual report on the factory and hand-working industries of Finland is contained in this volume. The report presents a general summary of the industrial condition of the country, and then gives for each individual industry the gross value of the product, the kind and amount of the product, the capacity of the steam engines used, and the persons employed, classed by sex in three age groups, for the year 1900. The report concludes with an account of industrial accidents in 1900 and furnishes a list of the different insurance, saving, and other funds in existence at the various establishments.

The accompanying table shows the development of the factory and hand-working industries since 1890:

TOTAL ESTABLISHMENTS, EMPLOYEES, AND VALUE OF PRODUCTS OF ALL INDUSTRIES, EXCEPT MINING AND METAL WORK, 1890 TO 1900.

Year.	Establishments.		Employees.		Value of product.	
	Number.	Per cent of increase over preceding year.	Number.	Per cent of increase over preceding year.	Amount.	Per cent of increase over preceding year.
1890	5,261		48,202		$26,407,321	
1891	5,478	4.1	49,467	2.6	27,699,336	4.9
1892	5,623	2.6	47,250	[a] 4.5	26,901,947	[a] 2.9
1893	5,580	[a] .8	46,085	[a] 2.5	26,435,976	[a] 1.7
1894	5,825	4.4	47,783	3.7	28,387,175	7.4
1895	6,012	3.2	53,185	11.3	31,362,472	10.5
1896	6,054	.7	59,182	11.3	36,179,375	15.4
1897	6,165	1.8	64,927	9.7	41,359,599	14.3
1898	6,331	2.7	73,857	13.8	46,132,465	11.5
1899	6,581	3.9	83,844	13.5	49,904,491	8.2
1900	6,677	1.5	80,556	[a] 3.9	55,405,702	11.0

[a] Decrease.

The following table shows the number of employees and the gross value of the product of each of the industrial groups for the years 1899 and 1900, together with the per cent of increase:

NUMBER OF EMPLOYEES AND VALUE OF PRODUCT, BY GROUPS OF INDUSTRIES, 1899 AND 1900.

Industries.	Employees.			Value of product.		
	1899.	1900.	Per cent of increase.	1899.	1900.	Per cent of increase.
Stone, earthenware, glass, etc.	8,424	7,578	[a] 10.04	$2,274,159	$2,175,043	[a] 4.36
Chemical products	2,237	2,305	3.04	1,585,199	1,663,839	4.96
Leather and hides	3,569	3,514	[a] 1.54	3,102,416	2,933,770	[a] 5.44
Textiles	11,047	11,614	5.13	6,519,070	6,758,982	3.60
Paper, cardboard work, bookbinding	7,173	7,079	[a] 1.31	4,907,589	5,761,094	17.39
Woodworking, bone, cork, etc.	23,704	25,816	8.91	14,439,466	17,090,883	18.36
Building trades	9,416	3,736	[a] 60.32	1,321,612	1,263,953	[a] 4.36
Food products	10,788	11,179	3.62	12,728,486	14,647,335	15.08
Clothing	5,171	5,240	1.33	1,929,127	1,936,752	.40
Printing and allied industries	2,315	2,497	7.86	1,097,367	1,179,051	7.44
Total	83,844	80,556	[a] 3.92	49,904,491	55,405,702	11.02

[a] Decrease.

FRANCE.

Annuaire des Syndicats Professionnels, Industriels, Commerciaux et Agricoles, constitués conformément à la Loi du 21 Mars, 1884, en France et aux Colonies. Direction du Travail, Ministère du Commerce, de l'Industrie, des Postes et des Télégraphes. 1901. lviii, 624 pp.

This is the twelfth annual report on trade, industrial, commercial, and agricultural unions and associations organized in France and the French colonies under the provisions of the law of March 21, 1884.[a] Under this head are included trade unions, employers' associations, mixed associations composed of both employers and employees, and organizations composed of persons engaged in agricultural pursuits. The greater part of the report consists of a directory of these organizations arranged by departments. It also contains several tables showing the number and membership of the unions and associations; a reproduction of the legislation, etc., affecting organizations since 1884; Government decrees and judicial decisions on the same subject; a list of the periodicals published by the organizations; lists showing the number of organizations by trades or industries, etc.

[a] For the provisions of this law see Bulletin No. 25, p. 838.

The following tables show the number and membership of the individual organizations on July 1 of each year from 1884 to 1896, and on December 31 from 1897 to 1900:

INDUSTRIAL, COMMERCIAL, AND AGRICULTURAL ASSOCIATIONS IN EXISTENCE ON JULY 1 OF EACH YEAR FROM 1884 TO 1896 AND ON DECEMBER 31 FROM 1897 TO 1900.

Date.	Industrial and commercial associations.			Agricultural associations.	Total.	Increase since preceding year.
	Employers'.	Workingmen's.	Mixed.			
July 1, 1884	101	68	1	5	175	.....
July 1, 1885	285	221	4	39	549	374
July 1, 1886	359	280	8	93	740	191
July 1, 1887	598	501	45	214	1,358	618
July 1, 1888	859	725	78	461	2,123	765
July 1, 1889	877	821	69	557	2,324	201
July 1, 1890	1,004	1,006	97	648	2,755	431
July 1, 1891	1,127	1,250	126	750	3,253	498
July 1, 1892	1,212	1,589	147	863	3,811	558
July 1, 1893	1,397	1,926	173	952	4,448	637
July 1, 1894	1,518	2,178	177	1,092	4,965	517
July 1, 1895	1,622	2,163	173	1,188	5,146	181
July 1, 1896	1,731	2,243	170	1,275	5,419	273
December 31, 1897	1,894	2,324	184	1,499	5,901	482
December 31, 1898	1,965	2,361	175	1,824	6,325	424
December 31, 1899	2,157	2,685	170	2,069	7,081	756
December 31, 1900	2,382	3,287	162	2,204	8,035	954

MEMBERSHIP OF INDUSTRIAL, COMMERCIAL, AND AGRICULTURAL ASSOCIATIONS ON JULY 1 OF EACH YEAR FROM 1890 TO 1896 AND ON DECEMBER 31 FROM 1897 TO 1900.

Date.	Membership of associations.					Increase since preceding year.
	Employers'.	Workingmen's.	Mixed.	Agricultural.	Total.	
July 1, 1890	93,411	139,692	14,096	234,234	481,433	.....
July 1, 1891	106,157	205,152	15,773	269,298	596,380	114,947
July 1, 1892	102,549	288,770	18,561	313,800	723,680	127,300
July 1, 1893	114,176	402,125	30,052	353,883	900,236	176,556
July 1, 1894	121,914	403,440	29,124	378,750	933,228	32,992
July 1, 1895	131,081	419,781	31,126	403,261	985,199	51,971
July 1, 1896	141,877	422,777	30,333	423,492	1,018,479	33,280
December 31, 1897	189,514	437,793	34,963	448,395	1,110,665	92,186
December 31, 1898	151,624	419,761	34,236	491,692	1,097,313	[a]13,352
December 31, 1899	158,300	491,647	28,519	512,794	1,191,260	93,947
December 31, 1900	170,030	588,832	29,044	533,454	1,321,360	130,100

[a] Decrease.

In addition to the number and membership of agricultural associations shown in the tables above, 696 agricultural mutual insurance societies with a membership of 48,458 have been brought under the law governing trade, etc., organizations, by act of July 4, 1900.

The total membership of women in trade organizations was 42,686. Of this number 2,180 were in employers' associations; 32,065 were in employees' (workingmen's) associations; 4,716 were in mixed associations, and 3,725 were in agricultural associations. In addition 784 females were members of agricultural mutual insurance societies.

Besides individual organizations, the report also relates to federations of trade, industrial, commercial, and agricultural associations, and to labor exchanges.

The following table shows the number of federations and of associations federated, and the total membership on December 31 of each year, 1897 to 1900:

FEDERATIONS OF INDUSTRIAL, COMMERCIAL, AND AGRICULTURAL ASSOCIATIONS IN EXISTENCE ON DECEMBER 31, 1897 to 1900.

Items.	Industrial and commercial organizations.			Agricultural organizations.	Total.	Increase since preceding year.
	Employers'.	Workingmen's.	Mixed.			
Trade federations:						
1897	46	94	9	30	179	.....
1898	49	76	11	34	170	[a] 9
1899	54	73	11	35	173	3
1900	59	95	9	36	[b] 200	27
Associations federated:						
1897	791	1,302	37	1,184	3,314	.....
1898	915	1,132	49	1,192	3,288	[a] 26
1899	927	1,199	49	1,326	3,501	213
1900	1,047	1,533	43	1,470	4,093	592
Membership of federations:						
1897	87,095	327,638	3,150	700,557	1,118,440	.....
1898	96,585	312,185	4,343	466,529	879,642	[a] 238,798
1899	105,557	432,950	3,331	487,145	1,028,983	149,341
1900	136,796	533,575	1,829	527,492	1,199,692	170,709

[a] Decrease.
[b] Including one federation composed of employers' and workingmen's organizations.

The number of labor exchanges (*bourses du travail*) in 1900 was 75. They were composed of 1,630 associations, with 276,837 members. Most of these exchanges received financial assistance from the municipalities or departments. In 1900 the subsidies received from municipalities amounted to 349,584 francs ($67,469.71), and those from departments amounted to 13,300 francs ($2,566.90). The exchanges secured employment for 61,294 persons during the year.

Among other things the organizations conduct 784 technical libraries, 26 cooperative loan funds, 553 funds for relief of the unemployed, 462 technical schools and technical lecture courses, 34 expositions and competitive displays, and 184 periodicals.

HUNGARY.

Die Fabriksindustrie des Königreichs Ungarn. Herausgegeben vom königlich ungarischen Handelsminister. 1901. viii, 211 pp.

The first part of this report is an account of the development of the Hungarian factory industries since the establishment of the Kingdom in 1867. The remainder of the report gives the results of investigations undertaken February 25, 1899, relating to the personnel of the factory establishments, the power used therein, and the amount and value of the annual products.

The term "factory," as here used, includes all industrial establishments employing 20 or more persons and those employing fewer than 20, but possessing other characteristics of the factory to a marked degree.

The industries are arranged in eleven groups. The establishments are classed as principal and subsidiary. The following table shows the number of establishments in each group and the number of principal establishments according to the form of ownership:

FACTORY ESTABLISHMENTS CLASSIFIED AS PRINCIPAL AND SUBSIDIARY AND ACCORDING TO FORM OF OWNERSHIP, BY GROUPS OF INDUSTRIES, FEBRUARY 25, 1899.

Industries.	Establishments.			Principal establishments owned by—			
	Principal.	Subsidiary.	Total.	Private firms.	Stock companies.	State, municipality, or commune.	Others.
Metals and metallic goods	230	129	359	175	39	8	8
Machinery, instruments, and transportation apparatus	192	9	201	88	67	30	7
Earthenware, glass, lime, cement, etc	403	4	407	294	85	.....	24
Woodenware and furniture	394	6	400	321	29	31	13
Leather, bristle, and hair goods	64	1	65	55	5	.....	4
Textiles	110	3	113	79	22	2	7
Clothing	114	3	117	107	2	2	3
Paper and paper goods	54	.....	54	45	9	.....	.....
Food products	558	18	576	427	104	24	3
Chemicals	175	7	182	102	66	4	3
Printing and allied industries	70	1	71	50	16	2	2
Total	2,364	181	2,545	1,743	444	103	74

Special attention was paid to securing detailed information as to the use of power in the factory establishments.

The following tables show, by industries, the number of principal establishments using motors, the horsepower per establishment, and the number and total horsepower of each class of motors used:

PRINCIPAL ESTABLISHMENTS USING MOTORS, AND HORSEPOWER PER ESTABLISHMENT, BY GROUPS OF INDUSTRIES, FEBRUARY 25, 1899.

Industries.	Principal establishments enumerated.	Principal establishments using motors.	Horsepower per establishment.
Metals and metallic goods	230	190	383
Machinery, instruments, and transportation apparatus	192	175	268
Earthenware, glass, lime, cement, etc	403	272	58
Woodenware and furniture	394	335	60
Leather, bristle, and hair goods	64	45	43
Textiles	110	89	142
Clothing	114	10	25
Paper and paper goods	54	45	236
Food products	558	479	146
Chemicals	175	138	68
Printing and allied industries	70	64	19
Total	2,364	1,842	142

MOTORS OF EACH KIND USED IN PRINCIPAL ESTABLISHMENTS, BY GROUPS OF INDUSTRIES, FEBRUARY 25, 1899.

Industries.	Stationary steam engines.	Portable steam engines.	Turbines.	Water wheels.	Gas engines.	Other motors.	Total motors.
Metals and metallic goods	543	40	35	444	30	15	1,107
Machinery, instruments, and transportation apparatus	301	45	17	2	13	75	453
Earthenware, lime, cement, etc	155	74	5	75	3	227	539
Woodenware and furniture	298	79	23	64	3	5	472
Leather, bristle, and hair goods	44	2	1	7	2	10	66
Textiles	160	7	12	28	9	12	228
Clothing	8	2	.....	.....	1	.....	11
Paper and paper goods	61	4	51	18	13	4	151
Food products	927	48	30	26	12	65	1,108
Chemicals	241	13	5	12	12	55	338
Printing and allied industries	15	.....	.....	.....	82	112	209
Total	2,753	314	179	676	180	580	4,682

TOTAL HORSEPOWER OF MOTORS OF EACH KIND USED IN PRINCIPAL ESTABLISHMENTS, BY GROUPS OF INDUSTRIES, FEBRUARY 25, 1899.

Industries.	Stationary steam engines.	Portable steam engines.	Turbines.	Water wheels.	Gas engines.	Other motors.	Total horsepower.
Metals and metallic goods	64,897	893	3,000	3,881	154	67	72,892
Machinery, instruments, and transportation apparatus	41,976	1,022	2,527	8	255	1,197	46,985
Earthenware, lime, cement, etc	13,078	1,751	126	446	18	366	15,785
Woodenware and furniture	16,836	1,465	783	1,165	34	15	20,298
Leather, bristle, and hair goods	1,695	21	16	98	16	103	1,949
Textiles	11,287	66	703	483	48	88	12,675
Clothing	222	20	.....	.....	6	.....	248
Paper and paper goods	3,962	49	6,135	304	171	4	10,625
Food products	65,419	816	2,809	471	94	402	70,011
Chemicals	8,510	192	107	109	90	362	9,370
Printing and allied industries	280	.....	.....	.....	662	290	1,232
Total	228,162	6,295	16,206	6,965	1,548	2,894	262,070

The returns relating to the number of persons employed and the character of their employment were complete enough to allow of a comparison for the various industrial groups. This comparison is shown in the following table:

PERSONS OF EACH CLASS EMPLOYED IN FACTORY ESTABLISHMENTS, BY GROUPS OF INDUSTRIES, FEBRUARY 25, 1899.

Industries.	Officers and clerks.			Foremen.	Factory employees and day laborers.	Apprentices.	Servants.	Total persons employed.		
	Commercial.	Technical.	Other.					Male.	Female.	Total.
Metals and metallic goods	727	347	203	519	40,797	2,921	617	44,381	1,750	46,131
Machinery, instruments, and transportation apparatus	1,292	803	14	618	33,284	2,806	547	38,663	701	39,364
Earthenware, glass, lime, cement, etc	458	198	33	244	30,659	533	398	28,034	4,489	32,523
Woodenware and furniture	713	231	149	385	27,092	393	325	27,086	2,202	29,288
Leather, bristle, and hair goods	114	21	.....	73	4,487	151	84	3,933	997	4,930
Textiles	247	105	18	173	13,446	176	120	6,564	7,721	14,285
Clothing	203	8	.....	70	3,298	238	3	2,422	1,398	3,820
Paper and paper goods	164	35	6	87	5,280	83	106	3,389	2,372	5,761
Food products	2,113	603	161	722	44,677	189	1,253	28,749	20,969	49,718
Chemicals	671	157	15	190	11,862	38	245	10,750	2,428	13,178
Printing and allied industries	281	69	42	96	4,967	956	155	4,894	1,672	6,566
Total	6,983	2,577	641	3,177	219,849	8,484	3,853	198,865	[a]46,699	245,564

[a] Of this total, 46,008 were factory employees and day laborers.

The investigation of the production of the factory industries included such points as the source of the raw materials used, the markets for the finished products, the countries which compete in the home and the foreign markets, and the causes which retard the growth of the factory industry at home. This information was desired in connection with the formulation of a new tariff policy, and forms an important part of the report. The period covered by the questions was that of the calendar year preceding the census date, or, in the case of seasonal industries, the season preceding that date.

The value of the product of the factory industries for the year 1898 is shown in the following table, together with the total number of establishments and the total number of persons employed:

FACTORY ESTABLISHMENTS AND PERSONS EMPLOYED FEBRUARY 25, 1899, AND VALUE OF PRODUCT FOR THE YEAR 1898, BY GROUPS OF INDUSTRIES.

Industries.	Number of factory establishments Feb. 25, 1899.	Total persons employed in factory establishments Feb. 25, 1899.	Value of product of factory establishments for the year 1898.
Metals and metallic goods	359	46,131	$36,918,029
Machinery, instruments, and transportation apparatus	201	39,364	34,691,735
Earthenware, glass, lime, cement, etc	407	32,523	10,415,660
Wooden ware and furniture	400	29,288	19,325,447
Leather, bristle, and hair goods	65	4,930	6,278,472
Textiles	113	14,285	10,854,996
Clothing	117	3,820	4,142,658
Paper and paper goods	54	5,761	3,238,881
Food products	576	49,718	131,133,628
Chemicals	182	13,178	17,017,618
Printing and allied industries	71	6,566	3,467,033
Total	2,545	245,564	277,484,157

ITALY.

Relazione sull'applicazione della legge 11 febbraio 1886, sul lavoro dei fanciulli negli opifici industriali, nelle cave e nelle miniere, dal 1° gennaio 1899 al 31 dicembre 1900. Camera dei Deputati. Presentata dal presidente del consiglio dei ministri, ministro ad interim per l'agricoltura, l'industria e il commercio. 1901. 80 pp.

This report relates to child labor in Italy for the years 1899 and 1900. In accordance with the provisions of the law of February 11, 1886, [a] the report contains the information usually found in reports of factory and mine inspectors, such as the number of mines and factories visited, the cases of violation found, the number of prosecutions, etc.

Tables are given showing in detail the number and proportion of children employed in various industrial establishments and in the mining and metal industries for the period covered by the report.

[a] For an account of this law see Bulletin No. 30, p. 1053.

The following table shows in condensed form the main features of the statistical matter presented in the report as far as it relates to child labor:

CHILDREN EMPLOYED IN MINES AND FACTORIES, 1899 AND 1900.

Industries and years.	Establishments which employed children.	Total employees.	Children employed.		Children of from—					
			Number.	Per cent of total employees.	9 to 10 years.		10 to 12 years.		12 to 15 years.	
					Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
MINING AND METAL.										
1899	3,440	75,438	11,753	15.58	348	2.96	1,645	14.00	9,760	83.04
1900	4,008	77,878	11,918	15.30	296	2.48	1,644	13.80	9,978	83.72
OTHER.										
1899	94	7,531	1,086	14.42	2	.18	134	12.34	950	87.48
1900	375	36,431	6,291	17.27	84	1.34	872	13.86	5,335	84.80

ONTARIO.

Second Report of the Bureau of Labor of the Province of Ontario for the year ending December 31, 1901. R. Glockling, Secretary. 173 pp.

This report contains an address on the value and influence of labor statistics by Carroll D. Wright; a list of labor bureaus of various States and countries; replies to inquiries of the bureau as to new industries established or desired in various localities; a report on labor organizations, including one on strikes and lockouts; statistics of manufactures; extracts from official publications, showing the results of the organization of labor; a consideration of free employment offices; decisions of courts affecting labor; a digest of a report on cooperation in Great Britain, with a contributed article on the cooperative system of constructing public works in New Zealand, and a synopsis of the labor laws of Ontario.

LABOR ORGANIZATIONS.—Schedules were sent to 438 addresses, to which 216 replies were received, representing 66 trades or other bases of union. Detailed reports are published, with a table furnishing a directory of officers and other information relating to each union. Average wages and hours of labor of members are also given, but no summaries are presented.

For the year ending August 31, 1901, 19 strikes and 1 lockout were reported; of the strikes 7 were successful, 7 were settled by compromise, 1 by arbitration, 2 were unsuccessful, 1 was still pending, and for 1 the result was not reported.

MANUFACTURES.—For presentation under this head, returns from 305 establishments were tabulated, showing for each the number of employees, days in operation, total wages paid, value of product, average yearly earnings and daily wages, and per cent of value of product

devoted to wages and to material, other expenses and profits. The returns were for the year ending December 31, 1900.

Of these establishments 249 represent 17 industries, 56 being grouped as miscellaneous. The following table presents the principal totals for each of these industry classes:

STATISTICS OF MANUFACTURES, 1900.

[Certain errors (probably typographical) in columns for employees, wages, and value of product make it doubtful in some cases whether the figures given for the details or the totals are correct. The few corrections which seem to be necessary have been made only after a careful comparison of details and totals.]

Industries.	Establishments.	Employees.	Total wages.	Average annual earnings.	Value of product.
Agricultural implements	11	968	$369,120	$381.32	$1,531,250
Brewing and malting	5	129	54,040	418.91	330,000
Canned goods	5	377	33,200	88.06	196,600
Carriages and wagons	16	651	271,975	417.78	1,235,600
Dairy products	14	[a] 87	113,805	[a] 334.43	456,493
Flouring mills	32	415	185,130	446.10	3,487,480
Furniture	10	662	213,320	322.24	577,810
Gas, electric light, etc	16	[b] 791	453,136	[b] 556.94	2,897,625
Lumber	14	910	303,810	333.86	805,000
Machinery and iron foundries	32	1,968	648,140	329.34	2,566,800
Brick, cement, etc	10	324	83,633	258.13	288,486
Planing mills	17	357	122,715	343.74	495,800
Printing and publishing	21	644	211,308	328.11	556,100
Pianos and organs	5	523	206,360	394.57	517,000
Sash, doors, and blinds	8	77	28,700	372.73	78,225
Wood specialties	11	352	109,580	311.31	302,160
Woolens and cottons	22	2,435	692,290	284.31	2,997,335
Miscellaneous	56	2,662	948,360	356.26	4,630,825
Total	305	[c] 14,332	5,048,622	[c] 345.47	23,950,589

[a] Not including 4 establishments not reported.
[b] Not including 1 establishment not reported.
[c] Not including 5 establishments not reported.

SWEDEN.

Undersökning af den mekaniska verkstadsindustrien i Sverige. I. Större egentliga mekaniska verkstäder. På uppdrag af kongl. kommerskollegium och under dess öfverinseende verkställd af Henning Elmquist. 1901. 359 pp.

The results of an investigation into the conditions of the larger factory establishments in Sweden in 1899 are contained in this report. The first 187 pages consist of text explaining the tables which compose the rest of the volume. The investigation was made under the supervision of the royal board of trade. Statistics are shown for 32 factory establishments, the main characteristics of which are given in the following table:

VALUE OF PRODUCT AND NUMBER OF PERSONS EMPLOYED IN THE LARGE FACTORY ESTABLISHMENTS, BY NUMBER OF EMPLOYEES TO AN ESTABLISHMENT, 1899.

Number of employees to an establishment.	Number of establishments.	Value of product.	Number of persons employed.
Over 500 persons	10	$6,703,414	7,187
From 300 to 500 persons	6	1,848,490	2,227
Under 300 persons	16	2,037,124	2,646
Total	32	10,589,028	12,060

The occupations of the 12,060 persons engaged in these establishments are shown in eleven age groups, as follows:

EMPLOYEES IN LARGE FACTORY ESTABLISHMENTS, BY AGE AND OCCUPATION, 1899.

Occupations.	Employees of each age group.											
	12 to 18.	18 to 25.	25 to 30.	30 to 35.	35 to 40.	40 to 45.	45 to 50.	50 to 55.	55 to 60.	60 to 65.	65 or over.	Total.
Foremen	.....	2	1	17	36	35	47	34	25	11	16	224
Founders	34	251	166	176	131	104	37	30	30	20	10	989
Core makers	146	91	17	10	13	3	5	4	2	1	3	295
Foundry laborers	29	115	46	44	25	31	21	21	15	9	11	367
Other foundry workers	11	33	32	34	45	26	18	18	17	6	7	247
Blacksmiths	4	62	73	51	62	56	62	24	39	19	21	473
Blacksmiths' helpers	66	212	50	37	24	30	24	25	8	12	9	497
Ship blacksmiths	6	37	55	45	48	49	36	42	26	16	4	364
Boiler makers	15	97	80	63	82	81	55	53	41	15	23	605
Hoop makers	.....	7	6	9	12	4	8	2	4	1	.....	53
Sheet-iron laborers	190	430	162	108	67	53	55	37	28	10	12	1,152
Other sheet-iron workers	42	13	8	15	14	13	12	8	6	5	1	137
Coppersmiths	23	43	26	13	15	11	12	3	7	3	6	162
Machine mounters	4	27	20	25	15	14	14	16	9	6	1	151
Filers	101	582	308	162	148	143	98	66	45	36	21	1,710
Pipe workers	.....	6	9	4	5	5	5	2	1	1	1	39
Setters-up	8	42	34	36	22	14	10	5	8	2	6	187
Lathe workers	151	349	136	99	69	53	42	40	15	10	10	[a]977
Planers	33	49	23	30	24	18	16	8	5	5	7	218
Turners	19	56	25	21	7	11	7	3	.....	1	1	151
Drillers	14	40	29	24	23	23	9	13	15	10	5	205
Polishers	17	14	11	7	11	11	5	6	4	1	1	88
Machinists' helpers	70	103	40	24	16	10	9	11	10	5	10	308
Other machine workers	74	114	53	28	36	27	24	19	16	14	16	421
Metal workers	18	22	18	6	9	5	1	3	2	.....	1	85
Pattern makers	16	61	39	39	44	31	38	23	25	16	28	360
Cabinetmakers	.....	21	13	19	17	21	23	18	17	12	7	[b]169
Carpenters	3	25	18	25	29	26	31	43	35	38	54	327
Other woodworkers	18	42	39	22	30	30	20	20	18	8	17	264
Painters	15	26	15	14	25	17	8	2	3	1	4	130
Engineers and firemen	2	14	12	9	10	16	12	14	9	9	5	112
Other workers	58	54	60	56	77	56	58	62	41	37	34	593
Total	1,187	3,040	1,624	1,272	1,191	1,027	822	675	526	340	352	[c]12,060

[a] Including 3 persons whose age was not reported.
[b] Including 1 person whose age was not reported.
[c] Including 4 persons whose age was not reported.

The length of the working day in the establishments under consideration is shown in the following table:

NUMBER OF EMPLOYEES IN LARGE FACTORY ESTABLISHMENTS, BY HOURS OF WORK PER WEEK, 1899.

Hours per week.	Number of employees.	Per cent of total.
Less than 54 hours	23	0.2
54 to 57 hours	795	6.6
57 to 60 hours	3,232	26.8
60 to 63 hours	6,955	57.6
63 to 66 hours	446	3.7
66 hours or over	540	4.5
Not reporting	69	.6
Total	12,060	100.0

The annual earnings of 5,161 persons steadily employed in the large establishments are shown in five classes in the following table:

PERMANENT EMPLOYEES IN LARGE FACTORY ESTABLISHMENTS, BY WAGE CLASSES AND OCCUPATIONS, 1899.

Occupations.	Employees in each wage class.									
	Over 1,500 kroner ($402).		1,500 to 1,200 kroner ($402 to $322).		1,200 to 800 kroner ($322 to $214).		800 to 500 kroner ($214 to $134).		Under 500 kroner ($134).	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Foremen	29	24.6	51	43.2	31	26.3	7	5.9	.....	.....
Founders	47	9.7	82	17.0	276	57.1	52	10.8	26	5.4
Core makers	.....	.....	.....	.....	17	27.9	23	37.7	21	34.4
Foundry laborers	.....	.....	1	1.1	31	34.1	51	56.0	8	8.8
Other foundry workers	.....	.....	12	12.1	55	55.6	32	32.3	.....	.....
Blacksmiths	33	12.8	38	14.7	141	54.7	46	17.8	.....	.....
Blacksmiths' helpers	.....	.....	.....	.....	44	29.9	89	60.6	14	9.5
Ship blacksmiths	1	.5	37	18.9	127	64.8	31	15.8	.....	.....
Boiler makers	7	2.3	51	16.7	159	51.9	82	26.8	7	2.3
Hoop workers	.....	.....	5	13.5	15	40.6	15	40.6	2	5.3
Sheet-iron laborers	.....	.....	.....	.....	161	41.6	189	48.8	37	9.6
Other sheet-iron workers	.....	.....	2	4.6	26	59.1	14	31.7	2	4.6
Coppersmiths	3	6.0	10	20.0	17	34.0	16	32.0	4	8.0
Machine mounters	5	6.4	15	19.2	41	52.6	12	15.4	5	6.4
Filers	24	3.5	100	14.5	344	49.9	174	25.3	47	6.8
Pipe workers	.....	.....	4	28.6	9	64.3	1	7.1	.....	.....
Setters-up	2	1.4	20	14.0	93	65.0	25	17.5	3	2.1
Lathe workers	23	5.3	48	11.2	200	46.5	100	23.3	59	13.7
Planers	6	5.1	15	12.8	53	45.3	30	25.7	13	11.1
Turners	3	3.7	7	8.7	35	43.8	27	33.8	8	10.0
Drillers	.....	.....	10	9.0	62	55.9	36	32.4	3	2.7
Polishers	1	1.8	8	14.3	34	60.7	10	17.8	3	5.4
Machinists' helpers	.....	.....	.....	.....	15	22.4	37	55.2	15	22.4
Other machine workers	4	1.9	27	13.2	100	48.8	56	27.3	18	8.8
Metal workers	4	9.5	5	11.9	13	31.0	14	33.3	6	14.3
Pattern makers	1	.6	23	12.7	114	63.0	33	18.2	10	5.5
Cabinetmakers	2	2.3	28	31.8	49	55.7	9	10.2	.....	.....
Carpenters	.....	.....	3	2.4	81	64.3	40	31.7	2	1.6
Other woodworkers	1	.8	16	12.9	63	50.8	42	33.9	2	1.6
Painters	2	3.0	9	13.2	37	54.4	17	25.0	3	4.4
Engineers and firemen	3	6.0	5	10.0	31	62.0	11	22.0	.....	.....
Other workers	.....	.....	3	1.4	68	31.6	113	52.6	31	14.4
Total	201	3.9	635	12.3	2,542	49.2	1,434	27.8	349	6.8

DECISIONS OF COURTS AFFECTING LABOR.

[This subject, begun in Bulletin No. 2, has been continued in successive issues. All material parts of the decisions are reproduced in the words of the courts, indicated when short by quotation marks, and when long by being printed solid. In order to save space, matter needed simply by way of explanation is given in the words of the editorial reviser.]

DECISIONS UNDER STATUTORY LAW.

BOYCOTTING—FREEDOM OF SPEECH AND OF THE PRESS UNDER STATE CONSTITUTION—INJUNCTION—*Marx & Haas Jeans Clothing Company v. Watson et al., Supreme Court of Missouri, 67 Southwestern Reporter, page 391.*—The clothing company here named sought by injunction to prevent Watson and his associates from declaring or enforcing a boycott against it by inducing its customers and others who might become such not to deal with it to the injury of its business. A temporary injunction was granted, but, on a hearing in the St. Louis circuit court, this injunction was dissolved and the petition dismissed. The company then appealed to the supreme court, which affirmed the action of the court below.

Marx & Haas had had trouble with their clothing cutters for some years, resulting first in a boycott by the Knights of Labor in 1895, and again in a boycott undertaken by a joint board of the Knights of Labor and the United Garment Workers of America, affiliated with the American Federation of Labor. In furtherance of this latter effort a circular reciting at some length the various difficulties and grievances was issued, and distributed freely among the patrons and possible patrons of the firm. This circular concluded: "We are positive we have proven to you the justice of our position, and we hope it will not be necessary to inform the labor and reform organizations with which we are affiliated who are in your locality, as we are satisfied we have convinced you that the stand we have taken in this case is a just one, and will command the support of all fair-minded men. We therefore request you to write to Messrs. Marx & Haas and inform them that you would request them to settle the dispute with their employees, or otherwise you can not afford to handle their goods as long as they are antagonizing organized labor, who are your friends and customers. By doing this you will aid us in getting simple justice from this more than unfair firm. Should this firm make a settlement with us, you

will be informed of the fact under the seals of the joint organizations. Until such time, we trust there will be no report made to our office that Marx & Haas have shipped you any more goods. Kindly inform us what action you take in this matter, and any further information you may desire will be cheerfully furnished by writing to headquarters of joint executive board, No. 911 Pine street, St. Louis, Missouri."

In addition to the sending of this circular, committees visited various merchants in St. Louis and vicinity to present the matter more fully, and in some instances threats were made by members of these committees that the patronage of the boycotters and their friends would be withheld from certain merchants unless they discontinued their business dealings with the clothing company. In no instance, however, were there threats of resort to violence or unlawful intimidation.

The petition of the clothing company concluded with the request that "the defendants, their associates, confederates, agents, and representatives, be enjoined and restrained by a temporary order of injunction, to be made final upon the hearing of this cause, from boycotting, or making effectual, promulgating, or in any wise proclaiming any boycott upon or against, the plaintiff or its goods, and from sending, conveying, or delivering in any way, to any person, firm, corporation, or association, any boycott notice, verbal or otherwise, referring to the plaintiff or its goods, and from in any way menacing, hindering, or obstructing the plaintiff from the fullest enjoyment of all the patronage, business, and custom which it may possess, enjoy, or acquire independent of the action of the said defendants, or any of them."

Judge Sherwood announced the opinion of the court. After stating the above facts and reviewing the evidence given before the court below, he disposed of the question of the jurisdiction of the Supreme Court in the case. Proceeding to the points in issue, he said:

Section 14 of our bill of rights declares that "no law shall be passed impairing the freedom of speech; that every person shall be free to say, write or publish whatever he will on any subject, being responsible for all abuse of that liberty." The evident idea of that section is penalty or punishment, and not prevention. Because, if prevention exists, then no opportunity can possibly arise for one becoming responsible by saying, writing, or publishing "whatever he will on any subject." The two ideas—the one of absolute freedom "to say, write or publish whatever he will on any subject," coupled with responsibility therefor, and the other idea of preventing any such free speech, free writing, or free publication—can not coexist. And just here it must be observed that the right of free speech, free writing, or free publication was not created by the Constitution, which recognizes those rights as now existing, and only seeks their protection and perpetuation.

Section 14, supra, makes no distinction, and authorizes no difference to be made by courts or legislatures, between a proceeding set on foot to enjoin the publication of a libel, and one to enjoin the publication of

any other sort or nature, however injurious it may be, or to prohibit the use of free speech or free writing on any subject whatever; because, wherever the authority of injunction begins, there the right of free speech, free writing, or free publication ends. No halfway house stands on the highway between absolute prevention and absolute freedom. The rights established by section 14 can neither be impaired by the legislature, nor hampered nor denied by the courts. Nor does it in any way change the complexion of this case by reason of its being alleged in the petition "that the defendants, and each of them, is [are] without means, and has [have] no property, over and above the exemption allowed by law, wherefrom the plaintiff might secure satisfaction for the damages resulting to it from the acts aforesaid." The Constitution is no respecter of persons. The impecunious man "who hath not where to lay his head" has as good right to free speech, etc., as has the wealthiest man in the community. And in this connection it is to be constantly borne in mind that the principle is firmly rooted in equity jurisprudence that, though there be no remedy at law, this does not necessarily and of itself give a court of equity jurisdiction to afford relief. The authority to enjoin finds no better harbor in the empty pocket of the poor man than in the full pocket of the rich man. And such authority to enjoin can have no existence in circumstances such as the present case presents, if the Constitution is to be obeyed. If these defendants are not permitted to tell the story of their wrongs, or, if you please, their supposed wrongs, by word of mouth, or with pen or print, and to endeavor to persuade others to aid them by all peaceable means in securing redress of such wrongs, what becomes of free speech, and what of personal liberty? The fact that in exercising that freedom they thereby do plaintiff an actionable injury does not go a hair toward a diminution of their right of free speech, etc., for the exercise of which, if resulting in such injury, the Constitution makes them expressly responsible. But such responsibility is utterly incompatible with authority in a court of equity to prevent such responsibility from occurring.

Judge Sherwood then stated that the question of the power of the court to enjoin in cases of intimidation, threats of violence, or of destruction of property was not passed upon, as not being involved in the record, and concluded:

Holding these views, we affirm the decree of dismissal entered in favor of defendants by the court below.

Judge Robinson dissented from the above.

CONTRACT OF EMPLOYMENT—INJUNCTION AGAINST VIOLATION—DEFENSES—COVENANTS IN RESTRAINT OF TRADE—UNLAWFUL COMBINATION—*Harrison v. Glucose Sugar Refining Co., United States Circuit Court of Appeals, Seventh Circuit, 116 Federal Reporter, page 304.*—Lee S. Harrison entered into a contract with the company named above for the term of five years, during which period he was to be and remain exclusively in the company's service and not to be or become interested in any way whatever in the business "of buying, manufacturing, or selling glucose, grape sugar, starch, or any kindred

products, or any of the products of a glucose factory, within a radius of fifteen hundred miles of the city of Chicago, Illinois," except in the service of this company. His compensation was fixed by the same contract at three hundred and thirty-three and one-third dollars per month, payable monthly.

After less than three years had expired, Harrison left the service of the Glucose Sugar Refining Company and entered that of the Illinois Sugar Refining Company at Pekin, Illinois. The latter company was a manufacturer of beet sugar and not a competitor of the Glucose Sugar Refining Company at the time of Harrison's engagement with it, but within a few months it began the manufacture of glucose and kindred products from corn, with Harrison as superintendent.

When Harrison first left the Glucose Company's service, he was informed by letter that his contract had not expired and was instructed to report to the general office. Again, when the Illinois Sugar Refining Company began the manufacture of glucose, he was addressed and offered a reinstatement in his former position and at the same time a protest was made against his violating his contract or using the information acquired during his service for the benefit of a rival company. Harrison paid no attention to these letters and the Glucose Company procured an injunction restraining him from engaging in the service or being in any way interested in any glucose factory within 1,500 miles of Chicago other than the one first employing him, and from imparting in any way to the Illinois Sugar Refining Company any information, knowledge, trade secrets, or processes relating to the business of his employers.

In his answer Harrison charged that the company is an unlawful pool, combination, monopoly, or trust, and that the area named includes the entire territory in the United States within which glucose and its kindred products are or can be successfully manufactured and marketed, so that the contract was unreasonable and void as being in restraint of trade. He denied the communication of any secrets by himself or that he intended to use any information imparted to him by the Glucose Company in his new position, and claimed that the company had a sufficient remedy at law for any damages sustained.

From the injunction an appeal was prosecuted, which resulted in its being affirmed. The conclusions of the court were given by Judge Jenkins, from whose remarks the following is quoted:

The objection that the appellee is an illegal trust or monopoly condemned by the law of the State of Illinois, and so declared by the supreme court of that State, can not be sustained. We have held in the case of an injurious combination of the nature here asserted that the remedy is by direct proceedings; that with respect to a contract which is independent of the illegal combination, and is merely incident to other and innocent purposes, one who voluntarily and knowingly deals with parties so combined can not on the one hand take the benefit of his bargain, and on the other defend against the contract on the

ground of the illegality of the combination. It is to be said also that since the submission of this case the Supreme Court of the United States in Conolly *v.* Sewer Pipe Co., 22 Sup. Ct., 431, has declared the antitrust law of the State of Illinois to be in derogation of the Constitution and an invalid enactment.

It is urged that the contract in question is one in restraint of trade because of the covenant that during the stipulated time of service the appellant would not, directly or indirectly, become interested in the specified business within a radius of 1,500 miles from the city of Chicago otherwise than under his engagement with the appellee. The doctrine of restraint of trade had its birth in conditions anciently obtaining, and now greatly changed. Then the area of trade was confined within narrow territorial bounds. Intercommunication has become largely extended, and trades anciently limited to a small locality have become national in their extent. The rule is bottomed upon the consideration whether such a covenant was broader than the covenantee required for his protection.

Notwithstanding some authorities which seem to have followed blindly the ancient rule, overlooking the reason of the rule and the changed conditions, it is not just to limit the territory within which restraint may be applied by any arbitrary geographical bounds, without regard to the nature and extent of the business in which the restraint is sought to be imposed. State lines can not justly be applied within the reason of the rule. It is a question not of State policy, but of national policy and of general law. The reasonableness of the restraint has respect to the territory occupied by the business. [Cases cited.]

In the contract in question the restraint is limited, as to time, to the period of service engaged for; as to territory, within a radius of 1,500 miles of the city of Chicago. It is contended that in the latter respect the restraint is unreasonable. The answer asserts that the territory described comprises the entire territory in the United States within which glucose and its kindred products are or can be successfully manufactured and marketed. The bill alleges that the market occupied by the appellee extends throughout the United States and to various foreign countries, but particularly extends throughout the territory described. Within the modern doctrine we can not say that this restraint is invalid, the circumstances being considered. The appellant engaged his services to the appellee for a specified term. He was to aid in the manufacture of glucose and its kindred products. He was to receive a compensation of $4,000 per annum, and in addition, as he states, was to have for his five years' service $17,500 par value of the common stock of the appellee. The restriction that during the term of service the appellant should not become interested in the manufacture of like products in the territory occupied by the appellee seems not unreasonable.

He engaged his whole service and his entire time for the period of five years and for a liberal compensation to be paid him. It is but common justice that during the period of service contracted, and from which service he had not been discharged, the appellant should not become interested in the manufacture or sale of the product of a rival in the business. The extent of the restraint here is only that during the time engaged for he should not enter the service of a rival within the territory occupied by his employer. There is in this agreement, as we conceive, nothing contrary to public policy. He is not deprived

of the opportunity to obtain the means of subsistence or of giving to the public the benefit of his skill in the business to which he has been accustomed. He has only to perform the duty which he engaged to perform to render himself and his family comfortable. We know of no public policy which requires us to sanction the bald violation of a contract lest the public should be deprived of the peculiar skill of the appellant because he will not exercise that skill where he has engaged to exercise it.

There is, however, another consideration which, as we think, should prevail to hold this contract valid. The appellant was under his contract employed in a confidential capacity in a business which, notwithstanding the denial of the appellant, we can not but believe upon the evidence presented required many secret processes. The statement of facts which precedes this opinion details the measures of care adopted to prevent knowledge of those secrets by rivals and by the servants in the business, except those occupying confidential relations. The record is replete with evidence, not necessary here to be set forth at large, to the effect that the experts were constantly experimenting to discover processes by which every part of the product might be utilized at the minimum of expense, and that the experiments and the results obtained were communicated confidentially to the appellant. It also satisfactorily appears, notwithstanding his denial, that the appellant entered into the employment of a concern not at the time engaged in a rival business, and forthwith superintended for them the construction of works for the manufacture of glucose and its kindred products with a view to compete with the appellee in such manufacture. Under the circumstances it would require something more than his mere denial to convince us that in the manufacture of glucose he would not employ the secrets of the business of the appellee which had been confidentially communicated to him. He could not well do otherwise. He was employed by the rival for that purpose. He was to give all his skill, including the knowledge confidentially acquired in the business of appellee, to his new master. He could not in good faith serve the one without breach of duty to the other. In such case it may well be doubted if the rule with respect to restraint of trade should apply, because these secrets of the business are the property of the appellee, to which the public has no right, and may not justly insist that it shall receive the benefit of the appellant's services through breach of confidence.

This is not a suit to enforce the specific performance of a contract for personal services, which it is conceded can not be done. The injunction sought to restrain the appellant from violating his covenant and from disclosing the secrets acquired by him while in the service of the appellee under his contract of employment. There is no adequate remedy at law for such violation. There are no means to determine the extent of the damages which would be sustained by disclosure of such secrets. To vacate the restraint imposed by the court below would practically decree for the appellant upon the merits of the case, for a decree would be useless if the secrets were once disclosed.

We are of opinion that the decree awarding the injunction should be affirmed.

EIGHT-HOUR LAW—CONTRACTS FOR WORK IN ALASKA—ARMY REGULATIONS—CONTRACTS WITH MECHANICS AND LABORERS—*Moses v. United States, United States District Court, District of Washington, Northern Division, 116 Federal Reporter, page 526.*—This was an action at law to recover from the Government of the United States under a contract to perform labor as a carpenter in Alaska. The work done was under the supervision of the War Department, the contract of hiring having been made by an officer in the quartermaster's department of the United States Army. In the performance of his work Moses was required to work ten hours per day during the summer season, the time being shortened to eight and one-half hours, and then to eight hours as the days became shorter. No allowance for excess was given, and it was for the purpose of securing an allowance for labor performed in excess of eight hours per day that this suit was brought. Moses relied on the Federal eight-hour law of August 1, 1892, and on article 62, paragraph 812, of the United States Army Regulations, which provides that "eight hours constitute a day's work for all mechanics and laborers employed by or on behalf of the United States, except in cases of emergency."

Judge Hanford, in announcing the decision of the court, spoke in part as follows:

Congress has not, by any express declaration, extended the entire body of the national laws to Alaska, but by special acts has made certain specified laws of Congress effective there, and has enacted a complete code of civil and criminal laws especially for Alaska, and it is my opinion that its treatment of Alaska evinces a purpose to govern that district by special local laws, and for that reason I hold that the eight-hour labor law of 1892 is not applicable to work contracted for by the Government to be performed in Alaska. The regulations prescribed by the War Department, however, were intended to be comprehensive, and to govern the conduct of the Army, and all work under the superintendence of its officers, whenever assigned to duty. The paragraph referred to defines what constitutes a day's work by laborers on works of the United States controlled by the War Department, and according to the regulations the contract must be construed as an agreement on the part of Major Bingham to pay the plaintiff at the rate of $5 per working day of eight hours. I hold that the plaintiff is entitled to extra compensation, to be computed at the rate of $5 for eight hours of labor for the aggregate number of additional hours in excess of eight hours per day which he was required to work when there was no special emergency.

In his petition the plaintiff alleges that by virtue of a custom having the force of law the rate of compensation for labor in excess of eight hours per day should be one and one-half times the contract rate, * * * but there is an entire failure of proof as to the existence of any such custom.

EMPLOYERS' LIABILITY—RAILROAD COMPANIES—DEATH FROM NEGLIGENCE—CONTRACT WITH RELIEF DEPARTMENT—EFFECT OF STATUTORY RECOVERY—*Oyster v. Burlington Relief Department of Chicago, Burlington and Quincy Railroad Co. et al., Supreme Court of Nebraska, 91 Northwestern Reporter, page 699.*—Margaret E. Oyster sued in the district court of Lancaster County, Nebr., to recover on a beneficiary certificate issued to her husband, Granville R. Oyster, who was killed in a railroad accident while in the employment of the railroad company named.

She had previously sued as administratrix and recovered $5,000, the full amount allowed by section 2, chapter 21, Compiled Statutes of Nebraska, claiming that this amount was for the use and benefit of the minor children of the deceased workman. The present action was for her personal benefit, as provided for in the certificate of the relief department. In this certificate was a clause providing that the acceptance of the benefits therein secured should operate as a release and satisfaction of all claims for damages against the railroad company for such injury, and that, if suit was brought against the company and should proceed to judgment or be compromised, all claims upon the relief fund should be precluded. Judgment was in favor of the relief department in the court below, and on appeal this was affirmed by the supreme court.

Judge Oldham, in announcing the judgment of the court, spoke in part as follows:

In the case at bar the widow of the deceased, as beneficiary of the certificate in issue, did not, in the first instance, elect to claim the benefit provided in such certificate, but, on the contrary, she took out letters of administration on the estate of the deceased, and in her representative capacity prosecuted the defendant railroad company under the provisions of the Lord Campbell's act, omitting, however, to name herself as widow among the beneficiaries. The result of the action was the recovery of the full amount allowed by statute for the wrongful killing of the deceased. In this action it is clear that the administratrix sued as trustee for all the beneficiaries permitted to recover under the provisions of section 2, c. 21, supra,—i. e., for the widow and the next of kin—and the mere fact that the petition omitted to name some one of the beneficiaries would not and could not prevent such beneficiary from participating in the distribution of the fund when recovered.

Seeing, then, that the railroad company has paid the full penalty prescribed by law for the unlawful killing of Granville R. Oyster to his personal representative, we must then look to the terms of the certificate on which this cause of action is predicated to determine whether or not it gives a further right of action to plaintiff for this same injury. It is plain that, if any such additional right of action for the wrongful killing of this man exists at all, it must be by the terms of the benefit certificate of the voluntary relief department of the defendant; and these terms provide that, if any authorized person brought a suit against the company which was prosecuted to judgment, or afterwards compromised, the beneficiary would have no claim on the relief fund.

Plaintiff must take this certificate with the conditions imposed by the contract, or not take it at all. Without the contract contained in this certificate, she has no right of action; and with the contract, by the condition it contained, she is barred from a recovery. [Cases cited.]

It is therefore recommended that the judgment of the district court be affirmed.

EMPLOYERS' LIABILITY — RAILROAD COMPANIES — SAFETY COUPLERS — PLEADING STATUTE — INTERSTATE TRAFFIC — PROXIMATE CAUSE — *Voelker v. Chicago, Milwaukee and St. Paul Railway Co., United States Circuit Court, Northern District of Iowa, Eastern Division, 116 Federal Reporter, page 867.*—In this case the administratrix of Emil Voelker brought action against the railway company named above to recover damages for the death of Voelker, which was occasioned by the coming together of two cars between which he was standing for the purpose of adjusting a defective coupler. Damages were awarded and a motion was made for a new trial, which was denied.

It was in evidence that the railway company had brought a loaded freight car from the State of Illinois into the State of Iowa, and that it was in the switch yard at Dubuque, where Voelker was employed. Cars were run upon the switch on which this car was standing for the purpose of being coupled thereto, but as the coupler was out of order so that it would not work automatically, Voelker undertook, as was his duty, to set the coupler so that it would work, and while so engaged other cars were run upon the switch, which caused Voelker to be caught and crushed between the cars where he was standing, and so occasioned his death.

Judge Shiras, in delivering the opinion of the court, said:

In the charge of the court the jury were instructed that, if the evidence proved that the car in question was brought by the defendant company from a point or station in Illinois to Dubuque, Iowa, then the company, in handling the same, was engaged in interstate traffic, and was subject to the provisions of the act of Congress approved March 2, 1893, and entitled "An act to promote the safety of employees and travelers upon railroads, by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes, and their locomotives with drive-wheel brakes and for other purposes" (27 Stat., 531). In support of the motion for a new trial it is earnestly contended that neither in the allegations of the petition nor in putting in the evidence did plaintiff base the case on the provisions of the act of Congress, and that the defendant was wholly taken by surprise by the action of the court in instructing the jury with respect to the duties imposed upon the company, as a common carrier engaged in interstate traffic, by the provisions of this act. The general rule invoked by the defendant that a plaintiff, to recover, must bring his proof within the allegations of his petition or declaration, is

not questioned; but the real inquiry is whether there was such a departure between the case declared on in the petition and the case made by the evidence that the latter will not fairly support the former.

A portion of the petition is then quoted, in which is set forth not only the fact that the cars were negligently run upon the track while Voelker was between the cars, but also the defective condition of the coupler, which was the cause of his going into the place of danger.

Continuing, the court said:

Upon the trial both parties introduced evidence upon this matter of the condition of the coupler, and much time was taken up in the introduction of testimony upon this point, and there is, therefore, no sufficient foundation upon which to base the claim that the defendant was not duly warned of the fact that the condition of the coupler was an issue in the case as one of the grounds upon which it was charged with negligence.

It is said, however, that the defendant was taken unduly by surprise, in that the court, in the charge of the jury, cited the provisions of the act of Congress of March 2, 1893, as applicable to the case, it being claimed that neither in the pleadings nor in the argument of counsel for plaintiff was any reference made to the act of Congress. As matter of pleading, it certainly can not be said that, in order to base a right of recovery on the provisions of the statute, it was necessary to cite the statute or its provisions in the petition. When the petition charged the defendant with negligence with respect to the coupler upon the car, the defendant must have known that, as the car was used in interstate traffic, the act of Congress would necessarily come into consideration in defining the obligations resting upon the defendant company. No matter what the views of counsel are upon the law of the case as expressed in their arguments, it is the duty of the court to give to the jury the law applicable to the facts, as the court understands it. If the law as given to the jury is applicable to the facts before them, no error is committed. If the law, as given, is not applicable, that is error, and cause for reversal; but the applicability of the law given is not dependent on the views of the counsel as expressed or omitted to be expressed in their argument before the jury.

But admitting to the fullest extent the claim now advanced that the counsel for defendant were taken by surprise by the action of the court in calling to the attention of the jury the named act of Congress, is this matter of surprise any sufficient reason for granting a new trial? At the close of the charge to the jury the court, following its usual custom, inquired of counsel whether there was any point or matter touching which counsel desired the jury to be instructed which was not covered by the charge as given. No such requests were made, and the case went to the jury under the instructions as originally given. The question of the actual condition of the coupler was thoroughly gone into before the jury, and evidence was introduced by both parties on this issue. Under such circumstances it can not be supposed that the court would be justified in granting a new trial upon the bare statement that perhaps it might be shown that the condition of the coupler was not in violation of the act of Congress.

It is next contended that it was error on part of the court to call the attention of the jury to the provisions of the act of Congress, because

it was not averred in the petition that the defendant had hauled or permitted to be used on its lines the car in question, or that it was hauled or used in connection with interstate traffic. If by this contention it is meant to assert that, in order to come within the purview of the act, it must be shown that at the time of the accident the car was loaded with freight which had been brought from another State, the answer is that the evidence proved such to be the fact in this case. But, further, that is not the proper construction of the act. The statutes, State and Federal, requiring railway companies to equip their cars with automatic couplers, were not enacted to protect the freight transported therein, but for the protection of the life and limb of the employees who were expected to handle these cars. The beneficent purpose of these statutes is defeated if the employees are required to handle cars not equipped as required by the statutes, without regard to the question whether the cars are loaded or not. Whenever cars are designed for interstate traffic, the company owning or using them is bound to equip them as required by the act of Congress; and when it is shown, as it was in this case, that a railway company is using the car for transportation purposes between two States, sufficient is shown to justify the court in ruling that the act of Congress is applicable to the situation.

It is next assigned as ground for a new trial that "it was error to leave it to the jury to find that the condition of the coupler was a proximate cause of the injury," it being claimed that the allegations of the petition and the evidence show that the alleged negligent kicking of the cars was the proximate and sole culpable cause of the injury. Subjecting an employee to risk to life and limb by calling upon him to use appliances which have become defective and inoperative through the failure to use proper care on part of the master is certainly negligence, which will become actionable if injury results therefrom to the employee; and liability therefor can not be avoided by the plea that, if the company was thus guilty of actionable negligence in this particular, it can not be held responsible therefor, because it was guilty of another act of negligence which aided in causing the accident. This accident happened because Voelker, in the performance of his duty, was called upon to place his person in a position where he might be caught between the cars he was expected to couple together. He was required to place himself in this dangerous position because of the negligent failure of the company to have upon the car a coupler in proper and operative condition, and certainly this negligent failure to [of] the company was a proximate cause of the accident.

The motion for new trial is overruled, and judgment will be entered on the verdict in favor of the plaintiff.

EMPLOYERS' LIABILITY—RAILROAD COMPANIES—SAFETY COUPLERS—SUFFICIENT EQUIPMENT—INTERSTATE TRAFFIC—ASSUMPTION OF RISK—*Johnson v. Southern Pacific Company, United States Circuit Court of Appeals, Eighth Circuit, 117 Federal Reporter, page 462.*—This case came before the circuit court of appeals from the circuit court of the United States for the district of Utah. In that court Johnson

had been denied damages for an injury received while employed by the Southern Pacific Company as brakeman, which judgment was affirmed in the circuit court of appeals.

Johnson undertook to make a coupling between a freight engine equipped with a Janney coupler and a dining car provided with a Miller hook or coupler. Both these couplers were automatic and worked satisfactorily with others of their kind, but would not work together, so that Johnson undertook to make the coupling with a link and pin, and in the effort his hand was caught and crushed so that it had to be amputated at the wrist. This was on a side track leading to a turntable where the car was being prepared for a return trip later in the day from Promontory, Utah, to San Francisco, Cal., from which latter city it had been brought in the regular course of traffic. Johnson was an experienced and competent brakeman and knew the risks of his calling, but it was held by his counsel that the common-law doctrine of assumption of risk was not applicable under the provisions of the act of Congress of March 2, 1893 (27 Stat., c. 196, p. 531), entitled "An act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes and their locomotives with driving-wheel brakes, and for other purposes." Section 1 of this act forbids the use, after January 1, 1898, of "any locomotive engine in moving interstate traffic not equipped with a power driving-wheel brake and appliances for operating the train-brake system." Section 2 relates to the hauling or use of "any car used in moving interstate traffic not equipped with couplers coupling automatically by impact, and which can be uncoupled without the necessity of men going between the ends of the cars." Section 6 prescribes the penalty for violation, while section 8 reads as follows:

"Any employee of any such common carrier who may be injured by any locomotive, car, or train in use contrary to the provision of this act shall not be deemed thereby to have assumed the risk thereby occasioned, although continuing in the employment of such carrier after the unlawful use of such locomotive, car, or train had been brought to his knowledge."

Johnson's counsel contended that this was a remedial statute, and that it should be broadly construed so as to relieve Johnson of any charge of assumption of risk or contributory negligence. This contention the court denied.

Judge Sanborn, speaking for the court, said:

The act of March 2, 1893, is a penal statute, and it changes the common law. It makes that unlawful which was innocent before its enactment, and imposes a penalty, recoverable by the Government. Its terms are plain and free from doubt, and its meaning is clear. It declares that it is unlawful for a common carrier to use in interstate

commerce a car which is not equipped with automatic couplers, and it omits to declare that it is illegal for a common carrier to use a locomotive that is not so equipped. As Congress expressed in this statute no intention to forbid the use of locomotives which were not provided with automatic couplers, the legal presumption is that it had no such intention, and provisions to import such an intention into the law and to effectuate it may not be lawfully enacted by judicial construction. The statute does not make it unlawful to use locomotives that are not equipped with automatic couplers in interstate commerce, and it did not modify the rule of the common law under which the plaintiff assumed the known risk of coupling such an engine to the dining car.

Continuing, the judge said:

There are other considerations which lead to the same result. If we are in error in the conclusion already expressed, and if the word "car," in the second section of this statute, means locomotive, still this case does not fall under the law, (1) because both the locomotive and the dining car were equipped with automatic couplers; and (2) because at the time of the accident they were not "used in moving interstate traffic."

For the reasons which have been stated, this statute may not be lawfully extended by judicial construction beyond the fair meaning of its language. There is nothing in it which requires a common carrier engaged in interstate commerce to have every car on its railroad equipped with the same kind of coupling, or which requires it to have every car equipped with a coupling which will couple automatically with every other coupler with which it may be brought into contact in the usual course of business upon a great transcontinental system of railroads. A car equipped with practical and efficient automatic couplers, such as the Janney couplers or the Miller hooks, which will couple automatically with those of their kind, fully and literally complies with the terms of the law, although these couplers will not couple automatically with automatic couplers of all kinds or constructions.

Again, the statute declares it to be unlawful for a carrier "to haul or permit to be hauled or used on its line any car used in moving interstate traffic not equipped," etc. It is not, then, unlawful, under this statute, for a carrier to haul a car not so equipped which is either used in intrastate traffic solely, or which is not used in any traffic at all. On the day of this accident the dining car in this case was standing empty on the side track. The defendant drew it to a turntable, turned it, and placed it back upon the side track. The accident occurred during the performance of this act. The car was vacant when it went to the turntable, and vacant when it returned. It moved no traffic on its way. How could it be said to have been "used in moving interstate traffic" either while it was standing on the side track, or while it was going to and returning from the turntable? The argument of counsel for the plaintiff is that because it had been used in moving interstate traffic on its way from San Francisco to Promontory, and because it was the intention of the defendant to put it to the same use in a few hours, when a west-bound train arrived, it was impressed with the use of moving such traffic in the interim. But this statute must be read not only in the light of the rules of construction to which we have adverted in the earlier part of this opinion, but also in view of the limitations upon the power of Congress in this

respect. It is by virtue of the power granted to Congress to regulate commerce among the States," and by virtue of that authority alone, that this statute was enacted and has efficacy. Congress had neither the authority nor the purpose to interfere with or to touch by this act anything except commerce among the States. Is the turning of a vacant car which its owner intends to use at some future time in moving interstate traffic any part of commerce among the States? Does the intention of the owner as to a future use of an implement of transportation affect the character of the act of turning this car? If the defendant had intended to use this dining car for traffic within the State of Utah only, if it had intended to send it to the shop to be destroyed or repaired, or if, after the car was turned, it had changed its intention and concluded that it would not use it to move interstate traffic, would any of these intentions or this change of purpose have affected the act of turning the car, and have impressed it with a use in interstate commerce or intrastate commerce? The only answer to these questions is a negative one, and, if this be true, then the intention of the defendant to use this car at some future time in interstate commerce would not make the act of turning it a part of such commerce, nor bring it under the ban of the act of March 2, 1893. The judgment below must accordingly be affirmed, and it is so ordered.

Judge Thayer concurred in affirming the judgment of the court below because the car and the locomotive were each equipped with automatic couplers, even if not fitted for use together, holding such provision to be a compliance with the law. He dissented from other conclusions of the majority, however, saying:

In my judgment, it is a very technical interpretation of the provisions of the act in question, and one which is neither in accord with the spirit nor with the obvious purpose of the lawmaker, to say that Congress did not intend to require engines to be equipped with automatic couplers. The statute is remedial in its nature; it was passed for the protection of human life; and there was certainly as much, if not greater, need that engines should be equipped to couple automatically, as that ordinary cars should be so equipped, since engines have occasion to make couplings more frequently. In my opinion, the true view is that engines are included by the words "any car," as used in the second section of the act. The word "car" is generic, and may well be held to comprehend a locomotive or any other similar vehicle which moves on wheels; and especially should it be so held in a case like the one now in hand, where no satisfactory reason has been assigned or can be given which would probably have influenced Congress to permit locomotives to be used without automatic coupling appliances.

I am also of opinion that, within the fair intent and import of the act, the dining car in question at the time of the accident was being hauled or used in interstate traffic. The reasoning by which a contrary conclusion is reached seems to me to be altogether too refined and unsatisfactory to be of any practical value. It was a car which at the time was employed in no other service than to furnish meals to passengers between Ogden and San Francisco. It had not been taken out of that service, even for repairs or for any other use, when the accident occurred, but was engaged therein to the same extent that it would have been if it had been hauled through to Ogden, and if the

accident had there occurred while it was being turned to make the return trip to San Francisco. The cars composing a train which is regularly employed in interstate traffic ought to be regarded as used in that traffic while the train is being made up with a view to an immediate departure on an interstate journey as well as after the journey has actually begun.

EMPLOYMENT OF WOMEN—HOURS OF LABOR—CONSTITUTIONALITY OF STATUTE—*Wenham v. State, Supreme Court of Nebraska, 91 Northwestern Reporter, page 421.*—In this case William Wenham was convicted of a violation of an act of the legislature which restricts the hours of employment of females in certain industries and provides for the enforcement of its requirements. It was charged that Wenham in operating a laundry had employed one Lizzie Falconer for fourteen hours per day and eighty-four hours per week. Section 1 of the law referred to provides "that no female shall be employed in any manufacturing, mechanical, or mercantile establishment, hotel, or restaurant in this State more than sixty hours during any one week, and that ten hours shall constitute a day's labor. * * *" Other sections relate to the posting of printed notices stating hours of labor, mealtime, time of beginning and ending the day's work, the providing of seats for female employees, the penalty for violation, and the method of enforcing the law.

Wenham claimed that the law was unconstitutional, as relating to more than one subject, the constitution of the State declaring that no bill shall contain more than one subject, and the same shall be clearly expressed in the title. It was further held that the bill was an amendment in unconstitutional form of a previous enactment, that it was special or class legislation, and that it deprived certain citizens of property rights without due process of law.

On these claims of unconstitutionality the district court of Douglass County allowed error, and on the points named the case came before the supreme court of the State, where the law was upheld and the conviction affirmed.

The following syllabus by the court presents its conclusions on each of the points mentioned:

1. The act of the legislature approved March 31, 1899, "to regulate and limit the hours of employment of females in manufacturing, mechanical and mercantile establishments, hotels and restaurants; to provide for its enforcement and a penalty for its violation," contains but one subject, and in its terms is no broader than its title, in which its subject is clearly expressed.

2. Such law does not amend the act of 1883 to protect the health of female employees in stores, offices, and schools. It is an act complete in itself, and is not repugnant to the provisions of section 11, article 3, of the constitution.

3. The law as expressed therein has a uniform and general application to all women employed in the establishments described therein, and is not class legislation, within the meaning of section 15, article 3, of the constitution.

4. The act, in effect, is only a fair and reasonable exercise of the police power. It does not deprive any citizen of his property, or the reasonable use thereof, without due process of law. It does not prohibit the right of contract. It merely regulates the same in a reasonable manner. It is therefore not in conflict with the constitution, and is in all things valid.

EMPLOYMENT OF WOMEN—HOURS OF LABOR—CONSTITUTIONALITY OF STATUTE—*State v. Buchanan, Supreme Court of Washington, 70 Pacific Reporter, page 52.*—This case arose under an act of the legislature of 1901 (Session Laws, p. 118), which closely resembles the Nebraska statute in question in the foregoing case of Wenham *v.* State. Information was submitted charging a violation of this law, to which information a demurrer was interposed on the ground that no offense was charged. The superior court of King County, Wash., sustained the demurrer, whereupon the State appealed and secured from the supreme court a reversal of the court below.

Buchanan relied on the constitutional provision that no person shall be deprived of life, liberty, or property without due process of law. On this point Judge Dunbar, who delivered the opinion of the court, said:

It may be conceded without discussion that a citizen's right to contract his or her labor is a valuable property right, which can not be restricted by the legislature, unless such restriction is necessary in the proper exercise of the police power of the State. Conceding that an arbitrary exercise of the legislative will, which, under the guise of a police power, restricts constitutional rights, can not be maintained, we are of the opinion that the act in question was a legitimate exercise of the police power of the State, enacted for the welfare of society at large, and is therefore constitutional. On this subject the authorities are somewhat divided, though we think the great weight of modern authority sustains statutes similar to the one under consideration.

The case of Ritchie *v.* People, 155 Ill., 98, 40 N. E., 454 (see Bulletin of the Department of Labor, No. 2, p. 203), is cited as the only case found in which an act of this kind has been declared unconstitutional by a court of last resort. Com. *v.* Hamilton Mfg. Co., 120 Mass., 383, and Holden *v.* Hardy, 169 U. S., 366, 18 Sup. Ct., 383 (see Bulletin of the Department of Labor, No. 17, p. 625), are cited as supporting the conclusions of the court.

The following is quoted from In re Jacobs, 98 N. Y., 98, 50 Am. Rep., 636: "When a health law is challenged in the courts as unconstitutional on the ground that it arbitrarily interferes with personal liberty and private property without due process of law, the courts

must be able to see that it has at least in fact some relation to the public health, that the public health is the end actually aimed at, and that it is appropriate and adapted to that end."

Judge Dunbar then said:

Accepting this statement of the law, we think it is easily ascertainable from a perusal of this act that its object was the public health, and that its provisions were appropriate, and adapted to that end. We think no constitutional right is invaded by this law, and the case will be reversed, with instructions to overrule the demurrer to the complaint.

GARNISHMENT—WAGES OF LABORER—PAYMENT—*Hill v. Arnold et al., Supreme Court of Georgia, 42 Southeastern Reporter, page 475.*—In this case Arnold & Co. sued J. B. Hill on a promissory note in the city court of Elberton and caused summons of garnishment to be served on the bank of Elberton. The bank answered that it held, subject to the order of the court, the sum of $127.38 that had been "deposited in the bank of Elberton to the credit of" Hill. Hill claimed that said sum was deposited in the bank by Mrs. R. C. Mattox at the request of S. P. Mattox and not at his request nor with his consent. It was further claimed that $100 of this sum was earned by Hill as a farm laborer in the employ of S. P. Mattox and was therefore not liable to garnishment.

The judge of the city court, presiding without a jury, rendered judgment in favor of Arnold & Co. for the entire sum in the bank, whereupon Hill moved for a new trial, which was not allowed, and Hill excepted. On this exception the case came before the supreme court, which reversed the judgment of the court below.

It appeared that Mattox gave Hill an order on his mother, who went with Hill to the bank to get the money, but the bank was closed, the day being a holiday. Mrs. Mattox then promised to arrange with the cashier for Hill to get the money there. In the afternoon of that day the cashier drove out to the home of Mrs. Mattox, and she gave him the money due Hill. When Hill applied at the bank for the money he was told that it was garnisheed and not subject to his order. Mrs. Mattox testified that she did not know that anything was said about depositing the money in the bank to Hill's credit; that she just told Mr. Hill that if she should go to Atlanta she would make arrangements with Mr. Heard for him to get his money at the bank. Hill testified hat he did not agree that Mrs. Mattox should deposit the money in the bank to his credit.

Judge Cobb, who delivered the opinion of the court, having stated the facts, said:

It is not contended that the wages of Hill as a farm laborer were not exempt from garnishment, but it is insisted that the judge could have found from the evidence that the money was deposited in the bank to

the credit of Hill with his consent, and that, this being so, it became mingled with the general funds of the bank, and stood in the position of an ordinary debt due by the bank to Hill. In other words, it is claimed that the transaction which took place between all these parties was equivalent to a payment of the money to Hill, and a deposit of it by him in the bank to his credit. We do not think this conclusion is fairly warranted by the evidence. The real meaning of the transaction was that S. P. Mattox constituted his mother his agent to pay Hill the money, and that Mrs. Mattox constituted the cashier of the bank her agent to do this; and the evidence probably warranted the inference that Hill consented that the cashier should so act. There was never any payment of the money to Hill, and we do not think the evidence authorized a finding that he so regarded the transaction. The code provides that the wages of certain classes of laborers, "whether in the hands of their employers or others," shall be exempt from garnishment. (Civ. Code, sec. 4732.) This being so, the money in the hands of the bank of Elberton was not subject to garnishment unless it had first passed, either actually or in legal contemplation, through Hill's hands. The judge erred in rendering judgment in favor of Arnold & Co. for the entire sum in the hands of the garnishee.

MECHANICS' LIENS—EFFECT OF DEBTOR'S DISCHARGE IN BANKRUPTCY—PERSONAL JUDGMENT AGAINST CONTRACTOR—*Holland v. Cunliff et al., Court of Appeals at St. Louis, Mo., 69 Southwestern Reporter, page 737.*—This was a suit to enforce a mechanic's lien under the Missouri statute (Rev. St. 1899, sections 4203–4227) after a discharge in bankruptcy of the debtor in accordance with the Federal statute of 1898. Holland obtained judgment on his lien in the St. Louis circuit court, from which the defendants appealed. Judge Barclay delivered the opinion of the court of appeals, affirming the judgment of the court below. From the syllabus prepared by the judge the following matter is reproduced:

2. Under Missouri statutes, the lien of a mechanic or materialman dates from the time of the commencement of the improvement. Such a lien is "not obtained through legal proceedings," within the meaning of the Federal bankrupt act of 1898, and is not discharged thereby.

3. The intent of the bankrupt act of 1898 appears to be to make the discharge personal to the debtor, and not to release other parties liable with him, or liens not declared to be released.

4. Where a judgment lien has been obtained against the property of a garnishee, the discharge in bankruptcy of the principal debtor will not release the lien.

5. A personal judgment against the contractor is not essential to a mechanic's lien under the Missouri statute. Even the omission to make the contractor a party to the lien suit is a mere irregularity.

9. Where separate buildings have been erected upon contiguous lots under one general contract, a mechanic's lien may be obtained, on proper proceedings, against all of the property, under the Missouri statute.

10. A mechanic's lien for labor or materials in erecting a building is a paramount lien on the building as against a prior deed of trust on the land on which the building is situated.

LAWS OF VARIOUS STATES RELATING TO LABOR ENACTED SINCE JANUARY 1, 1896.

[The Second Special Report of the Department contains all laws of the various States and Territories and of the United States relating to labor in force January 1, 1896. Later enactments are reproduced in successive issues of the Bulletin from time to time as published.]

DISTRICT OF COLUMBIA.

U. S. STATUTES—ACTS OF 1901-02.

CHAPTER 1352.—EXPENSES OF THE GOVERNMENT.

Exemption from taxation.

SECTION 6, PARAGRAPH 10. The following personal property shall be exempt from taxation:

Second. Libraries, schoolbooks, wearing apparel, articles of personal adornment, all family portraits, and heirlooms.

Third. Household and other belongings, not held for sale, to the value of one thousand dollars, owned by the occupant of any dwelling house or other place of abode, in which such household and other belongings may be located.

License tax for employment offices, etc.

SEC. 7, PAR. 42. Proprietors or owners of intelligence offices, information bureaus, registries, or employment offices, by whatsoever name called, shall pay a license tax of ten dollars per annum.

Approved July 1, 1902.

GEORGIA.

ACTS OF 1900.

ACT No. 175.—*Taxation—Emigrant agents.*

[Page 21.]

SECTION 2. In addition to the ad valorem tax on real estate and personal property, as required by the constitution and provided for in the preceding section, the following specific taxes shall be levied and collected for each of said fiscal years:

Tenth. Upon each emigrant agent, or employer or employee of such agents, doing business in this State, the sum of five hundred dollars for each county in which such business is conducted.

Approved December 21, 1900.

ACTS OF 1901.

ACT No. 428.—*Wages due deceased employees of corporations.*

[Page 60.]

SECTION 1. From and after the passage of this act it shall be lawful upon the death of any person employed by any railroad company, or other corporation doing business in this State, who may have wages due him by said railroad company, or other corporation, and who shall leave surviving him a widow or minor child or children, to pay all of said wages, when they do not exceed one hundred dollars, and in case such wages exceed one hundred dollars, to pay the sum of one hundred dollars thereof to the surviving widow of such employee, and in case he has no surviving widow, but leaves surviving a minor child or children, then said sum shall be paid to said minor child or children without any administration upon the estate of said employee, and that said fund to the amount of one hundred dollars, after the death of said employee, is hereby exempt from any and all process of garnishment.

SEC. 2. Such railroad company, or other corporation, are hereby required to pay over said fund on the demand of said widow, and in case there be no surviving widow, then on the demand of said minor child or children, or the guardian thereof.

SEC. 3. Said railroad company, or other corporation, paying over said fund as aforesaid, shall be, and are, hereby protected and released from all claims whatsoever against said fund by the estate of said employee or creditors thereof, or the claims of said widow or minor child or children, or the guardian thereof.

SEC. 4. All laws and parts of laws in conflict with this act are hereby repealed.

Approved December 18, 1901.

ACT No. 390.—*Contract of employment—Interference by third parties.*

[Page 63.]

SECTION 1. When the relation of employer and employee, or of landlord and tenant of agricultural lands, or of landowner and cropper, has been created by written contract duly executed before an officer authorized to administer oaths, it shall be unlawful for any person during the life of said contract, made and entered into in the manner above prescribed, to employ or to rent lands to, or to furnish lands to be cropped by said employee, tenant or cropper, or to disturb in any way said relation, without first obtaining the written consent of said employer, landlord, or landowner, as the case may be.

SEC. 2. Any person violating the provisions of the foregoing section shall at the option of the party alleged to have been injured, be prosecuted as for a misdemeanor, and upon conviction punished as provided in section 1039 of the Penal Code, or he shall be liable in damages to said alleged injured party, as follows: (1) In case of employer and employee, the damages shall not be less than double the amount of wages or salary for the entire period of said contract. (2) In case of landlord and tenant, or of landowner and cropper, the damages shall not be less than double the annual rental value of the lands rented or cropped, said value to be fixed at 1,000 pounds of middling lint cotton to the plow.

SEC. 3. In addition to other defenses, the following defenses in both civil and criminal cases arising under the provisions of this act shall be good and sufficient, when proved in every item to the satisfaction of the jury, to wit:

1. For the defendant to show that prior to the alleged violation of this act said employee, tenant or cropper, as the case may be, had for good reason and just cause abandoned his said contract and terminated the relation created thereby.

2. For the defendant to show as a complete defense all of the following facts, to wit: That prior to employing or otherwise contracting with said employee, tenant or cropper, he received from said employee, tenant or cropper an affidavit to the effect that said employee, tenant or cropper was not at the time under a prior existing contract, which affidavit defendant shall show to the court, and that immediately on proof that said employee, tenant or cropper was under contract defendant discharged him, and refused to permit and did not permit him to remain on his (defendant's) premises.

Whenever in a suit for the recovery of damages the defendant shall urge his defense successfully, he shall have judgment against the plaintiff for all costs and reasonable attorney's fees, and in case of a like result in the prosecution of a criminal case under the provisions of this act, the defendant shall have a like judgment against the prosecutor.

SEC. 4. The provisions of this act shall not apply where the employment given is of such duration and of such nature as to make it certain that it could not result in injury to the plaintiff or prosecutor.

SEC. 5. All laws and parts of laws in conflict with this act are hereby repealed.

Approved December 17, 1901.

ACT No. 343.—*Laborers' liens—Hauling logs, lumber, etc.*

[Page 80.]

SECTION 1. From and after the passage of this act all persons hauling stocks, logs or lumber, with teams for another person, shall have a lien against the personalty so hauled by them to the extent of the amount of the indebtedness, if by contract, and to the extent of the value of said services so rendered, if the price to be paid for the same is not agreed upon.

SEC. 2. Such lien, when so created, shall have and take the same rank as is now provided in section 2809 of the Civil Code of Georgia.

SEC. 3. The mode of enforcing said lien, when so created, shall be as prescribed in section 2816 of the Civil Code of Georgia.

SEC. 4. All conflicting laws are hereby repealed.

Approved December 16, 1901.

UTAH.

ACTS OF 1901.

CHAPTER 41.—*Hours of labor—Eight-hour law.*

SECTION 1. Section 1336 of the Revised Statutes of Utah, 1898, is hereby amended to read as follows:

1336. Eight hours shall constitute a day's work on all works or undertakings carried on or aided by the State, county or municipal governments. Any person, corporation, firm, contractor, agent, manager, foreman or any officer of the State, or any county or municipal government thereof, who shall require or contract with any person to work upon such works or undertakings longer than eight hours in any one calendar day, except in cases of emergency where life or property is in imminent danger, shall be deemed guilty of a misdemeanor.

Approved this 14th day of March, 1901.

CHAPTER 44.—*Coercion of employees—Company stores and boarding houses.*

SECTION 1. Every person, body-corporate, agent, manager, or employer, doing business in the State of Utah, who by coercion, intimidation, threats or undue influence, compels his employees to boarding at a particular boarding house, or to trade with or at a particular store, shall be deemed guilty of a misdemeanor.

SEC. 2. This act shall take effect upon approval.

Approved this 14th day of March, 1901.

CHAPTER 52.—*Protection of street railway employees—Inclosed platforms.*

SECTION 1. From and after the first day of November, 1901, it shall be unlawful for any person, partnership, or corporation owning or operating a street railway in this State, or for any officer or agent thereof, superintending or having charge or control of the management of the said line of railway, or of the cars thereof, operating electric, cable or other cars propelled either by steam, cable or electricity, which require when in operation the constant services, care or attention of any person or persons on any part of such car, to require or permit such services, attention or care of any of its employees, or any other person or persons between the first day of November, and the first day of April of each year, unless such person, partnership or corporation, its officers or superintending or managing agents have first provided, at least one-third of the entire number of cars so owned, with a proper and sufficient inclosure, constructed of wood, iron and glass or similar suitable materials, sufficient to protect such employees from exposure to the inclemencies of the weather: *Provided*, That such inclosure shall be so constructed as not to obstruct the vision of the person operating such car. That two-thirds of the said cars so owned shall be provided with inclosures as heretofore described, on or before the first day of November, 1902; and that the remaining one-third of such cars so owned shall be provided with inclosures in a similar manner on or before the first day of November, 1903.

SEC. 2. It shall be unlawful for any such person, partnership or corporation so owning or operating a street railway using steam, electric or cable cars, or any superintending or managing officer or agent thereof, to cause or permit to be used upon such line of railway, between said first day of November, and said first day of April, of each and every of said years, any car or cars upon which services of any employee such as specified in section 1 of this act, is required, unless said car or cars shall be provided with the inclosure required by said section 1 of this act.

SEC. 3. Any person, partnership, or corporation owning, operating, superintending or managing any such line of street railway, or managing, superintending officer or agent thereof, who shall be found guilty of a violation of the provisions of sections 1 or 2, of this act, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than $50 nor more than $250. Each day any of said persons cause or permit any of their said employees to operate such car or cars in violation of the provisions of section 1 of this act, or cause or permit cars to be run or operated in violation of section 2 of this act, shall be deemed a separate offense: *Provided*, That the provisions of this act shall not apply to cars used and known as trailing car or cars used solely in construction or repair work, or car or cars known as open or summer cars.

Approved this 14th day of March, 1901.

CHAPTER 55.—*Bureau of statistics.*

SECTION 1. A State bureau of statistics is hereby created and shall be under the control of a commissioner, who shall be appointed by the governor, by and with the consent of the senate, and whose term of office shall be four years and until his successor is appointed and qualified. He shall have an office at the capital of the State, and shall have the power to appoint a deputy and such other assistants, from time to time, as shall be necessary for the transaction of the business of his office.

SEC. 2. The duties of said bureau shall be to collect, assort, systematize and present in annual reports to the governor, statistical details relating to agriculture, mining, manufactures and other industries in the State; said reports to be published annually and distributed under the direction of the State board of examiners.

SEC. 3. The commissioner of the bureau of statistics shall have power to issue subpœnas, administer oaths and take testimony in all matters relating to the duties herein required by said bureau, said testimony to be taken in some suitable place in the vicinity to which testimony is applicable. Witnesses subpœnaed and testifying before the commissioner of the bureau shall be paid the same fees as witnesses before a justice's court, such payment to be made out of the contingent fund of the bureau in advance, but such expense for witnesses shall not exceed $100 annually. Any person duly subpœnaed under the provisions of this section, who shall willfully neglect or refuse to attend or testify at the time and place named in the subpœna, shall be deemed guilty of a misdemeanor, and upon conviction thereof before any court of competent jurisdiction, shall be punished by a fine not exceeding $50 and costs of prosecution, or by imprisonment in the county jail not exceeding thirty days: *Provided, however*, That no witness shall be compelled to go outside the county in which he resides to testify.

SEC. 4. Said commissioner shall give a bond of $10,000 for the faithful performance of the duties required by this act. The commissioner shall receive a compensation of $1,500 per annum and actual traveling expenses, to be audited and paid as with other State officers.

SEC. 5. In the reports of the commissioner no use shall be made of names of individuals, firms or corporations supplying the information called for by this act, such information being deemed confidential and not for the purpose of disclosing personal affairs; and any officer or employee of the bureau of statistics violating this provision shall be deemed guilty of a misdemeanor, and, upon conviction thereof, shall be fined in a sum not exceeding $500 and costs of prosecution, or by imprisonment in the county jail not exceeding one year.

SEC. 6. No report or return made to said bureau in accordance with the provisions of this act, and no schedule, record or document gathered or returned by its officers or employees, shall be destroyed within two years of the collection or receipt thereof. At the expiration of two years all records, schedules or papers accumulating in said bureau during said period, that may be considered of no value by the commissioner, may be destroyed: *Provided*, The authority of the State senate be first obtained for such destruction.

SEC. 7. Said bureau may collect the information called for by this act, or such information as the commissioner shall consider essential to perfect the work of the bureau, from the several State, county, city, town, precinct and school district officers, and from officers of prisons, penal and reformatory institutions; and it shall be the duty of all such officers to furnish, upon the written or printed request of the commissioner, such information as shall be considered necessary for the purposes of this act, upon blanks furnished by said bureau. Each owner, operator, or manager of industrial, mining or agricultural business, or other person having information necessary to the work of the bureau of statistics, shall, upon request of the commissioner, furnish the same, upon blanks to be provided by the said bureau.

SEC. 8. Each county assessor, or his deputies, at the time of taking lists of property for taxation for each year, shall require each person, company and corporation in his county or district, to make a statistical statement of the previous year, as indicated on blanks furnished by the bureau, as follows:

Agriculture: Number of acres, and production per acre, of each kind of crop; number of acres of different kinds of pasture; number of fleeces of wool, and average weight of the same; name of manager of farm; size of farm; quantity of land under fence; quantity of land not under fence; quantity of land under cultivation; assessed value of farm and of farming implements; number of different kinds of live stock, poultry, stands of bees; amount of honey produced; number of acres of nurseries, orchards and vineyards, with the production thereof and the amount of capital invested therein; number of mules, horses, cattle, sheep and hogs, subdivided into the breeds or classes where they belong; number and value of slaughtered animals; canals, reservoirs, etc., constructed and cost thereof.

Manufactures: Number of establishments; name and post-office address of corporation, company or individual producing; name of business; kind of motive power; average number of hands employed; capital invested; raw material used; product; number of flouring mills, woolen mills, saw mills, or factories of different classes; number of pounds of cheese and butter produced in factories; number and kind of cows used; number of mercantile establishments, average number of employees in each; and amount of capital invested; number of workshops and average number of employees; minimum wages; maximum wages; average wages; number of hours per day employees are required to work.

Mining: Quantity of precious or other metals produced or handled; capital employed; approximate area of property; area of undeveloped property.

In addition they shall furnish such other information as shall be practicable in the discharge of their duties, as listed on the blanks provided by the bureau.

These blanks shall be returned by the county assessor to the State bureau of statistics.

SEC. 9. An appropriation of $6,000 or so much thereof as may be necessary, is hereby made to carry out the purposes of this act.

Approved this 14th day of March, 1901.

CHAPTER 68.—*Board of labor, conciliation, and arbitration.*

SECTION 1. Upon the approval of this act the governor, by and with the consent of the senate, shall appoint three persons, not more than two of whom shall belong to the same political party, who shall be styled a State board of labor, conciliation and arbitration. One shall be an employer of labor; another shall be an employee and be selected from some labor organization; and the third shall be some person who is neither an employee nor an employer of manual labor, and shall be chairman of the board. One shall serve for one year, one for three years, and one for five years, as may be designated by the governor at the time of their appointment. At the expiration of their terms their successors shall be appointed in like manner for the term of four years. Should a vacancy occur at any time, the governor shall, in the same manner, appoint some one to serve the unexpired term, and until the appointment and qualification of his successor. Each member of said board shall, before entering upon his duties, take the constitutional oath of office. The board shall select from its members a secretary and shall establish suitable rules of procedure.

SEC. 2. Whenever it shall come to the knowledge of the said board that a strike or lockout is seriously threatened in the State, involving any employer and his employees, if he is employing not less than ten persons, it shall be the duty of the said board to put itself into communication as soon as may be with such employer and employees, and endeavor by mediation to effect an amicable settlement. Said board shall also request each of the parties to forward, to its secretary, an application for arbitration.

SEC. 3. As soon as practicable, after receiving such applications, the board shall request each of the parties to the dispute to agree upon a written statement of facts, relating to the controversy, and to submit the same to the board: *Provided*, That, when such agreement and statement can not be reached, each of said parties may separately submit to the board a written statement of grievances. Applications to the said board for arbitration on the part of employers must precede any lockout, and, on the part of the employee[s], any strike: *Provided*, That, in case a lockout or strike already exists, the board shall accord arbitration if the parties shall resume their relations with each other, as employers and employees. Said applications shall include a promise to abide by the decision of the board and shall be signed by the employer or employers, or his or their authorized agent, on the one side, and by a majority of his or their employees on the other.

SEC. 4. As soon as practicable, after receiving said applications, the board shall proceed to arbitrate. When it shall be necessary, in the judgment of said board, it may engage the services of a stenographer to take and transcribe an account of any arbitration proceedings.

SEC. 5. The board shall have power to summon as witnesses by subpœna any operative or expert in the departments of business affected, and any person who keeps the record of wages earned in those departments, or any other person, and to administer oaths, and to examine said witnesses, and to require the production of books, papers and records. In case of disobedience to a subpœna the board may invoke the aid of any court in the State in requiring the attendance and testimony of witnesses, and the production of books, papers and documents under the provisions of this section. Any of the district courts of the State, within the jurisdiction of which such inquiry is carried on, may, in case of contumacy, or refusal to obey a

subpœna issued to any such witness, issue an order requiring such witness to appear before said board and produce books and papers if so ordered, and give evidence touching the matter in question. Any refusal to obey such order of the court may be punished by such court as a contempt thereof.

SEC. 6. It shall be the duty of mayors of cities and sheriffs of counties, when any condition likely to lead to a strike or lockout exists, in the cities, or districts where they have jurisdiction, to immediately forward information of the same to the secretary of the State board of conciliation and arbitration. Such information shall include the names and addresses of persons who should be communicated with by the board.

SEC. 7. Any notice or process issued by the State board of labor, conciliation and arbitration shall be served by any sheriff, to whom the same may be directed, or in whose hands the same may be placed for service, without charge.

SEC. 8. As soon as practicable, after the board has investigated the differences existing between employer and employees, it shall make an equitable decision, which shall state what, if anything, should be done by either or both parties to the dispute, in order to amicably settle and adjust the differences existing between them. The findings of a majority of the board shall constitute its decision.

SEC. 9. This decision shall at once be made public; shall be recorded upon the proper book of record to be kept by the secretary of said board, and a short statement thereof published in an annual report to be made to the governor before the first day of March, of each year.

SEC. 10. The members of the board shall each receive a compensation of $4 for each day's services, while engaged in arbitration, said compensation to be paid by the parties to the controversy in such proportion as the board may decide; they shall also receive the actual and necessary expenses incurred in the performance of their official duties, which expenses shall be paid out of the State treasury.

SEC. 11. Chapter 1 of title 36 of the revised statutes of Utah, 1898, is hereby repealed.

SEC. 12. This act shall take effect upon approval.

Approved this 14th day of March, 1901.

CHAPTER 85.—*Mine regulations—Inspection.*

SECTION 1. For the purpose of securing an efficient and thorough inspection of coal and hydro-carbon mines within the State of Utah and to provide for an adequate force therefor, the governor shall appoint, by and with the consent of the senate, one mine inspector for coal and hydro-carbon mines. The inspector so appointed shall hold his office for the term of four years from the date of his appointment and until his successor is appointed and qualified: *Provided*, That such inspector may be removed at the pleasure of the governor. In case of resignation, death or removal, the vacancy shall be filled by the governor for the unexpired term.

SEC. 2. The said inspector of coal and hydro-carbon mines shall receive a salary of two thousand ($2,000) dollars a year and actual necessary traveling expenses incurred in the proper discharge of his official duties, to be paid quarterly by the State treasurer out of any moneys appropriated for that purpose, on the certificate of said inspector of mines showing service rendered, and also on presentation of the certificate of said inspector of coal and hydro-carbon mines showing a statement of all moneys received by him for fees, and the actual amount necessarily expended for actual traveling expenses for the quarter; and on presentation of such certificates the State auditor shall issue his warrant for the amount thereof, to be paid out of any appropriations aforesaid. He is hereby authorized to procure such instruments and stationery from time to time as may be necessary to the proper discharge of his duties under this act, at the expense of the State, which shall be paid by the State treasurer upon accounts duly certified by him and audited by the proper department of the State.

SEC. 3. Before entering upon the discharge of his official duties, the inspector shall give a bond to the State in the sum of ten thousand ($10,000) dollars, to be approved by the proper officers, conditioned for the faithful performance of his duties. Said bond shall be deposited with the secretary of state. The person so appointed must be a citizen of Utah, and must have attained the age of thirty years. He must have a knowledge of different systems of working coal mines, and he must produce satisfactory evidence to the governor of having had at least five years' practical experience in the coal mines of Utah. He must have had experience in coal mines where noxious and explosive gases are evolved. He must hold the certificate of examination required by law to be held by mine foremen of the State.

SEC. 4. The said inspector shall not act as manager or agent or lessee for any mining or other corporation during his term of office, but shall give his whole time and attention to the duties of his office.

SEC. 5. Every owner, agent, manager or lessee of any coal or hydro-carbon mines in this State shall freely admit the inspector or his assistants to such mine on the exhibition of his certificate of appointment, for the purpose of making the examination and inspection provided for in this act, whenever the mine is in active operation, and render any necessary assistance for such inspection; but said inspector or his assistants shall not unnecessarily obstruct the working of said mine. Upon the refusal of the owner, agent, manager or lessee to admit the inspector or his assistants to such mine, such owner, agent, manager or lessee shall be subject to a fine of not less than fifty dollars nor more than five hundred dollars for each and every such offense.

SEC. 6. The owner, agent, manager or lessee of any coal or hydro-carbon mine in this State shall make, or cause to be made, an accurate map or plan of the workings of such mine, on a scale of one hundred feet to the inch, which said map shall show all the openings or excavations, shafts, tunnels, slopes, planes, entries, cross-headings, rooms, etc., and show the directions of the air current and also the water system therein, and shall accurately show the boundary lines between said mine and adjoining mines. Such map or plan, or true copy thereof, shall be furnished to the inspector, and one copy shall be kept at such mine for the inspection of the inspector or employees thereof. The owner, agent, manager or lessee, at least once in every six months, shall place or cause to be placed on the map or plan, an accurate showing of all additional excavations which have been made in the mine during the said six months. The several maps or plans of mines in this State, which are furnished to the inspector, shall be the property of the State, and shall remain in the care of the said inspector, and shall be transferred by him to his successor in office; and in no case shall any copy of any of them be made without the consent of the owner, agent, manager or lessee. If the inspector shall find or have good reason to believe that any map or plan of any mine made or furnished him, in pursuance of the provisions of this act, is materially inaccurate or imperfect, he is authorized to cause a correct plan or map of said mine to be made, at the expense of the owner, agent, manager or lessee thereof: *Provided*, That if the map or plan which was claimed to have been inaccurate shall be found to be practically correct, then the State shall have to pay the expense of making the new map or plan of such mine.

SEC. 7. It shall be unlawful for the owner, operator or superintendent of any mine to employ any person or persons in such mine for the purpose of working therein, unless there are in connection with every seam or stratum of coal, worked in such mine, not less than two openings or outlets, separated by a stratum of not less than one hundred and fifty feet at surface and not less than thirty feet at any place, at which openings or outlets, safe and distinct means of ingress and egress shall at all times be available for the persons employed in the said mine. The escapements, shafts or slopes shall be fitted with safe and available appliances by which the employees of the mine may readily escape in case an accident occurs deranging the hoisting machinery at the outlets. In slopes used as haulage roads where the dip or incline is ten degrees or more, there must be provided a separate traveling way, which shall be maintained in a safe condition for travel, and kept free from dangerous gases. No inflammable structure, other than a frame to sustain pulleys or sheaves, shall be erected over the entrance to any mine; and no inflammable structure for the purpose of storing coal shall be erected nearer than two hundred feet to any such opening. But this act shall not be construed to prohibit the erection of a fan and its approaches for the purpose of ventilation, nor of a trestle for the transportation of cars from any slope or other opening. All entrances to any place, not in actual course of working, where explosive gas is known to exist, shall be properly fenced across the whole width, so as to prevent all persons from entering the same.

Hand rails and sufficient safety catches shall be attached to, and a sufficient cover overhead shall be provided on every cage used for lowering or hoisting persons in any shaft. The ropes, safety catches, links and chains shall be carefully examined every day that they are used by a competent person employed for that purpose by the mine owner, agent, manager or lessee, and any defect therein found shall be immediately remedied.

SEC. 8. It shall be the duty or [of] every owner, agent, manager or lessee to keep at the mouth of every mine, or at such other places as may be designated by the mine inspector, stretchers properly constructed for the purpose of carrying away any employee working in and around the mine, who may be injured in and about his employment.

SEC. 9. Every owner, agent, manager or lessee of coal or hydro-carbon mines shall provide and maintain a constant and adequate supply of pure air.

1. It shall be unlawful to use a furnace, for the purpose of ventilating any mine wherein explosive gases are generated.

2. The minimum quantity of air provided shall not be less than 100 cubic feet per minute for each and every person employed in every mine, and 300 cubic feet for each and every animal employed therein, and as much more as the circumstances may require.

3. The ventilating current shall be conducted and circulated to the face of each and every working place through the entire mine, in sufficient quantities to dilute, render harmless and sweep away smoke and noxious or dangerous gases to such an extent that all working places and traveling roads shall be in a safe condition for working and traveling therein.

4. All worked out or abandoned parts of any mine in operation, so far as practicable, shall be kept free from dangerous bodies of gases or water; and if found impracticable to keep the entire mine free from a dangerous accumulation of standing gases or water, the mine inspector shall be immediately notified.

5. Every mine wherein are employed more than 75 persons, must be divided into two or more districts. Each district shall be provided with a separate split of pure air, and the ventilation shall be so arranged that not more than 75 persons shall be employed at the same time in any one current or split of air.

6. All cross-cuts connecting the main inlet and outlet air passages, when it becomes necessary to close them permanently, shall be substantially closed with brick or other suitable material laid in mortar or cement, whenever practicable, but in no case shall said cross-cut stoppings be constructed of plank, except for temporary purposes.

7. All doors used in assisting or in any way affecting the ventilation shall be so hung and adjusted that they will close automatically. Main doors regulating the principal air currents of a mine shall be so placed in all cases where it is practicable, that when one door is open, another, which has the same effect upon the same current of air, shall be and remain closed.

8. All permanent air bridges shall be built of such material and of such strength as the circumstances may require.

9. The quantities of air in circulation shall be ascertained with an anemometer, or other efficient instrument; such measurements shall be made by the inside foreman or other competent person at least once every week. A report of these air measurements shall be forwarded to the mine inspector, together with the statement of the number of persons employed in each district, on or before the twelfth day of each month for the preceding month.

10. For the purpose of properly ventilating rooms and entries, cross-cuts in rooms shall not be more than 70 feet apart, and cross-cuts in main entries shall not, except in cases of urgent necessity, be less than 70 feet, nor more than 200 feet apart, the said provisions as to air shall not apply to hydro-carbon mines.

SEC. 8. Every owner, agent, manager or lessee of mines within the State of Utah shall provide and maintain a water system for the purpose of conducting water to the face of each and every working place, and throughout the entire open part of the mine, in sufficient quantities for sprinkling purposes to wet down the dust that shall arise and accumulate in and around the mine: *Provided*, That in mines or parts of mines where by reason of the natural wet condition, or the moisture derived from the introduction of steam into the air currents, or both, such sprinkling may not be necessary. And it shall be the duty of the superintendent, mine foreman and inspectors to see to it that this is done.

SEC. 9. It shall be the duty of every owner, operator, superintendent, or mine foreman to furnish to the miners all props, ties, rails and timbers necessary for the safe mining of coal and for the protection of the lives of workmen. Such props, ties, rails and timbers shall be suitably prepared and shall be delivered within 100 feet of the face of the room, or entry, free of charge.

SEC. 10. The following general rules shall be observed by every mine owner, operator, superintendent, mine foreman and employee within the State of Utah:

1. Every owner or operator of every mine shall use every reasonable precaution to insure the safety of the workmen, in all cases and shall place the underground workings thereof under the charge and daily supervision of a person, who shall be known as "mine foreman," and who must hold a mine foreman's certificate.

2. All accessible parts of abandoned portions of mines in which explosive gases have been found or are known to exist, shall be carefully examined by the mine foreman or his assistants, at least once in each and every week, and all danger existing therein from such gases shall be removed as soon as possible. A report of each and every examination shall be recorded in a book kept for that purpose, signed by the person making the examination.

3. In all mines known to generate explosive gases, the mine foreman, or fire bosses, shall make a careful examination every morning of all working places and traveling ways, and all other places which might endanger the safety of the workingmen, within three hours prior to the time at which the workmen shall enter the mine.

Such examination shall be made with the safety lamp. No person except those whose presence is necessary to prepare the mine for the entrance of the workmen, shall enter the mine or any part thereof, until the mine foreman or fire boss of his district shall report to him that his place is in a safe condition.

The mine foreman or fire boss making such examination shall record the result of his examination in a book kept for that purpose, which book shall be opened to the inspection of the mine inspector and all employees.

4. In any working place approaching any place where there is likely to be an accumulation of explosive gases, no light or fire other than locked safety lamps shall be allowed or used. Whenever safety lamps are required in any mine they shall be the property of the owner or operator, and a competent person, who shall be appointed for that purpose, shall examine every safety lamp immediately before it is taken into the mine for use. He shall clean, lock and otherwise ascertain if it is safe for use: *Provided*, That all fire bosses, or those who inspect the mine for the presence of explosive gases, must also personally examine their own lamps and be responsible for their safe condition.

5. Any miners or other persons having charge of a working place in any mine shall for his own protection keep the roof and sides thereof properly secured by timbering or otherwise, so as to prevent such roof and sides from falling and injuring him or his fellow-workmen; and he shall not do any work or permit any work to be done under loose rock or dangerous material, except for the purpose of securing the same.

6. No more than ten persons shall be hoisted or lowered at any one time in any shaft or slope. This, however, shall not prohibit the hoisting or lowering of ten or more persons at any one time on slopes where five or more loaded cars are regularly hoisted.

7. No person in a state of intoxication shall be allowed to go into or loiter about the mine.

8. Any miner or other workman who shall discover anything wrong with the ventilating current or with the condition of the roof, sides timbers or roadway, or with any other part of the mine in general, such as would lead him to suspect danger to himself or his fellow-workmen, or the property of his employer, shall as soon as possible report the same to the mine foreman or other person being in charge of that portion of the mine.

9. Any person or persons who shall knowingly or willfully damage, or without proper authority remove or render useless any fencing, means of signaling, apparatus, instrument or machine, or shall throw open or obstruct any air way, or open any ventilating door and not leave the same closed, or enter a place in or about a mine against caution, or carry fire, open lights or matches in places where safety lamps are used, or handle without proper authority, or disturb any machinery or cars, or do any other act or thing whereby the lives or health of persons or the security of property in or about the mine are endangered, shall be deemed guilty of a misdemeanor.

10. Gunpowder or any other explosive shall not be stored in a mine, and a workman shall not have at any time in any one place more than one can or box containing six and one-quarter pounds of powder: *Provided*, That under special conditions a larger amount may be allowed in a mine for immediate use, when approval of such action is made in writing by the State inspector.

11. Every person who has gunpowder or other explosives in a mine, shall keep it in a wooden or metallic box, securely locked, and such box shall be kept at least ten feet from the tracks in all cases where room at such a distance is available.

12. In charging holes for blasting in coal, slate or rock in any coal or hydrocarbon mine, no iron or steel-pointed needles shall be used, and a tight cartridge shall not be rammed into a hole in the coal, slate or rock with an iron or steel tamping bar, unless the bar is tipped with copper or other soft metal.

13. The charge of powder or any other explosive in coal, slate or rock which has missed fire, shall not be withdrawn or the hole reopened, except where such holes are tamped with wet wood pulp.

14. Before commencing work and also after firing of every blast, the miner working a room or other place in the mine, shall enter such room or place to examine and ascertain its conditions, and his assistant shall not go to the face of such room or place until the miner has examined the same and found it to be safe.

15. No person shall be employed to blast coal or rock unless the mine foreman is satisfied that such person is qualified by experience to perform the work with ordinary safety, or unless he is placed at work with an experienced miner.

16. Every passageway equipped with mechanical haulage used by persons as a regular traveling way for travel, and also at the same time used for transportation of coal or other material, shall be of sufficient width to permit persons to pass moving cars with safety, but if found impracticable to make any passageway of sufficient width,

then holes of ample dimensions, and not more than 150 feet apart shall be made on one side of said passageway. The said passageway and safety holes shall be kept free from obstructions and the roof and sides of the same shall be made secure. Safety holes when necessary shall also be made at the bottom of all slopes and plans and kept free from obstruction to enable the footman to escape readily in case of danger.

17. It shall be unlawful for any owner, operator, superintendent or mine foreman, of any mine which generates explosive gases, to employ any person who is not competent to understand the regulations of any mine evolving explosive gases.

18. No person or persons shall be permitted to enter any dry gilsonite or elaterite mine with any kind of light other than an electric or other safety lamp.

19. For the purpose of making known the provisions of this act to all persons employed in and around the mines the owner and operator of each and every mine within the State, to which this act applies shall post in a conspicuous place or places at or near the entrance of the mine, where they may be conveniently read by all persons employed therein, the foregoing rules, and keep the said rules posted at all times.

SEC. 11. The duties of the mine inspector, other than those heretofore enumerated, shall be as follows:

1. It shall be the duty of the mine inspector to make a careful and thorough inspection of each coal and hydro-carbon mine operated within the State at least once every three months, and oftener if the condition of the mines require his attention. He shall make an annual report to the governor, showing the condition of each and every coal and hydro-carbon mine in the State. He shall examine into the condition as regards the safety of the workmen of such mine working, machinery, ventilation, drainage and the method of lighting or using lights, and into all other matters connected with the working safety of persons in such mine, and give directions providing for the better health and safety of persons employed in or about the same. The owner or operator is hereby required to freely permit such entry, inspection, examination, inquiry and exit, and to furnish a guide when necessary. The said inspector shall make a record of his visit, noting the time of the inspection and the material circumstances of the same, and shall also notify the owner or operator of the mine by a written report of the condition of the mine at the time of such inspection.

2. If the inspector finds that a mine is not properly worked, or is not furnished with proper machinery or appliances for the safety of the miners and all other employees, it shall be his duty to give written notice to the owner or manager of such mine that it is unsafe, and such notice shall specify in what particulars the mine is unsafe, and shall direct the owner or manager thereof to make such improvements as are necessary within a reasonable period. If the improvements are not made as required in the notice, it shall be unlawful for the owner or manager to operate such mine until such improvements are completed.

SEC. 12. In shaft or slope mines where persons are lowered or hoisted by machinery, a metal speaking tube or other suitable appliance shall be provided in all cases so that conversation or signaling may be carried on through the same from the top to the bottom of the shaft or slope.

SEC. 13. Whenever by reason of an explosion or any other accident in any coal or hydro-carbon mine or the machinery connected therewith, loss of life or serious personal injury shall occur, it shall be the duty of the person having charge of such mine or colliery to give notice thereof promptly to the said mine inspector, and if any person is killed thereby, to the coroner of the county, who shall give due notice of the inquest to be held. If the coroner shall determine to hold an inquest, the inspector shall be allowed to testify, and offer such testimony as he shall deem necessary to thoroughly inform the said inquest of the causes of death, and the said inspector shall have authority at any time to appear before such coroner and jury and question or cross-question any witness, and in choosing the jury for the purpose of holding such inquest, it shall be the duty of the coroner to impanel at least two men experienced in coal mines on such jury. It shall be the duty of such inspector, when possible, upon being notified as herein provided, to immediately repair to the scene of the accident and give such directions as may appear necessary to secure the future safety of the men, and he shall proceed to investigate and ascertain the causes of the explosion or accident, and make a record thereof, which he shall file; and to enable him to make the investigation, he shall have the power to compel the attendance of persons to testify and to administer oaths and affirmations; the cost of such investigation shall be paid by the county in which the accident occurred, in the same manner as the costs of coroner's inquests are paid by law.

SEC. 14. On the petition of the mining inspector, the district court in any county in this State shall at the first term, after the approval of this act, appoint an examin-

ing board for such county, consisting of the State inspector of coal mines, and operator of a coal mine and a coal miner, who shall be citizens of the United States, and the latter two of which board shall have at least five years of experience in the mines of the State, whose duty it shall be to examine any person applying thereto as to his competency and qualifications to discharge the duties of mining boss; said board of examiners shall meet at the call of the inspector, and they shall grant certificates to all persons whose examination shall disclose their fitness for the duties of mining boss, and such certificate shall be sufficient evidence for the competency and qualification of the holders for the duties of said office: *Provided*, That any person who shall have been employed as a miner at least five years in the coal mines of Utah and as a mining boss continuously by the same person or firm or corporation, for the period of one year preceding the approval of this act, may be entitled, if in the judgment of the inspector he be qualified, to a certificate without undergoing such examination; but he shall not be employed by any other person or firm or corporation without having undergone such examination. The members of the examining board, other than the inspector, shall hold the office for the period of two years from the date of their appointment, and shall receive four dollars per day for each day necessarily and actually employed, and actual and necessary traveling expenses, while employed in their official duties, to be paid by the State. Vacancies in the membership of the board shall be filled by the court of the proper county except the vacancy in the office of inspector. Sessions of the examining board shall not exceed three days in each quarter, and for any certificate granted the board shall receive the sum of one dollar, the same to be paid into the State treasury. No person shall act as fire boss unless granted a certificate of competency by the State inspector of coal mines. After the approval of this act no owner, operator, contractor, lessee or agent shall employ any mining boss or fire boss who does not have the certificate of competency required. Said certificate shall be posted up in the office of the mine, and if any accident shall occur in any mine in which a mining boss or a fire boss shall be employed who had no certificate of competency, as required by this chapter, by which any miner shall be killed or injured, he or his estate shall have a right of action against such operator or owner, lessee or agent, and shall recover the full damage sustained; in case of death such action to be brought by the administrator of his estate, within three years from the date of accident, the proceeds recovered to be divided among the heirs of the deceased according to law.

SEC. 15. The provisions of this act shall not apply to or effect [affect] any coal or hydro-carbon mine in which not more than six men are employed in twenty-four hours.

SEC. 16. The neglect or refusal to perform the duties required to be performed by any section of this act, or the violation of any of the provisions hereof, shall be deemed a misdemeanor, and any person so neglecting or refusing to perform such duty or violating such provisions, shall, upon conviction, be punished by a fine of not less than one hundred dollars, nor more than five hundred dollars for each and every such offense.

SEC. 17. Chapter 2 of title 42 of the Revised Statutes of Utah, 1898, is hereby repealed.

SEC. 18. This act shall take effect upon approval.

Approved this 14th day of March, 1901.

CHAPTER 128.—*Mine regulations—Protection against fire.*

SECTION 1. All mines having but one exit, and the same is covered with the building containing the mechanical plant, furnace room, or blacksmith shop, shall have fire protection. Where steam is used, hose of sufficient length to reach the farthest point of the plant shall be attached to feed pump or injector, and the same kept ready for immediate use. In mines where water is not available, chemical fire extinguishers or hand grenades shall be kept in convenient places for immediate use, and it shall be the duty of any owner or operator of a mine in the State of Utah, to provide fire protection as mentioned in this section, by July 1, 1901.

SEC. 2. Any person or corporation who shall refuse or neglect to comply with the provisions of this act, shall be guilty of a misdemeanor.

Approved this 25th day of March, 1901.

CHAPTER 129.—*Mine regulations—Safety cages.*

SECTION 1. It is unlawful for any person or corporation to sink any vertical shaft, where mining cages are used, to a greater depth than two hundred feet, unless the shaft is provided with an iron-bonneted safety cage to be used in lowering and hoist-

ing employees, or any other person. The safety apparatus, whether consisting of eccentrics, springs or other device, must be securely fastened to the cage and of sufficient strength to hold the cage loaded at any depth, to which the shaft may be sunk. The iron bonnet must be made of boiler sheet iron of good quality, at least three-sixteenths of an inch in thickness and must cover the top of the cage in such manner as to afford the greatest protection to life and limb from any débris or anything falling down the shaft.

SEC. 2. Any violation of this act is punishable by a fine of not less than two hundred or more than five hundred dollars, the same to be paid into the county treasury of the county in which the case is tried.

SEC. 3. This act shall take effect upon approval.

Approved this 25th day of March, 1901.

WEST VIRGINIA.

ACTS OF 1901.

CHAPTER 5.—*Trade-marks, etc., of trade unions.*

1. Whenever any person, firm or corporation, or any association or union of workingmen, has heretofore adopted or used, or shall hereafter adopt or use any label, trade-mark, term, design, device or form of advertisement for the purpose of designating, making known, or distinguishing any goods, wares, merchandise or other product of labor, as having been made, manufactured, produced, prepared, packed or put on sale, by such person, firm, corporation or association or union of workingmen, or by a member or members of such association or union, and shall register the same as provided in section three of this act, it shall be unlawful to knowingly counterfeit or imitate such label, trade-mark, term, design, device or form of advertisement, or to knowingly use, sell, offer for sale, or in any way utter or circulate any counterfeit or imitation of any such label, trade-mark, term, design, device or form of advertisement.

2. Whoever so knowingly counterfeits or imitates any such registered label, trade-mark, term, design, device or form of advertisement; or knowingly sells, or offers for sale, or in any way utters or circulates any counterfeit or imitation of any such registered label, trade-mark, term, design, device or form of advertisement; or knowingly keeps or has in his possession, with intent that the same shall be sold or disposed of, any goods, wares, merchandise or other product of labor to which or on which any such counterfeit or imitation is printed, painted, stamped or impressed; or knowingly sells or disposes of any goods, wares, merchandise or other product of labor contained in any box, case, can or package to which or on which any such counterfeit or imitation is attached, affixed, printed, painted, stamped or impressed or knowingly keeps or has in his possession, with intent that the same shall be sold or disposed of, any goods, wares, merchandise or other product of labor in any box, case, can or package, to which or on which any such counterfeit or imitation is attached, affixed, printed, stamped or impressed, shall be punished by a fine of not more than five hundred dollars or by imprisonment for not more than three months, or by both such fine and imprisonment.

3. Every such person, firm, corporation, association or union that has heretofore adopted or used, or shall hereafter adopt or use, a label, trade-mark, term, design, device or form of advertisement as provided in section one of this act, shall register the same by filing the same for record in the office of the secretary of state by leaving two copies, counterparts or facsimiles thereof, with said secretary and by filing therewith a sworn application specifying the name or names of the person, association or union on whose behalf such label, trade-mark, term, design, device or form of advertisement, shall be filed; the class of merchandise and a description of the goods to which it has been or is intended to be appropriated, stating that the party so filing, or on whose behalf such label, trade-mark, term, design, device or form of advertisement shall be filed, has the right to the use of the same; that no other person, firm, association, union or corporation has the right to such use, either in the identical form or in any such near resemblance thereto as may be calculated to deceive, and that the facsimiles or counterparts filed therewith are true and correct. There shall be paid for such filing and recording a fee of one dollar. Said secretary shall deliver to such person, association, or union, so filing or causing to be filed any such label, trade-mark, term, design, device or form of advertisement so many duly attested certificates of the recording of the same as such person, firm, corporation, association or union may apply for, for each of which certificates said secretary shall receive a fee of one dollar. Any such certificates of record shall in all suits and prosecutions under this act be sufficient proof of the adoption of such labels, trade-marks, terms, designs, devices or form of advertisement. Said secretary of state shall not record for

any person, union, or association, any label, trade-mark, term, design, device or form of advertisement, that would probably be mistaken for any label, trade-mark, term, design, device or form of advertisement theretofore filed by or on behalf of any other person, firm, corporation, union or association. But the said secretary shall file and record under this act any label, trade-mark, term, design, device or form of advertisement, which may have been previously filed by any person, firm, corporation or any association or union of workingmen, provided the person, firm, corporation, association or union seeking to file and record under this act is the same person, firm, corporation, association or union that previously filed or recorded the same label, trade-mark, term, design, device or form of advertisement.

4. Any person who shall for himself, or on behalf of any other person, firm, corporation, association or union, procure the filing of any label, trade-mark, term, design or form of advertisement, in the office of the secretary of state under the provisions of this act, by making any known false or fraudulent representations, or declaration, verbally or in writing, or by any fraudulent means, shall be liable to pay any damages sustained in consequence of any such filing, to be recovered by or on behalf of the party injured thereby in any court having jurisdiction, and shall be punished by a fine not exceeding five hundred dollars or by imprisonment not exceeding three months, or by both such fine and imprisonment.

5. Every such person, firm, corporation, association or union adopting or using any such registered label, trade-mark, term, design, device or form of advertisement, as aforesaid, may proceed by suit for damages to enjoin the manufacture, use, display or sale of any counterfeits or imitations thereof, and all courts of competent jurisdiction shall grant injunctions to restrain such manufacture, use, display or sale, and award the complainant in any such suit damages resulting from such manufacture, use, sale or display, as may be by the said court deemed just and reasonable, and shall require the defendants to pay such person, association or union, all profits derived from such wrongful manufacture, use, sale or display; and such court shall also order that all such counterfeits or imitations in the possession or under the control of any defendant in such cause be delivered to an officer of the court, or to the complainant, to be destroyed.

6. Every person, firm, corporation, association or union, who shall knowingly use or display the genuine label, trade-mark, term, design, device or form of advertisement of any such person, firm, corporation, association or union when registered as aforesaid, in any manner, not being authorized so to do by such person, firm, corporation, association or union, shall be deemed guilty of a misdemeanor and shall be punished by imprisonment for not more than three months or by a fine of not more than five hundred dollars. In all cases where such association or union is not incorporated suits under this act may be commenced and prosecuted by any officer or member of such association or union on behalf of and for the use of such association or union.

7. Any person, firm, corporation, association, or union, who shall in any way knowingly use the name or seal of any such person, firm, corporation, association or union, or officer thereof, in and about the sale of goods or otherwise, not being authorized to so use the same, shall be guilty of a misdemeanor and shall be punished by imprisonment for not more than three months or by a fine of not more than five hundred dollars.

8. Nothing contained in this act shall be construed as affecting or impairing any right or remedy at law or in equity now existing for the protection of any label, trade-mark, term, design, device or form of advertisement, whether or not the same is registered under the provisions hereof.

Passed February 21, 1901. In effect ninety days from passage. Approved February 23, 1901.

CHAPTER 8.—*Protection of street railway employees—Inclosed platforms.*

1. From and after the first of January in the year of our Lord 1902, it shall be unlawful for any person, partnership, or corporation, owning or operating a street railway in this State, or for any officer or agent thereof having charge or control of the management of such line of railway, or the cars thereof, operating electric, cable or other cars propelled either by steam, cable or electricity, which require the constant services, care or attention of any person or persons upon the platforms of any such car, to require or permit such services, attention or care, of any of its employees, or any other person or persons, between the first day of November and the first day of April thereafter of each year, unless such person, partnership or corporation, its officers or superintending or managing agents, have first provided the platforms of said car or cars with a proper and sufficient inclosure constructed of wood, iron and glass, or similar suitable material, sufficient to protect such employees from exposure to the

winds and inclemencies of the weather: *Provided*, That such inclosure shall be constructed so as not to obstruct the vision of the person operating such car, or to endanger or interfere with its safe management by the operator.

2. From and after January first in the year of our Lord 1902, it shall be unlawful for any person, partnership or corporation, so owning or operating street railways using steam, electric or cable cars, or any managing officer or agent thereof, to cause or permit to be used upon such line of railway, between said November first and April first of each and every year thereafter, any car or cars upon which the services of any employee, such as specified in section one of this act, is required, unless said car or cars shall be provided with the inclosure required by section one of this act.

3. Any person, partnership or corporation, owning, operating, superintending or managing any such line of street railway, or managing or superintending officer or agent thereof, who shall be found guilty of a violation of the provisions of section one or two of this act, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine of not less than twenty dollars nor more than one hundred dollars; and in default of payment of the same, imprisonment in the county jail in which such conviction is had until such fine shall be paid. Each day that any said person or persons, partnership or corporation, cause or permit any of their said employees to operate such car or cars in violation of the provisions of sections one and two of this act, or cause or permit a car or cars to be used or operated in violation of said section two of this act, shall be deemed a separate offense: *Provided*, That the provisions of this act shall not apply to cars used and known as trailing cars.

4. It is hereby made the duty of the prosecuting attorney of any county in which any such street railway is situated and operated, upon information given him by any credible person, or upon knowledge that he may possess, that any person, partnership or corporation, has violated any of the provisions of this act, to promptly prosecute such person, members of such partnership or corporation, for such violation.

Passed February 11, 1901. In effect ninety days from passage. Approved February 18, 1901.

CHAPTER 14.—*Employment of children—Certain occupations prohibited.*

2. Any person having the care, custody, or control of any minor child under the age of fifteen years, who shall, in any manner sell, apprentice, give away, or otherwise dispose of such child, or any person who shall take, receive or employ such child for the vocation or occupation of rope or wire walking or as an acrobat, gymnast, contortionist or rider, and any person who, having the care, custody, or control of any minor child whatsoever, shall sell, apprentice, give away or otherwise dispose of such child, or who shall take, receive or employ such child for any obscene, indecent or illegal exhibition or vocation, or any vocation injurious to the health, or dangerous to the life or limb, of such child engaged therein, or for the purpose of prostitution, and any person who shall retain, harbor, or employ any minor child in or about any assignation house or brothel, or any place where any obscene, indecent or illegal, exhibition takes place, shall be guilty of a misdemeanor, and shall be fined not less than five dollars, nor more than one hundred dollars, for each offence.

3. Any person having the care, custody, or control, lawful or unlawful, of any minor child under the age of eighteen years, who shall use such minor, or apprentice, give away, let out, hire or otherwise dispose of, such minor child to any person, for the purpose of singing, playing on musical instruments, begging or for any mendicant business whatsoever in the streets, roads, or other highways of this State, and whosoever shall take, receive, hire, employ, use or have in custody, any minor for the vocation, occupation, calling, service or purpose of singing, playing upon musical instruments or begging upon the streets, roads or other highways of this State, or for any mendicant business whatever, shall be guilty of a misdemeanor and shall be fined not less than five dollars nor more than one hundred dollars.

4. Any person having the care, custody, or control of any minor child under the age of fifteen years, who shall in any manner sell, apprentice, give away or permit such child to sing, dance, act, or in any manner exhibit it in any dance house, concert saloon, theater or place of entertainment where wines or spirituous or malt liquors are sold or given away, or with which any place for the sale of wines or spirituous or malt liquors is directly or indirectly connected by any passageway or entrance, and any proprietor of any dance house whatever, or any such concert saloon, theater, or place of entertainment, so employing any such child, shall be guilty of a misdemeanor, and shall be fined not less than five dollars nor more than one hundred dollars for each offense.

Passed February 13, 1901. In effect ninety days from passage. Approved February 13, 1901.

CHAPTER 15.—*Free public employment bureaus.*

1. The commissioner of labor is hereby authorized to organize and establish, in connection with the bureau of labor, a free public employment bureau, for the purpose of receiving applications from persons seeking employment and applications from persons seeking to employ labor.

2. No compensation or fee shall be charged or received directly or indirectly from persons applying for work, information or help through said department. The commissioner of labor is hereby authorized to employ such assistance, and incur such expense as may be necessary to carry into effect the purpose of this act. But such assistance and expense shall not exceed five hundred dollars per annum.

3. The expenses of the employment bureau shall be paid in the same manner and way as other expenses of the bureau of labor, and there is hereby appropriated five hundred dollars to carry out the provisions of this act.

Passed February 13, 1901. In effect ninety days from passage. Approved February 15, 1901.

CHAPTER 19.—*Factory inspection.*

1. In all manufacturing, mechanical and other establishments, in this State, where the machinery, belting, shafting, gearing, drums and elevators, are so arranged and placed as to be dangerous to persons employed therein, while engaged in their ordinary duties, shall be safely and securely guarded when possible, and if not possible, the notices of the danger shall be conspicuously posted in such establishments, and no minor or female of any age shall be permitted to clean any of the mill gearing or machinery in such establishments while the same is in motion.

2. The opening of all hatchways, elevators and wellholes, upon each floor of every manufacturing, mechanical, mercantile or public building in this State, shall be protected by good and sufficient trapdoors, self-closing hatches, or strong guard rails at least three feet high. All due vigilance shall be used to keep such trapdoors closed at all times, except when in actual use.

3. In every factory, workshop or establishment, in this State, where females are employed, where unclean work of any kind has to be performed, suitable places shall be provided for such females to wash and to change clothing, and stairs in use by females shall, in all such establishments, be properly screened, and separate water-closets shall be provided for the use of employees of either sex, in all manufacturing, mechanical, mercantile and other establishments in this State where persons of both sexes are employed.

4. In every manufacturing, mechanical, mercantile and other establishments, in this State, wherein females are employed, there shall be provided, and conveniently located, seats sufficient to comfortably seat such females; and during such times as such females are not necessarily required by their duties to be upon their feet, they shall be allowed to occupy the seats provided.

5. And all establishments, to which this act applies, must be kept in a clean condition; the sanitary and hygienic regulations shall be such as will not endanger or be injurious to the lives or health of the employees employed therein.

6. Any person or persons, firm or corporation of any manufacturing, mechanical, mercantile or other establishments, business or calling, in this State, to which this act applies, who shall violate any of the provisions of this act shall be deemed guilty of a misdemeanor, and upon conviction, in any court of competent jurisdiction in this State, shall be fined not less than twenty dollars nor more than one hundred dollars, and in default of payment of such fine shall be imprisoned until such fine and costs are fully paid.

7. It shall be the duty of the commissioner of labor or his assistant to enforce the provisions of this act, and to prosecute all violations of the same before any magistrate or court of competent jurisdiction in this State.

8. All fines collected for violation of this act shall be paid into the common school fund of the county in which the offense was committed.

9. The provisions of this act shall become effective within ninety days after the date of its passage, and as soon as possible thereafter the commissioner of labor shall cause a printed copy thereof to be transmitted to all employers of labor in this State.

Passed February 14, 1901. In effect ninety days from passage. Approved February 16, 1901.

CHAPTER 20.—*Mine regulations—Check weighmen.*

1. Where the amount of wages paid to any of the persons employed in any manufacturing, mining, or otherwise public enterprise employing labor, depend upon the amount produced by weight or measure, the persons so employed may, at their own

cost, station or appoint at each place appointed for the weighing or measuring of the products of their labor a check weighman or measurer, who shall in all cases be appointed by a majority ballot of the workmen employed at the works where he is appointed to act as such check weighman or measurer.

2. Every corporation, company, or person engaged in the business of mining coal in this State, where such check weighman is employed by the miners working at such mines, shall furnish such check weighman with a check or number and pay the said check weighman for all coal placed to his check or number same per ton as is paid to the miners. Each of the persons so employed to see [to] the weighing of said coal before entering upon the discharge of the duties of his employment shall take and subscribe an oath before a justice of the peace or a notary public, that he will honestly and impartially do and perform the duties of his employment and do equal and exact justice between employers and employees to the best of his judgment, skill and ability.

3. This act shall apply to all weights, balances, steelyards, and weighing machines and measures used in any factory, mine, mill or otherwise industrial concerns, for determining the wages payable to any person employed according to the mineral or otherwise products produced by them through their labors.

4. Where the weighman is mutually selected by the consent of a majority of the miners working in any mine and the operator or agent of said company, it shall not be considered necessary to employ said check weighman, but at any time that either of the parties to said agreement should become dissatisfied with said weighman they may dismiss him on ten days' notice or the miners may employ a check weighman. Any corporation, company, or person violating any of the provisions of this act shall be guilty of a misdemeanor, and upon conviction thereof, shall be fined for each and every offense not less than ten nor more than two hundred dollars.

It shall be the duty of every court in each county, in which any such coal mine is operated and in which a grand jury is impaneled, to give this act in charge to the grand jury.

Passed February 22, 1901. In effect ninety days from passage. Approved February 23, 1901.

CHAPTER 31.—*Mine regulations—Inspection, etc., of oil.*

1. Only animal, vegetable or paraffine oil or other oil as free from the evolution of smoke as a standard cotton-seed oil, when burned in a miner's torch, shall be used in any open lamp or torch for illuminating purposes in any coal mine in this State, and kerosene and blackstrap oil, or a mixture of kerosene and blackstrap, shall not be used in miners' torches for illuminating purposes in any coal mine in this State; except that a mixture of mineral oil (other than blackstrap oil) and vegetable oil can be used upon machinery used as a motive power to haul coal in any mine in this State, and except, further, that a mixture of mineral and vegetable oil can be used for all stationary lights.

2. A standard cotton-seed oil shall have the following test:

(1) It shall be free from mineral oils or mineral-oil compounds.

(2) It shall be tested in a glass tube one and one-half inches in diameter by eight inches deep, and the oil shall be at a temperature of sixty degrees Fahrenheit when the test is made, and shall not exceed twenty-four degrees Tagliabue hydrometer.

3. If the oil to be tested is below forty-five degrees Fahrenheit temperature, it must be slowly heated until it reaches eighty-five degrees temperature. Should the oil be above forty-five degrees temperature and below sixty-five degrees it must be heated to seventy degrees, when, in either case, it must be well shaken and allowed to cool gradually to a temperature of sixty degrees, when the test must be made.

4. In testing the gravity of oil the hydrometer must be, when possible, read from below, and the last line which appears under the surface of the oil shall be regarded as the true reading.

5. Where the oil is tested in difficult circumstances an allowance of one-half of one degree may be made for error of parallax.

6. All oil sold to be used for illuminating purposes in the mines of this State shall be contained in barrels, casks or packages, branded conspicuously with the name and address of the manufacturer of said oil, the specific gravity of the same and the date of shipment.

7. Any person, firm, or corporation, either by themselves or an agent or employee, which shall sell or offer for sale for illuminating in any mine, in this State, any oil or any mixture or compound of oils which does not comply with the tests as prescribed in section one of this act, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined not less than twenty-five dollars nor more than one hundred dollars for each offense.

8. And any miner, or employee in any mine, or employee of any mine operator or mine owner, who shall knowingly use or permit to be used for illuminating purposes in any mine, in this State, any oil other than that prescribed in section one of this act shall, upon conviction thereof, be fined not less than five dollars nor more than twenty-five dollars for each and every offense; and in default of payment of such fine within twenty days from the day of conviction shall be given a sentence in the county jail for a period of not less than ten nor more than sixty days.

9. It shall be the duty of the district mine inspectors wherever they have reason to believe that oil is being used, or sold or offered for sale, in violation of the provisions of this act, to take samples of the same and have them tested under the direction of the chief mine inspector; and if they are found to be inferior to the quality prescribed by this act, the inspector shall make complaint to the prosecuting attorney of the county in which the offense is committed, who shall forthwith commence proceedings against the offender in any court of competent jurisdiction. Any miner, mine employee, firm, corporation or their agents, who shall refuse to permit the mine inspector to examine his or their oil used for or sold for illuminating purposes in the coal mines, in this State, shall be guilty of a violation of this act, and may be taken before any justice of the peace and fined five dollars or imprisoned in the county jail for ten days for each offense.

10. In all cases of prosecution, where the accused stands convicted of a violation of this act, the costs of such prosecution shall be borne by the person, firm or corporation so convicted, and in case of failure to convict the accused the State shall pay the costs in the same manner as in other prosecutions for misdemeanors.

Passed February 15, 1901. In effect ninety days from passage. Approved February 20, 1901.

CHAPTER 106.—*Mine regulations—Inspection.*

1. Chapter fifty-nine of the acts of the legislature of West Virginia of one thousand eight hundred and ninety-seven, "concerning mine ventilation and inspection" [shall] be amended and reenacted so as to read as follows:

1*a*. The governor of the State, by and with the consent of the senate, shall appoint one district mine inspector for each of the five mining districts created by this act, and a chief mine inspector who shall supervise and control the mine inspection of the State of West Virginia, and the chief shall have power to call the assistance of any one of the other five mine inspectors to any district in the State of West Virginia in case of emergency; and the chief mine inspector shall keep the reports furnished him by the five mine inspectors, and in addition thereto he shall copy said reports in a book or books by him purchased and kept for the purpose, and he shall index the same, and said books shall be open for inspection upon the request of any citizen of the State, and upon the request of the governor or attorney-general of this State, the said chief mine inspector shall lay said books and reports before either of said officers, and also maps of mines furnished him by the said district mine inspectors.

b. Any chief mine inspector who shall violate any of the provisions of this act shall, upon conviction thereof, be fined not less than twenty-five nor more than two hundred dollars, and may, in the discretion of the court, be imprisoned in the county jail not exceeding one year.

And each of the five mine inspectors shall report in writing monthly to the chief mine inspector, the number and condition of all the mines inspected by him during each month. The chief mine inspector shall have power to remove any of the five mine inspectors, mentioned in this act, for causes hereinafter mentioned in this act, and the governor of the State shall fill all vacancies caused by removal from office. Mine inspectors created by this act shall hold their office for the term of four years, as hereinafter provided, unless they be sooner removed, as hereinafter provided. They shall continue in office until their successors in office are appointed and qualified.

c. Every person appointed chief mine inspector must be a citizen of West Virginia and be a competent person, having had at least eight years' experience in the working, ventilation and drainage of coal mines in this State, and a practical and scientific knowledge of all noxious and dangerous gases found in such mines.

d. Every person so appointed district mine inspector must be a citizen of West Virginia, having a practical knowledge of mining and properly ventilating and draining mines, and a knowledge of the gases met with in coal mines, and must be a miner of at least six years' experience as a miner in the coal mines, or having been otherwise engaged as an employee for six years within the mines of this State; and he shall not while in office, be interested as owner, operator, agent, stockholder, superintendent or engineer of any coal mine, and he shall be of good moral character and temperate

habits. An inspector of mines shall be removed from office by the chief mine inspector of this State for incompetency, neglect of duty, drunkenness, malfeasance and for other good causes.

2*a*. Vacancies in office of inspectors shall be filled by appointment by the governor of the State for the unexpired term. Every person appointed inspector of mines, shall, before entering upon the discharge of the duties of his office, take the oath before some person authorized by law to administer oaths, that he will support the Constitution of the United States and the constitution of the State of West Virginia, and that he will faithfully and impartially, to the best of his ability, discharge the duties of his office, and file a certificate of his having done so in the office of the secretary of state, and he shall give a bond in the penalty of two thousand dollars, with sureties to be approved by the governor of the State, conditioned that he will faithfully discharge the duties of his office.

b. The salary of the chief mine inspector shall be eighteen hundred dollars per annum and not more than five hundred dollars for expenses, and the other five mine inspectors shall have twelve hundred dollars salary each, per annum, and not more than five hundred dollars each for expenses. Such salary and expenses shall be paid monthly out of the State treasury upon the approval of the chief mine inspector: *Provided*, That before payment of traveling expenses shall be made to the inspector, he shall file an account of such expenses verified by his affidavit showing that they accrued in the discharge of his official duties.

c. On the first Tuesday in April, one thousand nine hundred and one, and every four years thereafter, the governor of the State shall, with the consent of the Senate, appoint a chief mine inspector and one mine inspector for each of the five mining districts of the State created by this act, whose term of office shall begin when he has taken the oath of office and has given the approved bond, as required by this act, and whose term of office shall be four years, or until his successor shall be duly appointed and qualified.

d. Inspectors of mines shall devote their whole time and attention to the duties of their office and shall make personal examination, as set forth in sections three and four of this act, of the interior of all coal or other mines and outside of the mine where any danger may exist to the workmen employed in their respective districts.

3*a*. And it shall be the duty of each district mine inspector to visit each mine in his district at least once every three months, and it shall be unlawful for any mine inspector to do any surveying for any mine owner or owners, during his term of office, and it shall be unlawful for any mine inspector to appoint any deputy or other person to do and perform any work required of such mine inspector, and it shall be his duty to personally perform the duties of his office hereunder. He shall also in each year, ending with the thirtieth day of June, make a written report to the chief mine inspector of his proceedings, stating therein the number of mines in his district, the improvements made in and at the mines, the extent to which this act is obeyed or violated, and such other information in relation to mines and mining as he may deem of public interest, or required of him by the chief mine inspector. He shall also suggest or recommend such legislation on the subject of mining as he may think necessary. Such report shall be filed with the chief mine inspector on or before the thirtieth day of September next succeeding the year for which it was made. The chief mine inspector shall annually make a full and complete written report of his proceedings as such chief mine inspector to the governor of the State for the year ending the thirtieth of June. Such report shall include the reports from the district mine inspectors, the number of visits and inspections made in the State by the district inspectors, the quantity of coal and coke produced in the State, and the number of men employed, number of mines operated, ovens in and out of blast, improvements made, prosecutions, etc., and such other information in relation to the subject of mines, mining inspection and needed legislation, as he may deem of public interest and beneficial to the mining interests of the State. Such report shall be filed with the governor on or before the thirtieth day of December next succeeding the year for which it was made, and such report shall be printed upon the requisition of the governor, and in order that the report may be annually printed and distributed among the operators, miners and citizens of this State, the sum of fifteen hundred dollars shall annually be allowed out of the State treasury for this special purpose.

b. Any mine inspector failing to comply with the requirements of this act shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not less than one hundred dollars nor more than five hundred dollars, and be dismissed from office.

c. The governor of the State of West Virginia, together with the chief mine inspector created by this act, shall divide the State of West Virginia into five mining districts.

2. Sections 5, 10, and 11 of the acts of one thousand eight hundred and eighty-

seven, concerning "the working, ventilation and drainage of coal mines, etc.," [shall] be amended and reenacted to read as follows, and section 20 be added thereto.

5. The operator or agent of every coal mine shall, within six months after the passage of this act, make, or cause to be made, unless already made and filed, an accurate map or plan of such mine, on a scale to be stated thereon, not exceeding one hundred feet to the inch. Such map or plan shall show the openings or excavations, the shafts, slopes, entries, airways, headings, rooms, pillars, etc., and such portions of such mine or mines as may have been abandoned, the general inclination of the coal strata, and so much of the property lines and the outcrop of the coal seam of the tract of land on which said mine is located, as may be within one thousand feet of any part of the workings of such mine. A true copy of such map or plan shall, within the six months aforesaid, be delivered by such operator to the inspector of his district, to be preserved among the records of his office, and turned over to his successor in office; and the original map, or a true copy thereof, shall be kept by such operator at the office of the mine, and open at all reasonable times for the examination and use of the inspector; and such operator shall, twice within every twelve months, and not more than seven months apart, while the mine is in operation, cause such mine to be surveyed and the map thereof extended so as to accurately show the progress of the workings, the property lines and outcrop as above provided; and he shall immediately thereafter notify the inspector of his district, who shall forward to the said operator, or his engineer, the maps held by such inspector to be extended as above required.

10. The operator or agent of every coal mine, whether worked by shaft, slope or drift, shall provide and hereafter maintain for every such mine ample means of ventilation, affording no less than one hundred cubic feet of air per minute for each and every person employed in such mine, and as much more as the circumstances may require, which shall be circulated around the main headings and cross headings and working places, to an extent that will dilute, render harmless and carry off, the noxious and dangerous gases generated therein; and as the working places shall advance, break-throughs for air shall be made every one hundred feet in the pillars, or brattice shall be used, so as to properly ventilate the face, and all the break-throughs, not required for the passage of air, shall be properly closed with brattice, or brattices shall be used, so as to keep the working places well and properly ventilated. In all mines generating fire damp and where there is every reason to believe that gas will be constantly encountered in the future workings and developments of the mine, all stoppings on the main entries shall be constructed in a substantial manner and as nearly as practicable air-tight, except for temporary purposes; doors on main haul-ways shall be avoided in gaseous mines where practicable, and overcasts adopted when and where the same may expediently be built, and where doors are used they must be built in a substantial manner and hung so as to close automatically when unobstructed. All old unused workings and abandoned parts of the mines must be protected by such safeguards as will prevent the dangerous overflow of any standing gas therein, and all avenues leading thereto shall be so arranged and conducted as to give cautionary notice to all such workmen in such mines of the danger in entering therein. And in order to secure the safety of the workmen in general against danger in said abandoned or worked-out parts of the mines notices shall be put up and kept standing as far as practical, which shall afford warning to all such workmen not to enter in such parts of said mines; and in addition thereto, all persons, other than those specially charged with that duty, are hereby forbidden to enter such abandoned parts of such mines where gas may be found. And for violation of this provision of this act, such person or persons so offending shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not less than five dollars nor more than one hundred dollars and be confined in the county jail not less than ten days nor more than one year. No miner or other employee shall take into the mines in this State any larger quantity of powder or other explosive than he or they may reasonably expect to use during their term of employment of one day of twelve hours. In all mines where explosive gas, or other gas of a dangerous or poisonous nature, is known to generate in large and dangerous quantities, the workmen shall be immediately instructed to withdraw from the mine in case of stoppage of the fan, or heavy falls of the roof which may obstruct the main intake or return airway, until such obstruction is removed. And it shall be unlawful in all mines where gas is being generated in large and dangerous quantities, to use any other mechanical power for ventilation purpose except fan power, or the equal thereof; and the fan or other power, shall be kept in operation night and day unless written permission to do otherwise be granted by the chief inspector or the district inspector in whose district the mine is situated; but no mine operator shall be required to keep such fan going where it is necessary to shut it down for the purposes of repairing machinery or doing other work in the mines which may make it

necessary. It shall be unlawful for any miner after having exploded in any working place sixty cubical inches or more of powder, in one or more blasts, in any mine known to generate gas in large and dangerous quantities, to enter such working place and attempt to resume work in any manner whatever with a naked light in less than twenty minutes after the blast has been exploded.

It shall be the duty of every mine owner or operator in this State whose mine or mines are known to generate fire damp or other dangerous gas or gases, in dangerous quantities, to employ a "fire boss" or "bosses" where necessary, who shall be a citizen or citizens of this State, and have such knowledge of fire damp and other dangerous gases as to be able to detect the same with the use of safety lamps, and shall have a practical knowledge of the subject of ventilation of mines and the machinery and appliances used for that purpose, and be a person with at least three years' experience in mines generating such fire damp and dangerous gases. It shall be the duty of said fire boss or bosses where employed in said gaseous mines to fix and determine upon some intelligent plan to warn and give notice to all the employees of such mines when they may be permitted to enter such mine or mines to begin work upon each shift of their employment; and it shall further be the duty of said fire boss or bosses to go into all the working places of such mine or mines where gas is known to exist, or liable to exist, in dangerous quantities, and carefully examine the same with a safety lamp, and do, or cause to be done, whatever may be necessary to remove from such working place or places all dangerous gases and make the same safe for persons to enter therein as workmen in such mine or mines; such examination and removal of said gases shall be made immediately before each shift begins to work in such mines, and thereafter to at once give such notice or warning to the employees in said mine or mines on the outside thereof that the same is safe for them to enter therein and begin work. In the performance of the duties on the part of the fire boss or bosses they shall have no superior officer, but all the employees working inside of said mine or mines shall be subordinate to said fire boss or bosses in this particular work. It shall be unlawful for any person to enter said mine or mines for any purpose at the beginning of work upon each shift therein until such signal or warning has been given by said fire boss or bosses on the outside of said mine or mines as to the safety thereof, as herein provided, except under the direction of said fire boss or bosses, and then for the purpose of assisting in making said mine safe; and each person who shall enter such mine before such notice or signal has been given shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not less than fifty dollars nor more than five hundred dollars, and imprisoned in the county jail not less than sixty days nor more than one year. In all mines generating fire damp, accumulations of fine, dry coal dust shall, as far as practicable, be prevented, and such dust shall, whenever necessary, be kept properly watered down. The safety lamps used for examining any mine or which may be used for working therein, shall be furnished by, and be the property of, the operator of the mine, and shall be in charge of some person to be designated by the "fire boss," and at least one safety lamp shall be kept at every coal mine whether such mine generates fire damp or not.

11. In order to better secure the proper ventilation of every coal mine and promote the health and safety of persons employed therein, the operator or agent shall employ a competent and practical inside overseer, to be called "mining boss," who shall be a citizen of this State and an experienced coal miner, or any person having three years' experience in a coal mine, who shall keep a careful watch over the ventilating apparatus and the airways, traveling-ways, pumps and drainage; and shall see that, as the miners advance their excavations, proper break-throughs are made to properly ventilate the mine, and that all loose coal, slate and rock overhead in the working places and along the haul-ways be removed or carefully secured so as to prevent danger to persons employed in such mines; and that sufficient props, caps and timbers, as nearly as possible of suitable dimensions, are furnished for the places where they are to be used; and such props, caps and timbers shall be delivered and placed at such point as the rules for the government for each respective mine provide for them to be delivered; and every workman in want of props, cap pieces and timbers shall notify the mining boss, or such other person who may be designated for that purpose, at least one day in advance, giving the length and number of props or timbers and cap pieces he requires; but in case of an emergency the timbers may be ordered immediately upon the discovery of any danger; and it shall be the duty of each miner to properly prop and secure his place in order to make the same secure for him to work therein. The said mine boss shall have all water drained or hauled out of the working places where the same is practicable, before the miners enter, and said working places kept dry as far as practical while the miners are at work. And in mines in which the operations are so extensive that all the duties devolving upon the mine boss can not be discharged by one man, competent persons having had two years' experience in a coal mine may be designated and appointed as assistants, who

shall act under the mine boss's instructions, and who shall be responsible for their conduct in the discharge of their duties under such designation or employment. On all haul-ways, space not less than ten feet long and two feet, six inches wide, between the wagon and the rib, shall be kept open at distances not exceeding one hundred feet apart, in which shelter from passing wagons may be had. It shall further be the duty of the mining boss to have bore holes kept not less than twelve feet in advance of the face, and, where necessary, on sides of the working places that are being driven toward and in dangerous proximity to an abandoned mine or part of mine suspected of containing inflammable gases or which is filled with water. On all haul-ways where hauling is done by machinery of any kind, the mine boss shall provide a proper system of signals and a conspicuous light, and also for the carrying of a conspicuous light on the front car of every trip or train of cars when in motion in a mine, and when the hoisting or lowering of men occurs before daylight in the morning or at evening after darkness at any mine operated by shaft, the said mine boss shall provide and maintain at the shaft mouth a light of a stationary character sufficient to show the landing and all surrounding objects distinctly, and sufficient light of a stationary character shall be located at the bottom of the shaft so that persons coming to the bottom may clearly discern the cages and other objects closely contiguous thereto. No cages on which men are riding shall be lifted or lowered at a rate of speed greater than six hundred feet per minute. No mine cars, either empty or loaded, shall be hoisted, while men are being lowered or hoisted, and no cage having an unstable self-dumping platform shall be used for the carrying of workmen unless the same is provided with some device by which the same can be securely locked when men are being hoisted or lowered into the mine. At every mine where fifty men are employed underground, it shall be the duty of the operator thereof to keep always on hand at the mine a properly constructed stretcher, woolen and a waterproof blanket, and all necessary requisites which may be advised by the medical practitioner employed by the company, and if as many as one hundred and fifty men be employed two stretchers with the necessary equipments as above advised. The mining boss, or his assistant, shall visit and examine every working place in the mine as often as practicable and as to him may seem necessary while the miners of such places are at work, and shall direct that each and every working place shall be secured by props or timbers whenever necessary, which shall be placed and used by the miners working therein as in this act provided, to the end that such working places shall be made safe, and the said mine boss shall not direct anyone to work in an unsafe place unless it be for the purpose of making it safe. The mining boss shall notify the operator or agent of the mine of his inability to comply with any of the requirements of this section, and it shall then become the duty of any operator or agent to at once attend to the matter complained of by the mining boss, so as to enable him to comply with the provisions hereof if the same can be practicably done.

20. There shall be adopted by the operator of every mine in this State special rules for the government and operation of his mine or mines, covering all the work pertaining thereto in and outside of the same, which, however, shall not be in conflict with the provisions of the mining laws of this State. Such rules when established shall be printed on cardboard and shall be posted up in the drum-house, tipple or some other conspicuous place about the mines where the same may be seen and observed by all the employees at such mines, and when said rules are so posted the same shall operate as notice to all the employees at such mine of their acceptance of the contents thereof. And it shall be the duty of each mine operator to furnish a printed copy of said rules to each of his employees when requested by either or any of them.

Passed February 14, 1901. In effect ninety days from passage. Approved February 21, 1901.

WISCONSIN.

ACTS OF 1901.

CHAPTER 239.—*Sweat shops—Licensing, inspection, etc.*

SECTION 1. No room or apartment in any tenement or dwelling house or in a building situated in the rear of any tenement or dwelling house, shall be used for the purpose of manufacturing, altering, repairing or finishing therein, for wages or for sale, any coats, vests, knee pants, trousers, overalls, cloaks, hats, caps, suspenders, jerseys, blouses, dresses, waists, waist bands, underwear, neckwear, knit goods of all kinds, furs, fur trimmings, fur garments, skirts, shirts, purses, feathers, cigarettes, cigars or umbrellas, unless a license is secured therefor as provided in this act. Application for such a license shall be made to the commissioner of labor and industrial statistics by any family or a member thereof or any person, firm or corporation,

desiring to manufacture, alter, repair or finish any such articles in any room or apartment in any tenement or dwelling house or by any person, firm or corporation desiring to perform such work in any building in the rear of any tenement or dwelling house. Such application shall describe the room or apartment, shall specify the number of persons to be employed therein, and shall be in such form as the commissioner of labor and industrial statistics may determine. Blank applications shall be prepared and furnished by the commissioner of labor and industrial statistics. Before any such license is granted, an inspection of the room, apartment, or building sought to be licensed, must be made by the commissioner of labor and industrial statistics, factory inspector or assistant factory inspector. If the commissioner of labor and industrial statistics, factory inspector, or assistant factory inspector, ascertain that such room, apartment or building, is in a clean and proper sanitary condition, and that the articles specified in this section may be manufactured therein under clean and healthful condition, he shall grant a license permitting the use of such room, apartment or building for the purpose of manufacturing, altering, repairing or finishing such articles. Each license shall state the maximum number of persons who may be employed in the room or rooms to which such license relates. The number of persons to be so employed shall be determined by the number of cubic feet of air space contained in each room or apartment mentioned in such license, allowing not less than two hundred and fifty cubic feet for each person employed between the hours of 6 o'clock in the morning and 6 o'clock in the evening, and unless by a special written permit of the commissioner of labor and industrial statistics, factory inspector, or assistant factory inspector, not less than four hundred cubic feet for each person employed therein between the hours of six in the evening and six in the morning, but no such permit shall be issued unless such room or apartment has suitable light at all times during such hours, while such persons are employed therein. Such license must be posted in a conspicuous place in the room or apartment to which it relates. It may be revoked by the commissioner of labor and industrial statistics, factory inspector or assistant factory inspector, if the health of the community or of the employees requires it, or if it appears that the rooms or apartments, to which such license relates, are not in a healthy and proper sanitary condition. Every room or apartment in which any of the articles named in this section are manufactured, altered, repaired or finished, shall be kept in a clean and sanitary condition and shall be subject to inspection and examination by the commissioner of labor and industrial statistics, factory inspector, or assistant factory inspector, for the purpose of ascertaining whether said garments or articles or any part or parts thereof are clean and free from vermin and every matter of infectious or contagious nature. No person, firm or corporation, shall hire, employ or contract with any member of a family or any person, firm or corporation not holding a license therefor, to manufacture, alter, repair or finish any of the articles named in this section in any room or apartment in any tenement or dwelling house or in any room or apartment in any building, situated in the rear of a tenement or dwelling house as aforesaid; and no person, firm or corporation shall receive, handle or convey to others or sell, hold in stock or expose for sale, any goods mentioned in this section unless made under the sanitary conditions and in accordance with this act. This section shall not prevent the employment of a tailor or seamstress by any person or family for the purpose of making, altering, repairing or finishing any article of wearing apparel for such person or for family use.

SEC. 2. Whenever the commissioner of labor and industrial statistics, factory inspector or assistant factory inspector in his judgment revokes or refuses to grant a license to any person or persons because of the unhealthy or unsanitary conditions in or surrounding the place where any of the aforesaid goods are or are to be manufactured, the person or persons aggrieved by such decision may appeal to the board of health of such city, village or town wherein said license was refused or revoked. The board of health after receiving a written notice of the appeal from the person or persons aggrieved, shall immediately investigate the conditions and surroundings of the place wherein any of the goods are or are to be manufactured as mentioned in the aforesaid, and if they find that a license can be granted without injuring or impairing the public health, then such finding shall be immediately reported in writing to the commissioner of labor and industrial statistics who shall thereupon grant such license.

SEC. 3. The commissioner of labor and industrial statistics, factory inspector or assistant factory inspector, may when he deems it necessary, require that all rooms or apartments used for the purpose of manufacturing, altering, repairing or finishing therein, any of the aforesaid goods or articles as mentioned in section 1 shall be separate from and have no door, window or other opening into any living or sleeping room of any tenement or dwelling and that no such rooms or apartments shall be used at any time for sleeping purposes and shall contain no bed, bedding or cooking utensils. He may further require or direct a separate outside entrance to the room

or apartments where the work is carried on, and if such work is carried on above the first floor, then there may be directed a separate and distinct stairway leading thereto and every such room or apartment shall be well and sufficiently lighted, heated and ventilated by ordinary, or if necessary, by mechanical appliance. He may also require suitable closet arrangements for each sex employed as follows: Where there are ten or more persons and three or more to the number of twenty are of either sex, a separate and distinct water-closet, either inside the building with adequate plumbing connections or on the outside, at least twenty feet from the building, shall be provided for each sex. When the number employed is more than twenty-five of either sex, there shall be provided an additional water-closet for such sex up to the number of fifty persons, and above that number in the same ratio, and all such closets shall be kept strictly and exclusively for the use of the employees and employer and employers. All closets shall be regularly disinfected and the commissioner of labor and industrial statistics, factory inspector or assistant factory inspector may require all other necessary changes or any process of cleaning, painting or whitewashing which they may deem necessary, before the issuing of the license.

SEC. 4. Any person, firm or corporation, by themselves or by their agents or managers, contracting for the manufacturing, altering, repairing or finishing of any of the articles mentioned in section 1 of this act, or giving out material from which they or any part of them are to be manufactured, altered, repaired or finished, shall keep a register of the names and addresses, plainly written in English, of the persons to whom such articles or materials are given to be so manufactured, altered, repaired or finished or with whom they have contracted to do the same. Such register shall be subject to inspection on demand, by the commissioner of labor and industrial statistics, factory inspector or assistant factory inspector, and a copy thereof shall be furnished at his request.

SEC. 5. If the commissioner of labor and industrial statistics, factory inspector or assistant factory inspector find that infectious or contagious diseases exist in a workshop, room or apartment of a tenement or dwelling house or of a building in the rear thereof in which any of the articles specified in section 1 of this act are being manufactured, altered, repaired or finished or that articles manufactured or in process of manufacture therein are infected or that goods used therein are unfit for use, he shall report to the local board of health, and such board shall issue such order as the public health may require. Such board may condemn and destroy all such infectious article or articles manufactured or in the process of manufacture under unclean or unhealthful conditions.

SEC. 6. The owner, lessee or agent of a tenement or dwelling house or of a building in the rear of a tenement or dwelling house shall not permit the use thereof for the manufacture, repair, alteration or finishing of any of the articles mentioned in this act contrary to its provisions. If a room or apartment in such tenement or dwelling house or in a building in the rear of a tenement or dwelling house be so unlawfully used, the commissioner of labor and industrial statistics, factory inspector, or assistant factory inspector, shall serve a notice thereof upon such owner, lessee or agent. Unless such owner, lessee or agent shall cause such unlawful manufacture to be discontinued within thirty days after the service of such notice or within fifteen days thereafter, institutes and faithfully prosecutes proceedings for the dispossession of the occupant of a tenement or dwelling house or of a building in the rear of a tenement or dwelling house who unlawfully manufactures, repairs, alters or finishes such articles in any room or apartment therein, he shall be deemed guilty of a violation of this act as if he himself was engaged in such unlawful manufacture, repair, alteration or finishing.

SEC. 7. Any person, firm or corporation, agent or manager of any corporation who whether for himself or for such firm or corporation or by himself or through agents, servants or foremen shall violate any of the provisions of this act shall upon conviction thereof be fined in any sum not less than twenty dollars nor more than one hundred dollars for each offense, or imprisoned not less than twenty or more than sixty days or both, and in all prosecutions brought by or under the direction of the commissioner of labor and industrial statistics for the violation of this act, he shall not be held to give security for costs or adjudged to pay any costs but in all cases where the accused be acquitted or is found to be indigent, the costs shall be paid out of the county treasury of the county in which the proceedings are brought the same as the costs in all other cases of misdemeanor.

SEC. 8. Chapter 232 of the laws of 1899 is hereby repealed.

SEC. 9. This act and the repealing clause shall take effect and be in force, from and after the first day of August 1901.

Approved April 27, 1901.

CHAPTER 257.—*Protection of employees on buildings.*

SECTION 1. A person employing or directing another to perform labor of any kind in the erection, repairing, altering or painting of a house, building or structure shall not furnish or erect, or cause to be furnished or erected for the performance of such labor, scaffolding, hoists, stays, ladders or other mechanical contrivances, which are unsafe, unsuitable or improper, and which are not so constructed, placed and operated as to give proper protection, to the life and limb of a person so employed or engaged. Scaffolding or staging swung or suspended from an overhead support, more than twenty feet from the ground or floor, shall have a safety rail of wood, properly bolted, secured and braced, rising at least thirty-four inches above the floor or main portions of such scaffolding or staging and extending along the entire length of the outside and the ends thereof, and properly attached thereto, and such scaffolding or staging shall be so fastened as to prevent the same from swaying from the building or structure.

SEC. 2. Whenever complaint is made to the factory inspector that the scaffolding, or the part thereof declared to be unsafe. After ladders, irons, or ropes of any swinging or stationary scaffolding used in the construction, alteration, repairing, painting, cleaning or painting of buildings within the limits of a city are unsafe or liable to prove dangerous to the life or limb of any person, such factory inspector shall immediately cause an inspection to be made of such scaffolding, or the slings, hangers, blocks, pulleys, stays, braces, ladders, irons or other parts connected therewith. If, after examination, such scaffolding or any of such parts is found to be dangerous to life or limb, the factory inspector shall prohibit the use thereof, and require the same to be altered and reconstructed so as to avoid such danger. The factory inspector or deputy factory inspector making the examination shall attach a certificate to the scaffolding, or the slings, hangers, irons, ropes, or other parts thereof, examined by him stating that he has made such examination, and that he has found it safe or unsafe, as the case may be. If he declares it unsafe, he shall at once, in writing, notify the person responsible for its erection of the fact, and warn him against the use thereof. Such notice may be served personally upon the person responsible for its erection, or by conspicuously affixing it to the scaffolding, or the part thereof declared to be unsafe. After such notice has been so served or affixed, the person responsible therefor shall immediately remove such scaffolding or part thereof and alter or strengthen it in such manner as to render it safe, in the discretion of the officer who has examined it, or of his superiors. The factory inspector and any of his deputies whose duty it is to examine or test any scaffolding or part thereof, required by this section, shall have free access, at all reasonable hours, to any building or premises containing them or where they may be in use. All swinging and stationary scaffolding shall be so constructed as to bear four times the maximum weight required to be dependent therefrom or placed thereon, when in use, and not more than four men shall be allowed on any swinging scaffolding at one time.

SEC. 3. All contractors and owners, when constructing buildings in cities, where the plans and specifications require the floors to be arched between the beams thereof, or where the floors or filling in between the floors are of fireproof material or brickwork, shall complete the flooring or filling in as the building progresses, to not less than within three tiers of beams below that on which the ironwork is being erected. If the plans and specifications of such building do not require filling in between the beams of floors with brick or fireproof material all contractors for carpenter work, in the course of construction shall lay the under flooring thereof on each story as the building progresses, to not less than within two stories below the one to which such building has been erected. Where double floors are not to be used, such contractor shall keep planked over the floor two stories below the story where the work is being performed. If the floor beams are of iron or steel, the contractors for the iron or steel work of buildings in course of construction or the owners of such buildings, shall thoroughly plank over the entire tier of iron or steel beams on which the structural iron or steel work is being erected, except such spaces as may be reasonably required for the proper construction of such iron or steel work, and for the raising and lowering of materials to be used in the construction of such building, or such spaces as may be designated by the plans and specifications for stairways and elevator shafts. If elevating machines or hoisting apparatus are used within a building in the course of construction, for the purpose of lifting materials to be used in such construction, the contractors or owners shall cause the shafts or openings in each floor to be inclosed or fenced in on all sides by a barrier at least eight feet in height. If a building in course of construction is five stories or more in height, no lumber or timber needed for such construction shall be hoisted or lifted on the outside of such building. The chief officer, in any city, charged with the enforcement of the build-

ing laws of such city and the factory inspector are hereby charged with enforcing the provisions of this section.

SEC. 4. Any owner, contractor, subcontractor, foreman or other person having charge of work on building, if found guilty of violation of any of the former sections of this law shall be subject to a fine of not less than twenty-five dollars and not more than one hundred dollars, or imprisonment of not less than three months or not more than one year by any court having jurisdiction.

SEC. 5. This act shall take effect and be in force from and after its passage and publication.

Approved May 2, 1901.

CHAPTER 409.—*Factory inspector—Female assistant.*

SECTION 1. The commissioner of labor and industrial statistics shall have power to appoint one assistant factory inspector in addition to those now authorized by law who shall be a woman and who shall perform her duties under his direction and who may be removed by him for cause.

SEC. 2. Said additional assistant factory inspector shall be paid a salary at the rate of one thousand dollars per annum, together with necessary traveling expenses to be paid out of money in the general fund not otherwise appropriated.

SEC. 3. This act shall take effect and be in force from and after its passage and publication.

Approved May 14, 1901.

CHAPTER 420.—*Free public employment bureaus.*

SECTION 1. A free employment office is hereby created in each city of a population of thirty thousand or over according to the last State or national census, for the purpose of receiving applications of persons seeking employment, and applications of persons seeking to employ labor. Such office shall be designated and known as Wisconsin free employment office.

SEC. 2. Within thirty days after this act shall have been in force, the commissioner of the bureau of labor and industrial statistics shall recommend, and the governor, shall appoint a superintendent for each of the offices created by section one of this act, and who shall devote their entire time to the duties of their respective offices. The tenure of such appointment shall be two years, unless sooner removed for cause. The salary of each superintendent shall be twelve hundred dollars per annum, which sum, together with the proper amount for defraying the necessary costs of equipping and maintaining the respective offices, rent for such offices not to exceed five hundred dollars per annum, shall be paid out of any funds in the State treasury not otherwise appropriated.

SEC. 3. The superintendent of each such free employment office shall, within sixty days after appointment, open an office in such locality as shall have been agreed upon between such superintendent and the commissioner of the bureau of labor and industrial statistics as being most appropriate for the purpose intended; provided that said employment office shall be occupied in conjunction with the bureau of labor and industrial statistics when such bureau has an office in any of said cities, and in case said bureau has no office in any of said cities, then and in that case the city council wherein said free employment office is established shall furnish and equip an office for said employment bureau, either in conjunction with a department of said city or separately without cost to the State, such office to be provided with a sufficient number of rooms or apartments to enable him to provide, and he shall so provide, a separate room or apartment for the use of women registering for situations or help. Upon the outside of each such office, in position and manner to secure the fullest public attention, shall be placed a sign which shall read in the English language "Wisconsin Free Employment Office," and the same shall appear either upon the outside windows or upon signs in such other languages as the location of such office shall render advisable. The superintendent of each such free employment office shall receive and record in books kept for that purpose names of all persons applying for employment or help, designating opposite the name and address of each applicant the character of employment or help desired. Separate registers for applicants for employment shall be kept, showing the age, sex, nativity, trade or occupation of each applicant, the cause and duration of nonemployment, whether married or single, the number of dependent children, together with such other facts as may be required by the bureau of labor and industrial statistics to be used by said bureau: *Provided*, That no such special register shall be open to public inspection at any time, and that such statistical and sociological data as the bureau of labor may require

shall be held in confidence by said bureau, and so published as not to reveal the identity of any applicant: *And, provided, further*, That any applicant who shall decline to answer the questions contained in special register shall not thereby forfeit any right to any employment the office might secure.

SEC. 4. Each superintendent shall report on Thursday of each week to the State bureau of labor and industrial statistics the number of applications for positions and for help received during the preceding week, also those unfilled applications remaining on the books at the beginning of the week. Such lists shall not contain the names or addresses of any applicant, but shall show the number of situations desired and the number of persons wanted at each specified trade or occupation. It shall also show the number and character of the positions secured during the preceding week. Upon receipt of these lists, and not later than Saturday of each week, the commissioner of the said bureau of labor and industrial statistics shall cause to be printed a sheet showing separately and in combination the lists received from all such free employment offices; and he shall cause a sufficient number of such sheets to be printed to enable him to mail, and he shall so mail, on Saturday of each week, two of said sheets to each superintendent of a free employment office, one to be filed by said superintendent and one to be conspicuously posted in each such office. A copy of such sheet shall also be mailed on each Saturday by the commissioner of the State bureau of labor and industrial statistics to the State inspector of factories. It is hereby made the duty of said factory inspector to do all he reasonably can to assist in securing situations for such applicants for work, to secure for the free employment offices the cooperation of the employers of labor in factories, to immediately notify the superintendent of free employment offices of any and all vacancies or opportunities of employment that shall come to his notice.

SEC. 5. It shall be the duty of each such superintendent of a free employment office to immediately put himself in communication with the principal manufacturers, merchants and other employers of labor, and to use all diligence in securing the cooperation of the said employers of labor, with the purposes and objects of such employment offices.

SEC. 6. It shall be the duty of each superintendent to make a report to the State bureau of labor and industrial statistics annually, not later than December first of each year, concerning the work of his office for the year ending October first of same year, together with a statement of the expenses of the same, and such reports shall be published by the said bureau of labor and industrial statistics annually. Each such superintendent shall also perform such other duties in the collection of statistics of labor, as the commissioner of the bureau of labor and industrial statistics may require.

SEC. 7. No fee or compensation shall be charged or received, directly or indirectly, from any person or corporation applying for employment or help through said free employment offices; and any superintendent or clerk who shall accept, directly or indirectly, any fee or compensation from any applicant, or from his or her representative, shall be deemed guilty of a misdemeanor, and, upon conviction shall be fined not less than twenty-five dollars nor more than fifty dollars and imprisoned in the county jail not more than thirty days.

SEC. 8. In no case shall the superintendent of any free employment office created by this act, furnish or cause to be furnished, workmen or other employees to any applicant for help whose employees are at that time on strike or locked out; nor shall any list of names and addresses of applicants for employment be shown to any employer whose employees are on a strike or locked out; nor shall such list be exposed where it can be copied or used by an employer whose employees are on a strike or locked out.

SEC. 9. The term "applicant for employment" as used in this act shall be construed to mean any person seeking work of any lawful character, and "applicant for help" shall mean any person or persons seeking help in any legitimate enterprise. Nothing in this act shall be construed to limit the meaning of the term "work" to manual occupation, but it shall include professional service, and any and all other legitimate services.

SEC. 10. No person, firm or corporation in the cities, designated in section one, of this act, shall open, operate or maintain a private employment agency for hire or where a fee is charged to either applicants for employment or for help, without first having obtained a license from the secretary of state, for which license he shall pay one hundred dollars per annum; and no such private agent shall print, publish, or cause to be printed or published, or paint on any sign, window or newspaper publication, a name similar to that of the Wisconsin free employment offices. And any person, firm or corporation violating the provisions of this act, or any part thereof, shall be deemed guilty of a misdemeanor and upon conviction such person, firm or, if a corporation, all the officers thereof, shall be fined not less than twenty-five dollars nor more than fifty dollars.

SEC. 11. Whenever, in the opinion of the commissioner of the bureau of labor and industrial statistics, the superintendent of any free employment office is not duly diligent in the performance of his duties, he may summon such superintendent to appear before him to show cause why he should not be recommended to the governor for removal, and unless such cause is clearly shown the said commissioner may so recommend. In considering, such a case a low percentage of positions secured to applicants for situations and help registered, lack of intelligent interest in the work, or a general inaptitude or inefficiency may be deemed by said commissioner sufficient to recommend a removal. And if, in the opinion of the governor, such lack of efficiency can not be remedied by reproval and discipline, he shall remove such person from office as recommended by said commissioner: *Provided*, That the governor may at any time remove any superintendent or clerk for cause.

SEC. 12. All such printing, blanks, blank books, stationery and postage as may be necessary for the proper conduct of the business of the offices herein created shall be furnished by the secretary of state upon requisition for the same made by the commissioner of the bureau of labor and industrial statistics.

SEC. 13. This act shall take effect and be in force from and after its passage and publication.

Approved May 14, 1901.

WYOMING.

ACTS OF 1901.

CHAPTER 33.—*Seats for female employees.*

SECTION 1. Every person or corporation employing females in any manufacturing, mechanical or mercantile establishment in the State of Wyoming shall provide suitable seats for females so employed, and shall permit the use of such seats by them when they are not necessarily engaged in the active duties for which they are employed.

SEC. 2. Any person or corporation who shall violate the provisions of this act shall, upon conviction thereof, be considered guilty of a misdemeanor and shall be punished by a fine of not more than ten dollars, nor more than thirty dollars for each and every offense.

SEC. 3. This act shall take effect and be in force from and after its passage.

Approved February 13, 1901.

UNITED STATES.

ACTS OF CONGRESS OF 1901–02.

CHAPTER 641.—*Exclusion of Chinese laborers—Island territory.*

SECTION 1. All laws now in force prohibiting and regulating the coming of Chinese persons, and persons of Chinese descent, into the United States, and the residence of such persons therein, are hereby, reenacted, extended, and continued so far as the same are not inconsistent with treaty obligations, until otherwise provided by law, and said laws shall also apply to the island territory under the jurisdiction of the United States, and prohibit the immigration of Chinese laborers, not citizens of the United States, from such island territory to the mainland territory of the United States, whether in such island territory at the time of cession or not, and from one portion of the island territory of the United States to another portion of said island territory: *Provided, however*, That said laws shall not apply to the transit of Chinese laborers from one island to another island of the same group; and any islands within the jurisdiction of any State or the district of Alaska shall be considered a part of the mainland under this section.

SEC. 3. Nothing in the provisions of this act or any other act shall be construed to prevent, hinder, or restrict any foreign exhibitor, representative, or citizen of any foreign nation, or the holder, who is a citizen of any foreign nation, of any concession or privilege from any fair or exposition authorized by act of Congress from bringing into the United States, under contract, such mechanics, artisans, agents, or other employees, natives of their respective foreign countries, as they or any of them may deem necessary for the purpose of making preparation for installing or conducting their exhibits or of preparing for installing or conducting any business authorized or permitted under or by virtue of or pertaining to any concession or privilege which may have been or may be granted by any said fair or exposition in connection with

such exposition, under such rules and regulations as the Secretary of the Treasury may prescribe, both as to the admission and return of such person or persons.

SEC. 4. It shall be the duty of every Chinese laborer, other than a citizen, rightfully in, and entitled to remain in any part of the insular territory of the United States (Hawaii excepted) at the time of the passage of this act, to obtain within one year thereafter a certificate of residence in the insular territory wherein he resides, which certificate shall entitle him to residence therein, and upon failure to obtain such certificate as herein provided he shall be deported from such insular territory; and the Philippine Commission is authorized and required to make all regulations and provisions necessary for the enforcement of this section in the Philippine Islands, including the form and substance of the certificate of residence so that the same shall clearly and sufficiently identify the holder thereof and enable officials to prevent fraud in the transfer of the same: *Provided, however,* That if said Philippine Commission shall find that it is impossible to complete the registration herein provided for within one year from the passage of this act, said Commission is hereby authorized and empowered to extend the time for such registration for a further period not exceeding one year.

Approved April 29, 1902.

CHAPTER 1093.—*Irrigation works—Hours of labor—Mongolian laborers.*

SECTION 4. Upon the determination by the Secretary of the Interior that any irrigation project is practicable, he may cause to be let contracts for the construction of the same, * * * *Provided,* That in all construction work eight hours shall constitute a day's work, and no Mongolian labor shall be employed thereon.

Approved June 17, 1902.

CHAPTER 1356.—*Mine regulations.*

SECTION 6. The owners or managers of every coal mine shall provide an adequate amount of ventilation of not less than eighty-three and one-third cubic feet of pure air per second, or five thousand cubic feet per minute for every fifty men at work in said mine, and in like proportion for a greater number, which air shall by proper appliances or machinery be forced through such mine to the face of each and every working place, so as to dilute and render harmless and expel therefrom the noxious or poisonous gases. Wherever it is practicable to do so the entries, rooms, and all openings being operated in coal mines shall be kept well dampened with water to cause the coal dust to settle, and that when water is not obtainable at reasonable cost for this purpose accumulations of dust shall be taken out of the mine, and shall not be deposited in way places in the mine where it would be again distributed in the atmosphere by the ventilating currents: *Provided,* That all owners, lessees, operators of, or any other person having the control or management of any coal shaft, drift, slope or pit in the Indian Territory, employing twenty or more miners to work in the same, shall employ shot firers to fire the shots therein. Said shots shall not be fired to exceed one per day; at twelve o'clock noon in cases where the miners work but half a day, and at five o'clock in the evening when the mine is working three-quarters or full time, and they shall not be fired until after all miners and other employees working in said shafts, drifts, slopes or pits, shall be out of same. The violation of this act shall constitute a misdemeanor and any person convicted of such violation shall pay a fine of not exceeding five hundred dollars.

Approved July 1, 1902.

CHAPTER 1369.—*Philippine Islands—Slave labor.*

SECTION 5. Neither slavery, nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist in said islands.

SEC. 74. The government of the Philippine Islands may grant franchises, privileges, and concessions, including the authority to exercise the right of eminent domain for the construction and operation of works of public utility and service, * * * *Provided further,* That it shall be unlawful for any corporation organized under this act, or for any person, company, or corporation receiving any grant, franchise, or concession from the government of said islands, to use, employ, or contract for the labor of persons claimed or alleged to be held in involuntary servitude; and any person, company, or corporation so violating the provisions of this act shall forfeit all charters, grants, franchises, and concessions for doing business in said islands, and in addition shall be deemed guilty of an offense, and shall be punished by a fine of not less than ten thousand dollars.

Approved July 1, 1902.

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No. 2. The poor colonies of Holland, by J. Howard Gore, Ph. D.
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