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**INDUSTRIAL LEAD POISONING, WITH DESCRIPTIONS OF LEAD
PROCESSES IN CERTAIN INDUSTRIES IN GREAT BRITAIN AND
THE WESTERN STATES OF EUROPE.**

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INTRODUCTION.

A little over two decades ago Great Britain awoke to the fact that in consequence of a great wastage of human life which was occurring in some of her industries, legislative intervention was called for, since it was evident that industrial occupation, far from being a source of welfare to a certain class of workers, was in many instances a cause of their too early infirmity and death. Although regulations had been in force for years in white-lead factories, it was apparent from the amount of sickness which prevailed and the number of deaths, particularly of young females, which were taking place, that there was something seriously wrong. In an address delivered at a meeting of the British Association for the Advancement of Science, in Newcastle-upon-Tyne, 21 years ago, the writer of this monograph drew attention to the sad condition of affairs and pleaded for something to be done to check the high mortality rate among young female lead workers and the necessity of purifying the trade generally. Government intervention followed and with happy results. Abolition of female labor in the dangerous processes of white-lead manufacture, fresh regulations, insistence upon personal cleanliness on the part of the workers, and the better provision by employers of washing appliances, prohibition of eating and drinking in the factory, and periodical medical examination of the workers have materially reduced the sickness and mortality rates in the lead industries. In the manufacture of pottery alone the sickness rate has fallen 70 to 80 per cent. While these measures have freed the trade from continued reproach, a careful watch is

still required, for with the progress of civilization mechanical invention keeps pace, new methods of production from time to time are introduced, and in some of these lead or its compounds are used. The enormous demand for motor cars is an illustration of what these words mean. Experience shows that in electrical accumulator and other factories work may proceed satisfactorily for a period, when all at once there occurs an outbreak of plumbism among the hands employed, or a worker unexpectedly dies without having previously exhibited signs of ill health, and on a post mortem and chemical examination of the body being made death is found to have been caused by lead poisoning. It is owing to the slow and subtle but none the less sure manner in which lead acts as a poison that manufacturers must be ever on their guard to see that ventilation is kept effective and that both they and the workers attend rigidly to the regulations which have been framed. There can be no underrating of the responsibility which in this matter rests equally upon employers and employees.

For the abolition of female labor in the dangerous processes of white-lead manufacture in Great Britain the writer accepts full blame. Experience and experiment alike support him in the attitude he has assumed. Is there, for example, another occupation than lead pursuance of which for three months has caused the death of a previously healthy worker from purely industrial causes? The withdrawal of female labor has neither dislocated the trade, as was predicted at the time by the manufacturers, nor has it increased the cost of production. On the other hand, it has rid the industry of opprobrium, saved many lives, and averted a considerable amount of suffering. It is a peculiar fact in regard to lead that there is a sexual idiosyncrasy to its influence whereby females become more prone to plumbism, and the worst type of it, than males. Lead poisoning, too, is unlike many infectious diseases in so far as one attack, instead of conferring immunity to other attacks, rather increases the liability to subsequent seizures. Youthful workers are more prone to plumbism than persons of mature years, but no age is exempt, nor does familiarity with the dangers, in the absence of carefulness, lessen risks.

Although plumbism is usually easy to diagnose, lead occasionally induces obscure affections of the nervous system, the cause and true nature of which are not always easily recognized. As a cause of poverty, too, its influence is not sufficiently known nor the rôle it may be playing in the physical degeneracy of the race. The extent to which industrial lead poisoning still prevails and the good effected by legislation and attention to minute details the following pages show.

ANTIQUITY OF THE LEAD INDUSTRY.

In its metallic form and in chemical combinations lead has long been known. The Romans used it. The writer has found lead pipes in the remains of the Roman camps in the north of England. In Pompeii the lead pipes which carried water into the city can still be seen. The difference between these and modern lead pipes is that in Roman times they were rolled and not molded. Vitruvius condemned the use of lead pipes for the conveyance of water on account of their harmfulness, while centuries later his compatriot, Ramazzini, a physician, discoursed on the dangers of certain industries in which lead is used.

In England and in Scotland lead mining is an old industry. The Romans worked the Weardale mines. After the foundation of the See of Durham lead became indispensable for religious houses. Eadbert, Bishop of Holy Island, A. D. 688, had the church at Lindisfarne covered with plates of lead. In 1152-1195 King Stephen granted the Weardale mines to Hugh Pudsey, Bishop of Durham. For centuries, therefore, the north of England has been familiar with lead mining and the manufacture of lead compounds. In a Roman station of Derbyshire there have been found pigs of lead bearing Latin inscriptions. Some of these are now in the gallery of antiquities in the British Museum. In 1777 a pig of lead was found near Crowford with the following inscription in raised letters on the top: "Imp. Caes. Hadriani Aug. Met Lvt." In 1783 another pig of lead was found near Matlock weighing 84 pounds. Upon it in raised letters were the words: "L. Arvconivere cui & Meal nnd Lucius Aruconus Verecundus." Upon another block, also found near Matlock, are inscribed "T. Cl. Tr. Lvt. Rr. Gx Aeg.," probably a tribute to Tiberius Claudius Caesar. These pigs of lead point to the fact that the lead mines in Great Britain were worked by the Romans A. D. 14-138. Centuries after the Roman invasion the mines were held by the religious houses.

LEAD MINING.

Men mining lead ore, such as galena or sulphide, do not suffer from plumbism. They incur most of the ordinary risks of the coal miner, excluding those arising from the presence of fiery gases. If working in ill-ventilated mines, men can not avoid inhaling dust given off from the ore, fumes from the gunpowder used in blasting, and smoke from the candles. As a consequence some of them suffer from pneumoconiosis, a hardening or fibrosis of the lungs due to a low form of inflammation of the supporting texture of the lungs. To working in a dusty atmosphere the respiratory diseases of the lead miner are attributed, but there are other factors in operation, such

as sleeping in overcrowded and ill-ventilated barracks close to the mines; also exposure of the miners to the cold winds of our northern climate, when, overheated and fatigued with their day's work, they may have to travel 2 or 3 miles across a bleak moorland before reaching home. The freedom of the British lead miner is due to the fact that lead is present in the ore in almost a pure metallic state, whereas in some of the Italian mines and in those at Broken Hill, in Australia, the lead is found in the form of a carbonate, and, in consequence, the miners have suffered from some of the most serious symptoms of plumbism. The unloading of heavy volcanic lead ore from a ship at a British port was followed by seven cases of plumbism among the men. Such ore ought always to be well watered first.

LEAD SMELTING.

DUST AND FUMES.

The danger to health commences with the smelting of the ore. It may be said that dust and fumes are responsible for most cases of lead poisoning. The knowledge of this danger is one of the reasons why lead smelting is usually carried on in remote and sparsely populated districts away from human dwellings, and yet even there, as at Leadhills in Scotland, the Peak of Derbyshire, and Bleiberg in Austria-Hungary, owners of smelting works have had to pay considerable sums of money to farmers for ruined crops and for lead-poisoned cattle. In Weardale, cattle grazing on the hill-sides near the chimneys of the works are said in the district to have become "bellond" (belly bound), and have died from lead colic. Frequently the chimneys are a mile or more away from the smelting works. Flues, which connect the two and in which the metallic dust is deposited, run between the smelting works and the chimney and are of sufficient height for men to enter, so that they may be cleaned from time to time. Flue dust contains, according to H. O. Hofman,¹ from 0.8 to 15 per cent of the weight of the ore charged, while the amount of flue dust carried off with the gases is about 2 per cent. In the flue dust of lead smelting works at Freiberg, in Saxony, there were found, according to Hofman, from 16.2 to 26.2 per cent of lead and from 7.5 to 46.4 of arsenic; in the Globe Works, Denver, Colo., 5.1 to 19.4 per cent of lead and 0.3 per cent of arsenic. As the fume travels from the smelting furnace to the chimney, a large part of it is deposited in the flue and is recovered. Roughly speaking, flue dust is composed of about 30 per cent of metallic lead, together with lead oxide and a variable proportion of sulphur, arsenic, and other admixtures.

¹ The Engineering and Mining Journal, 1906, p. 380.

CLEANING OUT FLUES.

Cleaning out the flues in order to recover lead dust is a dangerous occupation. Where the flues are not very long, and the fumes have to pass through condensers, there may be 2 or 3 feet of lead dust deposited in places, and this has to be shoveled away in buckets, barrows, etc. This work, carried on as it is in a gallery provided only with manholes, many yards apart, is extremely dusty. In the Peak of Derbyshire the writer found that many of the men after only a few hours' work in the flues suffered so severely from headache and violent vomiting and were so overcome by the lead dust that they became ill and had to be removed. This is one of the departments of a lead smelting factory in which men should only work for not more than two hours at a time, and where the work should be done in relays. The dust might be watered by spraying, and the men ought to wear respirators and overalls.

BLAST FURNACES.

Lead smelting is carried on in blast furnaces, calcining furnaces, cupelling furnaces, and dezincking retorts. Dr. Edgar L. Collis,¹ His Majesty's medical inspector of factories, has discussed from the medical point of view the various processes and dangers incidental to the smelting of lead. It is the refractory ores and dross which are treated in blast furnaces. The furnaces are cylindrical, with hearths for lead and slag at the bottom. Each furnace is fed from above with coke and ore, air being driven into the lower part of the glowing charge by a strong blast. The fumes are carried off from the upper part of the furnace into one of the main flues, such as that I have already mentioned. The molten metal and slag collect in the hearth and are run off from time to time.

The dangers to health incidental to lead smelting are (1) the dust given off when shoveling the charge; (2) inhalation of the fumes which escape from the furnace at the charging point. Charge men are known to suffer from tremor and paralysis, while in many of the men thus employed the gums show a well-marked blue line. Should, from one cause or another, the flue become partially blocked, the fumes from the furnace become reflected upon the workmen, and as a consequence they run the risk of becoming poisoned. Another danger to which furnace men are exposed is inhalation of carbon monoxide gas, due to incomplete combustion of the fuel. The percentage of carbon monoxide by volume given off in the gases from lead blast furnaces varies from 3.5 to 10.8. The slag varies in the melting point from 1,030° to 1,270° C. (1,886° to 2,318° F.), and

¹ Special Report on Dangerous or Injurious Processes in the Smelting of Materials Containing Lead and in the Manufacture of Red and Orange Lead, and Flaked Litharge. Home Office, London, 1910. By Edgar L. Collis, M. D., His Majesty's medical inspector of factories.

since lead melts at 325° C. (617° F.), its vapor will be given off at the ordinary heat of the furnace.

SCOTCH HEARTH.

In what is known as the Scotch hearth, a smaller furnace than the English blast furnace, only galena is treated. The fire is an open hearth, upon which the workman feeds the charge, while the two blast pipes open into the glowing charge from the back of the hearth. When the molten lead rises to the top of the well or sump of the hearth it flows off by a small channel into a collecting pot, the slag being removed from time to time and placed in water to cool. The slag often contains sufficient lead to warrant it being remelted. Unless it is well watered, a workman will, while breaking up the slag with a hammer, raise clouds of dust more or less dangerous. During the tapping of the molten slag and the molten lead fumes are given off. From an analysis of these fumes¹ it is calculated that in eight hours a man might breathe 7.38 grains of lead. M. Boulin, factory inspector of Lille, in alluding to the circumstance that at a lead smelting works in Bohemia the dust obtained from the place where the blast furnace charges were mixed contained 14.5 per cent of lead, makes further reference to the fact that at a smelting works in the north of France the whole of the men employed at the furnace showed signs of lead poisoning.² Collis found, of 32 blast furnace men examined by him, that 22 showed a blue line on the gums and 12 had weakness of the extensor muscles.³

REVERBERATORY FURNACES.

Galena and impure lead rich in precious metals are treated in reverberatory furnaces, the process to which the metal is exposed being known as softening and oxidizing. These furnaces have a sloping floor or hearth, at the bottom of which is a vent for tapping. They are heated at one end by an ordinary coal fire or by producer gas. The hot draft from the fire is carried up against the dome of the furnace and there reflected or reverberated on to the surface of the mass on the hearth, from which it is carried away at the far end of the furnace by a flue. When the material in the furnace has melted there rises to the surface the dross, which contains lead, copper, sulphur, and arsenic. The dross is raked off, deposited on the floor, and allowed to cool, giving off fumes all the time. As subsequent shoveling of this is a dusty procedure, it would be better if the dross were placed in a proper receptacle provided with an exhaust

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for 1900, p. 438.

² Bulletin de l'Inspection du Travail, 1906, p. 494.

³ Special Report on Dangerous or Injurious Processes in the Smelting of Materials Containing Lead, etc., p. 10.

hood to remove fume and dust. After drossing, the temperature is raised, and air is permitted free access, whereby the various impurities of the lead—e. g., tin and arsenic vapors—are oxidized and given off in the form of vapor, or they are removed in the form of skimmings. Subsequently the slag and lead are run off from the furnace into an open pit almost at the feet of the men, so that they can not help breathing the fumes. The worst “smother” from fume comes from reverberatory furnaces, and at times it is so bad that the men recognizing the danger cover their mouths with handkerchiefs. There is plenty of dust lying about in these furnace houses. It contains 8.5 to 23.7 per cent of lead. The molten lead thus purified and free from precious metals is run off into molds, when it is known as pig lead. As this is done at a comparatively low temperature—350° to 400° C. (662° to 752° F.)—there is little danger to the health of the men, although on their gums a blue line is often seen.

DESILVERING.

Since lead ore frequently contains silver and gold, these metals have to be removed. This is done by either Pattinson's or Parkes's process. Pattinson's process, the method of desilvering used on Tyne-side, depends upon the fact that lead crystallizes at a higher temperature than an alloy of lead and silver, so that the crust which forms on the surface contains lead and silver, and is removed for further purification and separation. In Parkes's process zinc is added to the lead. This forms an alloy of silver, lead, and zinc, which rises to the surface and is removed. The further stages of the process consist in separating these, the zinc being drawn off in the form of vapor in a dezincing apparatus, known as the Faber du Faur retorting furnace. The writer has frequently had under his care on account of lead poisoning men employed in the Pattinson process. In the dezincing process, zinc as well as lead fumes escape, and these give rise to nausea.

CUPELLING.

In the cupelling of lead a blast of air is blown upon the molten metal. This oxidizes the lead into litharge, which is blown off the surface by the force of the blast and falls into a receptacle placed to receive it. By this means all the lead is gradually burnt off, leaving only the silver and gold behind. Owing to the high temperature at which cupelling is carried on and to the volatility of litharge and to the dangerous nature of the fumes given off, great care is required in this process. Men thus engaged run the risk of being poisoned by lead. Allusion has already been made to the large quantities of dust present everywhere in smelting works. It only requires a glint of sunshine to penetrate a works in order to see the metallic particles suspended in the air.

SMELTING OF ZINC ORE CONTAINING LEAD.

Zinc smelting is a frequent source of plumbism, owing to the fact that zinc ores often contain lead, and as this is regarded as an impurity it has to be removed. Calamine ore contains from 44 to 60 per cent of zinc in the form of carbonate. In blende ore the zinc is present as sulphide, combined with silica, while lead is also present to the extent of 9.3 to 18 per cent. In the manufacture of spelter, blende is roasted in a calcining furnace, in order to drive off sulphur, while in the residue there may be left 1 to 10 per cent of lead. The burnt blende is mixed with calamine and zinc ashes, a mixture of zinc oxide, and a minute quantity of zinc chloride, obtained from the skimmings of galvanized pots and retort crucibles. The whole is mixed with anthracite and the charge placed in retorts and exposed to a high temperature, when the zinc distils over and is condensed in a crucible close to the retort. In addition to breathing the fumes of lead and zinc the men who carry on this work are exposed to injurious gases, such as sulphur dioxide, and to the effects of high temperature. German physicians who have had large experience of spelter workers say that the men are old and broken down at 40 years of age. These men suffer from bronchitis, gastric and intestinal troubles, also from nervous affections which are attributed to lead. Dr. Collis states that in a large spelter works employing 92 men the manager informed him that out of 38,031 working days the men lost through ill health 7,425 days; in other words, the time lost was 19.5 per cent.¹ The source of plumbism in spelter works, according to Ingalls,² is the bluish-white powder which condenses on the prolongs. This contains 0.5 to 2.5 per cent of lead. In one factory the dust deposited from the fumes gave on analysis 3.25 per cent of lead. When the retorts are about to be charged the men who mix the blende and the calamine are exposed to considerable quantities of dust, an inconvenience which could be diminished by keeping all ore, whether roasted or not, damp.

Unless the furnaces, slag holes, and silver-refining furnaces are carefully hooded or provided with exhaust drafts the workmen can not avoid inhaling lead fumes. In the case of open caldrons containing molten lead, tallow when poured upon the surface of the molten metal checks the ascent of vapors. This is specially useful during the casting of type for printing purposes, owing to the low temperature at which lead melts. In a lead-pipe factory in Germany where there had been several cases of plumbism the malady disappeared when tallow was added to the surface of the molten lead and when the men

¹ Special Report on Dangerous or Injurious Processes in the Smelting of Materials Containing Lead, etc., p. 15.

² The Engineering and Mining Journal, 1903: "The metallurgy of zinc and cadmium," W. R. Ingalls.

gave greater attention to personal cleanliness and drank milk. In the manufacture of lead pipes the metal is molded and pressed outward; the pipes when still warm are grasped by the men, whose hands are thickly gloved or enveloped in tow. Lead-pipe makers occasionally suffer from plumbism. It is interesting to know that the lead which makes the best pipes and also makes the best white lead is that obtained from ore which contains the least silver.

HOURS OF LABOR.

Increase of the hours of work has been found to be associated with a rise in the number of cases of plumbism. A change from six to eight hour shifts of employment was in a Scotch factory found to be the only explanation of an outbreak of plumbism in a works which had hitherto been free.

EFFECT OF VENTILATION ON PLUMBISM.

When in lead-smelting works any of the men are found to be suffering in an unusual degree from plumbism, the ventilating shafts and flues ought to be examined, for experience has shown that temporary obstruction of these outlets is a frequent cause of saturnine poisoning.

That bad conditions in a factory are a fruitful source of plumbism and that the health of the workmen can be considerably improved by the introduction of exhaust ventilation are shown by M. Boulin¹ in the incidence of plumbism in lead-smelting works at Selmeczbánya, in Hungary, where in 1895 there were 291 cases (73.5 per cent) in this works alone.

CASES OF LEAD POISONING PER 100 EMPLOYEES IN A LEAD-SMELTING WORKS IN HUNGARY, 1885 TO 1903.

Year.	Per cent of workers attacked by plumbism.	Year.	Per cent of workers attacked by plumbism.	Year.	Per cent of workers attacked by plumbism.	Year.	Per cent of workers attacked by plumbism.
1885.....	46.5	1890.....	20.0	1895.....	73.5	1900.....	28.8
1886.....	45.5	1891.....	22.2	1896.....	38.5	1901.....	29.5
1887.....	43.5	1892.....	37.5	1897.....	39.5	1902.....	13.0
1888.....	49.4	1893.....	47.8	1898.....	55.2	1903.....	3.0
1889.....	24.2	1894.....	55.5	1899.....	49.8		

In 1895 at the works a central chimney was erected and pipes from the hoods connected to it. Between 1898 and 1901 means were adopted to insure the better removal of the fumes, with the highly satisfactory results shown in the above table. Equally gratifying results are shown by M. Boulin to have followed the installation of improved methods of ventilation at the roasting furnaces of lead

¹ Bulletin de l'Inspection du Travail, 1906.

smelting works at Friedrichshütte in Silesia, where the number and per cent of cases of plumbism were as follows:

NUMBER AND PER CENT OF EMPLOYEES SUFFERING FROM LEAD POISONING IN A LEAD-SMELTING WORKS IN FRIEDRICHSHÜTTE, SILESIA, 1884 TO 1892.

Year.	Cases of plumbism.		Year.	Cases of plumbism.	
	Number.	Percent- age.		Number.	Percent- age.
1884.....	63	64.3	1888-89.....	17	14.0
1885.....	84	73.7	1889-90.....	5	3.6
1886.....	98	70.0	1890-91.....	4	2.9
1887-88.....	37	28.8	1891-92.....	1	.8

Without burdening the text too much, it may not be inappropriate to mention here that owing to the great amount of plumbism among the men employed in the lead works in the Harz Mountains the managers of the various works met in conference and decided to introduce improvements, especially concerning better ventilation over the places where the pouring of the molten lead and the casting were done; also over the basins where the metal skimmings were remelted. From that date the number of cases of illness considerably declined.

CASES OF LEAD POISONING IN A LEAD-SMELTING WORKS AT OKER.

[Neisser, D. E. J., Internationale Übersicht über Gewerbehygiene, p. 24. Berlin.]

Year.	Number of hands in general.	Number of hands under special rules.	Number of lead cases.	Number of days of sickness.	Year.	Number of hands in general.	Number of hands under special rules.	Number of lead cases.	Number of days of sickness.
1895.....	612	177	21	203	1901.....	651	186	5	142
1896.....	610	177	9	149	1902.....	657	189	5	74
1897.....	613	179	20	243	1903.....	659	189	6	63
1898.....	612	179	18	266	1904.....	654	189	4	63
1899.....	608	177	46	437	1905.....	652	189	1	13
1900.....	621	184	7	163					

REMELTING.

The remelting of old lead and of the thin sheets of lead taken from the inside of tea chests is a frequent source of plumbism, especially when it is carried on as a home industry. Men who cut out leather on lead slabs are also known to have suffered, owing to the surface of the lead becoming oxidized and converted into fine dust.

There is a personal and a family idiosyncrasy to plumbism. In the sparsely populated dales of the county of Durham, where lead ore is mined and smelted, several if not all the male members of working-class families resident in the district become either miners or lead smelters. These lead miners living in the secluded valleys of that county form a class by themselves. Although poorly paid they are thrifty; they are a devotional and well-behaved people. Close

intermarriage has exaggerated their peculiar tendencies. In the case of lead smelters the writer has seen strong stalwart sons in a family die one after another at a comparatively early age from kidney disease induced by plumbism, while in other instances men of other families were hardly affected by the metallic fumes.

MANUFACTURE OF WHITE LEAD.¹

DUTCH PROCESS.

One of the greatest uses to which lead is put is the manufacture of white lead for plumbing, house and carriage painting, etc. There are several methods by which the conversion of metallic lead into lead carbonate is brought about, but of all the methods it is generally admitted that the product obtained by the Dutch process, which was introduced into England about the year 1780, is probably the best. It is the method mostly in use in the north of England. The conversion of metallic lead into carbonate or hydrocarbonate is slow. The first stage in the process consists in ladling out molten lead into molds to form long thin plates, called in the north of England "wickets." Factory regulations allow of this work being done both by men and women. The skin of the back of the fore arms of those thus employed becomes deeply bronzed, interrupted here and there by white spots, varying in size from a split pea to a 3-penny piece, marks left by burns the result of spluttering of the molten metal. In some works the molten lead instead of being ladled out by hand is allowed to run automatically from the furnace or kettle into a continuous series of steel molds, which are constantly traveling, like the buckets of a dredging machine, and which after passing an incline let fall their contents.

In the Dutch process the thin sheets of metallic lead or "wickets" are taken to what is called the "blue bed," a large quadrilateral space, one side of which is not closed in. Open-mouthed earthenware jars half filled or more with a 3 to 4 per cent solution of acetic acid are placed in rows upon the floor previously strewn with bark from a tannery. On the Continent farmyard manure, especially that of the horse, is used instead of tanbark, care being taken not to employ that of carnivorous animals, such as the dog or pig, since there would be disengaged sulphureted hydrogen, which would form black sulphide of lead. Horse manure also gives off sulphureted hydrogen, but the quantity is too small to affect the whiteness of the lead carbonate. Tanbark is better; it is more sanitary and does not evolve sulphureted hydrogen. It is slower in its action, requiring three months for the operation, whereas with horse manure the procedure is over in six weeks.

¹ Carbonate of lead; Céruse (French); Bleiweiss (German).

The films or "grids" of metallic lead are laid upon the jars, care being taken that the lead does not touch the acid, otherwise corrosion is retarded. Wooden planks are placed over the series of earthenware jars and the superimposed lead plates, and upon the planks is strewn fresh tanbark. Another layer of earthenware jars charged with dilute acetic acid is laid upon the bark, and upon these again lead plates, over both of which are placed wooden planks. Layer after layer is thus built up, and as each tier rises the open side of the space is at the same time planked in with wood. All this is done by hand labor, often by women; the work is unskilled. An unoccupied area is left between the topmost layer and the roof, while at the sides running up from the bottom of the blue bed to the top are placed pipes, which serve for ventilation and the removal of vapors. In Scotland each layer of bark, jars, lead, and wooden planks is called a "heat." In some of the works which the writer has visited the stacks are too high. There are 15 heats. Experience has shown that from 12 heats better results are obtained than from 15, since the midzone is found to be better corroded, a circumstance which makes it appear as if some change was effected between the uppermost and the lowest heats, which interferes in some way or other with corrosion of the midzone. Instead of earthenware jars to hold the diluted acetic acid manufacturers have occasionally made use of newly made lead jars, but works managers have informed the writer that the product has not been increased thereby, and in most cases they have discontinued their use.

Although there is considerable handling of the metallic lead plates in making up a blue bed or stack, this is not followed by much sickness on the part of those engaged in it, and yet in some instances the writer has found it to be a cause of pretty severe lead colic and of the minor forms of plumbism. The making up of a stack is in Great Britain work in which women may take part. Once the doors of a blue bed are closed, the stack is left untouched for three months. When opened out again it is no longer known as a "blue bed," but as a "white bed," and into it women are not allowed to enter. During the three months' closure fermentation occurs inside owing to certain changes in the tanbark, because of which the temperature rises during the first five or six weeks to 60°-70° C. (140°-158° F.). The acetic acid in vaporizing acts upon the lead and converts it into lead acetate, but a double conversion takes place owing to the carbonic acid evolved from the tanbark acting upon the lead acetate and converting it into white lead or carbonate. During the summer fermentation inside the stack is more active than in winter, so that the operations have to be more carefully watched. The object sought is to have as much as possible of the metallic lead converted into carbonate, and to have as few traces of the acetate as

possible. On an average for every hundredweight of metallic lead thus treated from 50 to 78 pounds of lead carbonate are obtained.

The stripping or emptying of a white bed or stack is a dangerous process, owing to the dust raised. The men thus employed ought to wear overalls and respirators. Watering each heat or layer with a hose after removal of the wooden planks lessens very considerably the amount of dust. In some factories wicker baskets filled by hand with the corroded and uncorroded lead are carried away from the white beds by men, but in others the filled boxes or buckets are lifted by means of an electric crane and the material transported to the rollers. Mechanical carriage is quicker, safer, and cheaper, since one man, with the assistance of an electric crane, can do the work of 15 to 20 men.

Even when the stacks are well watered the stripping of the white bed is a dangerous process. On the gums of nearly all the men a blue line is observed, a circumstance to which attention will be drawn later on. It is work at which the men should not be kept constantly employed. It is imperative that all persons employed in lead processes should wash their hands well before eating, and that men who wear a beard should wash it also before taking food. If the hands of a workman engaged in stripping a white bed are examined they are seen to be coated with hard dust, which has penetrated well beneath the nails and along their margins and which ordinary washing with soap and water does not remove. Scrubbing brushes, soap, towels, and plenty of warm water should be provided by employers and sufficient time taken off the workmen's shifts to allow them to cleanse their finger nails properly before leaving the factory. In some factories the men before commencing work insert vaseline under their finger nails, in other works the men wear india-rubber gloves.

From the white beds the lead, converted and unchanged, is taken to the rollers or screens, where, under water, the two are separated, the unchanged pieces of lead being removed in order to be remelted, while the carbonate of lead suspended in the water is carried on through several grinding wheels. If the white lead is to be made into paint this can be done by allowing the suspended carbonate to pass on into a series of vats to which oil is automatically added, and where by mechanical mixing the oil gradually replaces the water. This compound of white lead and oil, with a small percentage of water, is subsequently placed in a heater where it loses moisture, with the result that a finished white paint is produced without there having been any handling of the white lead after it has left the stacks. This method of grinding paint in which linseed oil is added to the mass in the wet state is a great advance over the old method, which required the lead carbonate first to be dried—a process which

was most destructive to health and life. Manufacturers tell us how much improved the health of paint grinders has become since this method has been introduced.

It is not known who is the inventor of the process, but it was in the works of Messrs. Expert Besançon et Cie, Paris, that the writer's attention was first directed to it, and being satisfied with the excellent results obtained there, as regards the health of the workmen, he brought it under the notice of the home secretary, then Sir Matthew White Ridley, who subsequently circularized the British manufacturers upon the point. Some persons attribute the invention to Theodore Lefèvre, of Lille, others to the Paris firm just mentioned. The merit of the process is that there is no handling of the white lead, and there is no stoving required, while time and labor are saved. So complete is the removal of the water from the paint that only a small fraction, not more than 0.1 per cent, is left.

Paint is pretty constant in its composition, viz, 90 parts of dry white lead and 10 of oil. Since dust is the danger in all lead processes, it has been thought that all wet methods are safe. Certainly they are safer than dry methods of manufacture, but all splashing must be avoided, for the splashes become dry and give rise to dust. Where possible grinding mills should be inclosed. Above the cover of each there ought to be an aspirator to remove the vapors which arise in consequence of the heat generated during grinding.

When dry lead carbonate in the powdered state is required, the white-lead pulp on leaving the moist-grinding department is ladled into basins and placed on shelves in an oven or drying chamber, or run into these chambers in wagons. The drying chamber should be ventilated, in order to allow of the moist vapor with the odor of lead escaping. The oven is generally heated by steam to a temperature of 80° C. (176° F.). Until 11 or 12 years ago the stoves in Newcastle and on Tyneside were made up by women, who carried the bowls of white lead on the head and in the arms. The emptying or drawing of the stoves was effected much in the same manner and was one of the most dangerous processes in the manufacture of white lead. The writer has known of young women, quite healthy until they went into the factory, who died within eight weeks of work at the stoves. A considerable quantity of fine dust is raised when the bowls of white lead are being placed upon the shelves in the oven, also during their removal, and if care has not been previously taken to allow the temperature of the heated drying chamber to fall before an attempt is made to empty it, so much greater is the danger. It was the high death rate from plumbism among females employed in emptying the white beds and in the drawing of the stoves which led the writer to recommend the secre-

tary of state to exclude females from all the dangerous processes of white-lead manufacture. Since then the introduction of means for the mechanical filling and emptying of drying chambers has considerably reduced the mortality of white-lead workers, a circumstance to which the abolition of female labor in these departments has also contributed, since men raise less dust at work than women owing to their method of clothing.

The filling of barrels with finished dry white lead ought to be done under cover provided with an exhaust draft. By this means the atmosphere of a factory is rendered comparatively clear of dust. Coopers who fix the lids on the barrels run the risk of plumbism by inhaling dust during the hammering. Occasionally the grindstones referred to in the earlier part of the description of the processes have to be cleaned and freshly chipped. The writer has known this operation to cause plumbism.

FRENCH OR CLICHY PROCESS.

In the French or Clichy process of white-lead manufacture carbonic acid, on being forced through a solution of basic acetate of lead, precipitates lead as carbonate and regenerates the normal acetate which, by dissolving fresh oxide, forms the basic acetate of lead, and this is again treated with carbonic-acid gas. When first introduced the Clichy process consisted in placing litharge dissolved in acetic acid into a wooden vat tarred so as to prevent disintegration of the wood. The oxide of lead and the acid were mixed by means of an agitator, and when solution was effected the clear liquid was run off into a copper vat from which, after undergoing further clearing, the liquid was transferred to a decomposition vat closed by a lid, traversed by numerous copper tubes, through which carbonic acid from burning coke was carried. The carbonic acid thus projected into a solution of basic acetate of lead produced a precipitate in 12 hours; this was removed and washed, and was at once ready for the market. White lead produced by this method¹ differs slightly in some of its properties from that made by the Dutch process. It is said to have less covering power. In France the manufacture of white lead by precipitation has, practically speaking, ceased.

CHAMBER PROCESS.

In the chamber process thin sheets of metallic lead are suspended on a wooden framework. Hot carbonic-acid gas and acetic-acid vapor are driven into the chamber, which has been hermetically closed. Chemical changes are induced similar to those mentioned as

¹ The Manufacture and Comparative Merits of White Lead and Zinc White Paints. G. Petit.

taking place in the stacks of the Dutch process. Within two weeks the metallic lead is converted into white lead. It is said that more metallic lead is converted into the carbonate by this method. Before men enter the chamber to strip it, steam is injected so as to moisten the material and to keep down dust. The lead carbonate thus produced differs from that obtained by the Dutch process, in so far as the scales are softer and, when mixed with oil, the paste is less compact than that obtained by the Dutch process.

KREM'S PROCESS.

White lead is manufactured in Austria by Krem's process, a modification of the Dutch, artificial heat being substituted for tan-bark or farmyard manure. Into wooden boxes containing grape skins and skins of different fruits acetic acid is poured. These boxes are placed inside stacks, and layers of metallic lead are placed upon them. The chamber is closed. Gradually the temperature rises, so that by the third week it stands at 45° C. (113° F.) and by the fourth it reaches 50° C. (122° F.). After this the temperature is allowed to cool slowly. Corrosion is completed by the end of six weeks. The heat generated within the chamber causes the acetic acid to vaporize while, owing to fermentation of the fruit skins, carbonic acid is evolved. The reaction is similar to that in the Dutch process, and the resultant is a beautiful white-lead carbonate, which owes its whiteness to the purity of the metallic lead used and the absence of sulphur in the fruit skins.

ENGLISH OR QUICK DUTCH PROCESS.

Another method, known as the English or quick Dutch process, which aimed at rapidity of conversion and rested upon the simultaneous action of acetic acid or acetate of lead and carbonic acid on litharge, has been discontinued.

LEAD SULPHATE.

On account of the danger to health incidental to the manufacture of the carbonate of lead, lead sulphate has been recommended, owing to its greater insolubility in the gastric juice, but experiments which will be detailed later on show that there is nothing to support this statement. The manufacturers of Purex white lead at Greenford, Middlesex, claim for their chemically pure basic sulphate, owing to the extremely fine state of subdivision of its particles, great resistance to atmospheric gases, chemical fumes, and sea water, and utility as a protective to iron. Its gloss and covering power compare favorably with those of any other form of white lead. It is also said to act well as a drier of linseed oil. The writer has visited the works, inspected

the men, and examined the processes of manufacture, which, since they are all carried on under cover, leave the atmosphere free from dust. On this account the occupations seemed to be unattended by the risks to health encountered in most white-lead factories.

PREPARATION OF LITHARGE OR MASSICOT: RED LEAD OR MINIMUM.

Red lead or minimum (Pb_3O_4) is a mixture of PbO with varying amounts of Pb_2O_3 or PbO_2 . It is prepared by placing pure lead in the open hearth of a reverberatory furnace and heating it to dull redness. During the process the material is raked from time to time. The lead is slowly oxidized and is converted into PbO , which is known as litharge or massicot, rather a green-looking substance, but becoming yellow or yellow-red on being washed. The massicot thus washed to remove all pieces of unoxidized lead—nearly 50 per cent—is again heated, but at a lower temperature, when, owing to further oxidation having taken place, the material changes its color to a bright red. It is then known as red lead or minimum. In this form it is removed, dried, and made ready for packing. Red lead can not be converted into paint straightway by the addition of oil, like white lead. It would not keep.

During the oxidation processes just referred to fumes may escape onto the face of the workmen, if the flue is not working effectively, or if the mouth of the furnace is not well-enough hooded. On removing the converted material from the furnace clouds of red dust rise. Packing of the minimum is an equally dusty occupation. It is sometimes said that red lead is not so poisonous as white lead, but some of the writer's worst cases of plumbism have been red-lead makers. In the 19 British red-lead factories, each of which gives employment to 6 to 28 workmen, there occurred between 1900 and 1909, inclusive, 108 cases of plumbism; 31 of these cases were severe, 30 were moderate, 45 were slight, and for 2 the severity of the symptoms was not stated. Expressed as percentages, the figures are 27.8, 28.7, 41.7, and 1.8, respectively.¹ During the 10 years above alluded to 16 cases of lead poisoning occurred in laborers employed to sweep the floors, while during the same period 64 cases occurred in litharge makers and 39 in flaked-litharge makers. Flaked litharge is lead monoxide (PbO) in the form of hexagonal semitransparent yellow or orange-yellow flakes, obtained during the cupellation of rich lead ore. The semimolten lead collected below the cupel is withdrawn and allowed to cool. During the process of cooling it exfoliates to form flaked litharge. The dangers to health are largely owing to the high temperature at which the men work and the volatility of the litharge. During 1900 to 1909 25 men became ill from the effects of lead. They

¹ Special Report on Dangerous or Injurious Processes in the Smelting of Materials Containing Lead, etc., pp. 17, 18.

had been engaged in sieving, grinding, and packing the litharge. During the same period 13 furnace men suffered in a similar manner, and one bricklayer, who had been called in to reconstruct a flaked-litharge furnace, died from lead poisoning.

STATISTICS OF LEAD POISONING IN GREAT BRITAIN.

Owing to the compulsory notification of cases of industrial lead poisoning to the chief inspector of factories, and for which medical men are paid half a crown (60.8 cents) for each notification, a mass of statistics, which is becoming of great value, has been placed at the disposal of the Home Office. Dr. T. M. Legge, medical inspector of factories,¹ points out that during the past 10 years there has been a reduction of more than 50 per cent in the number of cases reported. The decrease is principally noted in those trades or processes in which exhaust ventilation for the removal of dust has been applied, as in the manufacture of white lead, earthenware and china, litho-transfers, paints, and colors. On the other hand, in lead smelting and in industries using paint, where hitherto it has been found difficult or impossible to apply local exhaust, there has been a slight increase in the amount of plumbism. The number of fatal cases of saturnine poisoning have not decreased as they ought, but this may be partly due to the fact that medical men are now certifying deaths as due to lead poisoning which were formerly attributed to kidney disease, without any special reference to its supposed cause. During the 10 years above alluded to, there have been something like 7,000 cases of lead poisoning notified to the British Home Office as occurring in 18 industries. The cases reported include all attacks reported in one year and not previously reported in the preceding 12 months; no name appears twice in the same year. After an interval of 12 months between two reports, a fresh attack is again included. The number of such second reports was 284, or 4.2 per cent.

It is now more than a decade since the Home Office Lead Commission, of which the writer was a member, published its recommendations, in which was included the abolition of female labor in the dangerous process of the manufacture of white lead. I can vouch for the improvement since then in the conditions of labor in the factories and in the health of the workers. As an illustration of the unsatisfactory state of things which existed at that time, the home secretary, Sir Matthew White Ridley, on February 17, 1898, announced in the House of Commons that there had been 37 fatal cases of industrial lead poisoning of boys under 18 years of age. Until the crusade against lead poisoning hardly a week passed without patients seeking advice at the Newcastle Infirmary, and scarcely a month went by without there appearing in the daily press the announcement of the

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, p. xxxvi.

death of a lead worker, usually a young female, from plumbism. All this is changed, as the following figures show.

Taking the Newcastle district, the numbers of cases of plumbism among white-lead workers notified to the Home Office for the two six-months' periods preceding and succeeding June, 1898, the date of the displacement of female by male labor, are as follows:¹

Period.	Notifications.			Fatal cases.		
	Males.	Females.	Total.	Males.	Females.	Total.
Dec. 1, 1897, to May 31, 1898.....	19	66	85	1	4	5
June 1 to Nov. 30, 1898.....	82	12	94	2	2	2

Between January and October, 1898, there were notified 192 cases of lead poisoning. The "stoves," the most dangerous department in the factory, supplied 76 patients, and the "white beds" 31. The ages and the number of the workers were as follows:

Age group.	Number of workers.	Age group.	Number of workers.
Under 20 years.....	5	40 to 50 years.....	24
20 to 30 years.....	84	50 to 60 years.....	15
30 to 40 years.....	58	Over 60 years.....	1

The declension in the number of cases of plumbism in Newcastle and district during the last few years has taken place without a reduction in the number of persons employed. In 1897 the number of persons employed in the lead works was 900, of whom 571 were females; in 1898, 998, of whom 350 were females; in 1899, 968, of whom 227 were females; and in 1900 there were 1,000 persons employed, of whom 231 were females. Since then the number of females working in lead factories has fallen, so that in 1910, according to Mr. W. B. Lauder, His Majesty's inspector of factories, to whom I am indebted for this information, there are 75 women employed, and 1,245 men. The numbers of cases of lead poisoning in the past 10 years are as follows:

Year.	Number of cases, by sex.						Year.	Number of cases, by sex.					
	Nonfatal.			Fatal.				Nonfatal.			Fatal.		
	Males.	Fe- males.	To- tal.	Males.	Fe- males.	To- tal.		Males.	Fe- males.	To- tal.	Males.	Fe- males.	To- tal.
1901.....	89	7	96	1	.....	1	1906.....	33	2	35	3	.....	3
1902.....	64	2	66	2	.....	2	1907.....	26	3	29	1	.....	1
1903.....	53	3	56	.....	.....	.....	1908.....	49	1	50	1	.....	1
1904.....	56	2	58	.....	2	2	1909.....	16	1	17	1	1	2
1905.....	37	.....	37	.....	.....	.....	1910.....	3	.....	3	1	.....	1

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1898, p. 120.

The remarkable decrease in the past two years is attributed to considerable improvements in mechanical ventilation, the introduction of new methods for the removal of dust, and the provision of better washing accommodations.

HOUSE AND COACH PAINTING; SHIP PAINTING; COLOR MIXING.

Although house, ship, and coach painting does not come quite within the sphere of the operation of the factory and workshop acts in Great Britain, yet all cases of plumbism occurring in these trades have to be notified to the Home Office. In the past 10 years 1,973 cases of saturnine poisoning were reported¹ as occurring in house painters and plumbers, including the large number of 383 deaths. The statistical information thus acquired shows plumbism to be much more widely prevalent among painters than has hitherto been believed. This is the case not only in Great Britain, but in countries abroad as well. Formerly white-lead workers stood at the head of the list of trades which gave the highest incidence of plumbism, but painters now compete with them for this unenviable position. Out of 300 patients who entered the Paris hospitals for plumbism, 233 were painters. In another instance, out of 111 patients examined by Prof. Layet, painters formed two-thirds of the number. The total lead cases in painters and plumbers in Great Britain were, in 1903, 202 reported, with 39 fatal; 1904, 227 reported, 39 fatal; 1905, 163 reported, and 23 fatal.

Dr. Paddock, one of the certifying surgeons for East London, made an examination of 520 painters employed in seven paint and color works, and found that 70 per cent of the men showed a blue line on the gums, combined in 15 per cent of the men with more or less anæmia.

CAUSES OF LEAD POISONING AMONG PAINTERS.

Of the causes of plumbism in painters mention may be made first of the grinding of white lead with oil. This, however, as a source of plumbism, is sure to diminish, since in an increasing number of white-lead works the paint is now made with the lead carbonate in the moist state when without further preparation it is ready for the market. House painters are often heedless of the dangers to which they expose themselves. Plumbism has been traced in them to the practice of holding the brush between the teeth, to holding putty and white-lead paint in the palm of their hands, also to not washing before eating. When sandpapering a painted surface so as to smooth it before applying a fresh coat of paint, a considerable quantity of dust, rich in lead, is given off. This the men can not

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, p. 196.

help breathing. In Vienna the smoothing of painted surfaces is done by pumice stone, but in Belgium this is not allowed, for the dust created is very fine and is highly dangerous when inhaled. According to Stieler the particles of dust given off under these circumstances consist of oleate of lead, which is more readily assimilable by the body than other forms of lead. In the burning off of old paint fumes are evolved, which are a fruitful source of plumbism. So, too, is the dust which dries upon the overalls of the painters.

In connection with this the writer presents here the case of a married woman living at home who consulted him on account of an inveterate paralysis of both hands and which was found to be due to plumbism, the result of washing the overalls of a nephew who was a house painter. In the water taken from the washtub I found a large quantity of lead. A similar fate frequently befalls the women who wash the overalls of workers in white-lead factories and color works. In the washing off of old paint with caustic potash, the men should see that there are no cracks in their skin, as apart from the pain and the risk of blood poisoning thereby possible, there is also the risk of plumbism.

It has long been known that from newly painted surfaces there are given off emanations which are harmful to some people. To this cause was traced a few years ago an outbreak of colic on board of a newly painted French man-of-war. While writing this paper the writer is treating an extremely severe case of colic and albuminuria accompanied by physical and mental depression in a young London medical practitioner, who has become the subject of plumbism through living in his house while it was being painted. Although exposed to the emanations for only a few weeks he has become so ill that he has had to give up work for a few months. In his urine I found considerable traces of lead. A few weeks previous to seeing Dr. X., I was consulted by the commercial manager of a large india-rubber works, whose digestive functions had all gone wrong, who was suffering from an inexplicable vomiting accompanied by a sense of fatigue, which was unusual to him, mental depression, irritability of temper, and albuminuria, all of which I found were the result of living at home when the interior of his house was being painted. There are some persons who can not bear the smell of paint without experiencing headache; there are others again who are seized with violent retching and vomiting. Toward paints that contain lead there is shown by some persons an idiosyncrasy which can not be ignored. Emanations from a freshly painted surface are harmful, owing to the volatilization of the turpentine which the paints contain. Experience and experiment alike show that in these emanations there are traces of lead. According to spectroscopic examination some painted surfaces give off more lead than others.

A French chemist made the experiment of placing metal boxes freshly painted with white lead in a glass jar. He aspirated the air from these jars and, passing the air through a 10 per cent solution of sulphuric acid, he found that it contained traces of lead. Prof. Trillat of the Pasteur Institute, Paris, has discovered a very delicate test for lead, whereby the presence of one three-millionth part of the metal can be detected, provided steps have been taken previously to convert the lead into binocide by oxidizing the lead salt by an alkaline hypochlorite solution. The test rests upon the fact that an acetic-acid solution of tetramethylate of diphenyl methane gives a beautiful blue color with lead binocide.

As it is only recently that lead has been proved to be present in emanations from freshly painted surfaces, the experiment carried out by Messrs. Heim and Hébert and by Prof. Trillat at the Pasteur Institute are worthy of mention. Heim and Hébert exposed cultures of a mold known as "*Penicillium glaucum*" to air in closed bell jars under different conditions—(a) air alone, (b) air which might become infected from dry white lead, and (c) air in contact with fresh paint. In (a) the mold developed by the third day and in (b) shortly after the third day, while in (c) the delay was considerable, and at the best only a few colonies of growth appeared. The development of another mold, "*Aspergillus niger*," was similarly arrested by emanations from paint. Trillat found that while neither white lead nor oil singly or combined checked vegetable growth, fully formed paint had the power of doing so. A guinea pig placed in a bell jar, the air of which had passed over a freshly painted surface, died within 18 hours from acute congestion of the lungs, probably caused by breathing terebinthinated vapor. Turpentine is poisonous to some people. It causes headache and induces vomiting, but it alone will not explain the symptoms consequent upon breathing emanations from fresh paint, for Trillat found that when the paint was made with zinc white instead of white lead, although it contained the same amount of turpentine, no symptoms developed. Some peculiar combination is formed between the white lead and oil mixture, and it is this which is harmful. During the mixing of paints disagreeable odors are occasionally evolved which frequently cause headache and vomiting. This is particularly the case with some oils as compared with others. The writer has known men to suffer from violent retching when mixing pigments with certain oils. To repeat, between a terebinthinated oil and white lead there is apparently some compound formed which in its nascent state is harmful to those who breathe it.

An attempt has been made by French writers to attribute plumbism in painters to the excessive use of alcohol. There is no evidence that

in Great Britain painters are more intemperate as a class than other workmen. The part which alcohol plays in predisposing to plumbism will be referred to later on. Of 131 house painters examined in Lille, Dr. Verhaeghe¹ tells us that 27 per cent acknowledged that they took alcohol, but there is no mention that they took it in excess. Sixty-three of the men suffered from colic and digestive derangements. Most of the men were between the ages of 30 and 35. Verhaeghe's statement, although meant to, throws no light upon the question.

The paints used for the exterior of ships in an ordinary way contain large quantities of iron, sometimes they also contain lead. The use of quickly drying or spirit paints is dangerous, less from the amount of lead they contain than from the spirit, which is inflammable and which also intoxicates the men if the air in which they are working is stagnant. Ship and coach painting has often to be done, too, in closely confined and badly ventilated places. This circumstance favors plumbism. It is the custom with coach builders to give a carriage three coats of priming, six coats of filling up, three or four coats of oil color, two of varnish color, i. e., oil color and varnish mixed, and four coats of varnish. The colors principally used by coach builders are white lead, lampblack, burnt umber, raw sienna, ultramarine, yellow chrome, rose pink, zinc white, vermilionette, Indian red, etc. Driers such as sugar of lead and terebene are used. It is when the men are sandpapering a painted surface so as to have it perfectly smooth before applying another coat that they are apt to suffer, also when they are using certain kinds of "stopping" to fill up cracks or irregularities. The application to the back of the painter's hand of a small apparatus for exhaust draft on the lines of a vacuum cleaner might remove the dust and prevent plumbism. At any rate it is worthy of a trial.

Another source of plumbism in coach works is the application of paint to iron coach frames when still heated. This, to the knowledge of the writer, has been a cause of wrist drop and of colic. In the last 10 years the number of cases of lead poisoning reported in coach building in Great Britain has been 697, with 41 deaths. Commencing with 1900, when the numbers were 70, they were in the next nine successive years 65, 63, 74, 49, 56, 85, 70, and in 1909 they were 95.²

Motor-car painting is also a source of plumbism. The prosperity of the motor-car industry is largely responsible for the increased number of cases of plumbism noticed generally throughout the country. Painters of perambulators and railway carriage painters also run the risk of becoming lead poisoned. In the annual report of the chief

¹ *L'Echo Médical du Nord*, Sept. 9, 1906.

² Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, p. 193.

inspector of factories, 1907, 10 cases of plumbism are stated to have occurred in the paint shop of one railway carriage works, the interesting point being that the men were all engaged in wet rubbing processes as distinguished from dry. I have had under my care in the infirmary at Newcastle railway engine painters suffering from severe lead poisoning. Teleky, of Vienna, found painters of agricultural machines the victims of plumbism. Of 23 such painters whom he examined, in only 2 was there no blue line on the gums. The same writer draws attention to the fact that when the painting is done out of doors there is less risk to health. In one large factory in which 80 tons of white lead were used annually in indoor work there were 163 cases of lead poisoning, while among the men employed in outdoor painting and who used during the same period 237½ tons of white lead there were only 50 cases of plumbism.

Metal painting is a more important industry than at first it appears to be, owing to the large number of articles which are made of iron. The painting of many of these is coarse and has to be done cheaply. The colors used have great covering powers, hence lead is much used. On the Continent of Europe more than in Great Britain a good deal of unskilled labor and many young persons are employed in this particular kind of work, hence the small wages and the comparative poverty of those who follow the occupation. Small toys, too, are often painted with lead colors. The safety of children deserves consideration. Zinc white and other harmless paints could, for such purposes, quite easily replace lead and ought to be insisted upon. Two cases of plumbism occurred recently in shipbuilding yards, owing to the custom of the men using white lead paint to mark off on the iron plates the sites of the holes preparatory to boring them with the punching machine. It is difficult to see why such unnecessary risk should have been run, since whiting or zinc white mixed with oil would have served the purpose equally well.

MORTALITY RATES AMONG HOUSE PAINTERS IN HOLLAND.

Evidence of the unhealthy character of their occupation is shown by the large number of deaths of painters from diseases of the heart and blood vessels, also from kidney disorders, which are known to be a consequence of lead poisoning. The following table taken from a pamphlet published by Factory Inspector Is. P. de Vooy's shows the mortality rates per 1,000 among house painters in Holland.¹

¹ Bericht über Bleivergiftung in den polygraphischen Gewerben in den Niederlanden, erstattet von Is. P. de Vooy's, Arbeitsinspektor, Deventer, pp. 9-11.

MORTALITY RATES PER 1,000 OF HOUSE PAINTERS AND OF ALL TRADES, FROM SPECIFIED DISEASES, BY AGE GROUPS.

Age group.	Phthisis.		Apoplexy and meningitis.		Heart and blood vessels, rheumatism, etc.		Dropsy and affections of the urinary organs.	
	House painters.	All trades.	House painters.	All trades.	House painters.	All trades.	House painters.	All trades.
12 to 17 years.....	3.87	2.70	¹ 1.10	0.98	¹ 0.83	0.40	0.27	0.44
18 to 22 years.....	14.82	11.96	¹ 3.82	1.42	¹ 1.67	.92	¹ 1.19	.66
23 to 35 years.....	15.54	12.40	1.54	1.33	1.67	1.08	¹ 1.80	1.07
36 to 50 years.....	15.87	11.25	2.81	1.69	¹ 3.97	2.78	2.48	2.39
51 to 60 years.....	16.64	12.16	¹ 12.07	6.81	¹ 9.45	7.91	¹ 8.55	6.07
61 to 65 years.....	14.86	11.22	¹ 27.02	12.07	¹ 20.27	14.70	¹ 18.92	10.30
66 to 70 years.....	19.35	11.00	¹ 51.64	23.69	21.59	26.90	¹ 36.56	17.80
Over 70 years.....	4.92	6.80	¹ 77.32	50.39	44.32	47.10	¹ 44.32	31.00
Total.....	13.85	10.65	5.95	4.65	4.35	4.70	4.05	3.50

¹ These figures indicate where the mortality begins to become abnormal among house painters.

The diseases above mentioned are directly and indirectly associated with lead poisoning and show that house painting is an unhealthy occupation.

EFFORTS TO FIND A SUBSTITUTE FOR WHITE LEAD.

Since the use of colors is, practically speaking, coeval with art itself, painting and the mixing of pigments go far back into antiquity. Theophrastus, B. C. 371 to 286, mentions the use of white lead by painters, and Hippocrates gives a description of lead colic. In those comparatively early times, just as to-day, people suffered from lead intoxication without the malady being always recognized. At the time of the birth of Christ, Dioscorides speaks of what now would be called industrial-lead poisoning. In 1670 Ramazzini, professor of medicine in Modena, drew attention to the subject. Raphael and Correggio are said to have suffered from plumbism, and Michelangelo is believed to have been similarly afflicted.

It is only within recent years that the subject of lead poisoning in house and allied forms of painting has again come prominently under the notice of the medical profession and the public, and in no country has it been so much to the front as in France. A strike against the use of white lead was revived by the French house painters in 1902, when they asked for the prohibition of the use of white lead both in the dry and the liquid state. Congress after congress had called for its abolition. As far back as 1781, Courtois of Dijon had begun to manufacture oxide of zinc in commercial quantities, and three years later Guyton de Morveau published a report upon the advantages of zinc white as a pigment from the health point of view of the workers. Since then the abolition of lead paints and their replacement by harmless colors have formed the occasion of many heated debates in the Paris Senate and the Chamber of Deputies. The problem

bristled with difficulties, commercial and social, for it concerned the enforced disappearance of an important industry. The question which the French legislators had to decide was whether white lead could be adequately replaced by a pigment of a less harmful nature. The opinions expressed until then had been for the most part academic. Experiments had not been conducted upon a sufficiently large or commercial scale. The French Parliament discussed the various qualities which a good paint ought to possess and laid stress upon the durability and the covering power of paints, the difficulty or ease of applying them, and the price of the products used. Several pigments were believed to be suitable, and many substitutes were recommended for white lead, of which zinc oxide or zinc white, sulphide of zinc and lithopone (a mixture of zinc sulphide and sulphate of barium prepared chemically by precipitation) were the most important. While it was denied that zinc white could replace white lead for external painting, it was held that for internal decorative purposes zinc white was just as good. Since the subject is one of great importance, both sides of the question will be reviewed.

White-lead paint has for so long held the field that from this circumstance alone there has been perhaps a prejudice against zinc white. Obtained from metallic zinc or spelter by a process of melting and sublimation, zinc oxide frequently contains traces of such impurities as lead, bismuth, and arsenic, but even when obtained thus it contains 99.9 per cent of chemically pure oxide of zinc. Another process consists in roasting zinc ore, in volatilizing and oxidizing the metal. By this means a chemical product of 99 per cent of pure oxide of zinc is obtained. Continental manufacturers occasionally sell zinc oxide which contains 2 to 5 per cent of lead sulphate, the presence of which, apart from its danger, is likely to blacken the paint on exposure to sulphureted hydrogen.¹ Oxide of zinc, otherwise called zinc white, requires from 16 to 20 per cent of oil to grind it into "stiff paint." Much of the failure in using zinc white has been due as much to insufficient mixing of the white flocculent zinc powder with oil as to not using the proper kind of lubricant. Generally speaking, it may be said that the use of zinc white requires greater care, greater attention, and the application of higher intelligence than are required for white-lead paint. Refined linseed oil is necessary, since ordinary raw linseed oil, owing to its yellow color, tends to stain the oxide of zinc. The choice of a paint for any large surface is largely dependent upon the length of time occupied in drying. In England it may take 12 hours before another coat can be laid on, and while this length of time can be shortened by the use of driers such artificial means is likely to be followed by a rapid deterioration of the paint film and by damage to the surface which the paint was intended to protect.

¹ The Paint Question, J. Cruickshank Smith. 1909.

Since a mixture of pigments is necessary, it is more than likely that even the keenest supporter of zinc white will occasionally be obliged to use white lead, barytes, or gypsum (hydrated calcium sulphate). Such pigments as zinc sulphide, white lead, barium sulphate, and gypsum may be added to paint with the intention of cheapening the product, while others, such as zinc sulphide alone in limited quantities, may confer upon lead paints properties of an advantageous nature—that is to say, the blending of zinc oxide with white lead may give rise to a paint possessing superior properties to another containing only one pigment. It is common knowledge that in using paints, both for protective and decorative purposes, composition and mode of application must vary with the object sought to be attained. Zinc white paint not only requires the exercise of greater care generally, but it must be applied in as thin a layer as possible, so that it may spread properly, for if advantage is taken of this circumstance it is maintained that “three coats of oxide of zinc paint properly applied obscure the surface equally as well as three coats of genuine white-lead paint.” Only a minimum quantity, however, of such a volatile agent as turpentine must be added. For decorative purposes the addition of a certain quantity of barium sulphate to zinc oxide and white-lead paint confers greater resisting powers to destructive influences than are possessed by paint made from one of the pigments only. Cruickshank Smith’s opinion, as well as that of many master decorators, is that from a hygienic and sanitary point of view zinc white is superior to white lead, whereas in permanence of color zinc oxide quite equals, if it does not even exceed, white lead.

As a marine paint for ships’ sides zinc oxide withstands well the action of sea salt, so that it forms the basis of several of the well-known antifouling compositions already in the market. When ground in oil it is equally useful as a protective paint for ordinary iron or steel. During the debate in the French Assembly on the relative merits of zinc and lead as marine paints it was stated that the naval engineers at Rouen, after three years’ experience of both pigments, preferred zinc to lead, since the white color of the paint did not blacken under the influence of sulphur. Similar favorable reports were submitted from Bordeaux, Calais, and elsewhere. Although savoring of repetition, mention may here be again made of the fact that if in white-lead paint there is accidentally present a small quantity of sulphide this is almost sure to blacken the paint and induce chemical changes in the oil by a process of vulcanization.

Oxide of zinc is not a drier like white lead, so that a painter accustomed only to white-lead paint may fail with zinc oxide. Dr. A. P. Laurie, of the Herriot-Watt College, Edinburgh, in dealing with the subject of zinc being a slow and bad drier, and therefore not suitable

for damp and cold weather, raises the question as to what is meant by "drying." So far as water is concerned, it means loss by evaporation, but as regards a spirit varnish it means evaporation of spirit and an undissolved resin left behind. In the drying of linseed oil the oil absorbs oxygen and changes its fatty acid into oxylinoleic acid, the most stable form linseed oil can assume. A warm atmosphere favors this change. Generally speaking, in drying a loss of weight occurs, but in drying of linseed oil there is a gain. Raw linseed oil takes days to dry, but the drying process can be hastened by treating the oil with such a pigment as white lead. Lead compounds, therefore, are driers; so, too, are several of the manganese compounds. If samples of white lead and zinc white are respectively mixed with linseed oil and the paints are applied on a surface side by side, the white-lead paint will dry more quickly than the zinc white. If, however, a suitable drier is added to the zinc, such as manganese resinate or borate, the paint will dry just as quickly, if not more so, than the white-lead compound, and the surface painted with zinc white will keep its color in impure air, while that covered by lead rapidly blackens.

Dealing with the objections raised against the covering power of zinc white, Laurie says¹ that, although the painted surface is thinner, and therefore more coats are required, yet weight for weight zinc white covers as well, if not better, than white lead, since it is not so liable to crack and blister. Laurie holds that given exposure to the weather zinc oxide is more durable, so that if the proper oil has been used and the mixing and grinding carefully attended to, zinc white will last longer than white lead. The comparative durability of paints is shown in the subjoined table taken from Cruickshank Smith.

FIGURES SHOWING COMPARATIVE DURABILITY OF VARIOUS PROTECTIVE PAINTS.

Kind of paint.	Spreading capacity in square yards per hundred-weight.	Price per hundred-weight in shillings.	Materials cost in shillings per 100 square yards.	Estimated number of times painted in 20 years.	Materials cost in shillings per 100 square yards for 20 years.	Labor costs in shillings per 100 square yards for 20 years.	Estimated total cost of painting and renewals in shillings per coat per 100 square yards for 20 years.
Oxide of zinc.....	370	46	5.29	4	21.16	66.66	87.82
Red lead.....	424	28	6.60	4	26.40	66.66	93.06
White lead.....	614	28	4.56	5	22.80	83.33	106.13
Do.....	806	32	3.97	6	23.82	100.00	123.82
Oxide of iron.....	1,080	24	2.22	7	15.54	116.66	132.20

The above data, drawn from British sources, show that many of the objections to the use of zinc white as a substitute for white lead, also many of the advantages claimed for white lead, do not rest upon

¹The Paint Question, J. Cruickshank Smith. 1909.

solid fact. French experience is like that in England. At the request of the French Parliament a number of experiments was carried out at the Annex of the Pasteur Institute in Paris. The Society of Public Medicine and of Sanitary Health nominated a commission to undertake a series of comparison experiments of painting with zinc and lead bases. The commission was composed of Dr. L. Martin, M. Livache, a chemist, and M. Vaillant, an architect, along with Messrs. Mauger, Wernet, and Rigolet, representing the building trades of Paris. The application of different paints containing zinc and lead bases was made in August, 1902, by a working painter under the supervision of the commission, and the following is, briefly, the report: (1) The coloring and the polish of zinc white are equal to those of white lead; (2) the covering power and drying are practically the same. To test the solidity of the painting it was necessary to allow atmospheric agents to exercise their destructive influence in order to decide upon the effects. It was therefore arranged to examine the paintings a year afterwards. In October, 1903, the commission reported that there was no appreciable difference between the paintings in regard to their behavior under atmospheric influences, and that both for internal and external painted surfaces the results were absolutely comparable. Since that date three other examinations have been made, September 30, 1904, October 11, 1905, and October 31, 1906, all of which support the previous statement.

ATTITUDE OF VARIOUS EUROPEAN COUNTRIES IN REGARD TO THE SUPPRESSION OF LEAD.

After France it was the International Association for Labor Legislation which at the meeting in Basel in 1904, by confirming an earlier resolution of November 28, 1901, for the suppression of white lead in painting and in all occupations where other substitutes could be employed, gave that impetus to the study of the question which in France and a few other countries is now about to be practically realized. In 1908, at Lucerne, the same association suggested that the various Governments should be requested to have experiments made as to the possibility of entirely suppressing white lead for interior painting and the use of minium for all kinds of painting. In consequence of this several Governments have issued a decree for the complete or partial suppression of white lead.

In France M. J. L. Breton, a member of the Chamber of Deputies, has ultimately seen his efforts crowned by success in the passing of a law July 20, 1909, which forbids the use of white lead in the painting of houses either externally or internally. At the end of five years the employment of white lead in France in house painting will be a thing of the past. As this law will later on be briefly detailed, we

may proceed to a consideration of the attitude of other countries in regard to this subject.

In Austria, in accordance with the terms of an order of the minister of commerce of April 15, 1908, white lead is forbidden in the interior decoration of buildings after April 1, 1909. This order was issued after a series of investigations upon the employment of colors containing lead in laying on, in varnishing, and in painting. During the inquiry employers and workmen alike pronounced in favor of the prohibition of the use of white lead or of lead compounds in the interior of buildings. By interior painting is meant painting not directly exposed to the influence of the weather. The prohibition did not apply to the application of the first layer upon an old lead ground, or where the painted surface had been exposed to the action of steam or other vapors.

The Federal Council of Switzerland has by a decree of June 30, 1908, invited all the federal administrative bodies to prohibit the use of lead in the interior decoration of buildings either executed by the Government or by private individuals. The Cantons of Basel and Zürich and the town of Zürich have followed the example of the Federal Council.

In Belgium the minister of justice by a circular November 29, 1902, and the minister of war by a circular of December 7, 1902, forbade the use of lead in painting executed on their account.

In Germany the general board of directors of the railways of the Kingdom of Württemberg decided in 1905 to discontinue the use of lead colors in their workshops. In January, 1907, the general administration board of the railways of the Grand Duchy of Baden came to a similar determination. The buildings committee of the municipality of Berlin has also interdicted the use of white lead in the town's buildings, while that of Charlottenburg has agreed to the interdiction for three years.

In the Netherlands a commission appointed by Minister Kuyper, after sitting for five years and having carried out several experiments, has declared that white lead can be in a large number of instances replaced by colors containing a zinc base, especially for internal painting.

In Denmark the feeling is in favor of forbidding lead in interior decoration. A similar feeling is growing in other countries. It is because the prophylactic measures hitherto employed to protect painters have not given satisfactory results that only by the prohibition of lead pigments is it believed possible by many writers to prevent plumbism. It has also been proposed, for example, to mark all ware prepared with lead: "Contains lead and is poisonous." Workers do not and can not always get to know whether the colors mixed by employers contain lead or not, but by having inscribed

upon the articles produced that they contain lead, it is believed that a degree of protection would be afforded. White lead and lead colors are not distinguished by any external character from their substitutes except by their greater weight. It requires experience to rapidly distinguish by sight pure white lead from zinc white. When, as is the custom in practice, these substances are mixed separately with barytes in considerable quantities the difference in specific weight is sensibly altered, so that for these and other colors containing white lead the criterion of specific weight becomes no longer a reliable test.

A large number of coloring substances in the market contain barytes. Pigments inclosing a varying quantity of white lead and zinc white find an important usage in the polishing and laying-on processes of painting. Colors containing lead are variously named according to the particular locality where they have been manufactured. These names often mislead, for they conceal the true character of the pigments. In Germany and Austria white lead is known commercially under the names of Krem's white; Venice white; Hamburg, Holland, Cologne, and Magdeburg white; lithographic and Pattinson white. Minium is known as Paris red and vermilion of Saturn. The following also contain lead, viz, chrome yellow; patent yellow; Turner's yellow; Montpellier, Verona, Naples, Paris, Cologne, Leipzig, Cassel, and English yellow; mineral yellow; the new royal and citron yellow; vermilion green; green leaf; green oil; patent cinnabar; carminette; and lackrot. Likewise the following colors to which German names are attached also contain white lead: Platinfarbe, Glimmerfarben including Schuppenpanzerfarben of Graf, Rostinit of Weber, Bessemerfarbe of Lutz, Rubigonit of Jellinck, and Krokodilschuppenfarbe of Laubrecht. Similarly in France there are also in the market, besides white lead and minium, pigments which contain lead as, for example, silver white, Clichy white, Mulhouse white, chrome yellow, orange and Naples yellow, Turner's yellow, litharge, English green, etc.

Under the name of vermilionette there is sold a coloring agent which is composed of minium, white lead, and barytes. An inquiry instituted by German painters showed that there are 27 substances used in painting which contain lead, all of which have such misleading names as Dresden white, Victoria white, etc. Any person purchasing colors has no means of knowing whether what is offered him contains zinc or lead. In view of the confusion raised by names a compulsory declaration as to the composition of the pigments is desirable. Austria insists upon this declaration. In all trades using lead the work people ought to be warned of the dangers to which they are exposed by having each material labeled "contains lead" and "is dangerous." The International Association for Labor Legislation

has recommended that where a country has not yet seen it to be its duty to prohibit the use of colors containing lead, the prohibition should be hastened as early as possible so far as it applies to the use of lead in painting the interior of buildings and, so long as the sale of lead commercially can not be prohibited, that the colors ought only to be available when the jars and packages which contain the lead colors carry clearly the inscription: "Contains lead and is dangerous."

SUBSTITUTES FOR WHITE LEAD.

The harassing details of the suffering experienced by persons living in houses recently painted, or during the process of being painted, and whose active life has thereby been suddenly arrested are the reasons which have led to the abolition of the use of white lead as a pigment in France and to the recommendation of substitutes for it both there and elsewhere. To fulfill all requirements a substitute must be capable of combining with oil and must not alter the tint of any other pigments used. Attention has already been drawn to the comparative merits of zinc white and lead carbonate. Two other substances are also spoken of as substitutes for lead, viz, zinc sulphide and lithopone. The white lead commission of which the writer was a member took considerable pains a few years ago to ascertain from house decorators, foremen, and working painters their views upon this question. At the time it was believed that while white lead could be replaced by zinc in interior decoration, yet, for outdoor purposes, white lead gave better results. Within the last five or six years, as stated in the text, larger experience and an extended series of experiments have done more than merely raise doubts as to the alleged superiority of white-lead paint even in outdoor work.

Lithopone is a compound obtained by the double decomposition of barium sulphide and zinc sulphate; the precipitate consists of barium sulphate and zinc sulphide. Both of these products are beautifully white. The precipitate is washed, dried, ground, and mixed with oil to form a paste, which resembles white-lead paint. Lithopone is strongly recommended as a substitute for white lead, but according to Petit it has less covering power owing to the large quantity of barium sulphate it contains. It is composed of 67 per cent of barium sulphate and 33 of zinc sulphide. When lithopone is applied to certain metallic surfaces the zinc sulphide is said to part with its sulphur to the iron and to form iron sulphide, also that while the zinc sulphide mixes readily enough with oil, yet, owing to a process of vulcanization, it is liable to undergo decomposition. Dr. Ignace Kaup says that in Vienna the master decorators have of late been substituting zinc white and lithopone for white lead, but

for public buildings they use white-lead paint and varnish. In the case of a Government building recently painted with lead, he states that several of the men suffered from plumbism. In 10 years there were 944 cases of plumbism with 20,391 days of illness notified, a number hardly less than that of persons employed in the printing trades, although the membership of the painters' benefit societies was only one-fifth of those employed in the polygraphic industries.¹

Painting executed with lithopone does not, according to some master decorators, retain its color well. This circumstance, they say, makes its use only partial at the best. Its covering power is not so good as that of lead. It does well on plaster, but not so well on wood, especially new wood. Lithopone possesses one advantage, it is cheap; it sells for 4 shillings (97 cents) less per hundredweight than white lead. Opposed to this, it is interesting to know that at the large engineering works of Messrs. Sulzer Bros., Winterthur, Switzerland, the contractors for the Simplon railway tunnel and other great enterprises, no white lead is used for painting, but only zinc white and lithopone. On the other hand, the use of white lead on the Swiss railways has not been altogether abolished. Allusion has been made to the attitude of Switzerland in regard to the white lead question. As far back as 1902 the Swiss Federal Council was requested by the guilds of painters and plasterers to encourage and try experiments with colors free from lead, which private enterprise had already begun, but the difficulty has been to get the various Cantons to work unitedly. The sympathy of and the support of hospitals and medical colleges have been enlisted on the side of the discontinuance of lead. In Great Britain many of the large railway companies have replaced lead paints by harmless substitutes.

FRENCH LAW REGULATING USE OF LEAD PAINTS.

The following are the main points of the law in France regarding the use of white lead in the painting of buildings.

In all the factories, workshops, and buildings in course of construction or repair, master decorators and foremen must comply with the law which requires that at the end of five years the use of white lead will be prohibited in all painting of whatever kind executed by working painters, both in the interior and on the exterior of buildings. If there is occasion, permission to use lead may be granted for special kinds of work. Factory inspectors are to have the right of entry into all buildings except inhabited houses, into which they can enter only after having received permission from the persons occupying them.²

¹ Dr. Ignace Kaup, Blei- und Phosphorvergiftungen in den gewerblichen Betrieben Österreichs, p. 34. Wien, 1902.

² For text of law, see pp. 173 and 174.

ATTITUDE OF MASTER PAINTERS TOWARD DISPLACEMENT OF LEAD PAINTS.

If there is one circumstance which will hasten the substitution of harmless compounds for lead in paints, it is the attitude of the master painters to the subject. In this matter events are moving slowly, but in the proper direction, for there is a growing conviction that zinc white can in all respects adequately replace lead. The demands made by lead-poisoned workmen upon employers' funds through the Workmen's Compensation Act have stimulated enterprise and encouraged experiments. In October, 1910, the seventeenth annual convention of the National Association of Master House Painters and Decorators of England and Wales was held in Newcastle-upon-Tyne. The writer carefully inspected the exhibits and their designs for house painting, in fully 50 per cent of which efforts had been successfully made to show what effective results could be obtained by the use of zinc oxide and zinc sulphide as compared with lead. The subject of the use of white lead was discussed at considerable length by the master painters themselves. After comparing the properties of white lead with basic sulphate of lead, zinc oxide, and lithopone, the three substances which the opener of the debate put forward as alternatives to the use of white lead, he said each of the four pigments—white lead and the three suggested alternatives—had certain virtues and defects which prevented him from recommending any one of them to the exclusion of the others under all conceivable circumstances. It was maintained that each had a particular sphere in which it was superior to others. A series of exposure tests was about to be carried out, and in order to place the investigation upon a firm and scientific basis it was suggested that a representative investigation committee should be appointed whose opinions should be authoritative. In the discussion which followed the feeling was in favor of the retention of lead in the manufacture of paints for the present.

POTTERY: MANUFACTURE OF EARTHENWARE AND CHINA.

Next to painting, the manufacture of china and earthenware is one of the most frequent causes of industrial plumbism. The writer has visited the potteries of Great Britain, France, Belgium, Holland, Germany, and Hungary, and has thus had opportunities of contrasting the methods and workpeople of various countries. In Great Britain there are 550 places where pottery is made. Many of these factories are in large towns like Newcastle, Glasgow, Derby, the neighborhood of Manchester, Worcester, and Bristol, but in England the industry is concentrated in a group of towns in North Staffordshire. Here, since there are located 329 of the 550 factories already

mentioned, the towns collectively constitute the Potteries. In Great Britain 63,000 persons are employed in the manufacture of pottery. Of these 48,000 are employed in North Staffordshire. There are 6,865 persons employed in dangerous processes involving contact with lead and 23,000 who are daily incurring danger from breathing dust.¹ About 11 per cent of pottery workers are exposed to the possibility of lead poisoning.

The dangers incidental to the manufacture, from the point of view of plumbism, are traceable in largest measure to the use of glazes containing lead, but great as is the risk to health from this cause it is considerably less than the possibility of lung diseases due to breathing dust. So serious was the amount of lead poisoning in the pottery industry of Great Britain a few years ago that the Government appointed Prof. T. E. Thorpe (now Sir Edward Thorpe), of the Government laboratory, and the writer to make a special inquiry both at home and abroad into the causes of the prevalence of plumbism and the means whereby the evil might be mitigated. Before alluding further to the subject, it might be well to describe briefly some of the processes in the manufacture of pottery.

PROCESSES IN THE MANUFACTURE OF POTTERY.

For ordinary earthenware the common clay of the locality may be used, but for better ware such ingredients as Cornish stone, china clay, or calcined bone are required. These constitute the "body" of the ware. The better ware found on a dinner or tea table is composed of fine clay to which considerable quantities of calcined bone or feldspar have been added. In Limoges the ware is made from kaolin, a beautifully white clay found in the neighborhood. The glaze into which earthenware and china are dipped with the object of giving them a polished surface and of rendering them impervious is a liquid containing finely ground clay suspended in water. In most instances it usually contains lead in some form or other and is, roughly speaking, a mixture of silicates and silica borates. At the time when Thorpe and myself commenced our inquiry the glazes contained large quantities of white or raw lead, to which circumstance the great amount of sickness among the workpeople was due. In other glazes lead was present in the form of red oxide or as the native sulphide galena. Pottery workers are more exposed to lead in some branches of the industry than in others. The 6,865 persons employed in lead processes were distributed as follows.²

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, pp. 4, 5. Home Office, London, 1910.

² Idem, p. 7.

NUMBER OF LEAD WORKERS EMPLOYED IN BRITISH EARTHENWARE AND CHINA FACTORIES, 1907.

Kind of manufacture.	Number of lead workers employed (1907).	Kind of manufacture.	Number of lead workers employed (1907).
China.....	927	Jet and Rockingham.....	241
Earthenware.....	3,946	China furniture and electrical fittings.....	245
Tiles.....	961	Sanitary ware.....	279
Majolica.....	266		

By China is meant such translucent ware as is placed upon the breakfast and dinner table, and by earthenware the ordinary ware used for domestic and other purposes. Tiles, while made from the same material as earthenware, are not worked up in a moist state, but are made of dust molded under great pressure. Majolica is decorative ware, made from clay, china clay, flint, and stone, and upon which colored glazes containing lead or other pigments are applied. To articles made from simple brown clays without other ingredients and which have been dipped in glazes containing cobalt, which causes the ware to become black, the term "jet" is applied, while the ware dipped in manganese glaze, owing to its brown hue and plum-colored shade, is spoken of as Rockingham.

It was in May, 1898, that the subject of lead poisoning in the potteries was referred by the Home Office to Sir Edward Thorpe and the writer. At this date the amount of sickness and the fatalities to workers had become so great that public opinion was fully roused. A previous commission upon which the writer sat had recommended that all cases of industrial plumbism should be notified so that not only would the country have correct information as to the amount of industrial poisoning which was going on, but that by directing attention early to the malady in particular factories the causes might be found and the defect if possible quickly remedied or removed. This was the commencement of the compulsory notification of industrial diseases which has since played such an important part in legislation both at home and abroad.

In Newcastle-upon-Tyne and neighborhood there are a few white-lead factories from which lead-poisoned workmen occasionally come to the infirmary, while in other factories the workpeople remain quite well. On making investigations the writer generally found that some defect had occurred in the ventilation, that the means for facilitating the escape of dust had broken down, the joints of machinery had become loose, or the floors imperfect, or that the regulations had been less stringently attended to. Excessive employment of casual labor is also a cause of plumbism, since men thus engaged are less careful. Over-pressure of work tends to carelessness. These remarks

apply equally to pottery manufacture as to white-lead works, since it has been recently shown that 173 potteries were responsible for 517 cases of plumbism, whereas from 377 factories no case of lead poisoning had been reported; in other words, in 68 per cent of factories plumbism did not exist at all.

Reverting to the description of the processes of manufacture of earthenware and china, the pieces leave the hands of the potter and are either dried naturally or artificially in an oven. When dried in an oven or kiln, the ware is said to have been biscuited. The products are afterwards dipped in glaze. Such ware as terra cotta and stoneware require only one firing, but the greater proportion, for example, that used for domestic purposes is fired twice—once before being dipped (biscuited), and again after having been dipped. Mention has already been made of the fact that glazes usually contain lead. This may be in the form of raw white lead (carbonate), or it may have undergone a special preparation known as “fritting,” in which it is fired with other substances such as silica or boric acid, and converted into a glasslike material. Lead thus vitrified or fritted is rendered less soluble in acids and is therefore less dangerous to the workers than when used in the raw state. Whether used in the fritted form or in the raw state all lead compounds are ground and mixed with fine clay and water to form a glaze, a white liquid like a mixture of stirred up chalk and water. All ware which has been dipped in glaze has to be subsequently smoothed and cleaned by the dipper’s assistant. This is dusty work. According to the form in which lead is present in the glaze, so are the character and the solubility of the dust. If raw lead has been added, the dust is practically an attenuated white lead, if it has been fritted a less soluble lead dust is given off from the ware. It is inhalation of this dust which renders dippers’ assistants so liable to plumbism. After having been cleaned the dipped ware is placed in “saggers,” large earthenware vessels made from coarse clay and capable of withstanding high temperatures. The saggers are carried into the kilns, and deposited there by the glost placers. When the kilns have been filled, they are closed, and the fires are lit. In consequence of the high temperatures to which the ware in the kiln is exposed, the glaze on the ware melts, leaving a glistening surface, such as is seen on cups and saucers.

The men who make and mix the glaze incur the risk of plumbism, especially if raw lead is used. In the fritting of lead the ingredients are fired in a kiln, from which the finished product flows away, like a stream of molten glass, into water, where it solidifies. As larger quantities of fritted glazes are usually made at one operation than those from raw lead, there is a greater danger in making raw-lead than fritted-lead glazes on account of the more frequent repetition of the

process. Fritted lead has to be finely ground before being mixed with clay and water. As, under all circumstances, glaze after it has stood for a time tends to contain solid particles of too large a size to render the glaze effective, it has to be strained through a lawn sieve, hence the term "lawnning the glaze," a process which may be carried on by hand by the dipper, or by means of an automatic machine. Lawnning of glaze made from raw lead, if done by hand, is dangerous on account of splashing. In British potteries no women are allowed to weigh or mix the ingredients of glazes. This is done by men wearing respirators, and who have to undergo a medical examination once a month. On account of the dust evolved, the weighing and mixing of the materials are a source of plumbism to all who work in the lead house. The men thus employed frequently suffer from plumbism, and workmen will continue to suffer until efforts are made by means of exhaust fans to remove dust generated during weighing and mixing.

In Great Britain the dippers plunge the ware with their naked hands into the liquid glaze, but in France this is done by a pair of fine tongs. In some countries gloves are used. On removal from the tub the dipper inverts the ware, and with a slight swirl allows the excess of glaze to fall back into the tub. The dipped article is thereafter set aside for further drainage and to dry. The following table shows the number of cases of lead poisoning among dippers and ware cleaners in the United Kingdom:¹

CASES OF LEAD POISONING AMONG POTTERY WORKERS IN GREAT BRITAIN,
1899 TO 1909.

Occupation.	Number of cases in the year—										
	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899
Dippers:											
Male	14	20	21	23	12	20	16	11	19	36	38
Female	4	7	6	5	4	8	1	4	4	5	17
Dippers' assistants:											
Male	1	6	1	4	4	.....	6	3	4	9	13
Female	9	19	13	19	15	20	18	12	11	23	21
Ware cleaners:											
Male .....	.....	2	.....	1	3	.....	3	2	1	6	3
Female	13	20	17	18	14	26	15	19	23	44	33
Total males...	15	28	22	28	19	20	25	16	24	51	54
Total females.	26	46	36	42	33	54	34	35	38	72	71

There were employed in Great Britain in 1904 781 male dippers and 132 female dippers, or 913 altogether, and for 1907 the numbers were 786 and 150, respectively, or a total of 936. Although dippers when at work have their hands and forearms frequently immersed in the glaze, many of them go on working thus for years without suffering, a circumstance which shows how tardily plumbism is in-

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, pp. 67, 70, 75. Home Office, London, 1910.

duced by absorption through the skin. Probably plumbism in those employed in the dipping room is caused by inhalation of the dust given off during the cleaning of the dry ware and friction of the dried splashes on the floor. This fact points to the necessity of having the dipping house well lighted, also well ventilated, and of having a concrete floor, from which splashes of glaze can be removed by a daily washing. Dippers' assistants are usually young persons. As there is a tendency to employ assistants of too tender an age a great risk is thereby incurred, since experience has shown that young persons are more prone to lead poisoning than those of maturer years. At present young persons of 15 years of age may be employed, but where lead glaze is used it is a question whether the age should not be raised to 17 or 18. It has been found that female dippers' assistants are three times more liable to plumbism than male assistants, the ratio being 4.7 and 1.4. These figures point to the desirability of at any rate raising the age of the female dippers' assistants.

Ware cleaners who remove by scrapers the superfluous glaze on the dried dipped ware preparatory to fixing or placing it in the glost oven can hardly avoid inhaling dust. Ware can be cleaned equally well by the moist method, in which the articles are rubbed with a wet sponge or piece of flannel or scraped with a knife before the glaze has had time to become too dry. It was at Messrs. Bou langer et Cie's works, at Choisy-le-Roi, France, where I first saw the wet method used and where I found, as a consequence, the work-people remarkably free from plumbism. The method is becoming more widely adopted all over. In Great Britain in 176 potteries all the ware cleaning is now done by the moist method, and in 105 part of it. As an encouragement the Home Office allows the provision of a fan or exhaust draft to be dispensed with, where the cleaning is done moist. In Holland the factory inspector of the first district has drawn attention to the great improvement of the health of the workers consequent upon the substitution of the wet method for the dry in cleaning the ware by means of a piece of wet felt. It is advantageous to have the ware cleaned in a room separate from the dipping house, especially if the ware which is being cleaned is in the dry state, for by means of fans or exhaust drafts dust can be more readily removed.

Glost placers, the men who carry the saggars filled with dipped ware to the kilns and who also remove the saggars when they have been fixed, do not suffer from plumbism in the same ratio as persons employed in the dipping and cleaning house. Owing to the laborious and dusty nature of the work, also the changes of temperature to which the men are exposed, the dangers incurred by them are rather on the side of the lungs than from lead poisoning. The work is not suitable for females.

Since the introduction of and demand for leadless glazed ware manufacturers, in order to meet the wishes of the public, occasionally dip the ware in glaze free from lead, so that the words "Made from leadless glaze" appear upon the products, but they fire the articles in saggars which have been washed internally or have been lined with a paste rich in lead, so that during the act of firing volatilized lead passes from the internal lining of the sagger to the ware. Sagger washing is not the harmless process which manufacturers and some factory inspectors consider it. While I pen these lines I have under my care in the infirmary a young man, a sagger washer, who is the subject of an extremely severe and protracted form of plumbism, in which colic, recurrent vomiting, headache, and nervousness are the principal symptoms, and in whose urine and fæces, several months after giving up the work, there have been found traces of lead.

In the manufacture of majolica ware, glazes rich in lead and other pigments are used. The glazes melt at low temperature and are applied at one process to biscuited ware by dipping, painting, mottling, and blowing. Dipping of majolica differs in no way from dipping of other articles. Painting is done by brushes and is generally done by females. It is not high-class painting. Although done by the moist process, there is a considerable amount of splashing. The splashed material dries rapidly. The fingers and hands of the women become smeared with the colored glaze. In my visits to the potteries it was the majolica paintresses who impressed me most by their pallid appearance and in whom I found plumbism more than usually prevalent. The anæmia and lead poisoning from which they suffered had been probably hastened by the imperfectly ventilated and overcrowded condition of the workrooms. It can not be too strongly insisted upon that badly lighted, badly ventilated, and overcrowded workrooms predispose to plumbism by reducing the physical resistance of the workers. Where a cheap class of majolica ware is being produced the conditions in the factory are not as a rule favorable to the workers. There are usually greater carelessness, less supervision of the work, more splashing, and, as a consequence, more plumbism. In order to produce a mottled appearance of majolica ware, the colored glaze is applied by means of a sponge, but only to certain parts of the surface. Both in this kind of work and in glaze blowing, by which colored glaze is driven from a small reservoir by means of a jet of compressed air through a fine nozzle in the form of spray, the hands and clothing of the paintresses become besmeared with glaze. The colored glaze ought to be drawn away from the workers by an exhaust draft.

PRINTING ON POTTERY.

The printing of patterns upon ware is usually done by females, who place upon the pieces the transfer or colored paper with the design or pattern upon it, rubbing the back of the paper with a dry tool to make it adhere to the ware and subsequently removing the paper by dipping the article in a tub of water. The designs are imprinted upon paper pressed upon a metal plate and rolled between cylinders. The colors having been previously mixed in a suitable medium containing boiled oil are thus transferred from the paper to the ware and do not come off in the water.

Once ware has been glazed, all colors subsequently applied upon it must be fixed by an additional firing. This is known as "on-glaze" printing and differs from "under-glaze" decoration, where the colors are applied to the biscuit ware before it is dipped in glaze free from lead; this metal being believed by many to be essential in "on-glaze" decoration, since it acts as a flux and thereby facilitates the process. As the painting is done wet by hand, by means of a brush, those persons who are thus employed seldom suffer from plumbism, but it is otherwise with "ground-laying." This process, which is known in the potteries as "oil and dusting," is confined to "on-glaze" decoration. It consists of the application of an oily medium to the surface of the ware and then dusting a dry powdered enamel color upon it by means of a pad of cotton wadding. The pigment adheres wherever required. Ground laying is a dangerous process, as the powders used are dry and frequently contain large quantities of lead. All cotton wool which has been used for this purpose should, when finished with, be burnt. The number of persons, male and female, employed as ground layers were in 1904, over the whole country, 249 and in 1907 215, while in North Staffordshire for the same years the numbers were 237 and 195, respectively, the decrease in numbers being due to the blowing process having largely replaced ground laying. The number of cases of lead poisoning in this occupation in North Staffordshire alone is shown below:¹

Occupation.	Number of cases in the year—													
	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	1898	1897	1896
Ground layers	1	2	.....	2	3	4	1	7	10	55	55	50

In 1898 fans were introduced, and a monthly medical inspection of women and young persons was begun, with the result that the number of cases of plumbism began at once to decline.

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, p. 89. Home Office, London, 1910.

In what is called color dusting the tissue paper bearing the imprint of the design obtained by an oily medium and which has been transferred to the ware is not washed off in water, but is quickly pulled off, leaving a rough surface, upon which is dusted the powdered color, which adheres to the oily medium, the remainder being dusted off. The number of persons employed as color dusters were for the whole of the United Kingdom 159 in 1904 and 157 in 1907. The following are the numbers of cases of lead poisoning in this occupation:¹

Occupation.	Number of cases in the year—										
	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899
Color dusters	1	.....	.....	2	.....	1	1	3	5	9

The fall in the number of cases of lead poisoning in color dusters is, according to the framers of the Report of the Departmental Committee, 1910, largely due to a reduction in the amount of color dusting, consequent upon the growth of the blowing process, and to an increased perfection of the printing process, whereby it is possible by means of the simple method of transferring and washing off to apply many colors, for which the operation of dusting was formerly believed to be indispensable.

The "aerographic" process consists in the application of colored liquids to the surface of ware by compressed air. Fine clays suspended in water and colored with simple pigments free from lead are blown through a nozzle upon ware before it is fired. There is no danger attendant upon this, but it is otherwise when the glaze blown contains lead. Unless there is sufficient exhaust draft the aerographer runs the risk of becoming the subject of plumbism. In the whole of the United Kingdom there were employed in color and glaze blowing 251 persons, male and female, in 1904, and 339 persons in 1907. Among color and glaze blowers the following is the number of cases of lead poisoning:²

Occupation.	Number of cases in the year—										
	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899
Color and glaze blowers.....	5	7	7	2	1	4	2	2	5	2

Shortsightedness in an aerographer should be a disqualification, since it obliges the individual to lean forward too much when at work.

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, p. 91. Home Office, London, 1910.

² Idem, p. 92.

In the making of lithographic transfers by printing machines and the dusting of the papers with enamel colors the excess of powder is removed by means of cotton wool. Should the powder which is dusted on contain lead, there is the risk of plumbism. Some of the severest types of lead poisoning I have seen have been in youths 17 to 18 years of age, who only worked a few months in this process when they developed lead poisoning. At Limoges, in France, most of the cases of plumbism I found occurred among lithographic transfer workers. By means of a strong exhaust draft the dust should be drawn away from the face of the worker. Seven potteries in England make their own transfers, and in three the persons employed number 132 males and 125 females, or a total of 257. In these 7 factories the cases of lead poisoning have been as follows:¹

Year.	Males.	Females.	Total.	Year.	Males.	Females.	Total.
1899	7	4	11	1906		5	5
1900	7	3	10	1907	2	8	10
1901	6	1	7	1908		2	2
1902		2	2	1909	1		1
1903	2	1	3	Total	27	32	59
1904		3	3				
1905	2	3	5				

These numbers show a larger total and relative incidence of plumbism among females than males.

The processes in the manufacture of pottery which are responsible for lead poisoning of the workers are the handling of glazes and colors. It is more important therefore that a substitute should be found for lead in glaze than in the pigments used for decorative purposes, owing to the large number of persons employed, as the following table shows:²

Year.	Number of cases of lead poisoning.			
	In glaze processes.	In decorative processes.	Un-classified.	Total.
1901	97	6	3	106
1902	78	7	2	87
1903	84	3	5	97
1904	99	3	4	106
1905	78	4	2	84
1906	98	9		107
1907	90	3	5	103
1908	106	6	5	117
1909	58			58
Total	788	51	26	865
Number of persons employed in 1907	5,695	711	459	6,865
Average annual rate per 1,000 employed	15	8	6	18.7

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, p. 94. Home Office, London, 1910.

² Idem, p. 13.

In the following table is summarized all the lead-poisoning cases in the potteries of the United Kingdom for the last 11 years:¹

	Number and rate per 1,000 of cases of poisoning, by sex, in the year—																					
Industry, etc.	1899		1900		1901		1902		1903		1904 ¹		1905		1906		1907		1908		1909	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
China:																						
Cases.....	13	8	11	10	7	2	3	2	1	6	2	1	4	3	5	2	6	7	4	1	2	1
Attack rate per 1,000...	24	34	21	42	13	8	6	8	2	25	4	4	8	13	8	7	10	23	6	3	3	3
Earthenware:																						
Cases.....	106	83	62	67	37	28	30	33	29	32	31	41	25	23	34	41	38	33	45	42	22	17
Attack rate per 1,000...	89	74	23	60	13	25	11	29	11	29	11	37	9	20	12	37	13	30	16	38	8	15
Tiles:																						
Cases.....	7	21	12	15	9	7	6	5	8	9	6	19	4	14	7	10	4	6	3	8	4	7
Attack rate per 1,000...	13	37	22	27	16	12	11	9	14	16	11	34	7	25	15	21	8	12	6	16	8	14
Majolica:																						
Cases.....	2	4	3	2	...	2	...	2	1	6	...	1	...	4	...	3	...	1	...	1	...	...
Attack rate per 1,000...	20	36	30	18	...	13	...	18	10	55	...	9	...	36	...	13	...	6	...	6	...	...
Jet and Rockingham:																						
Cases.....	...	...	5	...	3	1	...	1	3	...	...	1	...	2	...	...	1	...	1	...	...	2
Attack rate per 1,000...	...	...	23	...	14	14	...	14	14	...	...	14	...	23	...	...	6	...	6	...	...	29
China, furniture, and electrical fittings:																						
Cases.....	...	5	1	11	1	9	...	4	...	1	...	4	2	2	...	3	...	3	1	8	...	2
Attack rate per 1,000...	...	32	23	70	23	57	...	25	...	6	...	25	45	13	...	17	...	17	15	45	...	11
Sanitary:																						
Cases.....	...	...	1	...	...	...	1	...	1	...	...	1	...	1	1	3	1	2	1	...	1	24
Attack rate per 1,000...	...	...	5	...	...	...	5	...	5	...	...	5	...	4	24	13	24	8	24	...	...	...
Total:																						
Cases.....	123	121	95	105	57	49	40	47	43	54	39	67	36	48	47	60	52	51	56	61	23	30
Attack rate per 1,000.....	29	53	22	46	13	21	9	20	10	23	9	29	8	21	10	25	12	22	12	26	6	13
Total cases, male and female.....	249		200		106		37		97		106		84		107		103		117		53	
Attack rate per 1,000.	37		30		16		13		14		16		13		16		15		17		8	

¹ Medical examination of men began.

OFFICIAL INVESTIGATIONS OF THE USE OF LEAD IN POTTERY MANUFACTURE.

The prevalence of lead poisoning in the manufacture of china and earthenware in Great Britain has been the occasion of three important inquiries, one of the main questions always being the possibility of substituting other materials for lead in glazes. Pottery manufacture is one of the most conservative of industries. The customs of any trade die hard. We are not surprised, therefore, to be told by manufacturers that lead is the only substance which produces all round a satisfactory glaze for every kind of ware. This was also the opinion of the committee appointed in 1893 to inquire into the use of glazes free from lead—"after carefully considering the evidence before us we do not see any immediate prospect of such glazes becoming universally applicable to pottery manufacture." As the number of cases of lead poisoning in the potteries during the nineties still remained far in excess of what the trade should bear, and as public opinion was not satisfied the subject again attracted the at-

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, p. 96, Home Office, London, 1910.

tention of Parliament, with the result that a fresh inquiry was instituted by Prof. Thomas E. Thorpe (now Sir Edward Thorpe) and the writer. We were appointed on May 7, 1898, by Home Secretary Sir Matthew White Ridley (afterwards Viscount Ridley) to inquire into and to ascertain "(1) How far the danger may be diminished or removed by substituting for the carbonate of lead ordinarily used, either (a) one or other less soluble compound of lead, e. g., a silicate; (b) 'leadless' glaze; (2) how far any substitutes found to be harmless or less dangerous than the carbonate lend themselves to the varied practical requirements of the manufacturer; (3) what other preventive measures can be adopted:"¹

In order to satisfy ourselves upon these points Sir Edward Thorpe and I visited singly or together not only the potteries of Staffordshire and other districts of England and Scotland, but also several of the large factories in France, Holland, Belgium, Germany, and Denmark. Our recommendations, published in a bluebook presented to the House of Commons in February, 1899, were as follows:²

1. That by far the greater amount of earthenware of the class already specified [i. e., white and cream-colored ware] can be glazed without the use of lead in any form. It has been demonstrated, without the slightest doubt, that the ware so made is in no respects inferior to that coated with lead glaze. There seems no reason, therefore, why in the manufacture of this class of goods the operatives should still continue to be exposed to the evils which the use of lead glaze entails.

2. There are, however, certain branches of the pottery industry in which it would be more difficult to dispense with the use of lead compounds. But there is no reason why, in these cases, the lead so employed should not be in the form of a fritted double silicate. Such a compound, if properly made, is but slightly attacked by even strong hydrochloric, acetic, or lactic acid. There can be little doubt that, if lead must be used, the employment of such a compound silicate—if its use could be insured—would greatly diminish the evil of lead poisoning.

3. The use of raw lead as an ingredient of glazing material, or as an ingredient of colors which have to be subsequently fired, should be absolutely prohibited.

4. As it would be very difficult to insure that an innocuous lead glaze shall be employed, we are of opinion that young persons and women should be excluded from employment as dippers, dippers' assistants, ware cleaners after dippers, and glost placers in factories where lead glaze is used, and that the adult male dippers, dippers' assistants, ware cleaners, and glost placers should be subjected to systematic medical inspection.

It was hardly to be expected that these recommendations would be received by the manufacturers with general approval, for an old industry was being dealt with whose methods of production it was

¹ Report on the Employment of Compounds of Lead in the Manufacture of Pottery, etc., p. 3.

² *Idem*, p. 15.

difficult to change. There was a financial as well as an industrial and economic side to the question. A compromise was temporarily effected between the Home Office and the manufacturers, but the subject was afterwards referred to arbitration, Lord James of Hereford receiving evidence at an open court at Stoke-upon-Trent in November, 1910. Briefly, the Thorpe-Oliver recommendations were the use of leadless glaze for certain kinds of goods, the more frequent use of fritted lead in the form of a double silicate, the abolition of raw lead in the glazes, and the exclusion of young persons and women as glost placers and from the dipping and ware-cleaning departments.

At the time of the inquiry above alluded to raw lead was being added to glaze in a manner bordering upon the reckless and which called for interference if the industry was to become reinstated in public favor. Among the master potters themselves there was no unanimity of opinion as to the quantity of lead the glazes should contain. As an indication that raw lead was being simply added to glazes by rule of thumb and upon no scientific basis, it may be mentioned that some manufacturers used glazes containing as much as 20 per cent of white lead and others 10 per cent or less. On analysis Sir Edward Thorpe found on some of the ware 12 per cent of lead estimated as monoxide, and in the glazes 13 to 24 per cent of lead. As a result of Prof. Thorpe's examinations and experiments, the Home Secretary announced that there must be in pottery a standard of insolubility of fritted lead for glazes, the standard of insolubility to be that the glaze shall not yield more than 2 per cent of lead when acted upon by hydrochloric acid under certain conditions. The 2 per cent standard of insolubility being regarded as too hard a requirement, the manufacturers suggested 5 per cent. It was pointed out to the manufacturers that if the standard was fixed at 5 per cent this would allow of the use of a glaze from which it was possible in one hour to extract one-third of the lead by dilute acid at ordinary temperatures and that this would only perpetuate the evils which at the time existed. Without coming to any conclusion, the manufacturers were given two years to improve the conditions of work in their factories, after which, in July, 1903, Lord James of Hereford as umpire, at the close of the adjourned arbitration, delivered his award, the text of which became the basis of a series of amended rules issued by the Home Office, in which the spirit of compromise is apparent. One reason why the fritting of lead was not made compulsory was that if fritting is performed in a slovenly manner it affords no protection at all to the worker. It was therefore settled that no glaze was to be used which gave to 0.25 per cent of solution of hydrochloric acid more than 5 per cent of its dry weight of lead calculated as lead monoxide, that a monthly medical examination of the workers employed in certain specified processes was to be held, power of suspen-

sion given to certifying surgeons, casual workers to be examined at their own expense, a health register to be kept, overalls and head coverings to be provided and maintained by employers for women and young persons engaged in certain specified processes, respirators to be worn by persons when mixing unfritted lead compounds and in preparing frits and glazes, drying stoves were to be ventilated, the floors of the workrooms to be sprinkled and swept daily, and a scheme of compensation for workers in lead processes arranged.

FATAL CASES OF LEAD POISONING, 1899 TO 1909.

That manufacturers honestly tried to improve the conditions on the factories, also that the introduction of the 5 per cent standard of insolubility and the greater use of fritted lead compounds did something to lessen the amount of lead poisoning in the pottery industry is shown by comparing the number of cases of plumbism in 1898, 457, with 58 in 1909, but although in one sense this may appear satisfactory, there has not been the uninterrupted reduction in the amount of sickness there ought to have been, especially during recent years. It has been suggested that the system of granting compensation to persons suffering from lead poisoning contracted at work is partly responsible for the large number of cases of plumbism notified, but even allowing for this probability, defective hygiene, laxity of management, partial observance only of regulations, and carelessness on the part of the workers are the more likely causes. Under no circumstances could it explain the increase in the fatal cases during 1907 and 1908. It is fortunate that only a small proportion of cases of plumbism prove fatal, the average being about 1 per 1,000 persons employed in lead processes, as the following table shows:¹

NUMBER OF DEATHS AND DEATH RATE PER 1,000 FROM PLUMBISM IN THE UNITED KINGDOM, 1899 TO 1909.

Locality.	Number of lead work-ers employed, according to the re-turns of 1909.	Number of fatal cases of lead poisoning in the year—										
		1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909
North Staffordshire district	5,299	14	7	2	4	2	4	3	4	8	11	5
Potteries outside North Staffordshire	1,566	3	1	3	1	1	.....	.....	.....	1	1	.....
Whole of United Kingdom	6,865	17	8	5	5	3	4	3	4	9	12	5
Death rate per 1,000	.....	2.46	1.16	0.73	0.73	0.43	0.58	0.43	0.58	1.30	1.74	0.73

¹ Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 1, p. 10. Home Office, London, 1910.

USE OF LEADLESS GLAZES IN POTTERY MANUFACTURE.

Ten years have passed since the Thorpe-Oliver report was published and the use of leadless glazes recommended. An opportunity has therefore been given to the manufacturers to overcome some of the difficulties which if leadless glazes were used they stated would be encountered, such as crazing or cracking of the glazed surface of the ware. To the public, with whom after all rests the decision of this matter, has been equally given the opportunity of purchasing and thereby of testing leadless dipped ware, since, if there is a growing demand for such products, whatever at present may be the difficulties and defects in the methods of manufacture, these are certain to be overcome by greater industrial skill and by closer attention to chemical and other details.

The Departmental Committee on the use of lead in potteries in 1910 took evidence from 20 persons experienced in the manufacture of pottery and from 8 large buyers of earthenware and china. One of the manufacturers, using leadless glazes only, informed the committee that while his firm had been entirely successful in the use of leadless glazes for the whole of their output, yet their ware, which was one of common quality and possessing a good gloss and brilliancy of coloring, did not satisfactorily compare with the highest products of British manufacture. In India and Africa they found a good market for their leadless glazed ware, and as regards the manufacture they had overcome all the difficulties of production. They had no crazing or cracking of the glazed surface of their products, either shortly after their manufacture or months afterwards, and they had found leadless glaze cheaper than the lead glaze it had supplanted. Another manufacturer stated that the leadless glazed earthenware had competed satisfactorily in the open markets both at home and abroad with lead-glazed ware, that leadless glazed ware was $12\frac{1}{2}$ to 20 per cent cheaper than that made from raw lead, that with care in firing there is practically no loss in "seconds" (i. e., pieces not of first-rate finish and which have therefore to be sold at a cheaper rate), the cost of the finished article is 25 per cent less than that made from lead, the colors are brighter, and that there has been no complaint from purchasers in regard to crazing. One of the manufacturers stated that he had formerly more crazing when he used lead glazes than now. It is only right to add that the larger mass of evidence supplied by manufacturers was opposed to the views just expressed.

It was a recommendation of Sir Edward Thorpe and the writer that leadless glazes should be given a fairly long trial and that in their opinion there was a large quantity of cheap ware, for example, sanitary ware, which could be made just as well from leadless as from

lead glazes, also that while lead might yet have to be used for certain kinds of ware, it could even then be more sparingly employed.

The bulk of the manufacturers who have given leadless glazes a trial are of the opinion that for common articles, such as jam pots, it is satisfactory and cheaper. Others, however, stated that the loss in "seconds" is greater with ware dipped in leadless glaze, so that in some factories it, on this account, raised the cost of production 10 per cent, that the gold tended to peel off the edges of the ware, and that the enamel colors were not so bright. It was affirmed by the chief clerk to the metropolitan police that all the ware purchased by the department since 1900, such as tea and dinner services, fire-clay sanitary goods, glazed bricks and tiles, had been made with leadless glaze, and that in regard to their quality and durability he was quite satisfied. A representative of the prisons' department had found the goods satisfactory as to quality and durability, but the cost was about 10 per cent more than for lead-glazed ware. It is only right to interpose the remark that this slight increase in cost might be due to the difficulty of getting manufacturers to submit bids for leadless glazed ware. The director of naval contracts of the Admiralty stated that the leadless glazed ware cost from 10 to 15 per cent more than lead-glazed ware, that as regards durability no complaints had been received, but that so far as general quality was concerned the reports were conflicting, some being favorable, others the reverse. The representatives of the War Office had not found leadless glazed ware quite satisfactory.

So far as concerns the use of leadless glazes for electrical insulators, the evidence supplied by the Post-Office and Telegraph Department showed that the products were quite as good as those glazed with lead, not more costly, and that brown insulators coated with leadless salt glaze had been found to be even more efficient than the white specimens which contained lead.

Under this mass of conflicting evidence it was hardly possible for the Departmental Committee to come to a definite opinion as to the advantages and disadvantages of leadless glazes.

This difficulty is not lightened by the latest pronouncement upon this subject. Since the above sentences were penned the postmaster general, Mr. Herbert Samuel, in reply to a question in the House of Commons (Daily Press, Nov. 21, 1910) regarding the use of leadless glazes in post-office requirements, stated that more recent experiments of the post-office engineers had shown leadless glazed insulators to be less efficient for telegraphic and telephonic purposes than lead-glazed insulators and therefore not serviceable for long-distance lines. For this reason only about 20 per cent of the insulators ordered by the post office during the last four years had been leadless glazed, the actual number being 4,600 gross out of 23,700 gross. He also

stated that of the firms employed only one quoted a higher price for leadless than lead-glazed insulators, the difference being 1 shilling (24 cents) per gross. The manager of a large works where electrical fittings are made informed the writer that the porcelain insulators for high-tension currents inserted in switchboards of generating and distributing stations answer equally well when coated with lead-glaze.

Notwithstanding this conflict of opinion, there is yet much to show that the recommendations regarding the use of leadless glazes as contained in the Thorpe-Oliver report rested upon a sufficiently sound experimental basis to warrant leadless glazes being given a longer trial, while later experience of several manufacturers has shown that their use is not altogether impracticable. It was never contended by Thorpe and the writer that lead should be eliminated entirely from the manufacture of pottery. All they maintained was that it could be diminished in many instances and in others entirely abolished.

The Departmental Committee, 1910, thus concludes: "While considering that every encouragement should be given to manufacturers to dispense with the use of lead, [we] do not recommend that any attempt should at present be made to prohibit it in the manufacture of certain articles by scheduling them for that purpose." From this conclusion Miss Gertrude M. Tuckwell, one of the members of the committee, expresses her dissent. She is in favor of scheduling certain articles to be made only with leadless glaze and that, as time goes on, the schedule could be gradually extended in accordance with experience, so that by degrees the use of lead in the manufacture of china and earthenware might be abandoned. The use of lead, too, in colors should be restricted and the importation into Great Britain of articles made with lead prohibited. As stated in a previous part of this paper, ware dipped in leadless glaze is occasionally fired in saggers which have been washed internally with a raw lead glaze. In the act of firing the volatilized lead passes to the leadless glazed ware and makes it leaded.

In Holland specimens of leadless glazed ware are handed over to Dr. van Eyck, professor of chemistry in the Royal Military Academy, who is paid by the Government to examine the glazes and render to pottery manufacturers such chemical assistance as may help them with their products.

On two occasions at least, exhibitions of leadless glazed ware have been held in London on a large scale. Those who have had the opportunity of inspecting the products have been struck by the high-class character of the goods exhibited, and by the variety, depth, and brilliancy of the coloring. Since a wider use of leadless glazes would obviate much human suffering, all the assistance which technical chemistry and industrial skill can give ought to be brought to bear upon solving this problem, the importance of which to thou-

sands of workers throughout the whole civilized world is so great as to require no pleading from any person, especially when viewed in the light of antiquarian research it is known that the enameled bricks used in Babylon 522 B. C. and the decorative tiles in Egypt did not contain lead and in regard to the durability of which there is no question.

The hygienic value of fritted lead compared with raw lead has never been contested. Some continental manufacturers are as keenly alive to its advantage as are the British; they even make a greater use of it, but this is not general. As the pottery manufacturers in Holland did not adopt the 2 per cent solubility test recommended by Thorpe, the Dutch Government permitted them to use a larger percentage of lead in the glaze, but even with this concession some manufacturers were found exceeding the limits allowed. There is much to be said in favor of the 5 per cent standard of solubility of lead in the glaze, but in Holland there is a feeling that the test of mere solubility is not enough, since if a glaze is coarsely ground and the particles on that account are fairly large the hydrochloric acid acts solely upon the outer surface of the granule and in the one hour required by Government regulations will dissolve off only a small portion of lead, leaving the central portion unaffected, whereas if the particles have been more finely ground and are smaller they present more suitable conditions for the hydrochloric acid to act upon, and as a consequence a greater amount of lead will pass into solution.

In Germany earthenware is sometimes fired in saggars washed internally with litharge, common salt, and potash, so that during the process of firing there are formed chloride of lead and alkaline compounds, which mix during the melting with the clay of the pieces of the pottery. Prof. Sommerfeld, who is an acknowledged authority upon dangerous trades, is in favor of substituting leadless for lead glazes, and of raw lead being under most circumstances prohibited. The prefect of police in Berlin as far back as 1888 ordained that the kilns in a pottery should be so situated that lead vapors given off must not enter into the workshops but be drawn away by hooded chimneys or by aspiration, also that the grinding of lead glazes should be done moist, and that all workers engaged in mixing and sifting lead glazes or in cleaning dry ware should wear respirators containing a piece of sponge soaked in weak acetic acid.

Of 226 potteries examined in Austria there was found in the earthenware of 155 an excess of lead.¹ As a consequence, the minister of the interior in 1896 gave the police authorities power to examine roughly all earthenware with a clear polish exposed for sale in the public markets, and to remove samples for a more careful examination by means of sulphureted hydrogen. Sulphureted hydrogen

¹ Bulletin de l'Inspection du Travail, 1904, p. 431.

water is poured upon the ware in such quantity as gently to cover the surface by inclining the article so that all portions can be successively moistened. If, after having wetted all portions, the color of the enamel remains the same the ware is regarded as sanitary. Especially is this the case if ammonium sulphide produces no effect. Should the enamel, on the other hand, exhibit a deeper or doubtful color, the ware has to be more carefully examined, to see whether it contains only traces or larger quantities of lead, which might become soluble in food or drinks. For this purpose weak vinegar, 6 to 8 per cent, is placed in the ware, and this is boiled for at least 10 minutes. If after this period the vinegar precipitates a concentrated solution of sulphureted hydrogen, which has been added to it, and forms flakes of the brownish-black lead sulphide, the ware is discarded as being dangerous to health. If the color is only deepened, yet tending to brown, such ware is regarded as harmful, according to the degree of coloration. Glazes can be made containing lead and yet be not easily attacked by acetic acid. The lead has to be fritted and in the form of a double silicate when an alloy of lead oxide and silicic acid is formed during the process of fusion.

On the Continent of Europe closed stoves take the place of our open fires. In connection with these, the manufacture and use of enameled tiles are a fruitful source of plumbism. Complaints are made that it is not always easy to get the workmen to take the necessary precautions. At Wurzen, in Saxony, notwithstanding the introduction into the works of the most modern improvements, it was impossible to get the men to realize the necessity of carefulness. As a consequence, several of them became ill. Similar exhibitions of carelessness occurred at Chemnitz, and was the cause of a considerable amount of suffering. In the glazes used for enameling the tiles of stoves in the pottery works at Velten, in Germany, Rasch found from 1 to 10 per cent of oxide of lead soluble in acids and alkalis.¹ The process of fritting the lead compounds as carried on there was a source of danger to the workpeople, for it was shown that by respiration the men might absorb in 12 hours about 0.03 gram, and even as much as 0.69 gram of lead oxide in a badly arranged workshop.

RECOMMENDATIONS OF THE INTERNATIONAL ASSOCIATION FOR LABOR LEGISLATION AS TO USE OF LEAD GLAZES.

At the meeting of the delegates of the International Association for Labor Legislation held in Lugano in September, 1910, the subject of lead poisoning in the manufacture of earthenware and china was carefully discussed and several recommendations drafted which

¹ Bulletin de l'Inspection du Travail, 1904, p. 403.

were to be submitted to the various Governments. As these have more or less the sanction of international agreement and are the most recently expressed views of experts, they are digested here at considerable, but not greater, length than the importance of the subject demands. There was a general consensus of opinion that the Governments should put forth their best efforts to abolish the use of lead in its poisonous forms in the manufacture of pottery, and that wherever porcelain and other forms of manufacture required a high temperature in firing all glazes containing lead should be prohibited. There are many articles glazed without lead which can be fired at a low temperature. It was felt that if a list of these could be drawn out it might furnish the basis of international agreement. In the manufacture of cheap pottery, which is fired at a low temperature, and of earthenware such as is made in small potteries and in the homes of the people on the Continent, an industry to which attention will be drawn later on, it was recommended that lead sulphide (galena) should be substituted for the litharge and minium in use at present, and that it is desirable to have the glazes purchased from special factories, wherein glazes could be manufactured on a large scale, rather than made by the owners of small potteries themselves. It would be of considerable assistance to the movement if State instruction could be given to potters who are wishful to try glazes free from lead. It was felt that all glazes might be considered as free from lead, all substances, too, the products of vitrification which do not contain more than 1 per cent of lead, or so long as the amount of lead contained in either of them does not exceed that arising from such impurities as are commercially unavoidable in the substances used. The following glazes are regarded as being, comparatively speaking, free from danger: Those which contain galena, those which before firing do not contain more than 2 per cent of lead, and all fritted glazes which do not yield more than 2 per cent of their dry weight of a soluble lead compound calculated as lead monoxide determined by the Thorpe test—i. e., continuous shaking of the glaze material, ground freely for use, for 1 hour with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of acid.

The mixing and grinding of the lead compounds of glazes as well as the transport of these should be effected in the moist state or in closed apparatus from which dust can not escape. Fritted lead should be diverted in the liquid state into water. In all dusty processes efficient exhaust draft should be provided. What the height of the rooms should be where lead compounds and lead glazes are manipulated it is difficult to say. Three and a half meters (11.48 feet) high, and 15 cubic meters (529.72 cubic feet) space of air for each workman, have been recommended. There is nothing to be

gained by making the rooms too lofty, unless other means of ventilation are provided. Good flooring and walls which can be washed are of importance. The manufacture and manipulation of the compounds for glazes should be absolutely forbidden in living and sleeping rooms, and there should not be introduced into either of these rooms glazes or their lead ingredients, or any articles of pottery which have been dipped in a glaze the ingredients of which have not been fritted.

Females should not be employed in any kind of work whatever which brings them into contact with lead compounds and lead glazes. Opinions are divided as to the age at which apprentices should commence work in processes in which lead compounds are used. Eighteen years of age was recommended, but by some of the delegates it was felt that 16 years would be, if not quite safe, certainly more in keeping with the conditions of labor in some countries. So far as the limitation of age is concerned it must not be forgotten that young people are more liable to plumbism than those of maturer age, and that two or three years one way or the other in late adolescence is, so far as predisposition to plumbism is concerned, a matter of the greatest importance. Dipping and firing of the glazed ware, also cleaning of ware dipped in glaze, whose principal ingredients have not been fritted, are not occupations for females or for young persons.

It is desirable that persons employed in the fritting of lead compounds should not be occupied more than four hours on any one day, nor on more than six days in succession. There should be an interval of at least a fortnight between two such spells of work. Overalls should be worn by all persons employed in mixing lead compounds and in manipulating raw-lead glazes. It should be incumbent upon employers to provide the overalls, also a plentiful supply of water for drinking and washing purposes, individual drinking glasses, soap, and towels; the washing of the overalls and towels to be the duty of the employers. There should be no eating, drinking, or smoking, or even the introduction of food, drink, or tobacco into places where lead compounds and lead glazes are manipulated, and all persons whose work brings them into contact with lead should be medically examined at least once every three months, the results of the examination to be entered in a health register to be placed at the disposal of the factory inspector whenever required.

Workers suspended on account of plumbism should not be reemployed until after a medical examination. Two cloakrooms, one for the working clothes and one for the outdoor clothes, bathrooms supplied with hot and cold water, and a dining room should be provided, and on their engagement employers should, by means of

printed instructions, inform the workers of the danger of lead poisoning and of the means of preventing it. Where a workman has fallen ill or has been suspended from work for medical reasons, and is not receiving an allowance from a sick club or insurance fund to which the employer has contributed, the employer should indemnify him for the loss of money to which he is exposed during his illness or suspension. An employer may fulfill this obligation by providing the employee with other work, paid for at the same rate and of such a character as the state of health and the general circumstances of the case will reasonably allow the suspended workman to undertake.

MANUFACTURE OF POTTERY AS A HOME INDUSTRY.

The writer's attention was first directed to work in lead as a home industry during a visit to the hand file makers of Sheffield. However harmful file making has been in Sheffield, and however insalubrious the conditions of labor, these are as nothing compared with the disastrous results which have followed the manufacture of cheap pottery and earthenware in the homes of the small master potters of Hungary. In consequence of the enormous amount of sickness and the extremely high death rate among the wives and children of small potters in Hungary, circumstances specially brought under my notice by the late Dr. Adalbert Chyzer, of Budapest, I went to Hungary accompanied by Mr. Hermann Belger, of the Armstrong College, Newcastle-upon-Tyne. Along with Dr. Chyzer and Mr. Marcel Gallai, one of the royal inspectors of factories, whose services had been kindly placed at my disposal by His Excellency Mr. Josef Sztérényi, secretary of state, I made a tour of inspection of those villages wherein, apart from agriculture, pottery is the chief industry and where the work is carried on in the homes of the people..

At Hódmező-Vásárhely we were met by M. Berecci, a master potter, chairman of the potters' guild. He had assembled in the courtyard of his house 80 working potters, many of whom were paralyzed in their hands, face, and legs. I examined several of the men. Some of them were the worst cases of plumbism I had ever seen. It was appalling to see so many men, not yet in the prime of life, rendered helpless through their occupation. Some of them not more than 35 to 40 years of age had been paralyzed for 6 years and more. In several of the kitchens of the master potters I found, for example, the wheel for grinding the raw lead glaze, the tub filled and ready for the dipping of the ware, the potter's wheel upon which is thrown the clay, the usual furniture met with in kitchens, also a bed and a cradle with, in some instances, a child in it, while between the kitchen and the bedroom was the kiln or oven in which the lead-dipped pottery was fired.

The glazes used by the small master potters of Csákvár contain 60 per cent or more of white lead, 30 of kaolin, and one-half of 1 per cent of copper, and, as dipping is attended by a good deal of splashing, there is in many of the living rooms abundant evidence of dry glaze all over the hardened earth which forms the floor. Husband and wife work together in the lead processes and frequently suffer in consequence. Children, if born in the adjoining room, are cradled in the workroom, where dried glaze dust rich in lead carbonate is much in evidence not only on the floor and upon the furniture and shelves in the room, but also on the utensils used for cooking, as well as on the bedclothes and pillows in the cradles.

Dr. Chyzer, on analyzing dust taken from the kitchens, found that it contained lead varying from 0.63 to 1.08 per cent. In one of the houses which I visited with Dr. Chyzer the husband, wife, grown-up children, and a child of 4 years of age lived and took their meals in the workroom. As a consequence all the children had suffered from colic, and on the gums of each member of this household there was a well-marked blue line. Close by, in an adjoining house, I found a child 6 years of age who had suffered from saturnine encephalopathy, which had left him with cramped limbs, legs flexed upon abdomen, head retracted, eyeballs paralyzed, loss of control of the sphincters, and with defective mental development. Saturnine meningitis in children usually proves fatal within two or three days, or there is an incomplete recovery with such sequelæ as I have mentioned. How much of the lead encephalopathy is relatively due to heredity, congenital toxæmia, and to environment, it is difficult to say. Children born to potters, where both of the parents are impregnated with lead, invariably die; but of the children born into the unhealthy surroundings I have indicated, while some of them live, all run the risk of becoming lead poisoned and of developing at an early age the peculiar nervous symptoms to which further attention will be directed.

In one potter's house, where the owner had but recently recovered from lead colic, the dust removed from the top of the oven 6 feet high was found to contain 3.9 per cent of lead. In the dust removed from the floor near the grinding wheel in another potter's house at Békés, where the husband was paralyzed in both hands, and where the wife, who had suffered severely from colic, had become the subject of osteomalacia, Dr. Chyzer found 14.9 per cent of lead, while in the dust removed from the kitchen floor of yet another potter, who was the subject of profound cachexia and of double wrist drop, there was 8.7 per cent of lead. Carrying his investigations further, Dr. Chyzer found in the blouse of the son of a potter, aged 5 years, and on whose gums there was a well-marked blue line, lead to the extent of 0.243 gram, and in his cap 0.0144 gram of lead. In

these two articles of clothing were also found traces of copper which the father was in the habit of mixing with the glaze. These are only a few examples of many analyses of the dust which were made, all of which point to a wide dissemination of lead, not only in the living rooms of working potters, but upon the clothes worn by their children. No wonder, therefore, that during my visit to Hungary I was able to confirm all that Chyzer had drawn my attention to. I have never seen such widespread suffering from lead poisoning, nor have I witnessed such harrowing sights as those I saw among the Hungarian potters who make their trade a home industry. Young men paralyzed in hands, face, and feet, helpless, and unable to dress and feed themselves; women paralyzed; children imbecile and blind, paralyzed in their legs, or suffering from colic, and all of them with a well-marked blue line on their gums. As to the connection of the illness with lead there is no possibility of doubt. One master potter whom I saw had lost his wife from plumbism; this man married again; his second wife had also died from lead poisoning. He has three children; one was paralyzed and at home, the other two were being treated for plumbism in the hospital of an adjoining town. Some children whom I examined were suffering from rickets, were undersized and undeveloped. A child 3 years old, carried in his mother's arms, looked like an infant of 12 months; he could not speak; his legs were atrophied; he was imbecile. In Mezötur I found in a potter's family a boy, aged 7 years, the subject of recurrent convulsions; he was paralyzed in left hand and foot, was imbecile, and could not talk. His brother, 3 years old, also could not talk. A man of 21 looked more like a boy of 14 years.

The infant mortality of the home-working potters of Hungary is high. They have few children, some none at all, owing to their wives so frequently miscarrying. At Békés, Dr. Elek Henszlmán informed us that a large number of the children in the village die from acute saturnine meningitis. At Temerin seven children in one family born to potter parents died from convulsions, and at Silos a master potter had lost six of his children from the same cause.

In Hungary, therefore, it is not only the working potters who suffer from plumbism, but their wives and families as well. The domestic animals, too, do not escapé. A potter can not keep in his house a singing bird nor can he rear fowls in the courtyard, for the dried splashed lead glaze rapidly kills them. Cats are extremely susceptible to lead. They suffer from colic and in their agony they roll upon the ground, bending their limbs toward their body, or they strike their abdomen against the floor, mewing as if in pain. In some of these animals symptoms akin to madness arise. Losing control of themselves they run wildly about heedless of obstacles,

or they throw themselves into water and are drowned. In one instance a cat in its agony leaped into the fire.

Struck by the distressing consequences of the manufacture of pottery as a home industry in Hungary, upward of 60 per cent of the master potters in the village of Csákvár, for example, being the subjects of plumbism, we drew up a few recommendations, which were forwarded to the Government in the hope of ameliorating the misery and the suffering which prevailed. One difficulty in altering the conditions of manufacture of earthenware in Hungary is the scarcity and dearness of fuel. The kilns are heated by wood. It is owing to the ready volatilization of lead at a comparatively low temperature that the rather free use of raw lead in the glazes has arisen. Steps will be taken, if not to abolish the manufacture of pottery as a home industry in Hungary, to at any rate forbid the processes being carried on in the rooms occupied by potters and their families; regulations will be drawn up for altering the methods of preparing and using the glazes, and the potters and their wives instructed in the dangers incidental to the unregulated use of lead.

FILE MAKING.

File cutting by hand is an unhealthy occupation. The death rate of file cutters from lead poisoning and from pulmonary phthisis exceeds the mortality standard of ordinary occupied males by 90 per cent, and after 35 years of age it is still higher. The explanation of the unhealthy nature of the trade in England is not far to seek. The work is frequently carried on in small buildings in the rear of dwelling houses and in back yards in which there is little circulation of air. In most of the workshops in Sheffield—the principal seat of the industry in Great Britain—there is no ventilation. Usually the floor is the ordinary earth. Men and women work together, and overcrowding is common.

In file cutting by hand the man or woman sits astride a “stock.”¹ In front of him is a stone block, into the center of which a steel bar called a “stiddy” is inserted, and on this “stiddy” is placed a piece of metallic lead called “the bed” or “cushion.” When about to be cut, the file is strapped flat on the “bed.” By means of a hammer and chisel fine lines are made upon the file, each line representing one blow of the hammer. The work calls forth a considerable amount of effort on the part of the file cutter, for the hammer usually weighs from 7 to 9½ pounds, and in a large file there may be as many as 3,800 lines. When one face of the file has been cut it is lifted from the cushion, rubbed with charcoal or chalk, and then replaced, cut face downward, for the other side to be similarly dealt with. Much dust is given off both during the cutting of the file and on its

¹ Oliver, *Diseases of Occupation*, p. 169. London, 1903.

being rubbed with charcoal. In the dust collected from the rafters of a file-cutting shop in Sheffield there were found 2.64 grains of metallic lead, in dust taken from the top of a "stock" 14.82 and 22.28 grains per 100, and from the floor under the stock 2.63 and 4.37 grains per 100.

File cutters are not a cleanly class of men. They were until lately in the habit of taking food into the workshops and of eating it there without previously washing their hands. They acquire the dirty habit, too, of licking their fingers when at work, so as to get a better grip of the chisel. Their work obliges them to bend down toward the "stiddy" and thus they inhale dust, which is the cause alike of plumbism and diseases of the lungs. Although the lead given off is generally in a metallic state, yet there is always a certain amount of oxidation taking place, and this converts the lead into a soluble form.

Partly as the result of the work being carried on in close ill-ventilated rooms and partly also owing to the nature of the work itself, the men and women sooner or later become anæmic, suffer from colic, or develop paralysis of the extensor muscles of the fingers and wrists, especially of the left hand, since it is by the fingers of this hand the chisel is tightly gripped. The prolonged muscular strain thereby incurred is one explanation of the left hand becoming more frequently affected than the right. In other instances there is double "wrist-drop." Plumbism in file cutters tends to chronicity, and as a consequence we find in them a high death rate from diseases of the kidneys. The number of cases of lead poisoning in file cutters reported to the Home Office during the last 11 years has been as follows:¹

NUMBER OF CASES OF LEAD POISONING AMONG FILE CUTTERS REPORTED TO THE BRITISH HOME OFFICE, 1899 TO 1909.

Occupation.	Number of cases of lead poisoning reported in the year—										
	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899
File cutting:											
All cases.....	8	9	10	15	12	20	24	27	46	40	41
Fatal cases.....		2				4	2	1	7	3	1

The upper figures are those of all cases, fatal and nonfatal; the figures in the lower line of the table relate to fatal cases only. Between 1900 and 1909 there were reported in the United Kingdom 241 cases of plumbism in file cutters and of these 19 terminated fatally. In 211 cases of plumbism notified as occurring in file makers, 202 were file cutters proper and 9 file hardeners, i. e., men who temper files by plunging them into a bath of molten lead. Greater attention to ven-

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, p. 193.

tilation and better hooding of the bath, whereby the lead fumes can be drawn away from the worker, would, if file cutting is to be carried on the old lines, materially reduce the tendency to plumbism.

Machine-made files are replacing those made by hand, and in many engineering shops work hitherto done by hand filing is now done by wheels coated with carborundum and run at a great speed. Several substitutes, too, have been tried for the metallic lead plate upon which the file rests when being cut, but until lately for hand files there seems to have been considerable difficulty in finding anything which adequately replaces it. In Prussia the factory inspectors state that the men can not make files without a lead cushion. There, too, as in England, numerous unsuccessful attempts have been made to find a substitute, but from nearly every country comes the same answer, that the lead cushion is softer and receives the recoil better. For files of a coarser character an alloy of tin and zinc can be used, but, whether this or any other cushion is adopted, personal cleanliness on the part of file cutters is an absolute necessity. In Bavaria there are 26 small file factories giving employment to 59 men and 13 youths. Only two cases of plumbism are said to have occurred in these factories in five years. Pure-lead cushions were used in 5 of the works, in 13 lead alloys, and in the remainder tin and zinc. Employers and workmen in the file shops of Saxony say that they can get along well without the use of lead in the cushions. For files which are subsequently to be used upon wood it is said that, while lead is desirable, it is not necessary, since tin can take its place. The factory inspector for the Brunswick Government states that in his district there is a file maker who has worked uninterruptedly for 38 years without being ill. This is a proof that by cleanliness and attention to details of hygiene the occupation can be robbed of many of its dangers. The same inspector states that lead cushions can be replaced by tin, and that the molten-lead baths into which the files are plunged in order to harden them can also be dispensed with. For the purpose of hardening, it is enough to insert the files between hot iron bars.

File cutting is one of the unhealthiest of occupations. For this the stooping attitude at work, the ill-ventilated workrooms, and the inhalation of the dust are responsible. Phthisis is extremely prevalent among file cutters. The work is arduous and fatiguing, as well as dusty. In a sample of dust taken from the outside of a furnace for tempering files Prof. Sommerfeld¹ found 1.2 per cent of lead.

As bearing upon the question of substitutes for lead, the opinion of continental authorities and of sick assurance funds is of importance. A recent report of the Sick Insurance Fund of Machine Constructors of Berlin states that during a period of two years and

¹ Bulletin de l'Inspection du Travail, Paris, Imprimerie Nationale, 1904, p. 399.

three months, there were 148 file cutters at work. Of these 55 used only tin cushions and remained in good health, whereas of the 93 who used lead, 55 were attacked with plumbism. The Chamber of Commerce of West Prussia reports that during 1903 nearly all the file cutters of the district suffered from lead poisoning. Similar accounts come from Magdeburg, Hildesheim, and Düsseldorf.

In Germany, Prof. Sommerfeld has for years been pressing hard for the suppression of lead and for the use of tin as a substitute. He is of opinion that it is only the higher price of tin as opposed to lead which prevents employers using it more freely. Upon this point the testimony of Dr. Ignace Kaupa¹ given at the meeting of the International Association for Labor Legislation at Basel, 1904, is of special interest, although it refers only to Austria. In the annual reports of the hospitals of Vienna from 1895 to 1898 there appeared on an average three to four cases of plumbism in file cutters who had worked with soft lead cushions. The factory inspector thereafter proposed that the cushions should be made of a composition other than lead, and since then there have been no cases of lead poisoning. This experience points strongly in the direction of interdicting lead in file cutting.

In some countries the workmen themselves have taken up the question. Dr. Karl Wächter¹ states that lead cushions can be replaced by zinc, but that the cost is slightly greater. In 1906, there was a strike of file makers in Offenbach. Before returning to work the men insisted upon the lead cushions being replaced by an alloy of zinc, that the files should not be hardened in a lead bath, the ventilation should be improved, regular cleaning of the workshops take place, and that they should be provided with sulphur soap for their personal use.

Apart from the risk of lead poisoning and disease of the kidneys, to which file cutters are prone, they are also liable to phthisis in greater proportion than men employed in other ordinary occupations. Of 27 deceased members of the Sick Insurance Fund of Machine Constructors, in Berlin, 13 (48.1 per cent) died from phthisis, the mean age at death of these 27 men being 43.7 years. In the Occupation Mortality Tables of Ogle the average age at death of file cutters is stated to be 40 years. The British Home Office has done much by special rules to remove from file cutting many of its dangers.²

ELECTRICAL ACCUMULATOR WORKS.

The increasing use of electricity for lighting and motor purposes, for telegraph and telephone requirements, has led to the manufacture of electrical accumulators (storage batteries) on a large scale

¹ Die gewerbliche Blevergiftung und ihre Bekämpfung im deutschen Reich. Karlsruhe, 1908.

² For rules in full, see pp. 143, 144.

and made it an important industry. In the manufacture of electrical accumulators a paste made of red lead and sulphuric acid is rubbed into the openings of perforated plates. The workmen thus employed wear india-rubber gloves. But these become thin with friction so that, unless the greatest watchfulness is exercised, the gloves cease to be a protection and become a source of danger. The mixing of the paste should be done automatically in a closed chamber provided with an exhaust draft. The stringent regulations in force in Germany have considerably diminished the amount of lead poisoning in electrical accumulator works in that country, and although in Great Britain the manufacture is well supervised there are yet far too many cases of plumbism, as the following table shows:¹

NUMBER OF CASES OF LEAD POISONING IN ELECTRICAL ACCUMULATOR WORKS REPORTED TO THE BRITISH HOME OFFICE, 1899 TO 1909.

	Number of cases of lead poisoning reported in the year—											Total
	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	
All cases	27	25	21	26	27	33	28	16	49	33	32	317
Fatal cases	2	1	.....	.....	1	.....	.....	1	1	.....	.....	6

During 11 years there have been notified 317 cases of lead poisoning, including 6 deaths, in men employed in electrical accumulator works. Most of the illness the men suffer from is the result of the use of the red lead paste already referred to, but there are other risks, such as those consequent upon casting the plates, soldering by means of a blowpipe flame, and the inhalation of dust when fitting up the plates in a battery. Of 69 cases of plumbism which occurred in a large accumulator works near Ashton, Dr. Hugh Hughes states that 45 of the men affected were mixers, pasters, laborers, and 16 were lead burners. In a large works in Germany 37.5 per cent of the cases of lead poisoning occurred in men employed in the soldering department, 30 per cent in plumbing, 30 in pasting, and 10 per cent in casting. It is in the soldering, plumbing, and pasting processes that the men are exposed to the greatest risks. Of 106 men employed in electrical accumulator works, Dr. Puddock found that 53.5 per cent showed a well-marked blue line on the gums and that 9 per cent were anæmic.

Electrical accumulator works resemble white-lead factories in so far as in certain works there is always a certain amount of plumbism among the men, whereas other works are remarkably free, a circumstance which points often to some structural defect in the buildings, probably old to commence with, or to laxity in observance of the

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, p. 193.

regulations. In one works in Vienna 19 per cent of the men fell ill; in another 50 per cent.¹ It is well, therefore, to set as high a standard of requirements as possible and to insist upon attention to the most minute details, such as good ventilation, effectual separation of the processes, provision of receptacles for lead ashes, exhaust drafts on the pasting benches, and conveniently situated lavatories supplied with hot and cold water.

A difference exists between factories where electrical accumulators are simply used and where they are made. While there is little danger in the use of accumulators, there is a considerable risk to health in their manufacture, since, as already stated, lead in one form or another enters into most of the processes. Metallic lead has to be melted and made into grids or perforated plates; these have to be pasted with red lead; soldering of the plates is required, and the plates when finished have to be placed in wooden boxes lined with lead. There is scarcely a process, therefore, in which the men either do not handle metallic lead, are not exposed to its fumes, or do not run the risk of inhaling red lead dust. The most severe cases of plumbism are usually met with among the younger men. That it is an industry attended by risk to health is shown by the fact that in one large works in Vienna, giving employment to 107 men, an average of between 4 and 5 workmen daily were unable to follow their occupation on account of lead poisoning. Several of the men suffered from colic, which lasted a few days, but kept returning, while others were off ill on account of stomach trouble and bronchial catarrh.¹

Men commencing work in electrical accumulator factories should have the dangers and the risks of the occupation explained to them. In a large accumulator works in Berlin several of the men became ill because the regulations were neither understood nor followed. Within one month two medical examinations in one works revealed the presence of 7 cases of plumbism among 14 workmen, equal to 50 per cent. The owner was fined for not having the rules observed. It has again and again been shown that the best way to teach workmen to take preventive measures is to have them periodically medically examined. In one accumulator works personal cleanliness on the part of the workmen was sought to be assured by the promise of a gift to the men of 10 to 20 marks (\$2.38 to \$4.76) if they would faithfully observe the rules. The value of a periodical medical examination of the workers is testified to from all parts. In Pomerania there was an electrical accumulator works which had lain idle for a time. Before being taken on again all the workmen were examined. After commencing work there was no further medical examination for two months. By this time many of the workmen had fallen ill,

¹ Dr. Ignace Kaup, *Blei- und Phosphorvergiftungen in den gewerblichen Betrieben Österreichs*, p. 48. Wien, 1902.

and to such an extent that they had to be dismissed. As a few of the old hands also suffered the monthly examination was reestablished and with excellent results.

In men employed in small electrical accumulator works where ventilation is defective symptoms of plumbism may develop with great rapidity. A patient under the writer's care became the subject of lead poisoning after having worked for 10½ days as a paster of grids for small hand batteries. The workroom was not adapted for the kind of work it had been put to.

PRINTING, LINOTYPING, AND TYPE FOUNDED.

The occupation of printing and type founding is attended with risks to health, not only from lead poisoning, but from tuberculous phthisis as well. The rooms in which printing is carried on are generally kept too hot, are badly ventilated, and too frequently illuminated by such artificial means as gas or lamps, which consume the oxygen of the air and add combustion products to it. Type metal is an alloy of lead with one-fourth or one-third of antimony, which is added in order to give hardness to the type. Occasionally tin and copper are also added in small quantities.

The high death rate among printers and type founders from phthisis contradicts the opinion expressed several years ago by two French physicians, Tanquerel and Pidoux, that there exists an antagonism between lead poisoning and tuberculosis, or, in other words, that the presence of one of these diseases tends to exclude the other. On the contrary, experience of several trades in which lead is used raises the question as to whether lead by reducing the resistance of the worker does not rather predispose him to tuberculosis. There is a growing belief that such is the case. It was the opinion of Leudet, another French physician, that when pulmonary phthisis becomes grafted upon plumbism, the disease of the lungs tends to run a more rapid course than in other sick but not lead-poisoned persons. While work in overheated and badly ventilated rooms may of itself predispose the printer and type founder to lung disease, there is the influence of dust as dust to reckon with. Since tuberculous phthisis as a special morbid incident is not met with in all industries in which lead is used, it would seem as if some other factors were present, such as an unusually irritating form of dust. The lead miner, for instance, is more prone to lung trouble than either the coal or the iron-stone miner. Bad ventilation and the absence of means for the removal of the smoke of the lamp of the miners and of the fumes given off by explosives are largely responsible for the pulmonary troubles of the lead miners. Type founders, grinders, fitters, finishers, and stereotypers suffer from the fumes given off by the molten lead to which they are exposed, where the old method of stereotyping is done by casting. During the polishing of type by means of files,

the men can hardly avoid inhaling dust. According to Kaup, this work in Vienna is done by young girls, and they suffer severely from lead poisoning.¹ Printers and machine workers run risks when, after having soiled their hands with lead through handling the type, they wash the metal characters in benzine. In type founding there is another possible risk—when the antimony contains arsenic.

Between 1900 and 1909 there were reported to the British Home Office 200 cases of lead poisoning in printers; of these 17 were fatal. During 1909, 21 cases were notified, whilst for the previous nine years the numbers were, respectively, 30, 26, 16, 19, 15, 13, 19, 23, and 18. The 200 cases were made up as follows: Ninety-two compositors, 71 stereotypers and linotype operatives, and 37 persons employed in the type-casting room.² Taking his figures for four years from the Typographers and Type Founders' Assurance Society of Vienna, Jehle found on an average that per 100 printers, 1.02; per 100 printers' assistants, 0.52; per 100 compositors, 1.92; per 100 type founders, 7.07; per 100 female printers, 0.98; and per 100 female compositors, 21.25 suffered from lead poisoning.³

At Lugano in September, 1910, Dr. Teleky, of Vienna, informed the writer that if female labor in the compositors' room had not been already entirely suppressed in Austria, it was on the point of being abolished, for it is among compositors that the largest number of cases of plumbism occur. Although in Great Britain the number of cases of lead poisoning in printers is not great considering the number of persons employed, still the symptoms are usually severe. The nervous system is specially prone to be affected in printers, hence the high proportion of paralysis and of brain symptoms. Mention may also be made of the fact that in many female printers who are suffering from lead intoxication there is frequently an absence of a blue line on the gums.

The remarks made in regard to printers and compositors apply equally to type founders and linotypists. To the fumes which rise from the molten metal in the casting and lino melting pots must be attributed the plumbism from which the men suffer. Other probable sources of illness are inhalation of dust and absorption of poison through the skin by handling the type. The dust given off by type frequently contains as much as 14 per cent of lead. In Great Britain, although cases of plumbism among printers and type founders can not be said to be on the decline, on the Continent the percentage of persons affected in the polygraphic trades is much higher. In Leipzig alone in one year 132 typists, 25 type founders, and 9 music typists suffered from lead poisoning. An interesting legal point was

¹ Kaup, op. cit., p. 20.

² Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, pp. 193, 195.

³ Kaup, op. cit., p. 23.

recently raised in Bavaria, when a printer's apprentice, 13 years old, developed lead colic. The father of the boy was advised to change his son's occupation, but refused. Law, while sufficient to keep the youth away from work when ill, had no power to prevent his returning to work when he had recovered. In Great Britain such a difficulty might be got over by requiring the worker who had suffered from lead poisoning to furnish a medical certificate, stating that he had recovered and was fit for work. The certifying surgeon could refuse to pass the applicant for work on the ground that he was physically unfitted for it.

Although Holland is a small country, her polygraphic trades are very important. In 1899 there was given employment to 13,749 men and 147 women; in 1904, 16,199 workers were employed, of whom 10,143, or 62.5 per cent, were adults. The subject of the maladies of printers and type foundrymen has formed the basis of an interesting inquiry by Is. P. de Vooys,¹ factory inspector, Deventer. In Amsterdam, Rotterdam, 's Gravenhage, and Utrecht the youths employed equal 32.5 per cent of the whole.

Since in Holland boys are employed in the printing trades at a comparatively early age, Dr. S. Elias,² of Rotterdam, has made an inquiry into the effect of the occupation upon the subsequent growth and development of these youths. Comparing the height and weight of the boys who enter the printing shops at the age of 12 years with boys at the orphanage in Brussels; well-developed German lads; sons of wealthy Italians, and with healthy boys generally, Elias finds that the Dutch boys at the age stated are taller and heavier than the others mentioned, but that at the end of three years they are shorter and of lighter weight than all of them. This effect of work in printing shops raises the question as to the advisability of the height and weight measurements of all young persons taken by certifying surgeons on commencing work being registered with the view of comparing the influence of various occupations upon the growth and development of youths.

The average daily wages of the adult printers are about 3 shillings and 6 pence (85 cents), which, compared with those of the agricultural laborers, 2 shillings and 9 pence (67 cents), are not much considering the risks of the occupation and the necessity of good food. In order to make a decent living the men engaged in the typographic industries have to work longer than the allotted 10 hours, but even with overtime the wage increment is so small as to be hardly worth the extra strain which the labor involves. Considerable interest is being taken in the printing trades on account of the frequency of

¹ Bericht über Bleivergiftung in den polygraphischen Gewerben in den Niederlanden, erstattet von Is. P. de Vooys, Arbeitsinspektor, Deventer.

² Quelques observations chez les jeunes ouvriers travaillant dans les ateliers de Polygraphie et Imprimerie. Bruxelles: Congress, Sept., 1910.

tuberculosis among the workers. In Holland compulsory notification of plumbism among printers is not yet required. The following table suggests a higher mortality for printers and house painters than for the other trades:¹

Occupation.	Per cent of persons working in specified occupations, by age groups.							
	12 to 17 years.	18 to 22 years.	23 to 35 years.	36 to 50 years.	51 to 60 years.	61 to 65 years.	66 to 70 years.	71 years and over.
Printers.....	26.71	19.72	30.14	16.19	5.13	1.88	1.02	0.71
Shoemakers.....	14.29	14.92	23.95	13.15	9.54	8.69	2.77	2.69
House painters.....	14.21	16.42	30.57	23.73	8.76	2.90	1.82	1.59
All trades.....	10.51	13.46	29.88	24.86	11.60	4.35	2.81	2.58

After 50 years of age there are fewer persons working in the printing trade than in most other trades. In the case of shoemaking, which is to some extent a sedentary occupation and is usually carried on in overheated rooms, the influence of the occupation is probably more felt as the men become older.

It is not the number of cases of lead poisoning which strikes us as a cause of death of printers so much as phthisis. As showing the unhealthiness of the trade from this point of view, there died in the 18 years from 1850 to 1868 in Vienna 712 printers, of whom 69.7 per cent died from tuberculosis.²

The high mortality rate from phthisis in printers in the Netherlands between the ages of 18 and 35 is readily apparent.

PER CENT OF DEATHS DUE TO PHTHISIS IN SPECIFIED OCCUPATIONS, BY AGE GROUPS.³

Trade.	Per cent of the total deaths in the age group due to phthisis.								
	12 to 17 years.	18 to 22 years.	23 to 35 years.	36 to 50 years.	51 to 60 years.	61 to 65 years.	66 to 70 years.	71 years and over.	Average.
Printers.....	5.92	31.23	22.67	17.83	16.88	7.04	28.80	13.51	13.75
Shoemakers.....	4.06	21.79	19.35	16.13	15.16	7.34	5.44	9.06	15.80
House painters.....	3.87	14.82	15.54	15.87	16.64	14.86	19.35	4.92	13.85
All trades.....	2.70	11.96	12.40	11.25	12.16	11.22	11.00	6.80	10.66

In many instances work in lead and inhalation of dust appear to undermine the health of workmen without their exhibiting signs of plumbism. This circumstance has already been mentioned. Miss Anderson, principal lady inspector of factories, drew attention in her annual report, 1906, to the absence of a blue line on the gums in 32 women and female young persons engaged in printing, and yet in several of them there were other signs suggestive of plumbism.

De Vooy's mentions the occurrence of plumbism in a family where type casting was carried on as a home industry. To the habit of

¹ De Vooy's, op. cit., p. 6.

² Kaup, op. cit., p. 21.

³ De Vooy's, op. cit., p. 9.

young printers holding the type between their teeth, when correcting, several cases of lead poisoning have been traced, also to the disagreeable practice printers occasionally have of moistening their fingers with saliva in order to get a better hold of the type. In one printing shop De Vooy's found seven workmen with signs of lead poisoning, including tremor, presence of a blue line on the gums, and in some of the men a history of colic, and yet no cases of plumbism had been reported from the district, a circumstance which shows how unreliable statistics of industrial poisoning may be, unless notification is compulsory and the medical profession loyally cooperates with the Government inspectors.

The dangers to which printers are exposed are inhalation of dust which contains lead, cleaning the type; also inhalation of fumes from rotary presses and printing machines. In the dust taken from type boxes both lead and antimony have been found. Dr. C. van Eyk, professor of chemistry at the Royal Military Academy at Breda, has made several examinations of the dust. He estimates the amount of lead present by shaking it in 0.25 per cent solution of hydrochloric acid for one hour.¹

Test.	Percentage of lead dissolved after shaking in 0.25 per cent solution of hydrochloric acid for 1 hour.	Test.	Percentage of lead dissolved after shaking in 0.25 per cent solution of hydrochloric acid for 1 hour.
1.....	3.48	6.....	1.76
2.....	3.70	7.....	1.82
3.....	3.59	8.....	1.68
4.....	3.38	9.....	2.43
5.....	1.23		

The foregoing table shows how much of the lead present in the dust is soluble, while the succeeding table shows the character of the dust taken from different parts of the workroom:¹

Test.	Place from which the dust was taken.	Height above floor (feet).	Percentage of lead dissolved after shaking in 0.25 per cent solution of hydrochloric acid for 1 hour.
1.....	Gas pipes.....	8.08	2.34
2.....	A beam.....	10.82	1.47
3.....	Water pipes.....	8.20	1.64
4.....	Stovepipes.....	7.87	1.43
5.....	Top of cupboard.....	7.54	2.04
6.....	Beams supporting ceiling.....	10.82	2.25
7.....	A beam.....	9.84	1.29

From all parts of Europe comes the same indictment of dust in printing works. It is dust which menaces health from all points of

¹ De Vooy's, op. cit., p. 22.

view. Prof. Steingraber analyzed the dust from a type box in a Krakow printing works and he found it contained 16.43 per cent of lead; the dust from the top of a stove in a compositor's room contained 0.24 per cent; while that from the floor of a gallery 5 meters (16.4 feet) high in a compositor's room contained 0.37 per cent of lead. In these works there were several cases of plumbism.¹

Dr. van Eyk having raised the question as to why some dust contains more lead than others, answers it by saying that where the percentage of lead is small the dust must be coming from other sources than the printing. A number of printers after working for hours with type were asked to wash their hands in a weak solution of hydrochloric acid. In this liquid there was found on an average from 6 to 15 milligrams of lead per man.

An equally interesting study of the unhealthiness of printing as an occupation has been made by Prof. Martin Hahn,² of Munich. The union of German book printers has a membership of 54,000. Among these the sickness rate is higher than in the occupied male population generally. From 1891 to 1904 printers gave a morbidity rate of 46.10 per 100 members, whereas in the sick funds of Germany it was 37.58. In Munich the ordinary insurance sickness fund gave 49.5 for males and 43.4 for females, whereas for the polygraphic trades the numbers were 39.7 and 50.5 per 100 members, respectively. In Berlin the figures for printers and the general insurance funds are practically equal, but if book printers alone are taken, the illness of printers, 1901 to 1907, amounts to 45.65 per 100 members, compared with that of the male members of sick funds other than printers, 39.59. The type founders in Berlin show, strange to say, comparatively low figures—37.1 for males and 37.8 for females. Compared with the other trades the mortality rate of printers and persons employed in some parts of Germany in the polygraphic industries is low. In Dresden the polygraphic trades gave a mortality rate of 0.67 per 100 members and trades generally 0.84; in Munich the figures were, respectively, 0.57 and 0.89. From Berlin comes similar information.

MORTALITY RATE PER 100 MEMBERS IN BERLIN.³

	Years.	Males.	Females.	Average.
General mortality, local sick funds.....	1902-1907	1.26	0.74	0.99
Book-printing trades.....	1901-1907	.92	.62	.84
Type founders.....	1902-1907	.98	.....	.98

Where there is an excess of sickness among persons employed in the polygraphic trades, Hahn is disposed to regard it as the result of the harmful nature of the occupation and the employment of women in

¹ Kaup, op. cit., p. 23.

² Martin Hahn, M. D., *Die Gesundheitsverhältnisse im polygraphischen Gewerbe Deutschlands mit besonderer Berücksichtigung der Bleivergiftung*. Berlin, 1910.

³ Idem, p. 15.

lead processes, and not as the results of the conditions under which the work is carried on, nor from the fact of printers being physically a weaker class of persons than those employed in other trades or of their being more poorly paid.

In the polygraphic trades some of the work brings a few of the persons employed more into contact with lead than others. Taking all cases of lead poisoning in these trades, it would appear that from 60 to 90 per cent occur in printers and type foundry, and among them the incidence of plumbism is especially high in the male assistants on account of their youth. Other departments, such as chromolithography and lithography, furnish, comparatively speaking, few cases of plumbism and then mostly as the result of carelessness. In the Munich section of the German Senefeld Union, out of 1,000 members of lithographers, chromolithographers, etc., excluding printers and type foundry, there were 600 cases of illness between 1904 and 1907, with only 1 certain and 1 doubtful case of lead poisoning.¹ Plumbism can not, therefore, be said to be prevalent to any extent in the lithographic department of printing.

In Germany as elsewhere it is the diseases indirectly caused by plumbism and, notwithstanding what has already been said, the conditions under which the work is carried on which cause printing to be regarded as an unhealthy occupation. The rate of pulmonary diseases, for example, increases with a rise in the incidence of lead poisoning. In Stuttgart for 1906 the figures are:

CASES OF SICKNESS PER 100 MEMBERS FROM TUBERCULOSIS OF LUNGS AND OTHER ORGANS, STUTTGART, 1906.²

	Males.	Females.	Average.
Total, local sick funds.....	5.95	8.73	6.80
Book-printers' sick fund.....	11.32	9.32	10.10

As a contrast to the above, the figures for Munich for 1907 may be taken, but in this instance not for book printing, but for the polygraphic trades generally:

CASES OF SICKNESS PER 100 MEMBERS FROM TUBERCULOSIS OF ALL ORGANS, MUNICH, 1907.²

	Males.	Females.	Average.
Total, local sick funds.....	5.30	8.79	6.58
Polygraphic trades.....	9.69	10.59	10.12

The polygraphic trades show a much higher rate of sickness than the general insurance funds, but of all the polygraphic trades in Germany book printers show in this respect the worst record. Taking the years 1901 to 1904, the mortality of printers was 48.05 per

¹ Hahn, op. cit., p. 18.

² Idem, p. 20.

10,000 members, whilst for the same years in seven of the most densely populated districts of Germany, such as Hamburg and Saxony, the figures were 38.5 for the general population. The figures are confirmed by the percentage mortality of tuberculosis in Berlin:¹

PER CENT OF TOTAL DEATHS DUE TO TUBERCULOSIS AMONG MEMBERS OF SICK FUNDS IN BERLIN.

	Years.	Males.	Females.	Average.
Total, local sick funds.....	1902-1907	29.5	33.1	30.9
Book-printers' sick fund.....	1901-1907	37.2	39.4	37.7

It has already been stated that if the various departments of the polygraphic trades are separated printers show the highest mortality from tuberculosis. In Berlin, between 1901 and 1907, the mortality of book printers and apprentices was 35 per 10,000 members, whilst in the other departments it was 31.¹ The Berlin type founders show among the male members comparatively a low figure for diseases of the respiratory organs, but a high tuberculosis mortality. No great statistical value, however, can be attached to the figures owing to the small number of persons employed in type founding.

Austria also presents problems connected with the polygraphic industries. Her printing trades give employment to at least 18,000 men and women, and the principal diseases from which these people suffer are plumbism and pulmonary tuberculosis. Among persons employed in the polygraphic trades of Vienna and neighborhood, Lewy states that during 10 years, 1862 to 1872, 1,186 cases of lead poisoning were reported.² Contrary to the experience of most physicians, he is of the opinion that in printers plumbism is more frequent than tuberculosis. Twenty years later things were no better as regards lead poisoning, for Kaup³ tells us that in the 10 years 1891 to 1900 there were 1,308 cases of plumbism among the printers and type founders of Vienna, with 41,838 days of sickness and 8 deaths. To these should be added other 400 cases of plumbism, but of such mild character as not to have prevented the persons working. This gives a total of 1,780 cases of lead poisoning, a terrible figure, which tells its own tale of lost health and of work abandoned through industrial poisoning. The tale becomes the sadder when to these is added 1,652 cases of tuberculosis which occurred among the printers during the same period. At the time to which Kaup refers the conditions of the printing shops in Vienna were bad. Compositors were suffering from lead poisoning to the number of 2.5 to 5.48 per 100 members, but the greatest amount of suffering fell upon the founders, and especially the female hands employed in the type-casting shops.

¹ Hahn, *op. cit.*, p. 21.

² Kaup, *op. cit.*, p. 20.

³ *Idem*, p. 23.

While of the male type casters 3.6 to 11.7 per cent fell ill with lead poisoning, female workers suffered to the extent of from 13.1 to 45 per cent. "Badly nourished, young, barely out of school, knowing nothing of the danger of the occupation, these girls enter the work-shops only to be overcome a few weeks after by the harmful action of dust and the fumes of lead." Speaking of married women working in type-casting shops, Kaup says that only 50 per cent of them are capable of becoming mothers. Taking his figures from the typographers' sick funds for the years 1887 to 1890, he tells us that of 288 pregnant women working in typographic printing shops, 258 were confined normally, while 30, or 10.4 per cent, had miscarriages. Of 78 pregnant women employed in the type-casting shops only 37 reached the natural term of pregnancy; the remaining 41, that is to say, 52.4 per cent, had miscarriages.¹

Lead poisoning as an immediate cause of death does not appear in the mortality columns of the annual reports of the British Typographical Association for the last few years, but since chronic plumbism leads to the establishment of pathological changes in the kidneys, heart, and blood vessels, the number of deaths from disease of these organs conveys some idea of the extent to which lead may have been slowly but surely exerting its malign influence. Taking the deaths for the separate years 1904 and 1907 the percentage of deaths, speaking roughly, from kidney and circulatory diseases combined was 18.7 and 20, respectively, but for tuberculosis the per cents for the same years were 22.6 and 25.4.

A similar high death rate from tuberculosis, with a remarkable freedom from the immediate consequences of lead poisoning, is also found among members of the London Society of Compositors. Through the kindness of their secretary, the writer has had the opportunity of studying its mortality experience for the last three years. In 1907 the society had a membership of 12,387. During this year the deaths numbered 138. One member died from lead poisoning at the age of 38. The deaths from tuberculosis were 36 and from heart and kidney diseases 25, or 26.1 and 18.1 per cent, respectively. With a membership of 12,202 in 1908 there occurred 141 deaths; no mention is made of lead poisoning having been an immediate cause of death. Tuberculosis removed 30 members and diseases of heart and kidney combined 24, or 21.3 and 17 per cent, respectively. Although in 1909 the membership had fallen to 12,090, the deaths rose to 152. Lead poisoning was not an immediate cause of death. Tuberculosis caused 39, or 25.7 per cent, of the deaths and diseases of heart and kidneys combined 20, or 13.2 per cent. Both in the British Typographical Association and the London Society of Compositors, it is not lead poisoning or its immediate consequences which is destruc-

¹ Kaup, *op. cit.*, p. 24.

tive to life. Tuberculosis carries off more of the members than diseases of the heart and kidneys combined.

From all of the northwestern European countries comes the same evidence of the high death rate from tuberculosis among printers and those engaged in the typographic industries generally. To the question incidentally raised here and there in the text, as to the relationship between plumbism and tuberculosis in printers, I shall now briefly address myself. Does plumbism predispose to tuberculosis?

Prof. Hahn draws attention to the fact that in Vienna and Berlin for 1901 to 1907 the cases of sickness from lead poisoning and the mortality from tuberculosis ran concurrently.¹ In Vienna the cases of sickness from lead poisoning per 100 members declined 48 per cent, while the deaths from tuberculosis per 100 members declined 57 per cent between 1901 and 1907; in Berlin in the same period cases of lead sickness per 100 members fell 46 per cent and deaths from tuberculosis per 100 members fell 40 per cent. Hahn has attempted to impress this parallelism of the two diseases by diagrams, which are reproduced herewith. (Pp. 74 and 75.)

When a comparison is made between the various sections of the polygraphic trades as regards percentage mortality from lead poisoning and tuberculosis we find that while the highest figures for plumbism obtain for printers and type founders, the highest death rate from tuberculosis is also found in printers and type founders. The attention which is being given everywhere to the detection and treatment of pulmonary tuberculosis in its early stages is bearing fruit in the reduction of the death rate from this disease in nearly every country. Nowhere is this more noticeable than in Germany, and yet if the decrease in the sickness and mortality rates of diseases of the respiratory organs, including tuberculosis, among book printers be compared with those of the total population it is seen that the disease among printers is higher than that among the occupied male population generally. It is difficult to explain this difference solely by any improvement that may have taken place in the conditions of life owing to the slightly increased wages of the printers and by the public measures which are in force for the suppression of tuberculosis. Hahn is of the opinion that in consequence of the means which are being adopted to diminish lead poisoning in the typographic trades there has been a correlative reduction in the amount of pulmonary tuberculosis. A predisposition on the part of printers to tuberculosis would therefore appear to be the result of the influence of chronic lead poisoning; but this raises the question as to why this relationship is specially noticeable in printers. Workers in white-lead factories are exposed to dust, finer in form and richer in lead than are printers, without developing pulmonary tuberculosis, and yet to this malady printers, file cutters, and potters suc-

¹ Hahn, *op. cit.*, pp. 22, 58, 59.

SICKNESS RATES FROM LEAD POISONING AND DEATH RATES FROM TUBERCULOSIS, PER 100 MEMBERS, OF MALE AND FEMALE MEMBERS OF THE VIENNA BOOK-PRINTERS' SICK FUND.

[I=Cases of lead poisoning. II=Deaths from tuberculosis.]

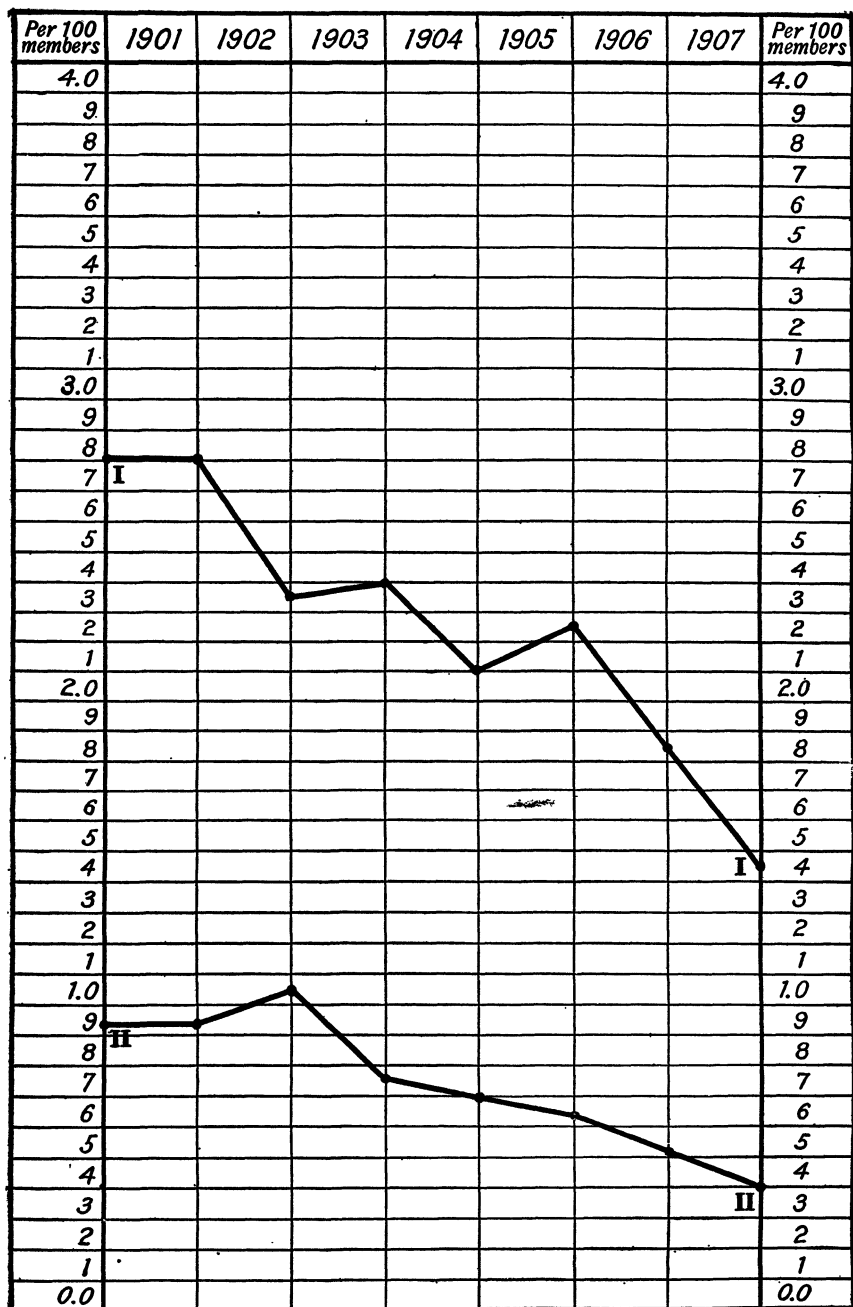
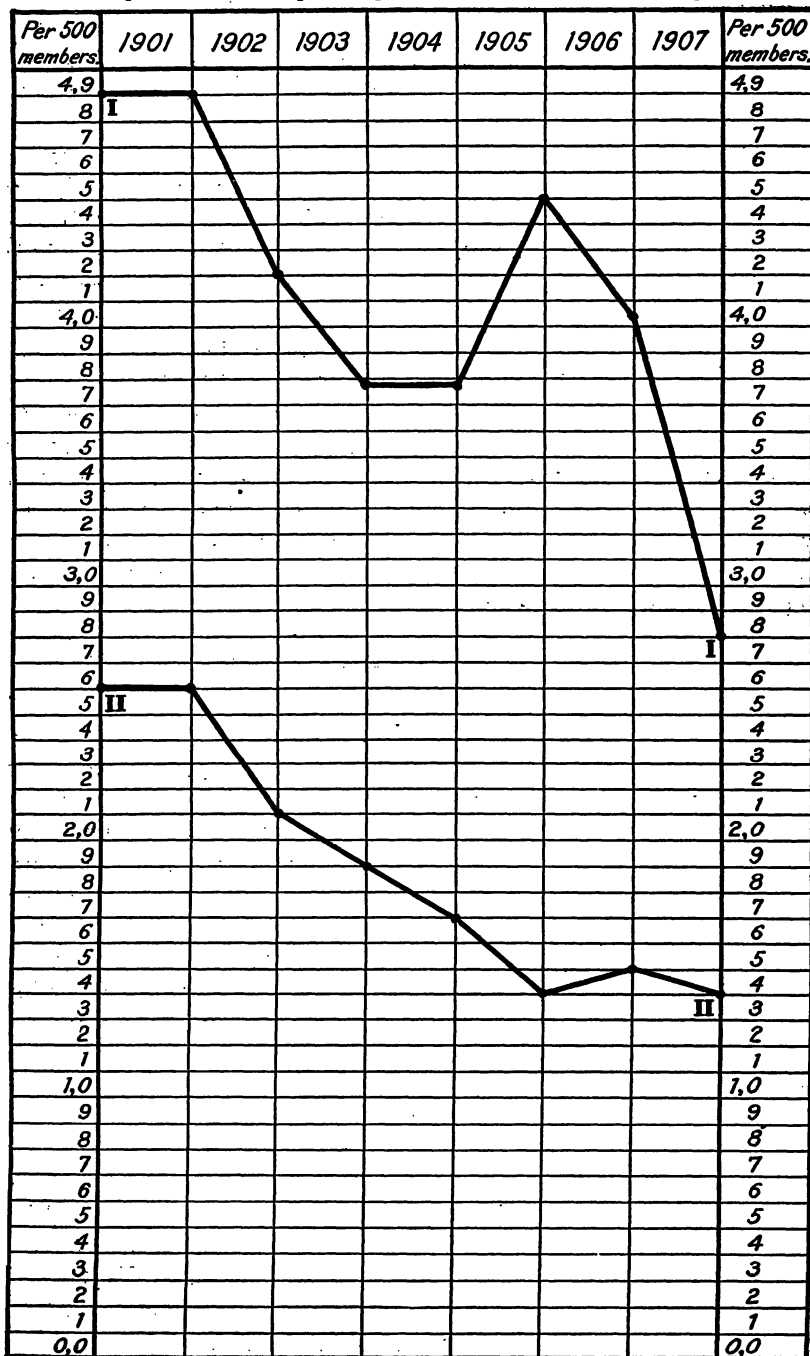


FIG 1.

SICKNESS RATES FROM LEAD POISONING AND DEATH RATES FROM TUBERCULOSIS, PER 500 MEMBERS, AMONG COMPOSITORS AND PRINTERS OF THE BERLIN LOCAL SICK FUND FOR THE BOOK-PRINTING TRADES.

[I—Cases of lead poisoning. II—Deaths from tuberculosis.]



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FIG 2.

cumb in large numbers. It must be, therefore, the physical rather than the chemical quality of the dust which is responsible for the injuries inflicted upon the lung, whereby the respiratory organs of printers and file cutters become more easily affected by Koch's bacillus, a circumstance to which work in overheated and ill-ventilated rooms may also contribute.

Can type metal be made without lead? Until now it has been thought that nothing can take the place of lead and that the best alloy is one of lead and antimony. Iron and wooden characters have been used but without success. The suitability of lead is largely due to the fact that it can be easily melted, that it forms sharp outlines, distributes the ink well, and when combined with antimony becomes sufficiently hard to withstand pressure and friction. Since it can hardly be that the last word has been said upon this subject, it is to be hoped that by the combined resources of chemistry and metallurgy a substance may yet be found possessing none of the harmful attributes of lead.

Although printing by typesetting is being rapidly replaced by linotyping and monotyping, the manufacturers of the machines often fail to attach ventilating tubes to the metal pots, and even where the hooding and the exhaust of these machines are attempted the results are often unsatisfactory owing to defective construction or design.

DIAMOND CUTTING AND THE SETTING OF PRECIOUS STONES.

The market for diamonds is London and the workshop Amsterdam. The cutting of diamonds is one of the oldest industries of Amsterdam. In Antwerp, Oldenburg, and elsewhere branches of the trade have sprung up. Diamond cutters are a well-educated and an intelligent body of men. They make good wages, frequently £4 to £5 (\$19.47 to \$24.33) a week. The work is trying to the eyes, and can be undertaken by skilled men only. On the occasion of the writer's visit to the diamond-cutting shops of Amsterdam there were 8,000 men employed in the various processes. By one of the largest firms 400 men were employed. I found the workrooms overheated, owing to the large number of gas jets in use, and the rooms generally were badly ventilated. Work under these circumstances creates on the part of those following it an oversensitiveness to changes of temperature and a diminished resistance to cold.

After a rough diamond has been cut by another diamond, it is fixed in a mass of molten metal the size of a walnut. To the metallic mass, which is an alloy of 60 parts of lead and 40 parts of tin, a handle is attached. The diamond thus securely fixed is polished by hand or by a small iron wheel rotating at the rate of 2,400 revolutions a minute. It is during the melting of the metal that lead

fumes are given off, also during the polishing processes that dust is given off, which become dangerous to the workmen. The fingers of the men become quite black, partly through handling the alloy, and partly through handling the varnishes used. There is always floating in the air of the workrooms a certain amount of dust, rich in oxide of lead. Most diamond cutters are pale and anæmic. On the gums of several of the men I found a well-marked blue line, while other men whom I spoke to had suffered from colic, and others again had for a period lost the power of their hands. Wrist drop and colic are the prevailing forms of lead poisoning among diamond cutters.

In order to suppress plumbism in diamond cutting, the Dutch Government a few years ago offered a prize of £500 (\$2,433.25) for a substitute for lead in the alloy, but no award has as yet been made, although there are prospects of its taking place in the immediate future. Any alloy introduced must not add too much to the cost of production, otherwise trade limitations can not be ignored. In Oldenburg, on account of the possibilities of plumbism, the Government suggested that no young person should be employed, but the conditions of the trade did not allow of the recommendation being adopted, owing to the long apprenticeship required.

What has been said of diamond cutting applies equally to the cutting and polishing of precious stones. The medical officer of health of Reichenberg, in Bohemia,¹ points out that in the men employed in polishing precious stones in Turnau there is a considerable amount of lead poisoning. There were 25 men suffering from lead colic and paralysis. In addition several mild cases had passed unobserved by the workmen themselves. There are not included in the above the cases of plumbism in men who make the cutting and polishing of gems a home industry and who treat themselves by simple remedies. These men and the members of their household, having converted the living rooms of their houses into workshops, sit down to their meals often without washing their hands. The polishing is done on pieces of metallic lead, which from time to time require remelting. The men are exposed to the fumes of molten lead and to metallic dust. Lead is said by some to be no longer necessary, for in the technical school of the town disks of copper and zinc are used. The factory inspectors have tried to prohibit lead, but without success. As the work is still carried on by the old methods plumbism is not unknown. In Oldenburg some of the polishers of gems use an alloy of tin, copper, and bronze. Only one-fourth of the workmen

¹ Les Industries Insalubres. Rapports sur leurs dangers et les moyens de les prévenir, particulièrement dans l'industrie des allumettes et celles qui fabriquent ou emploient des couleurs de plomb. Published in the name of the International Association for Labor Legislation, p. 91. Jena, G. Fischer; Berne, A. Francke; Paris, Le Soudier. 1903.

are directly exposed to plumbism through using lead disks, and all of them are men of experience. Apprentices are not allowed to use lead. Three cases of plumbism occurred a few years ago. The powder which is used for grinding contains metallic lead and comes into contact with the fingers of the polishers. Once polished the stones are not allowed to come again near lead. This obliges the workmen to wash their hands frequently, and, as full opportunities to do so are given, to this enforced personal cleanliness is attributed the absence of lead poisoning during recent years. The grinding powder is kept in a moist state in a box below the revolving disk, and each part of the workshop where the grinding powder has been used is immediately cleaned.

PLUMBING.

Plumbers incur the risk of plumbism through handling and soldering metallic lead pipes and through using red and white lead for jointing purposes. They are not a healthy class of men. Some of them suffer from the minor forms of saturnism without being aware of the fact. In the older workmen anatomical changes of a degenerative character are set up in the kidneys, heart, and blood vessels in consequence of the tissues having become slowly poisoned by lead. Since 1902 there has been in Saxony an inspection of gas workers. Instead of the men using lead for jointing purposes, "fermite," a special kind of putty, whose composition by the way is not stated, has been recommended. At the end of a year's trial 11 gas-works managers were invited to give their opinion as to the value of "fermite." While the opinions differed, there was greater uniformity in regard to lead not being considered absolutely necessary. Six of the 11 managers expressed themselves as satisfied with "fermite"; one of the managers at Annaberg said that he had given up "fermite" on the grounds that it does not become hard enough, that it soils the hands more than lead does. He prefers a manganese compound obtained from the manganisite works of Hildburghausen. In this substance he believes he has found a substitute for lead putty.

PUTTY MAKING.

In consequence of putty usually containing red or white lead, the men who make it frequently suffer from colic. Meissl, an employer of labor in Vienna, found in making putty that on one occasion the use of 80 kilos (176.37 pounds) of white lead was followed by one of the workmen becoming ill with lead colic, whereas the use of 2.5 tons of white-lead paint was followed by only one case of plumbism. Meissl maintained that it is not necessary to introduce lead into putty, since chalk can replace it quite well. In a visit to a large color works

in Scotland the writer found that the putty which is produced on a commercial scale is made from whiting and linseed oil mechanically mixed. Formerly it was made by hand because it was thought that putty could only thus be made, but experience has shown that equally good material can be produced by machinery. Unless specially asked for, the Scotch firm does not add white lead to the putty. One of the advantages conferred upon putty by lead is that it keeps better. The putty is sent out in bladders and thereby retains its moisture well. Red-lead putty, which is used by engineers for jointing purposes, is said to harden better than any other kind. It is used especially for metallic pipes, and is a good protective. As a protective against rust, lead is said by Andès to be irreplaceable. He maintains that by the addition of lead putty acquires greater resistance to moisture and to acid vapors. Putty to which both glycerin and lead oxide are added is used for fixing iron to iron and iron to stone.

DYE WORKS AND CALICO PRINTING.

Yarn is dyed yellow by means of chromate of lead. In the nodding of yarn, dust is given off which, when swallowed or inhaled, is poisonous. In one large factory where this work was being carried on the writer found the hands of the girls and women stained and their hair lightly powdered with yellow dust. Many of the workers were anæmic, complained of headache, and had suffered from colic. On one occasion in a dye works in Scotland during a severe winter the female workers closed, unknown for a time to the foreman, the ventilators on account of the cold and they also stopped the running of the fan. An epidemic of acute lead poisoning, as unexpected as it was at first inexplicable, broke out among the women, one of whom died from saturnine encephalopathy. With the restarting of the fan and the reopening of the ventilators, no further case of plumbism occurred, a circumstance which shows the importance of free ventilation of places wherein lead compounds are used and dust is evolved. In addition to the provision of exhaust draft to carry away dust, women working in dyeing sheds should wear overalls, caps, and respirators.

In calico printing plumbism becomes possible during the printing of the colors on the cotton cloth by means of lead salts. The danger commences in the drying room and is also present during the handling of the dried goods, when dust is floating in the atmosphere.

The dyeing of silk is attended by similar risks. In Vienna this is a home industry. It is estimated that there are 700 women thus employed in dyeing silk thread and in trimming lace. The admission of two serious cases into the General Hospital of Vienna led to inquiries being made, with the result that of 41 samples of black silk

thread examined which were being used 32 contained lead—the quantity estimated as lead oxide varying from 14 to 32 per cent. Of 12 samples of lace similarly treated 10 contained lead. The silk thread is dipped in a solution of lead acetate after which it is allowed to drip and become dry. By exposure to the air the lead on the thread becomes converted into an oxide, and this comes off readily in the form of fine dust to such an extent in fact that in the sweepings of the floor there is often as much as 15 per cent of lead present. In nearly every instance the seamstresses had no idea of the danger until perhaps one of the household fell ill. Attempts have been made to replace the lead acetate by zinc salts, silicates, and iron. Lead is not necessary, for it is used as much to increase the weight of the products as to improve their color. During the weaving, cutting, and tailoring of the silk the women run the risk of plumbism partly from inhaling dust and partly from putting the silk threads into their mouth.

GLASS POLISHING AND PAINTING.

Crystal and certain kinds of glass when cut require to be polished. This is done by means of rouge or putty powder mixed with water and allowed to fall automatically upon revolving brushes running at great speed. Putty powder varies in its composition, but in several workshops the writer found it frequently contained as much as 60 to 70 per cent of carbonate or other compound of lead combined with tin. Owing to the friction between the piece of glass which is being polished and the rapidly-revolving brushes a considerable quantity of thick spray is thrown off. This spray falls upon the clothes and hands of the workers and upon the floor and the machinery of the workroom. It dries, and, rising into the atmosphere, is inhaled. Either by this means or by the workmen eating without having previously washed their hands, or by chewing tobacco when at work, many of the men become the subjects of plumbism. Colic is frequently complained of. Many glass polishers examined by the writer in Birmingham and neighborhood had suffered and recovered from paralysis of the hands, and they told him that some of their mates had died in convulsions.

Various substitutes have been tried for lead in the rouge or putty powder, some of which have been even more dangerous than lead. In one instance a putty powder which was advertised as a substitute for lead was found, on chemical analysis by Sir Edward Thorpe, to contain arsenic. In France a compound of metastannic acid has been found of service. In the glass works at Baccarat it has been used with satisfactory results. Clearly lead should be entirely abolished from putty powder, or if this is impossible, as some glass

polishers maintain, then the amount of lead should be diminished, and the cupboard-like spaces in which the work is carried on should be provided with a strong exhaust draft.

In glass painting some of the colors used contain lead. Attempts are being made to introduce colors free from lead.

TINNING OF HOLLOW WARE.

In Great Britain in the making of hollow tinware for domestic purposes considerable quantities of lead are used. The interior of such homely articles as pots and pans is swilled with molten metal composed of lead and tin. The cheaper the ware the greater is the amount of lead present. It may be as much as 70 per cent and more. It is all but impossible for the workman who swills the ware and who stands over the pot of molten metal to avoid inhaling fumes of lead, unless the furnace is hooded and provided with a good draft. Where the draft of the chimney and hood is insufficient, the insertion of gas heaters in the hood are well worthy of a trial. The people who use the ware also incur the risk of plumbism, since during the process of cooking food lead is readily dissolved out of the enamel. Dippers of hollow tinware are an anæmic and a badly nourished class of men. The muscles of their hands and arms are feeble, and on the gums a well-marked blue line is frequently present. Among them colic is a frequent complaint. The men as a class are intemperate, a circumstance which predisposes them to plumbism.

In the lining of hollow ware by vitrified white enamel lead was formerly used in much larger proportion than at present. This was not without danger, for during cooking pieces of enamel might chip off and lead might possibly be dissolved. Since manufacturers began to use enamels containing less than 1 per cent of lead there has been in this trade a notable decline of plumbism among the workmen.

WALL PAPER MAKING.

On two occasions the writer has had to treat serious symptoms of lead poisoning in persons caused by sleeping in bedrooms the wall paper of which, on chemical examination, was found to contain lead. A few years ago there was a public outcry against the use of arsenic in wall papers, in consequence of many people having become seriously ill through sleeping in rooms lined with the poisonous paper. It is not so generally known that serious symptoms may follow the handling of wall paper impregnated with lead, or by sleeping in rooms therewith papered. In France attention has been recently drawn to the subject by Dr. L. D. M. Charron,¹ who not only details his experience of patients treated by him for plumbism, the cause of which

¹ *De l'Intoxication saturnine par le Papier de Teinture.* Bordeaux, A. Destout aîné et Cie., 1909.

for some time remained unknown, until the walls of the sleeping rooms were analyzed, when they were found to contain 1.20 to 7.60 grams of lead per square meter (10.76 square feet). He also carried out a series of experiments with various papers. In the flock, satin, and velvety wall papers made in France lead is sometimes used, and especially in those papers of a deep yellow and beautiful red color. Wall papers impregnated with Cologne yellow, which is a mixture of calcium sulphate 60, lead sulphate 15, and chromate of lead 25, owe their attractive yellow color to the large quantity of lead they contain. Of 75 samples of wall paper of different kinds and color examined, 16 only were free from lead. It was found that the red and yellow colored papers contained the most lead, but even green paper, hitherto regarded as obtaining its color solely from arsenic, was also found to contain lead.

Charron carried out a series of experiments with animals, mostly guinea pigs, by placing them as far as possible under similar conditions to human beings, care being taken so that they could not gnaw the colored panels of their hutches. Several of the animals died. In the brain, liver, kidneys, stomach, and intestines of these animals traces of lead were found varying from 3 to 5 milligrams. In the stomach of some of the guinea pigs to whom dust from the wall papers had been administered lead was found. The younger animals were found to be more susceptible than their elders; pregnant guinea pigs aborted. In the foetuses, and in one of the mothers who died in convulsions 13 days after having given birth to an offspring of two, chemical analysis of the internal organs revealed the presence of lead. Analysis of the air of the cages showed the presence of colored particles of lead. Dust had therefore entered the bodies of the animals by the mouth and nostrils.

Men engaged in the manufacture of wall papers containing lead occasionally suffer from plumbism. This applies specially to the grinders, mixers of colors, and to the men who spread by hand the colors. Machine printing has materially diminished the risk of lead poisoning. Although such French physicians as Merat, Tanquerel, Gautier, and others speak of wall-paper makers as running considerable risk from plumbism in consequence of the dust to which they are exposed, my own experience is that plumbism is, on the whole, relatively infrequent. Although I have diagnosed only two cases of plumbism as the result of sleeping in rooms lined with lead-impregnated papers, it is more than likely that cases of serious illness similarly induced may have escaped my observation.

In the manufacture of certain kinds of wall paper large quantities of dry bronze powders which frequently contain small quantities of lead are used, but notwithstanding this circumstance the workers remain unaffected. This is largely due to the fact that the wall paper

on its way from the printing machine to the drying chamber passes through inclosed bronzing and dusting-off machines, and that while a certain amount of dust may escape this is carried away by exhaust ventilation.

BRONZING IN LITHOGRAPHIC PRINTING.

Under the term "bronzing" is included all processes for the production of a gold, silver, bronze, or similar metallic effect upon paper, wood, leather, and glass, etc., by means of metallic powders. Bronzing may be done by the dry or wet method by hand or by machinery. The wet methods by inks have not been so successful. Dry bronzing by hand is still had recourse to, although it is gradually being replaced by machine work. The process consists in the application of powder to the printed or sticky surface of paper or wood by means of cotton wool or a pad of felt. The surface is thereafter dusted off by rubbing with a clean pad. During this process clouds of dust rise into the air.

The bronze powders used in Great Britain come mostly from Nuremberg and other towns of Bavaria. Gold bronze powders are composed of copper and zinc in varying proportions, with usually traces of lead, tin, arsenic, and iron. Although these powders contain a small quantity of lead, it is seldom that the workers suffer from plumbism. Many of them become the subject of recurrent laryngeal and nasal catarrh, irritation of the eyes; they suffer from repeated headache and vomiting, and complain of a coppery taste in the mouth, symptoms not necessarily and solely the result of lead intoxication.

MINOR INDUSTRIES IN WHICH LEAD IS USED.

In addition to the trades described in the preceding pages, lead enters into a large number of other industries, so that cases of plumbism keep cropping up in most unexpected places. Beyond briefly mentioning incidences of lead poisoning and stating the circumstances under which they have arisen, it will be unnecessary to deal with these at length.

In a tannery in Berlin where the skins had to be rubbed with alum talc and a white powder which was not known to the employers or the workmen to contain lead, plumbism appeared among the workmen. In a brass tap factory the repeated handling of molded plates containing 10 per cent of lead was the cause of several of the men becoming ill. Women who make leaden capsules for the tops of bottles frequently develop symptoms of saturnism. Solderers employed in piano factories, men who polish marble tombstones with lead disks, men who make the enamel faces of watches, men engaged in the

manufacture of electric lamps, and men who use white lead cement instead of gypsum run the risk of becoming lead poisoned.

In the making of artificial flowers the women who melt and handle the metal which becomes the stem of the flowers often suffer in consequence. The handling of lead weights which in silk factories are attached to the ends of suspended threads during weaving has given rise to symptoms of saturnine poisoning. There is no reason why these weights should be made of lead. In the manufacture of Masonic aprons the girls who bind the white skin with ribbon complain of the dust that is given off. It causes headache and induces anæmia. On the gums of several of the girls a blue line is found. India-rubber mixers suffer from plumbism as a result of the use of lead carbonate as a whitening agent. Since in several instances painters of safes have become the subjects of plumbism, paints free from lead have been introduced. Men occupied in the tempering of the spiral springs of railway buffers by dipping them in a bath of molten lead have become poisoned. In the bronzing of piano frames a good deal of dust is given off and as a consequence symptoms of plumbism have followed.

Mr. Hermann Belger has reported to the writer an interesting case of lead colic in an organ builder in Johannesburg. It shows how a workman who has hitherto remained free from plumbism may, under altered circumstances, rather suddenly develop signs of lead poisoning. The man was sent out by a firm of English organ builders to clean and repair an organ in South Africa. In three weeks after being engaged in this work he developed symptoms of acute lead colic, and yet this man had followed the same occupation for 20 years in England without having had a symptom of plumbism.

In the annual reports of the chief inspector of factories there are noted from time to time outbreaks of plumbism under unexpected circumstances. The soldering and unsoldering of cartridge cases produced an epidemic of lead poisoning in a factory. Nearly two-thirds of the men employed were found to be suffering from plumbism notwithstanding the provisions of excellent washing conveniences and the insistence on washing. The introduction of exhaust ventilation into the workrooms arrested the spread of the disease. A fatal case of lead poisoning occurred in an engine works where textile machinery is made and where the work consisted in the fitting of "pot guides," i. e., small porcelain rings through which the yarn passes into the iron sockets of trap levers for twist frames. White lead made into a stiff paste with oil, applied by means of a stick, was used for the purpose. The man had followed this occupation for 10 years. It was not assumed that any danger was present, and as a consequence no precautions were taken. Since the death of this workman efforts have been made to find a nonpoisonous substitute for lead, but so far without success.

ORGANS OF THE BODY AFFECTED BY LEAD POISONING.

BLOOD PRESSURE EXPERIMENTS.

While we are familiar with chronic lead poisoning, we know little of the action of lead when directly introduced into the blood stream. Taken in a single dose, and not too large, lead is not a powerful poison, I have had patients under my care who had intentionally taken a few drams of acetate of lead, and who recovered without any inconvenience, but, on the other hand, I have seen women almost die from the effects of diachylon pills taken with the view of producing abortion. With the view of ascertaining upon which organ or organs lead primarily acts, when introduced intravenously, I carried out a series of experiments. For assistance rendered I am indebted to my colleague, Prof. R. A. Bolam.

Sollman, in his textbook of pharmacology (p. 638), says lead is a specialized poison for a number of tissues and organs, and a general poison to protoplasm. It seems to have a greater effect upon the more highly developed and formed tissues of the body—for example, nerve and muscle—than upon blood corpuscles, and yet in time the blood suffers, too. There is the opinion that lead acts upon striped muscular fiber so as readily to induce fatigue, but we require more information as regards its action both upon voluntary and involuntary muscular fiber. One of the most common and painful symptoms of plumbism is colic, and this is the result of strong contraction of segments of the intestine rather than of a peristaltic wave traveling downward. Attention has been drawn to the influence of lead in causing miscarriage. This may be induced by the metal acting directly upon the foetus and killing it or by setting up contraction of the muscular fibers of the womb and thereby expelling its contents.

Sollman considers colic to be the result of violent contraction of the intestinal muscular fiber which, by forcing blood out of the splanchnic area raises the blood pressure, hardens the pulse, and slows the beat of the heart, the cause of the spasm of the intestinal musculature being stimulation of the nerve endings, since it has nothing of the peristaltic character of ganglionic stimulation and is entirely abolished by atropine. Since, too, the colic is relieved by nitrites, which by dilating the small arteries reduce the blood pressure, a primary vasoconstriction suggests itself as one of the effects of lead. There is undoubtedly observed in some cases of lead colic high arterial tension, but in a greater number, where the pain is extremely severe, the pulse is so small and feeble that it can scarcely be felt, and the heart's sounds are so weak as to be practically inaudible.

The experiments about to be detailed were undertaken by me with the view of clearing up the question of the particular organ of the

body upon which lead exerts its harmful influence.¹ The experiments consisted in the intravenous injection of varying quantities of solutions of nitrate of lead into dogs anæsthetized by chloroform or ether. When 5 cubic centimeters of distilled water were injected into the vein of a dog, no effect was produced on the arterial pressure. The injection of 5 cubic centimeters of a 1 per cent solution of lead nitrate was followed shortly afterwards by a slight fall of blood pressure. Five cubic centimeters of a 2 per cent solution were also followed by a slight fall, which in each instance was quickly recovered from. After an injection of 10 cubic centimeters of a 10 per cent solution and recovery from a pronounced fall of arterial pressure, a second injection of the same quantity and strength of nitrate of lead was succeeded by a rapid declension of pressure and stoppage of the beat of the heart. Respiration continued. After an interval of from three to four minutes, the heart recovered itself; the beats returned feebly at first and becoming stronger they gradually reached the normal. In consequence of a further injection of 5 cubic centimeters of a 10 per cent solution there occurred a fresh decline in the arterial pressure of brief duration, but on injecting a double quantity of a double strength of lead-nitrate solution the blood pressure rapidly fell, and to an extreme degree, although respiration continued. Several struggling beats of the heart occurred, and the respiration became interrupted. By degrees the heart stopped beating; respiration also ceased. At the autopsy 24 hours afterwards the urine was found free from albumen, but it contained a reducing substance not unlike Fehling's solution. The wall of the heart was flabby, especially that of the right ventricle. The right ventricle contained a small quantity of dark-colored blood. Lungs were healthy, the abdominal veins were full and tense, kidneys appeared to be congested, the liver was dark but healthy, and the brain was slightly congested on the surface, although on section pale internally.

By a male dog, into whose veins 5 cubic centimeters of a 5 per cent solution of lead nitrate were slowly injected, and whose blood pressure had been gradually restored after the primary fall, amyl nitrite was inhaled, the result being a fresh fall of arterial pressure. The effect of a renewed injection of lead-nitrate solution was a rapid fall of blood pressure with a rise of the respiratory curve, possibly the result of stimulation of the respiratory center through want of blood. The beat of the heart and the respiratory movements ceased, but further attempts at respiration were renewed at intervals of two to four minutes, after which they ceased, the beat of the heart never having been reestablished. At the autopsy nothing specially was

¹ Some Unusual Features of Lead Poisoning: A lecture delivered at the Polyclinic in London, May 19, 1909. The Hospital, May 29 and June 5, 1909.

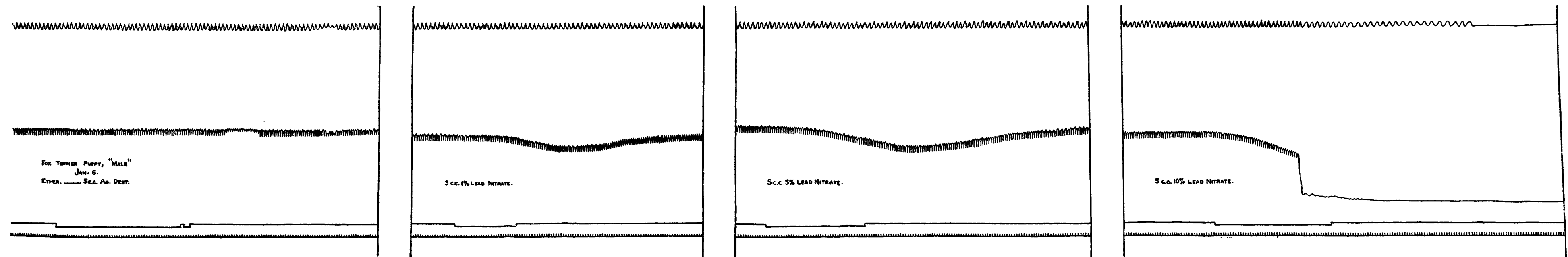


FIG. 3.

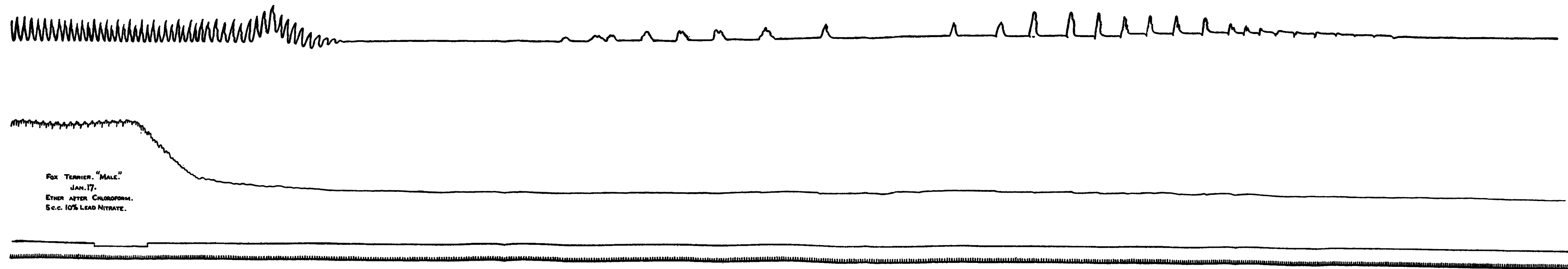


FIG. 4.

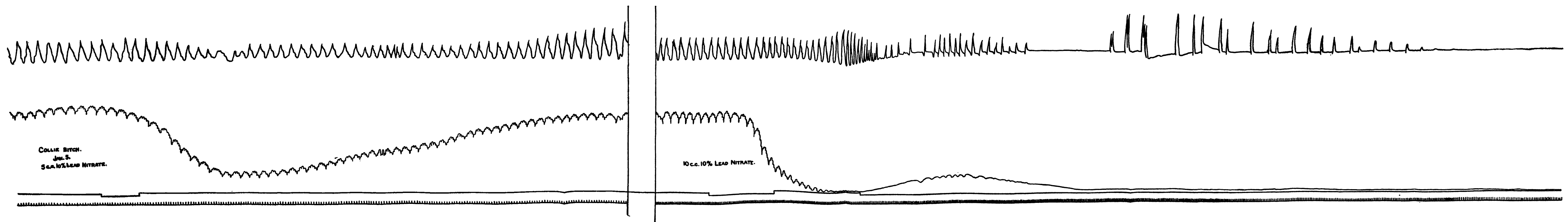


FIG. 5.

EFFECTS OF INTRAVENOUS INJECTION OF LEAD SALTS. OLIVER AND BOLAM.

found, except that the heart was filled with fluid blood and the abdominal veins were turgid.

Whether the animal made use of in these experiments was a rabbit or a dog, the effects of the intravenous injection of a solution of lead nitrate were invariably the same, viz, a general fall of blood pressure. This occurred equally in the splanchnic area as in the general systemic vessels. In the splanchnic area it was gradual, but yet on the whole fairly rapid. The heart would cease to beat, but this might be recovered.

The effect of lead salts carried directly into the blood stream is upon the heart and vasomotor center; the fall and subsequent rise of arterial pressure occur simultaneously in the systemic and splanchnic vessels. Respiration is not directly affected by lead; it is only indirectly affected through the falling blood pressure. One of the noticeable effects of the continuation of respiration is the reestablishment of the beats of the heart.

In reviewing the results of the injection of lead into the venous system, it can not be said that there is any striking uniformity in regard to the amount of lead required to cause death. It is known that some men and women are less liable to be affected by lead than others. There is a personal idiosyncrasy. In animals experimented upon no difference as to susceptibility was noticed between males and females. A sexual difference is observed in the subacute and chronic forms of plumbism; as will be seen further on. The previous injection of atropine had not the slightest influence in altering the effect of lead upon the heart or of preventing the fall of arterial pressure.

In the following tracings are reproduced the effects of lead upon the heart and circulation alluded to in the text.

HOW LEAD POISONING IS PRODUCED.

The repeated entrance of lead into the human body in minute quantities over a lengthened period of time is more productive of harm and gives rise to more serious symptoms than the absorption of lead in larger doses upon only one or two occasions. It is a question of elimination failing to keep pace with absorption. This is the secret of industrial lead poisoning in persons who follow their employment quite unconscious of the danger to which they are exposing themselves and of the slow development of the malady which will finally overtake them. Health is in many instances so gradually lost that it may never strike the worker that the occupation followed is the cause of his undermined health and of the loss of strength which is taking place. It is the circumstance of men and women being allowed to work in dangerous processes without employers having taken steps to forewarn them of the danger which makes

work of this nature the painful episode it often is, and lays upon employers a responsibility which can not be ignored.

Although the worst forms of plumbism are the result of minute doses of lead having been slowly absorbed, there is one instance on record of sudden exposure to enormous quantities of lead having been followed by permanent plumbism, and as the circumstances are unusual, the case deserves to be mentioned. The factory inspector for the district of Prague¹ reports the case of a workman employed in an engineering factory whose duty it was to grind red lead in properly guarded machinery, and who at the time of the accident was in good health. When carrying a cask containing 80 pounds of red lead the cask suddenly fell and broke. The workman was immediately enveloped in red dust. His eyes were blinded by the colored cloud; his nose was choked, and his mouth was partially filled with the dust. Acute lead poisoning followed, which became chronic and ultimately incurable, so that as a consequence of one overwhelming dose of lead the man became from a health point of view a total wreck.

Of all industrial poisons, lead is most productive of ill health. It is a subtle poison. There is an individual as well as a family and sexual idiosyncrasy to lead. That such is the case I pointed out a few years ago in my Goulstonian lectures, when, as the result of investigations on Tyneside, I indicated that there were members of certain families who were oftener ill and more frequently suspended from work than others who were equally if not more exposed to similar risks in the factories. In addition to family predisposition there is an individual susceptibility as well. Some persons are more readily influenced by lead than others. Speaking generally, young persons are more liable to plumbism than those of maturer years, hence the necessity of forbidding the employment of persons under 18 years of age in lead processes.

It is not always easy to say what is the type of constitution which is the more likely to be influenced by lead. The pale-faced, anæmic, and badly nourished worker becomes on the whole an easy victim of plumbism. Poor food and the usual concomitants of poverty are predisponents.

Clinical experience and my experiments upon animals have conclusively demonstrated the enormous influence of alcohol for harm in predisposing to lead poisoning. It can not be too strongly stated that alcoholic excess precipitates an attack of plumbism and aggravates the severity of it far and away beyond almost anything else. No person known to indulge freely in alcohol should be allowed to undertake work in processes connected with lead.

¹ Internationale Uebersicht über Gewerbehygiene, Neisser, 1907.

If age and habits as thus defined predispose to plumbism, the influence of sex is equally pronounced. Females are far and away more liable not only to plumbism in its subacute form, but to the worst types of it. There is a greater tendency in them, especially in young women, to the cerebral form of the malady known as saturnine encephalopathy. This predisposition on the part of females is purely sexual and is not the result of women when at work being exposed to greater risks, for in my feeding experiments I found it equally present in the lower animals. It is connected with menstruation and the function of reproduction and is therefore one of the strongest arguments for the prohibition of female labor in lead processes.

I am not aware of there being such a thing as a racial predisposition to industrial plumbism. One of my most serious cases was that of a young negro, in whom severe colic and headache, with a transitory but recurrent albuminuria, were the prominent symptoms.

The prevention of industrial lead poisoning is largely a question of personal cleanliness, when at work and on leaving it, and of loyalty in carrying out the regulations. While it is an obligation on the part of employers to see that the plant in their works is in good condition and up to date, that the floors of the factory are not loose so as to harbor dust, and that the workmen have been instructed as to the harmful nature of the substances they are manipulating, an equal obligation rests upon the workpeople also to faithfully observe the regulations drawn up on their behalf. Abstention from the smoking and the chewing of tobacco should be rigidly enforced. This interdiction, hitherto resting on academic grounds, is sanctioned by experience. In a large white lead and smelting works at Nantes the managers forbade the workmen to smoke in the factory for two years. This was followed by remarkable results, both as regards the incidence of plumbism and the gravity of the cases. The average number of workmen was 670. In 1901 there were 26 cases of plumbism; in 1902, 42 cases; in 1903, 9 cases; and in 1904, 4 cases.

It is not contended that the improvement in health after 1902 was solely the result of the interdiction of tobacco smoking and chewing when at work, for certain alterations had been made in the drying stoves at the same time; but the managers were disposed to attribute the better health of the workmen as much to the abstinence from tobacco as to the change in the methods of drying the lead. As an illustration of the thoughtless indifference of workmen to their own health, mention may be made of a typesetter who suffered from plumbism through keeping his tobacco for chewing in an open type box in a printing shop, also of the fact that in a printing works at Frankfort-on-the-Oder the typesetters smoked and drank beer when at work. The factory inspector of the district remonstrated with the men, but only received abuse. Subsequently they listened to and

for a time, acting upon the advice given by the owner of the printing works, discontinued the practice. The abstention, however, was not of long duration, for the beer drinking and the smoking were resumed. The employer's regulations prohibiting these had to be canceled, as the men threatened to strike. They insisted, too, upon a fellow workman who had been dismissed for breaking the rules being reinstated.

There is a difficulty experienced by lead manufacturers in the eastern provinces of mid-Europe to which those of Great Britain are not exposed. This is the employment of foreigners who can not read and who do not understand the language of the district. Much of the work in a lead factory is unskilled labor. Foreigners undertaking the work incur greater risks than the inhabitants of the place, owing to not having had the dangers of the occupation sufficiently explained to them. These men do not stay longer in a factory than three months. They correspond to the casual laborers met with in the larger towns in England, where experience has shown that casual laborers are much more prone to lead poisoning than the men who are permanently employed. They are more careless—they do not appreciate the dangers; besides the fact of their having to undertake casual labor is often an indication of their irregular habits and of poverty.

LENGTH OF EXPOSURE TO LEAD REQUIRED TO PRODUCE SYMPTOMS OF INDUSTRIAL POISONING.

There is no specified length of time of exposure necessary to produce lead poisoning. It varies with the idiosyncrasy and condition of health of the worker, the methods of labor in the factory, and the amount of lead dust to which the person is exposed. Mention has already been made of symptoms of plumbism developing in a male 10½ days after pasting grids with red lead in a small electric accumulator works. One of the writer's female patients died from saturnine encephalopathy within three months after entering the factory. As bearing upon this question, there is in "Vorwärts," 1897, the following short account of a small accumulator works with 10 workmen:

	Weeks.		Weeks.
1 man became ill with colic after..	1.5	1 man became ill with colic after..	5.5
1 man became ill with colic after..	2.5	1 man became ill with colic after..	6.0
1 man became ill with colic after..	3.5	2 men became ill with colic after..	7.5
1 man became ill with colic after..	4.5		

Recurrences of plumbism in lead workers are frequent. Instead of conferring immunity, one attack of plumbism rather prepares the way for another. Since 1904 the painters' guilds of Berlin have been in the habit of publishing health registers of their members, also tables of the diseases from which they have died. The list for

1905 gives the following: R. K., born 1858; since 1886 has had 13 attacks of lead colic and 3 of rheumatism. O. R., born 1861; since 1893 has had 11 attacks of colic and 1 of gastric catarrh. L. S., born 1857; since 1890 has had 15 attacks of lead colic and 1 of rheumatism; while R. K., born 1860, has had 11 attacks of colic, once his joints have been inflamed, and on one occasion the function of the kidneys was seriously deranged.

FORM IN WHICH LEAD ENTERS THE SYSTEM.

Lead enters the body in the form of fume, or as dust obtained from flues; from oxidation of the metal as in typesetting; in the form of white and red lead dust, or of chromate or yellow lead particles given off in the process of dyeing; also as dust evolved in various industries, such as the manufacture of earthenware. The readiness with which plumbism develops is determined by the solubility of the lead compounds in the secretions of the body. Considering the large number of trades in which lead is used, dust is the injurious form in which it is most frequently presented to the workers.

Mr. Kenneth Goadby¹ has carried out a series of experiments with gastric juice obtained by giving a test breakfast of tea and toast when fasting and subsequently removing some of the semidigested meal by the stomach tube, his object being to ascertain the comparative solubility in the gastric juice of lead sulphate, white lead, and litharge. It has been claimed by manufacturers of lead sulphate that lead in this form is less dangerous than the carbonate on account of its supposed greater insolubility in the stomach. The following were the results obtained: To 10 cubic centimeters of each of the samples of gastric juice were added (a) 0.1 gram lead sulphate, (b) 0.1 gram white lead, (c) 0.1 gram litharge. The mixtures were digested at 37° C. (98.6° F.) for one hour; the digest was centrifuged and 2 cubic centimeters of the supernatant fluid removed with a pipette and titrated with ammonium molybdate solution, 1 cubic centimeter of which was equal to 0.0008 gram PbO. The digests were made in duplicate and two estimations made of each. The average quantities of PbO present in the digests were:

1. (a) Lead sulphate, 0.080 per cent; (b) white lead, 0.048 per cent; (c) litharge, 0.040 per cent.
2. (a) Lead sulphate, 0.046 per cent; (b) white lead, 0.042 per cent; (c) litharge, 0.034 per cent.

From the above it would appear that of the three lead compounds lead sulphate is the most soluble; a circumstance which shows that the administration of sulphuric-acid lemonade to lead workers, hitherto so much relied upon in the belief that it converted in the

¹The Journal of Hygiene, Vol. IX, No. 1, April, 1909, p. 129.

stomach any carbonate of lead which had been swallowed into the less soluble sulphate, and was therefore a protective, receives no support from chemical tests, and yet on this point there remains the fact, which Sir Edward Thorpe drew attention to in our investigations into lead poisoning in the potteries, that the men who are beer drinkers do not suffer from plumbism to the same extent as workmen who are abstainers, a difference which was attributed to the presence of sulphates in the beer.

CHANNELS OF ENTRANCE.

Lead enters the body through the skin, the respiratory organs, and the alimentary canal. Of these three channels the skin is the least important. Since in white-lead workers the eyelids are often white with dust, some lead may also be absorbed from the inner surface of the eyelids. It has long been known that the poison may enter by the lungs, but it is Messrs. Kenneth Goadby and F. W. Goodbody¹ who, by their experiments, have drawn fresh attention to this part of the inquiry. Their work is a valuable contribution to the subject of lead poisoning.

In the writer's Goulstonian lectures delivered at the Royal College of Physicians, London, in 1891, it was remarked that lead dust disseminated through the atmosphere, whilst entering by the digestive organs, may also pass into the system by the respiratory mucous membrane. The lead carbonate is carried into the trachea and bronchi and probably into the air cells of the lungs, but in whatever part of the respiratory passages it is deposited it comes under the influence of heat and moisture, it is moistened by fluids rich in carbonic acid coming from the lungs, whereby the lead carbonate becomes converted into bicarbonate, which is fairly soluble. A similar chemical change in all probability occurs with the fumes of the molten metal. Carried into the respiratory passages, the suspended particles of lead would first be deposited, then acted upon by the carbonic acid during expiration, and converted first into carbonate and subsequently into bicarbonate. Statistical observations have shown that absorption by respiration is more dangerous and is followed by more deleterious consequences than reception of the metal by any other channel. The entrance of lead into the body through the respiratory organs is not only a fruitful source of plumbism, but is of a type in which the symptoms are often severe. Mr. Goadby's² experiments were carried out with white and red lead dust. Red lead, or litharge, is a heavier powder than the carbonate, and tends to induce coughing and sneezing on the part of the ani-

¹ The Journal of Hygiene, April, 1909, p. 122.

² Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, vol. 2, Appendixes, p. 56. Home Office, London, 1910.

mals exposed to it. Red lead is irritating to the lung, and is therefore productive of considerable discomfort. Flue dust, on the other hand, is composed of finely divided particles, which are extremely light and remain long suspended in the air. Within 18 days after inhaling flue dust on 10 occasions Goadby found that a cat suffered from colic, and shortly afterwards from extensor paralysis of the front paws, weakness of the muscles of the back, and from retinal hemorrhages, accompanied by loss of body weight. Inhalations of litharge and white lead produced similar symptoms. His experiments are extremely valuable, since they show the readiness with which men working in a confined space and exposed to lead dust become the subjects of plumbism, and they explain, too, those unexpected outbreaks of plumbism in a factory where there has been a breakdown in the ventilating apparatus. The greatest care was taken in the experiments to exclude the possibility of the animal licking its fur and of thus introducing lead by the alimentary canal.

In addition to the skin and the respiratory organs, lead enters the body by the alimentary canal. This is the mode of entrance in persons who have been poisoned by drinking water which has been for hours in lead pipes, also by lead dust caught in the mouth, dissolved in the saliva, and swallowed. As it is a common mode of entrance, I had a series of digestive experiments carried out for me by Prof. Bedson and his assistant, Dr. Best, in the chemical laboratory of the Armstrong College, Newcastle-upon-Tyne, in order to determine if possible the fate of any lead which might be swallowed. Human saliva was found to have a slight solvent action upon lead carbonate. Its influence is greater when there is no other substance present. During the digestion of starch by saliva in the presence of lead carbonate less of the metal was dissolved than when the saliva operated upon lead alone. The minced tonsils of a dog and a small quantity of white lead were digested together, but no lead was dissolved, either when the two substances were alone or during the additional digestion of starch. While human salivary secretion has a slight solvent influence upon lead carbonate, that of the tonsils of a dog has none at all, but buccal digestion in the dog is known to be never at any time very active.

DIGESTIVE EXPERIMENTS WITH CARBONATE OF LEAD (BEDSON FOR OLIVER).¹

(a) WITH HUMAN SALIVA.

Amount of lead carbonate.	Amount of human saliva.	Amount of lead carbonate taken up by saliva.
(1) 15.4 grains	154 grains	0.01488 grain per ounce.
(2) 15.4 grains	154 grains .....	.01688 grain per ounce.

¹ Lead poisoning, Goulstonian lectures, Oliver, 1891. Young, I. Pentland, Edinburgh.

(b) WITH HUMAN SALIVA WHEN DIGESTING STARCH (7.7 GRAINS).

Amount of lead carbonate.	Amount of human saliva.	Amount of lead carbonate taken up by saliva.
(1) 15.4 grains	154 grains	0.00816 grain per ounce.
(2) 15.4 grains	154 grains .....	.00816 grain per ounce.

Two double sets of experiments were performed with gastric juice, artificial and natural. The natural juice was obtained through the gastric fistula of a dog, the experiments being conducted both in ordinary test tubes and in parchment tubes. When white lead was simply digested by gastric juice for three hours at blood heat a certain quantity of lead was always found to have dissolved.

(A) WITH NATURAL GASTRIC JUICE OF DOG (OBTAINED FROM FISTULA IN STOMACH OF DOG)—1 PART OF GASTRIC SECRETION MIXED WITH 2 PARTS OF WATER.

Amount of lead carbonate.	Amount of gastric juice.	Amount of lead dissolved.
(1) 15.4 grains	154 grains, diluted	0.00812 grain per ounce of gastric juice.
(2) 15.4 grains	154 grains, diluted .....	.00206 grain per ounce of gastric juice.
(3) 15.4 grains	154 grains, diluted .....	.00298 grain per ounce of gastric juice.

(B) WITH ARTIFICIAL GASTRIC JUICE (MERCK'S).

15.4 grains	154 grains	0.001916 grains per ounce.
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EXPERIMENT TO SHOW THAT THE ACTIVE AGENT IN EFFECTING THE SOLUTION OF LEAD CARBONATE IN GASTRIC DIGESTION IS HYDROCHLORIC ACID (EXPERIMENT IN PARCHMENT MEMBRANE).

Amount of lead carbonate.	Amount of pepsin.	Amount of HCl (in terms of solution).	Lead, in grains, per ounce.		
			Diffused.	Non-diffused.	Total dissolved.
15.4 grains	15.4 grains	0.3 per cent	4.22	1.25	5.47
15.4 grains	7.7 grains .....	.3 per cent	3.28	2.05	5.33
15.4 grains	3.85 grains .....	.3 per cent	3.32	2.16	5.48
15.4 grains	15.4 grains .....	.3 per cent	3.56	2.31	5.87

(C) WITH NATURAL GASTRIC JUICE OF DOG, ETC., WHEN DIGESTING ALBUMEN.

Amount of lead carbonate.	Amount of gastric juice.	Amount of lead dissolved.
15.4 grains	154 grains, diluted; 200 grains albumen, diluted.	0.00048 grain per ounce of gastric juice.
15.4 grains	154 grains, diluted; 200 grains albumen, diluted.	.00057 grain per ounce of gastric juice.
15.4 grains	154 grains, diluted; 200 grains albumen, diluted.	.00048 grain per ounce of gastric juice.

ARTIFICIAL GASTRIC JUICE.

15.4 grains	154 grains, diluted; 200 grains albumen, diluted.	0.00048 grain per ounce of gastric juice.
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Gastric juice contains hydrochloric acid and pepsin. Hydrochloric acid is present in human gastric juice to the extent of 0.25 to 0.3 per cent. These chemical experiments just detailed show that it is the acid which is the principal agent concerned in converting carbonate of lead into the soluble and diffusible chloride. The greatest amount of lead carbonate becomes dissolved when only the acid and the metal are together in the fluid. When pepsin alone is present with lead, none of the metal is dissolved.

Having settled so far that it is the acid of the gastric juice which is the active agent in dissolving lead in the stomach, the next problem was to determine the influence of the digestion of proteids, i. e., albuminous food, upon the amount of lead carbonate dissolved. Here, as in the case of the salivary digestion of starch and lead, the presence of proteid during gastric digestion was found to reduce considerably the amount of lead dissolved. If there is no food in the stomach, but only saliva impregnated with lead which has been swallowed, any gastric juice present will act upon the lead, converting some of it into lead chloride, which, as a fairly soluble compound, will, when absorbed, unite with the proteids of the tissues and of the blood to form an insoluble albuminate; but if food is present the acid is first used up in the conversion of the proteid into acid albumen and peptone, leaving therefore the lead unacted upon; and as this is insoluble, it would pass out from the stomach, along with the chyme, into the intestine.

It is more than probable that it is in the form of chloride—a soluble and diffusible salt—that lead which has been swallowed is absorbed into the blood stream from the stomach. It must be as chloride, and not as albuminate, that lead is absorbed, for lead chloride, if mixed with albumen, forms at once a dense coagulum, which is neither very soluble nor diffusible. It is difficult to say what the compound called albuminate of lead really is. It is either a definite chemical compound of albumen and chloride of lead, or the albumen simply retains, mechanically, the chloride of lead. If this substance were bathed in a fluid rich in saline, such as lymph, the lead would be gradually transformed into a compound readily soluble in blood, which contains sodium chloride. In this form it would circulate through the body and pass out by the kidneys. It is thus, in my opinion, that lead is eliminated by these organs. Peptone, the end product of the gastric digestion of proteid food is, like native albumen, precipitated by lead, so that, as lead albuminate and peptone are both insoluble compounds, these are not likely to be absorbed in the stomach, but to pass on with the chyme into the intestine.

Lead taken into the system dissolved in drinking water is probably in the form of bicarbonate, and as this is a soluble salt, it might pass as such at once into the blood vessels of the stomach, or might

be first converted into chloride by the gastric juice. Whether lead reaches the stomach as white lead, red or yellow lead, these experiments show that if proteid digestion is going on at the same time, less lead is dissolved, and there is therefore less risk of plumbism. We find in these experiments an explanation of the readiness with which saturnine poison is induced in persons drinking, in the early morning before food is taken, water contaminated by lead, also of the fact of which white-lead manufacturers in Newcastle were long familiar, viz, that the workpeople who breakfast before beginning their toil are much less likely to become lead poisoned than those who have not broken their fast. The giving of a simple breakfast of cocoa, milk, and bread by the employers to the workpeople is a distinct preventive against plumbism. So satisfactory have been the results that no person should be retained in continuous employment in a lead works unless he has regularly a morning meal before commencing work.

Experiments, too, were made with bile and pancreatic juice, in order to demonstrate what probably happens when any undissolved lead passes out of the stomach. When lead carbonate was alone digested with bile, a relatively large quantity of lead was dissolved compared with that obtained by gastric juice. Bedson and Best found three times the amount of lead dissolved. When bile was allowed to act upon fat at the same time as upon lead less of the metal passed into solution.

(D) EFFECT OF BILE ON LEAD CARBONATE (OX BILE USED).

Amount of lead carbonate.	Amount of bile.	Amount of lead dissolved.
(a) 15.4 grains.....	156 grains.....	0.0152 grain per ounce.
(b) 15.4 grains.....	156 grains.....	.0139 grain per ounce.

(d) Ten cubic centimeters of albumen and 1 gram of lead were digested in presence of 10 cubic centimeters of natural gastric juice; after three hours, at 98° F., 10 cubic centimeters of bile were added, and digestion at 98° F. was continued for another hour.

Lead dissolved, 0.00625 grain per ounce of fluid.

Lead dissolved, 0.0125 grain per ounce of bile.

With natural gastric juice alone, 0.00312; with albumen and natural gastric juice, 0.00625.

With bile alone it was 0.0152; with albumen, natural gastric juice, and bile, 0.0125.

In order to ascertain what would probably occur in the human body during normal digestion, when the semidigested food called chyme passes out of the stomach into the duodenum and is there brought into contact with bile and the pancreatic juice, first of all

lead carbonate and white of egg were digested in gastric juice for three hours, then bile was added and digestion allowed to go on for an hour, when the amount of lead was found to be greater than in ordinary gastric digestion, although less than in biliary digestion alone. The diffusibility of lead under these circumstances was also investigated. Lead carbonate was digested for three hours in a parchment tube with excess of bile, but no lead was diffused, fat was then added, still none of the metal passed through the membrane.

In purely pancreatic digestion no lead carbonate was found to be dissolved, either when acted upon alone or in the presence of peptone, fat, or starch. On the addition of bile a small quantity of lead was dissolved, but an amount equivalent only to that dissolved by the bile alone.

As an addition to the above the writer carried out in the physiological laboratory a series of experiments with lead dust obtained from the file makers' shops in Sheffield. The dust when boiled in water gave none of the chemical reactions of lead. Placed in a 10 per cent solution of hydrochloric acid, slow bubbling occurred. Shortly afterwards it gave with sulphureted hydrogen a brown precipitate. In 0.2 per cent of hydrochloric acid gently warmed to body temperature, it gave a distinctly brown precipitate with ammonium sulphide. Two-tenths per cent of hydrochloric acid and pepsin when digested with the dust for half an hour gave distinct traces of lead. One-tenth gram of file dust in 20 cubic centimeters of 0.2 per cent hydrochloric acid gave distinct coloration with sulphureted hydrogen, which did not disappear on being made strongly acid. In an experiment of 20 cubic centimeters of artificial gastric juice to which fibrin, bread, and butter were added along with Sheffield file dust, all the fibrin was dissolved, but there was only a doubtful trace of lead present, if any at all, a circumstance of some importance when taken with the statement already made that when food is being digested at the same time with lead very little, if any, of the lead is dissolved.

METALLIC LEAD AND ITS DANGERS.

The foregoing remarks apply to the absorption of lead by the alimentary and respiratory passages, but metallic lead is also capable of being acted upon by the fluids of the body. Lead poisoning has followed, years afterwards it may be, the encystment in the body of pellets of lead after a gunshot injury. Messrs. Ribierre and Flandin¹ exhibited a patient at the Société Médicale des Hôpitaux, Paris, June 9, 1911, the subject of paralysis of extensors of hands and wrists, the remains of a wider spread paralysis which had involved the lower extremities, larynx, and eyeballs. These physical signs had been

¹ *La Presse Médicale*, 14 juin, 1911, p. 496.

preceded by colic and were consequent upon a gunshot wound of the chest. Radiography showed several pellets of lead encysted in the lung, dissolution of the pellets being favored by the large quantities of carbonic acid present in the pulmonary media and of lipoids of leucocyte origin. In the pus escaping from the suppurating wound in the chest wall caused by the gunshot, lead was detected.

SYMPTOMATOLOGY AND PATHOLOGY OF LEAD POISONING.

As already stated, it is the repeated entrance of lead in minute doses into the system which is productive of plumbism. One of the earliest signs of saturnine poisoning is pallor; the face becomes anæmic. Accompanying the pallor is a peculiar sallowness or cachexia, which, with alteration of the facial expression, the educated physician can usually interpret as pointing to lead intoxication. Once pallor has become pronounced it tends to persist, for it is due to the injurious influence of lead upon the blood-making organs. Sooner or later there is complaint of a disagreeable metallic taste in the mouth, especially in the morning. This prevents the workman taking breakfast with relish. If the distaste for food is increasing the individual should retire or be suspended from work, for it is one of the earliest indications of the resistance to lead having become diminished. There may also be complaint of a feeling of sickness and a tendency to vomit. Obstinate constipation and a sense of tiredness out of proportion to the amount of energy expended are also complained of.

In the midst of this there is more or less suddenly developed severe pain in the abdomen in the neighborhood of the navel. The pain is of an agonizing character and is often accompanied by vomiting. Patients roll about in bed, begging for relief to their suffering. The restlessness is in a sense peculiar to lead colic. The character of the pain varies. Some persons obtain relief by firmly pressing with their hands the abdomen, which is hard and retracted, while others can not bear even gentle pressure. The attack of colic may, with remissions, last for a few days and be pretty sharp, or, gradually subsiding, it may linger on for a week or two, and even after this lapse of time be attended by hyperæsthesia of the abdominal wall on pressure. In other instances the pain becomes confined to one-half of the abdomen and is revealed only by firm pressure. The tongue is coated and the breath fetid.

On examining the gums a blue line is observed close to the teeth. If it is an old worker, who is the subject of colic, the gums will probably be found ulcerated as well, so that the teeth are elongated and discolored. There are two kinds of blue line. One in which it appears as a delicate cloud lying upon the gums, and which will disappear on rinsing the mouth or by the use of a damp cloth. This col-

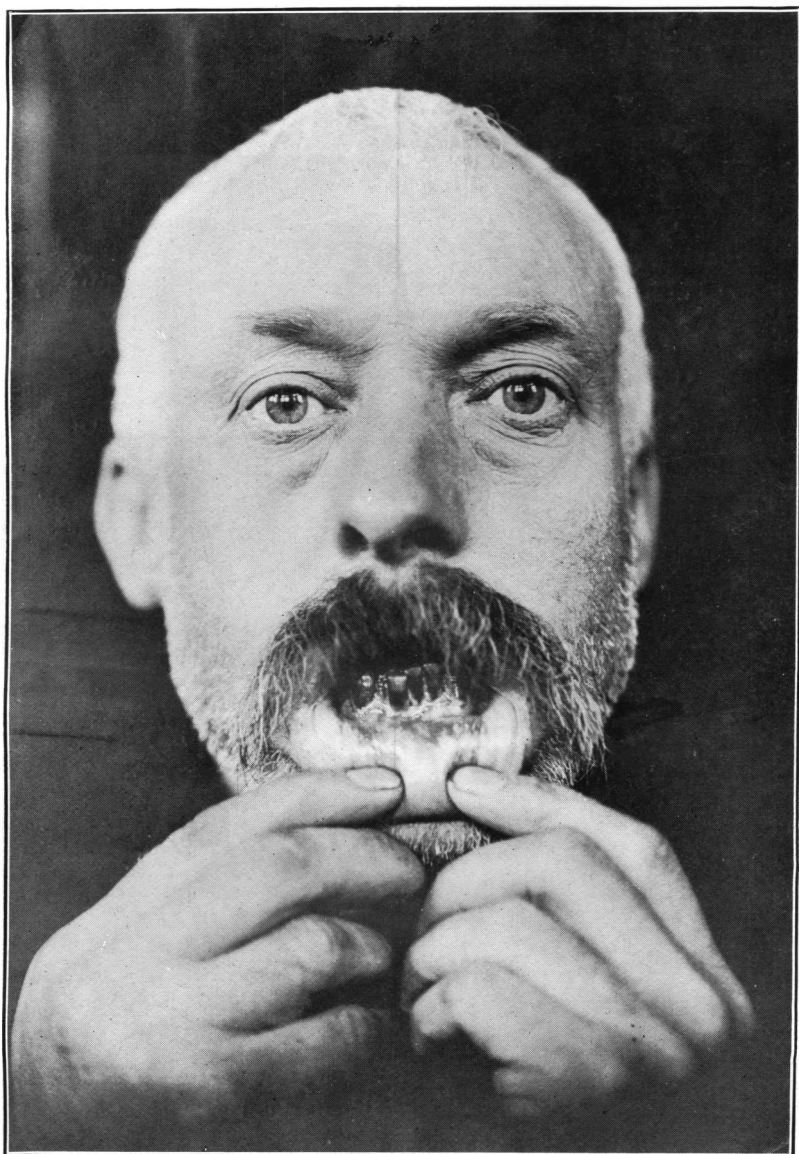


FIG. 6.—EFFECT OF LEAD POISONING.

H. W., age 39; white-lead worker; admitted to infirmary, suffering from colic and paresis of arms. Shows blue line on gums and bluish-black patches inside lower lip.

oration is seen on the teeth and gums of persons after working in a dusty process in the factory for a few hours, and there is the other, the true Burtonian line, close to the teeth, but on the gum. This persists. It is absent where the teeth have fallen out or been removed. Occasionally inside the cheek or inside the lower lip a bluish-black patch is seen the size of a 3-penny or 6-penny piece. These patches are found where the mucous membrane comes into contact with a decayed tooth. Occasionally, too, the surface of the tongue shows similar discoloration. Any vomit there may be is composed mostly of the food taken, accompanied by mucus. On chemical examination it is often found to contain lead. The urine is scanty, probably not more than 6 to 8 ounces are passed in 24 hours; it may contain a trace of albumen. Usually the pulse is feeble and slow; almost imperceptible. In a few patients during the height of the colic the pulse is firm and of high tension. The bowels may be opened with the greatest difficulty, for owing to the vomiting aperients can not be retained sufficiently long for them to act. Enemata of olive oil and warm water, however, can always be given. Although constipation is not altogether the cause of the colic yet movement of the bowels is attended at first with a distinct sense of relief. Where the extremely acute pain of colic has subsided a degree of it may still continue and become localized in one-half of the abdomen, and along with this patient will frequently wince when pressure is made upon the pneumogastric nerve in its course in the neck on that side. The radial pulses are often unequal; one is distinctly feebler than the other, a fact which the sphygmograph confirms, the peculiarity being that sometimes the weaker radial pulse is on the same side as that on which the abdominal and vagal pain is greater, sometimes the reverse. In addition the pupils are observed to be unequal, the more contracted pupil being usually, but not invariably, on the same side as the abdominal and vagal pain and the smaller radial pulse. The saliva of a patient who is suffering from acute lead colic as a rule contains no sulphocyanate of potassium. On the addition of a few drops of liquor ferri perchloridi to the saliva of a healthy person there is observed a brownish-red ring where the two fluids meet. This is absent in the saliva in lead colic, but the sulphocyanate returns on the subsidence of the pain in the abdomen.

The blue line on the gums demands further consideration. When present it is, when accompanied by other symptoms, a valuable aid in the diagnosis of lead poisoning. It is difficult to say how much importance ought to be attached to it, especially since a similar blue line can develop on the gums of persons who have taken internally large doses of bismuth, or made use of a bismuth mouthwash for ulceration of the gums and mucous membrane of the mouth. There is occasionally observed, too, a bluish-black blush and line on the

gums of persons using a carbolic and charcoal tooth powder. A blue line is present in over 50 per cent of lead workers who have no symptoms of plumbism, and it may be absent in persons who are undoubtedly suffering from the malady and in whose urine lead may be found. It can not, therefore, be regarded as an absolute sign of lead poisoning. It points to the presence of lead in the system, a slightly increased accession of which at any time might cause the development of symptoms. On that account, even although the person who has a blue line may never develop symptoms of plumbism, yet its presence and importance can not altogether be ignored, provided other metals than lead can be excluded. The blue line is due to fine dark granules in the large connective tissue corpuscles which are present at the edge of the gums, and is not the result of blocking of the capillary blood vessels with small emboli as earlier writers taught. The lead particles are deposited in the cells either as the result of lead having been excreted into the mouth in a soluble form from the blood by the salivary glands and there taken up by the phagocytic cells of the connective tissue, or as lead dust caught in the mouth, dissolved in the saliva, and converted into lead sulphide indirectly by the salivary sulphocyanate or by the microorganisms of the mouth inducing decomposition of the remnants of proteid food left between the teeth. As showing the rapidity with which the blue line can develop, it appeared in two of the writer's patients on the day following that on which they had swallowed rather large doses of acetate of lead.

In order to show whether lead is eliminated by the salivary glands, pilocarpin was administered to some of the writer's patients with the result that Prof. Bedson found as much as three parts of lead per million. That the metal is also eliminated by the mucous membrane of the stomach is shown by its presence in the vomit, not only during the acute stage of the poisoning, but in the recurrent vomiting occasionally met with long after patients have given up their work. In one of the writer's cases lead was found in the vomit several months after the man had given up work in the factory.

Lead colic has again and again been mistaken for appendicitis, and patients have been operated upon only for the surgeon to find the appendix healthy. Cases of appendicitis, too, have been overlooked in the belief that they were lead colic. A lead worker, like other people, is liable to appendicitis. When the pain of lead colic is referred to the appendix area, and no blue line is present in the gums, and no history of contact with lead is obtainable, the greatest care should be exercised in coming to a decision. In some cases a differential diagnosis may be impossible. Another source of abdominal pain in a lead worker is moderate stenosis or spasm of the pylorus. This gives rise to recurrent pain and to vomiting.

Although lead colic can be extremely severe, it is rare for a patient to die during the attack of pain.

Since obstinate constipation is the usual accompaniment of lead colic and is frequently attended by vomiting, the pain, vomiting, and constipation have frequently been mistaken for intestinal obstruction. Recently an old lead worker was sent into the surgical wards of the Newcastle Infirmary for operation for supposed intestinal obstruction, the diagnosis having been made upon a history of constipation and of recurrent vomiting. The abdomen was retracted, the vomit was distinctly fecal, the face pinched, and the expression anxious; patient was in a state of collapse and had a subnormal temperature. No operation was performed. A blue line was present on the gums, and the urine contained albumen. Patient died within 48 hours after his admission. The autopsy confirmed the view we took, that the man had been suffering from uræmia, due to chronic disease of the kidneys, the result of lead poisoning. At the post-mortem examination there was no evidence of intestinal obstruction.

In obscure abdominal cases, where pain, constipation, and recurrent vomiting are the prominent symptoms and where intestinal obstruction and strangulated hernia can be excluded, an inquiry into the occupation of the patient ought to be made, the gums examined, and if the symptoms continue, the urine should be examined for albumen and lead. Occasionally in women the pain of lead colic is referred to the organs of the pelvis and is mistaken for ovarian or tubal disease, functional or organic.

The uterine and pelvic pain caused by taking diachylon pills is often of an excruciating character, even when miscarriage has not taken place. It may also continue for days after the uterus has emptied itself.

In the chronic forms of saturnine intoxication severe headache of a persisting character is complained of. It is accompanied by a sense of inability to use the brain and by a feeling of great listlessness.

Mention has been made of the pallid appearance of lead workers and of saturnine cachexia. The blood on microscopical examination is found to be deficient in red corpuscles. Instead of there being 5,000,000 colored corpuscles, or erythrocytes, there may be only half or a little more than half that number per cubic millimeter, and with the fall in the number of red corpuscles there is also a corresponding diminution in the amount of hæmoglobin or coloring matter. The blood becomes thin, pale, and watery. The colorless corpuscles, or leucocytes, which in health are present to the extent of 10,000 per cubic millimeter, vary less than the red. It is unusual for them to be increased in number or to exhibit structural alterations. There is occasionally a very slight increase in the number of eosinophile corpuscles, a type of colorless cell which readily takes on the aniline

stain eosin. In health these cells form 2 to 4 per cent of the total of white corpuscles of the blood. In some of my lead patients the eosinophiles reached 8 per cent.

LEAD AND ITS EFFECT UPON THE BLOOD.

Because anæmia is a sign of lead poisoning, some physicians have stated that the degree of anæmia is proportional to the length of time persons have worked in lead. There is no absolute relationship between the two. Anæmia commences early. On that account Gra-witz and others have attempted to show that by a microscopical examination of the blood a diagnosis of plumbism can be made before some of the ordinary and more familiar signs of lead poisoning appear. Not only is there a deficiency in the number of red corpuscles and a diminution of the coloring matter, but there is also a structural change in these corpuscles, which is revealed by special re-agents; such as Jenner's or Manson's staining fluids. The contents of the corpuscles, which in health appear to be homogeneous, become studded with dark granules, brought into evidence by the basic aniline stain used.

Prof. Franz Hofmann,¹ after having taken a drop of blood from a workman and spread it out as a thin film on a microscopic slide, fixes it in absolute alcohol for 15 minutes and then stains it for 10 seconds in Manson's solution (borax, 5; methylene blue, 2; water, 100). He afterwards washes the slide in water, dries and examines the stained blood under a high power.

P. Schmidt² maintains that if the number of basophile stained erythrocytes reach 100 per million red blood corpuscles this circumstance is pathognomonic of lead poisoning. He considers it to be of assistance in diagnosing plumbism, when other symptoms are absent. Schmidt examined the blood of 546 lead workers and of 110 persons (including sick and healthy people) who had not been brought into contact with lead. In only 2 persons, or 1.8 per cent of the 110 persons, did he find over 100 basophile granular red corpuscles per million; in 14 persons, or 12.7 per cent, these were present up to 100; and in 94, or 85.5 per cent, there were no basophile red corpuscles. Dr. Arno Trautman³ examined the blood of 100 anæmic patients whose hæmoglobin maximum was 80 per cent, also of 100 healthy persons who had never worked in lead and whose hæmoglobin minimum was 85 per cent, for the purpose of comparing the results with those obtained from an examination of 233 lead workers. The technique adopted was exactly the same as that already described. In the blood of 86 of the 100 anæmic patients above referred

¹ *Münchener Medizinische Wochenschrift*, July 6, 1909, p. 1371.

² *Archiv für Hygiene*, vol. 63, H. I.

³ *Münchener Medizinische Wochenschrift*, No. 27, July 6, 1909, p. 1371.

to there were no basophile granular erythrocytes; in 2 over 100 (1 of whom had 283 per million and the other 120); 14 of the 100 patients had, on an average, 61 granular erythrocytes per million. The blood of 45 soldiers whose hæmoglobin averaged 94.2 per cent was examined and in 86.7 per cent there were no basophile red corpuscles; in the remaining 13.3 per cent there were basophile corpuscles on an average of 44 per million. In a perfectly healthy man Trautman found 33 basophile granular erythrocytes per million. In this man both the number of basophile corpuscles and the amount of hæmoglobin varied from time to time. In the bacteriological department of the Hygienic Institute of Leipzig University, up to the end of February, 1909, the blood of 779 lead workers had been examined, and of these 233 were examined by Trautman himself. When in any of the blood films the basophile corpuscles rose above 100 per million red corpuscles the circumstance was regarded as a sign of lead poisoning, and prophylactic measures were taken accordingly. The men whose blood was examined were painters, typesetters, type founders, music engravers, plumbers, and workers in electrical accumulator works. Most of the men were the subjects of more or less well-defined abdominal pain and complained of fatigue, headache, and loss of appetite. Others were suffering from paralysis of arms and legs. On the gums of many of the men there was a well-marked blue line. Most of the workmen were not suffering to any extent. Of these 233 patients—

	Per cent.
102 showed no basophile erythrocytes.....	43.8
48 showed over 100 basophile erythrocytes per million.....	20.6
83 showed under 100 basophile erythrocytes per million.....	35.6

The examination of the blood of 60 painters gave the following results:

In 18, or 30 per cent, no basophile erythrocytes.

In 22, or 36.7 per cent, up to 100 basophile erythrocytes per million.

In 7, or 11.6 per cent, 100 to 200 basophile erythrocytes per million.

In 13, or 21.7 per cent, over 200 basophile erythrocytes per million.

Of the 233 lead workers above indicated, although 195 complained of pains, only 12 exhibited unmistakable signs of plumbism, and in all of these the blood contained more than 100 basophile granular corpuscles per million. Schmidt found in 15 patients suffering from plumbism over 100 basophile corpuscles; the urine of 4 of the patients was examined for lead, and in 3 it was found. Of 38 lead workers who had no complaint, 6 had from 116 to 750 basophile corpuscles, and 32 had up to 100 or more. Trautman's opinion is that the number of basophile erythrocytes bears no relation to the gravity of the case. In one lead worker with slight symptoms of plumbism whose blood was examined on 25 occasions, the hæmoglobin

averaged 74 per cent and the basophile corpuscles 597 per million. M. André¹ found several nucleated red blood corpuscles in the blood of two men, employed in an electrical accumulator works, who had suffered from colic. This form of red corpuscle is usually only met with in severe types of anæmia, and yet anæmia was not present in either of the men, for their red blood corpuscles averaged 4,900,000 and the white corpuscles 7,700 per cubic millimeter of blood. Nucleated red corpuscles had been previously described by Sabrazès as occurring in lead poisoned guinea pigs.

In my own patients suffering from plumbism of various degrees of severity, and in the many lead workers whose blood I have examined, I have not found basophilia to be either so frequent or to be the early and important sign of plumbism which Grawitz and other writers have claimed for it. It occurs, but as I have found basophilia present in only a small percentage of cases, I do not attach the diagnostic value to it which many Continental physicians do. From 3 paint grinders my house physician, Dr. John Hare, and I took several films of blood, when the men were in the paint factory where they had worked from 13 to 29 years. No basophile corpuscles were found in the blood of a man who had worked 15 years, although his gums showed a faint blue line; in 3 films of blood of a paint grinder who had worked 18 months, but had been a laborer in the factory for 12 years, who had never suffered from colic, and on whose gums no blue line was discernible, only 6 basophile cells were found; while in the third man, with 29 years of service, 16 of which had been spent in paint grinding, and who had suffered from colic on three occasions and was the subject of well-marked arteriosclerosis, 7 basophile corpuscles were found. On another occasion we took films of blood from 15 men in a white-lead works whose years of service ranged from 7 to 23 years. These men were employed in various lead processes. Only a few of the men showed a blue line on the gums, several of them had decayed teeth, but none gave a history of colic, although in the urine of all of them traces of lead were found. In the blood of 9 of these 15 men, taken when the men were in the factory, here and there a degenerated red cell was found, but in none of them did the basophilia reach 100 per million. In the case of a male patient suffering from deep-seated malignant disease of the abdominal glands, accompanied by leucocytosis, a man who had not been brought into contact with lead, the writer found just as many basophile red corpuscles. Similarly in two women whose gums and internal lining of cheeks were deeply pigmented by lead, after having nearly poisoned themselves with diachylon pills, and who were still seriously ill, careful and repeated

¹ Lyon Medical, Nov. 30, 1902.

microscopical examination failed to reveal the presence of basophile red blood corpuscles. Dr. D. Gilbert, medical inspector of factories, Belgium, while not doubting the frequent presence of basophile cells in the blood in plumbism, says that basophile granules appear in the course of other intoxications than lead, sometimes, too, under the influence of debilitating circumstances which have nothing to do with occupation disease.

The erythrocytes of a red-lead worker aged 48, the subject of wrist drop, whose father, aged 80 years, had also followed the same occupation for 44 years, enjoying good health all the while, numbered 3,666,660, the white corpuscles 6,562, and the hæmoglobin measured 60 per cent. Only a very few of the red corpuscles of this patient had undergone basophile degeneration. The red-blood corpuscles of H. W., aged 39, whose photograph is reproduced, numbered 2,000,000 per cubic millimeter of blood. Among these was found here and there only after careful search a basophile corpuscle. Basophilia was absent in 6 of the 15 lead workers whose blood we removed when in the factory, and it was present in a red-lead worker in whose urine no lead was found on chemical examination. As a sign of plumbism, therefore, is basophilia more reliable than the presence of lead in the urine? There is always the possibility of lead in the urine being intermittent and of basophilia persisting. Neither in the blood of by no means the smaller number of patients admitted into the infirmary under my care for plumbism, nor in the blood of animals the subjects of experimental plumbism, have I found the granular degeneration of the erythrocytes above described so frequent or so pronounced as to be of the diagnostic value which some physicians have assigned to it. The negative position I have assumed in regard to the importance of basophilia is, as already shown, based upon the examination of several series of films of blood.

The diagnostic value of the presence of granular red-blood corpuscles in lead poisoning formed the subject of a discussion at a meeting of the Medical Society of Vienna in June, 1910. M. A. Götzl had examined 808 slides of blood taken from workers suffering from plumbism and from others working in lead who had not been ill, but were anæmic and exhibited a blue line on the gums. The blood had been stained with Löffler's methylene blue. Götzl gave it as his opinion that basophilia is not often met with in persons who are engaged in manipulating lead and its compounds, and that it is frequently absent in well-marked cases of saturnism. According to him the structural alteration in the red corpuscles is of no diagnostic importance. H. Weiss found basophilia in the blood after

the ingestion of raw meat. Max Sternberg stated that while basophile erythrocytes are frequently absent in lead poisoning, they are met with in tuberculosis, cancer, intestinal hemorrhages, and malaria.

The importance attached by Continental physicians to basophilia in plumbism must be my excuse for having dwelt at such length upon this part of the subject. Notwithstanding all that has been said, I yet deem it advisable to provide the opportunity of drawing attention to the structural changes which occur in the red corpuscles by reproducing a colored drawing of the blood of one of my cases of lead poisoning in which basophilia was present, but not in such a pronounced form as appears in the drawing. Reviewing the question generally, the fact that basophilia up to 100 per million red cells was found by Schmidt in 14 persons who had never worked in lead, that it was present in 13.3 per cent of soldiers, that in 102 out of 233 lead workers, or 43.8 per cent, no basophilia was found at all, and that in 40 per cent of my own cases of plumbism it was absent, are circumstances which weaken the value of the presence of degenerated red corpuscles as proof of lead intoxication. The presence of basophilia in 70 per cent of painters is no doubt of importance, but equally so is its absence in 30 per cent.

Opinions differ as to the cause of basophilia. Does it mean degeneration of red-blood corpuscles? Possibly, although J. Sabrazès is inclined to regard the presence of granules within the cells rather as a sign of regeneration. Since even in the early stages of plumbism there is often already established quite an appreciable degree of anæmia, and since, too, lead is occasionally found in the bones of men and animals who have died from saturnine poisoning, and it is in bone marrow that blood corpuscles are formed, it is reasonable to expect that chemical and structural changes would be found in the blood. Without in any way, therefore, undervaluing basophilia as a sign of plumbism, I unhesitatingly affirm that it is not a ready method of diagnosing plumbism. Preparation of the blood films requires technical skill. The granular erythrocytes are not always easy of detection; they have to be carefully searched for with an oil-immersion lens under a high magnifying power. It is these circumstances which prevent the microscopical examination of the blood becoming a ready method of diagnosis in the hands of busy medical practitioners. In the diagnosis of plumbism there is still a place for clinical methods, and while these can and ought to be aided by the researches of the physiological laboratory, I am, owing to basophilia occurring in other conditions, disposed to regard as more reliable signs of saturnine poisoning the presence of lead in the urine and fæces.

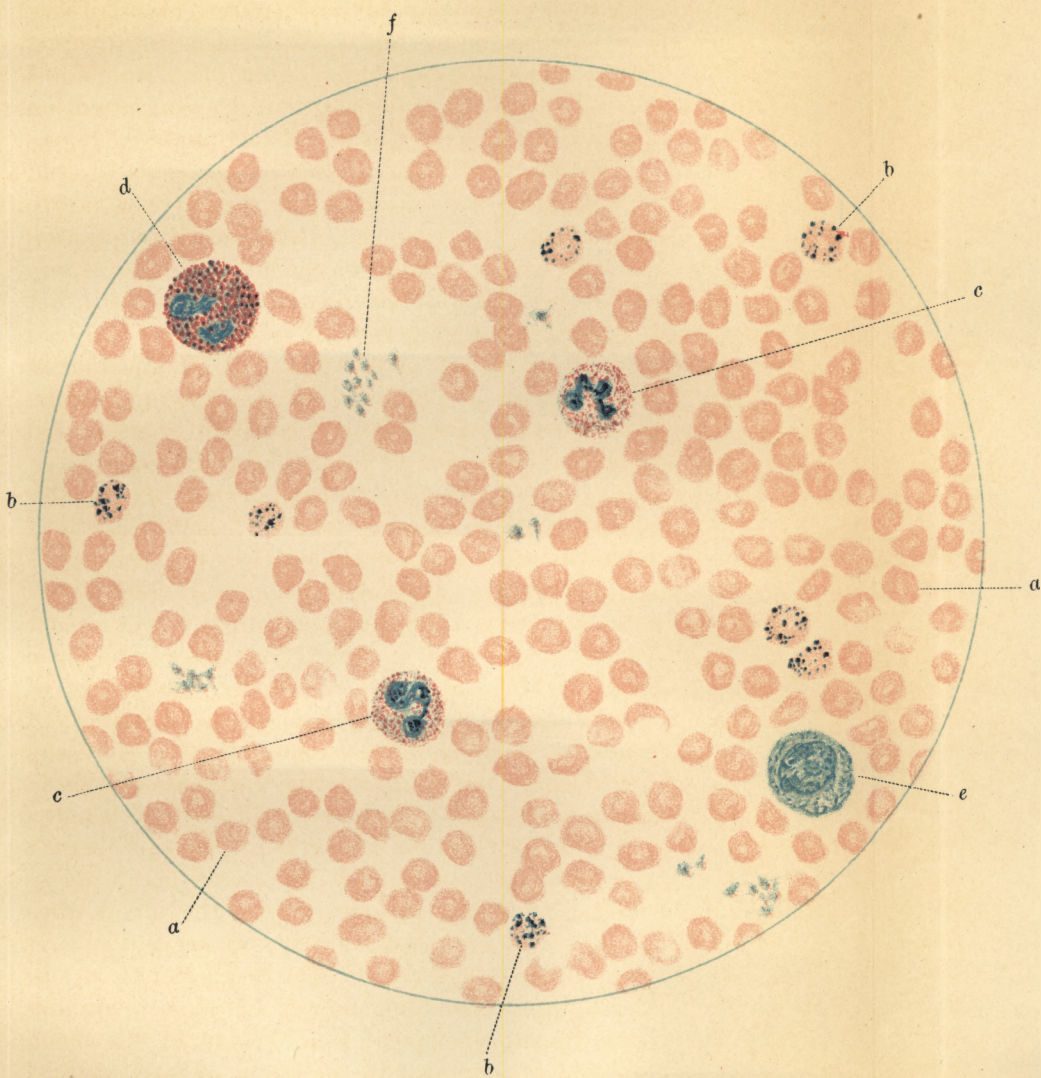


FIG. 7.—BLOOD IN LEAD POISONING.

a. Normal red blood corpuscles. *b.* Basophile degenerated red corpuscles.
c. Eosinophile leucocyte. *d.* Eosinophile corpuscle. *e.* Mononuclear
leucocyte. *f.* Blood platelets.

EFFECT OF LEAD UPON MOTHERHOOD.

It is largely the harmful effects of lead upon the blood-making organs of the body and the recurrent demands of menstruation upon the system which render females more susceptible to plumbism than males. Taking the pottery statistics for 1898 there were 3,123 men employed in lead or dangerous processes in the North Staffordshire district alone. Of these 152, or 4.9 per cent, suffered from plumbism, while of 1,580 women similarly employed 196, or 12.4 per cent, became ill. Of 12 deaths from plumbism 11 occurred in females; of 23 deaths from plumbism over a period of a few years in Newcastle-upon-Tyne, Miss M. E. Abraham (now Mrs. H. J. Tennant), when principal lady inspector of factories, found that 22 occurred in females. The reproductive functions become early deranged by lead, so that in consequence of this women workers suffer from menorrhagia. The excessive losses of blood thus induced at the menstrual periods doubtlessly contribute to the anæmia which is so strikingly present, but as anæmia is also present in male workers other causes must be in operation. Under the influence of lead women, if pregnant—and this remark applies also to females of the lower animals—miscarry in larger numbers than those who have not been exposed to the metal. Lead destroys equally the power of reproduction in man. It is almost impossible for a pregnant woman working in lead to go to term and give birth to a healthy child. She will either miscarry, or if a child is born at full time the infant is badly nourished and dies soon after birth in convulsions. It was because the writer found lead was the cause of an enormous destruction of human life through the numerous abortions and miscarriages it caused, also of the high death rate of infants born to lead workers, that he pressed the British Government to abolish female labor in lead works. Despite considerable opposition on the part of manufacturers, the recommendation was adopted, with the result that no tongue can tell what number of human lives has been saved and what amount of suffering has thereby been averted. Female lead workers who gave a history of having miscarried on six or seven occasions only succeeded in becoming mothers by giving up their work in the factory, as the following illustrations from the writer's notebook show:

Mrs. H., aged 35, had 4 healthy children born at full time. She went to work in a white-lead factory and was there for 6 years, during which she had 9 miscarriages and no living child. Mrs. K., aged 34, had 4 children before going into a white-lead factory and 2 children afterwards. Continuing at her employment she had 6 miscarriages in succession, when she was admitted into the Royal Infirmary under my care on account of paralysis of arms and legs,

due to lead poisoning. For a time she was extremely ill—a complete wreck, in fact—and unable to do anything for herself. She made a slow but good recovery, and, acting upon my advice, did not return to work in the factory. In her next pregnancy she went to term and gave birth to a healthy living child.

It is characteristic of lead poisoning that the withdrawal of the expectant mother from contact with lead usually enables her to go uninterruptedly not only through her immediate pregnancy but through successive pregnancies, and for the children born to be healthy.

Similar testimony to the malign influence of lead upon maternity is furnished by other physicians. Constantin Paul has published the results of 123 pregnancies where both parents worked in lead. Of these 64 ended in abortion, 4 were premature confinements, 5 were stillbirths, while 20 of the infants born alive died within the first year. Of 43 pregnancies of women working in lead 32 ended in miscarriages and 3 in stillbirths; only 2 living children were born, and these were badly nourished. Malnutrition and maldevelopment are characteristic of infants of lead workers. Balland gives the details of 100 pregnancies where one or both parents were lead workers. Abortion occurred in 40 instances; in 26 confinement was premature. Of 32 of the accouchements at term 60 per cent ended in stillbirths. Of other 40 children born alive to lead workers 26 died in their first year.

Lead acts prejudicially upon the offspring, both through the mother and the father, but its harmful influence is, as might be expected, greater through the mother. When both parents have been lead workers, the power for harm is then greatest. Rennert has attempted to express in statistical terms the varying degree of gravity in the prognosis of cases, in which at the moment of conception both parents are the subjects of mild lead intoxication without symptoms, also where one only is working in lead processes. Where both parents have been working in lead, pregnancy is prematurely brought to a close 94 times out of 100, 92 times when the mother alone is thus employed, and 63 times when the father alone is working in lead. In cases where women have had a series of miscarriages so long as their husbands worked in lead, a change of industrial occupation on the part of the men restores the wives to normal child-bearing powers. P. Rudaux¹ draws special attention to the effects of paternal lead intoxication. Of 752 women whose husbands were lead workers, he found in 442 pregnancies that 66 aborted, that 96 miscarried before the ninth month and 147 in the ninth month, and that 113 went to full term. In 47 instances the foetus was dead and macerated. The more by his occupation a man is exposed to lead the more harmful are the effects of this occupation upon his progeny. White-lead

¹ La Clinique, 21 janv, 1910. Intoxications chroniques et Puerpéralité.

workers, painters, printers, plumbers, and pottery dippers furnish the largest number of reproductive failures. Of the children of paint grinders I find that 40 per cent die of convulsions during the first year of life.

Maternal lead intoxication carries greater potentiality for harm than paternal. Where an expectant mother continues to follow her employment in lead processes the influence of the poison persists all through the period of intrauterine gestation, so that lead is found in the placenta and in the internal organs of the offspring as well. A young woman aged 20, a white-lead worker of four years' standing, and who during that period had been off work twice on account of colic and vomiting, and who since her marriage had had one miscarriage, gave birth to an infant at term. Her husband was a paint grinder; he was pale, and on his gums there was a well-marked blue line. The infant at birth was in size and weight more like a four or six months' foetus. The child lived for two weeks, during which it seemed to be unable to assimilate food. I made a post-mortem examination 18 hours after death, and was struck by the rapidity with which decomposition of the body was progressing. All the internal organs were small and in keeping with the diminutive size of the body generally. On microscopical examination the liver showed distinct atrophy of the hepatic cells and an exaggeration of the capillary spaces between the cells, also an increase of the interstitial tissue as in cirrhosis. In the kidneys there were found shrunken Malpighian glomeruli and degenerated epithelia with an increase of the connective tissue. On chemical examination lead was found in the internal organs. Lead had, therefore, passed through the maternal barrier, the placenta or "afterbirth," and had penetrated into the foetus, setting up structural changes in its liver and kidneys which led to death. Animals in whom I had produced experimentally plumbism suffered in a similar manner. In all the foetuses of a lead-intoxicated rabbit which had miscarried traces of lead were found.

The occupations which expose women to lead and which interfere with pregnancy are painting, typographing, and ware polishing; and, in countries where permitted, work in white-lead factories. At the risk of repeating myself, when the mild form of lead intoxication accompanies pregnancy and is unattended by symptoms on the part of women, it is in some respects a fleeting affair, for if they renounce the occupation and avoid further exposure to lead intoxication a normal termination to the pregnancy and the birth of a healthy child may yet be secured. Saturnism not only makes the continuation of pregnancy almost an impossibility, but it tends to aggravate some of its functional disorders, such as vomiting, headache, and albuminuria. Lead may kill the foetus in the womb directly by poisoning it and thus induce miscarriage, or the signs

of intoxication may not reveal themselves until shortly after birth, when the infant dies from convulsions or, as in the children of the Hungarian potters, may later on give rise to idiocy and other signs of an imperfectly developed nervous system.

Lead exercises its harmful influences upon reproduction probably through toxæmia. The abortifacient powers of lead have for long been known, not only to the medical profession, but to the public as well. In the potteries its use is resorted to by pregnant women who are anxious to get rid of their conception, a use not free from danger, since diachylon pills have on several occasions caused death of the child carrier as well as of the foetus. Lead produces powerful contraction of the muscle fibers of the intestines and of the womb; hence colic when the bowel is spasmodically contracted, and miscarriage when the musculature of the womb is similarly stimulated. Lead acts, too, as a direct poison to nearly all living beings. To its harmful action the foetus in utero is no exception, as the presence of the metal in its internal organs indicates. In one or other of these ways lead is prejudicial to reproduction, for an expectant mother without herself exhibiting signs or symptoms of plumbism can yet poison the offspring in her womb. Lead in some way, too, seems to alter the seminal fluid of the male, whereby the sperm cells are weakened and the impulses toward structural evolution are curtailed. In support of this statement the following table by Prof. Lewin¹ shows the result of 32 pregnancies of 7 women married to men working in lead:

RESULT OF 32 PREGNANCIES OF 7 WOMEN MARRIED TO MEN WORKING IN LEAD.

Number of women.	Abor- tions.	Still- births.	Deaths in the—				Living children.
			First year.	Second year.	Third year.	Later years.	
1.....	1						
1.....	1	1					
1.....	2		2				1
1.....	3		1				
1.....	1			2			
1.....	1		3	2	5		1
1.....	2		2			1	
Total.....	11	1	8	4	5	1	2

Each of the women had aborted. Out of 32 pregnancies there were only 2 living children.

While it was known to the older writers that lead administered in wine induced atrophy of the seminal vesicles of men, our knowledge of the malign effects of lead upon women is of comparatively recent date. Practically speaking, it is coterminous with the century that is past, and is associated with the rise of factories and the in-

¹ Bulletin de l'Inspection du Travail, 1904, numéros 5 et 6, p. 375.

dustrial employment of women. Although during the sixties of last century Tardieu in France had drawn attention to the fact that of 1,000 pregnancies of women working in lead 700 terminated prematurely, yet it is only within the last 30 or 40 years that medical men have begun to seriously realize the enormous influence of lead for harm upon female life in general. On the Harz Mountains, where there are lead smelting and desilvering works, it had been noticed that the cows, sheep, and hares which grazed on the pastures in the neighborhood were frequently attacked with hæmaturia and miscarried. Pregnant women who ate the hares also miscarried and subsequently became sterile. They remained childless during the remainder of their life, or at least during their residence on the Harz Mountains. Probably the drinking water and the vegetables grown in the gardens had also become contaminated; a circumstance which shows that whatever the source of plumbism, the result upon pregnant women is always the same.

Industrial lead poisoning as it affects woman surpasses in importance plumbism in man, since the morbid condition concerns not only the individual, but through her the future of the race. The subject has therefore a national as well as a socio-economic aspect. The number of human lives, actual and potential, sacrificed to lead will never be accurately known, but by the abolition of female labor in the dangerous processes of lead one step has already been taken, and by it mankind has been the gainer.

In an address¹ given to the Eugenics Education Society, London, May 4, 1911, on "Lead Poisoning and the Race," the writer asks the question, What is the fate of the children born to lead-intoxicated parents and who do not die in infancy? Since several of their brothers and sisters succumbed to convulsions, which they have escaped, are the survivors endowed with a good constitution and fitted to fight the battle of life? There is not the least doubt that while many of these children grow up and are quite healthy, others are of inferior physique: they are handicapped in their start in life, and they subsequently exhibit signs of mental as well as of physical deterioration. Such, too, is the opinion of Dr. Prendergast, of Hanley, Staffordshire, whose professional career has been spent in the Potteries. Something is inherited from lead-intoxicated parents which in later years may show itself in some of the obscure forms of nervous disease which are often otherwise inexplicable. Potters' children in Hungary exhibit a greater tendency to convulsions than the children of healthy parents free from lead. They are of shorter stature, too. The writer was struck by the infantilism of the potters' children in Hungary. Men upward of 20 years of age looked like lads of 13 and 14.

¹ Sir Thomas Oliver, in *Journal of Eugenics Education Society*, July, 1911.

PATHOLOGY OF LEAD POISONING.

Lead, if taken into the system in small quantities for a considerable length of time, induces structural changes in the eliminating organs, one sign of which is the presence of albumen in the urine. Albuminuria may appear early in plumbism and disappear, or it may not occur until late, and then be a sign of kidney disease. It is because interstitial nephritis is the form of kidney disease met with in old-standing cases of plumbism that it has come to be regarded as the renal lesion special to plumbism; but this does not apply to the condition of the kidney met with in patients who have died in acute lead poisoning of short duration. In these cases it is the cells which line the tubules and the glomerular epithelium that are the first to become affected. The fact that albuminuria may come and go with each returning and waning attack of colic suggests a toxic origin for the albumen in the urine in the early stages of the malady, but in chronic plumbism the structural changes in the kidneys are of another kind, and are part of a more widely distributed degeneration affecting the heart and arteries as well.

When a person is daily swallowing or breathing lead dust, it is more than probable that there is an elimination of the poison which keeps pace with its absorption. It is when a check is placed upon elimination that there commences storage of the poison. Plumbism, however, is not always a question of any stated amount of lead being present in the body, for some persons are more susceptible to its influence than others, and, besides, lead may, by destroying the functional activity of the eliminating organs, favor the retention within the body of poisons generated by the individual himself, so that the patient dies from a mixed form of toxæmia. While the death of old lead patients often comes with convulsions, due to chronic kidney disease, saturnine encephalopathy may occur in young adults in whose urine no albumen is found and in whose nervous system after death no lead is found on chemical analysis. In other cases lead is found in the brain, or there are observed small subarachnoid hemorrhages to which Dr. Mosny, of the Hospital St. Antoine, Paris, has drawn attention. It has been my fortune to see several cases of saturnine encephalopathy in young persons in whose urine no albumen was found. The attack is occasionally preceded by severe headache; in other instances by symptoms suggestive of hysteria. A young female lead worker, for example, who has not been known even to have felt ill, becomes rather excited. She laughs or cries on the slightest provocation and presents all the symptoms of ordinary hysteria. The attack must not be ignored, for it masks a serious implication of the nervous system. Within three days of the development of the toxic hysteria the patient may be dead. The hysteria is in itself a symptom of saturnine poisoning. Lead

stimulates into activity a neurosial tendency, to which the patient is hereditarily or otherwise predisposed.

Loss of vision, complete or partial, is not an unusually rare sequela of poisoning of the nervous system by lead. As far back as the middle of the eighteenth century, French physicians had noted the blindness and deafness to which potters were liable, and which were attributed to the lead glaze used. In 1775 it was reported of a lead worker that having gone to bed one evening quite well and with good eyesight he awoke next morning completely blind. The writer has had similar experience of lead workers in Newcastle-upon-Tyne. Usually, however, the onset of blindness is preceded by severe headache or by convulsions, and on ophthalmoscopic examination there are found evidences of acute neuro-retinitis or of retinal hemorrhages. Since retinal hemorrhages may occur without albumen being present in the urine, they are not always, therefore, the result of kidney disease, as some physicians believe, but are caused by either the direct action of lead upon the optic disk and retina, or, as Leuber and Deutschmann maintain, by irritating or infective particles carried by means of the subarachnoid fluid from the cavity of the brain to the vaginal sheath which surrounds the optic nerve. Probably more than one cause is in operation. In chronic lead intoxication retinal hemorrhages may be the result of uræmic retinitis. The influence of arterial constriction brought about by lead can not be ignored as a cause of loss of sight, nor can the fleeting toxic effects produced by lead upon the deeper parts of the brain concerned with vision be altogether set aside. Once blindness occurs, it may persist for life, or after lasting for weeks, eyesight may be gradually restored. Occasionally the loss of vision instead of being complete is limited to one-half of the visual field, or the trouble is not within the eye itself, but in the external muscles of the eyeball. When these become paralyzed the patient complains of diplopia or double vision.

Taking various lead industries into consideration, Prof. Lewin¹ found that of 130 men and women exposed to lead and whose eyesight had become affected, 34 were painters and 20 were white-lead workers. As there are far more painters than white-lead workers in the population, this gives an extremely high average of affected eyesight in white-lead workers. It would have been interesting if Prof. Lewin could have told us how far the nerve and muscle strain, and therefore fatigue, to which the eyeballs of the painters are exposed in their work may not have played a part in causing some of the defects of vision met with among these men, since probably among them much of defective vision was the result of muscular paralysis and not, as in white-lead workers, due to retinal changes. Lead respects neither age nor sex, hence men, women, and children can all be rendered blind by it. Taking 163 lead-poisoned persons,

¹ Bulletin de l'Inspection du Travail, 1904.

Lewin found that 122 of these were men and 41 were women; that of 70 of the men affected, 51 had become blind between 20 and 40 years of age; and of 27 females, 16 had become blind between the ages of 10 to 20, and 8 between 20 and 30. My own experience confirms what these figures show, namely, the earlier development of blindness in female compared with male lead workers. In the lead workers just referred to there had been other symptoms of plumbism previous to the onset of the blindness. Several of them gave a history of colic, others had suffered from headache, others again from paralysis, and a few had had convulsions. It is fortunate that a fairly large percentage of those who have suffered from blindness regain their eyesight. Of 114 thus affected, 40 recovered their eyesight entirely; in 22 only a fair recovery took place, while in 36 the optic disk passed into a state of atrophy, and in 16 life was brought to a premature close. It is unnecessary to add that where a patient has suffered from saturnine amblyopia and regained his eyesight he must for the remainder of his life avoid coming into contact with lead.

Once there has been lead intoxication, the individual ever afterwards exhibits an increased susceptibility to it. Many of the infectious diseases from which we suffer leave a protective influence behind them. There is conferred by one attack an immunity to other attacks, but there are other diseases, of which plumbism is one, which induce anaphylaxis, or a tendency for the body to become more readily affected by smaller doses of the poison.

While this in the main is true of lead, there are exceptions. The writer knows a family of lead workers the father of whom is still alive at the age of 80, after having worked for 44 years as a red-lead drawer. His three sons have been similarly employed without any of them becoming ill, until one of them, after 32 years' service became paralyzed in wrists and hands, but made a rapid recovery. Just as there is a personal and family idiosyncrasy to plumbism, so, too, there may be an increased resistance to it. This I have found in certain animals. Rats are resistant to lead. Rabbits are more readily affected, and yet one of my rabbits during the last 28 months has swallowed upward of 300 grains of nitrate of lead and remains in good condition.

RETENTION OF LEAD WITHIN THE BODY.

Another item of interest and of importance from the point of view of the British Workmen's Compensation Act is the length of time lead may remain in the system. Years after the symptoms of plumbism first show themselves and have disappeared there may be fresh signs of intoxication. Lead is slowly eliminated from the body by the kidneys and the intestinal canal. To Prof. Dixon Mann we

are indebted for having indicated the extent to which it is thrown out by the bowels. In one of the writer's patients who has no blue line on the gums, and therefore no visible signs of the presence of the metal within the body, who has, too, no symptoms of plumbism other than recurrent abdominal pain accompanied by attacks of vomiting, lead has been found in the urine, fæces, and vomit 16 months after leaving work.

The elimination of lead may extend over many months or years, or the elimination may cease, and the lead after lying dormant in the tissues for years be again eliminated with a renewal of symptoms of plumbism, as the following case shows: Mrs. P., aged 36, was admitted into the infirmary under my care, suffering from headache and paralysis of the muscles of the eyeball, attended with defective vision. She was the mother of six children, of whom five were alive. She had had three miscarriages. I recognized her as a patient who 17 years previously had been a white-lead worker, and been under my care on account of colic, followed by saturnine encephalopathy and blindness. After total blindness, which had persisted for several weeks, eyesight had been gradually regained, and patient ultimately made a good recovery. She did not return to the lead works, but after a time married and had children as above recorded. During her 16 years of married life neither she, her husband, nor any of the children had been brought into contact with lead. There was no history of syphilis, alcohol, or other cause to explain the severe headache and defective vision. Thinking that it was just possible the old occupation had something to do with her illness, I sent a sample of her urine to the chemical laboratory of the Armstrong College and asked Prof. Bedson for a report upon the same. The urine was found to contain lead. Knowing that lead may lie dormant in the tissues for a considerable length of time, I could not but regard this case as one of saturnine poisoning, although 17 years had elapsed since her recovery from the previous attack. During all these years patient had apparently been a healthy woman, and yet some chemical change had occurred in her system, whereby resolution of deposited inert lead had taken place, and this circulating in the blood had induced fresh symptoms of lead poisoning. Similarly in a laborer aged 41, with atrophy of hands, paralysis of extensors of wrists, and muscular tremor of six weeks' duration, who gave up house painting 18 years previously, the administration of potassium iodide was followed by the elimination of lead by the urine to the extent of 1 part per million. This is the longest duration of latent plumbism with which I am familiar. I have frequently found lead in the urine of patients two or three years after they had given up work in the factory. In such a case as that just mentioned the presence of lead in the urine was an

important sign, and of the greatest assistance in the diagnosis of plumbism.

In a large number of cases of lead colic indican is present in the urine. The test for indican is to pour a small quantity of urine into a test tube and to add to it an equal quantity of hydrochloric acid. Chloroform is then added and the fluid well shaken. At the lower level of the layer of supernatant chloroform indican will be revealed by a blue or red color, according to the kind of indican present—blue color being due to indican or blue indigotin, while a red color points to oxidized indigotin, or what is known as indirubin. Although indicanuria occurs in other diseases it is yet an additional, but not a reliable, sign of plumbism.

One of the commonest signs of lead poisoning is paralysis of the hands and wrists, or what is known as "wrist-drop." Although the affection is usually bilateral, on account of being the result of a general toxæmia, the loss of power is greater on the side that the muscles of which, when at work, have been most exposed to fatigue. Diminished local resistance caused by fatigue predisposes to the location of the paralysis, a point to which later on we shall return. Other factors, of course, may also be in operation.

Boerhaave was among the first to associate paralysis with saturnine poisoning, but it is to Tanquerel de Planches and to Duchenne, of Boulogne, that we are indebted for the earliest and most complete clinical description of paralysis in lead poisoning. It was Duchenne who, by using electricity in his investigations, first localized the paralysis and described the order in which the various muscles become affected. He observed, too, the immunity of certain muscles, such as the supinator longus, in "wrist-drop." Before paralysis appears the patient may have had headache, colic, and vomiting, or he may have had encephalopathy, but none of these are essential as prodromata, for experience shows that without any warning paralysis may develop. The common seat of the loss of power is the extensor muscles of the wrist and fingers. The muscles, while presenting the "degenerative reaction"—namely, loss of faradic irritability—still preserve their voltaic, but as the wasting of the muscles proceeds both faradic and voltaic irritability become in proportion lessened, and especially is this the case in that form of saturnine atrophic paralysis where weakness and wasting come on simultaneously and proceed *pari passu*. Double "wrist-drop," where the patient can not extend his hands and fingers, is the classical form of paralysis in lead poisoning. It usually develops on one side earlier than the other. It may commence as simple weakness or paresis and proceed to complete loss of power or paralysis.

Space will not permit an elaborative description in detail of the various muscles affected or of how in one instance certain fingers



FIG. 8.—“WRIST-DROP,” THE COMMONEST FORM OF LEAD PARALYSIS.

A. C., age 30; a red-lead worker for five years. Paralyzed in both arms.

escape and not others. The flexor muscles gradually become weakened partly through disuse and partly through the withdrawal of the antagonizing influence of the extensors. In the Duchenne-Erb type of the malady the muscles of the upper arm become involved. Here the deltoid, biceps, brachialis anticus, and the supinator longus become affected with the addition of the supra and infra spinatus muscles. Of these the deltoid is generally the first to become weakened. When "wrist-drop" alone is present the patient can not hold anything in his hand, he is unable to fasten his clothes, and he has difficulty in feeding himself; but when the Duchenne-Erb type of muscles is affected, the arms hang powerless by the side of the body, for the patient is quite unable to raise them. In other cases the small muscles of the hand are paralyzed, e. g., the thenar, hypothenar, and interossei.

Occasionally also the muscles of the legs become paralyzed. In the leg the peroneal and the long extensors of the toes, which correspond to the muscles of the forearm, suffer most—the tibialis anticus, like the supinator longus of the forearm, usually escaping. There is a form of generalized paralysis of rapid development met with in lead poisoning, where the muscular system is involved in its whole length, en bloc, so to speak. I have only seen three cases of this form of paralysis. On account of the extent of its distribution and the rapidity with which it develops, it is not without danger. The patient occupies the dorsal decubitus, is unable to move a limb, and is often even incapable of masticating and swallowing food, and yet, as happened in two of my cases, rapid as was the development of the paralysis, it just as rapidly amended. One of the patients who recovered gave birth a few years afterwards to a living child. Whilst recovery is the rule, death has occurred by respiratory paralysis.

Considerable discussion has taken place as to whether paralysis in lead poisoning is to be regarded as the result of a central lesion of the nervous system or whether the lesion is peripheral and seated in the nerves or muscles. In old standing cases the nerves are generally found to be the seat of an interstitial neuritis, in which the connective tissue framework of the nerve is found to have become increased and the nerve fiber to have undergone degeneration. We must draw conclusions, however, not from the late but from the early stages of the disease. The first question, therefore, we ask ourselves is whether lead paralysis is primarily a nervous or a muscular affection, for pathological changes are ultimately present in both. Where then does the change first begin? Charcot, Leyden, and Westphal support the neuropathic theory, whilst of the followers of the myopathic theory may be mentioned Gusserow, Henle, and Hitzig. Friedländer is of the opinion that lead causes primarily a functional

disturbance of muscle and that this is followed by a degeneration of the nerve. It is not a question of the affected muscles containing more lead than those which still functionate normally, for experiments carefully conducted by Bernhardt show that the flexors of the fingers and wrists and the supinator longus, which usually escape in "wrist drop," contain exactly the same quantity of lead as the extensors, the amount in each instance being small. Weight for weight, compared with the other organs of the body, the muscles contain the smallest amount of lead in saturnine intoxication.

If, therefore, peripheral conditions under the circumstances sketched above do not explain lead paralysis, does a study of the central nervous system throw any light upon the problem? Often no change is found in the spinal cord on microscopical examination, but this is no proof that lead may not have inflicted damage upon the cells in the anterior cornua of gray matter. Function may be deranged without any apparent structural alteration. In a few cases of fairly acute lead paralysis, minute hemorrhages have been found in the spinal cord, as in a case reported by Oeller.¹ Vulpian found in a man who died from saturnine poisoning and in a dog in which he produced experimentally lead paralysis distinct evidence of sub-acute myelitis. My own opinion is that in many cases of lead paralysis the lesion is primarily started in the nervous system. It is the most vulnerable.

Nearly all writers are agreed that if there is one thing in lead poisoning which favors the localization of paralysis it is fatigue of muscle; that is to say, the muscles which become paralyzed are those which do the greatest amount of work. It is on this theory that, along with other physicians, I have sought to explain the paralysis of the left-hand muscles in file makers, and of which a determining cause is the fatigue consequent upon the prolonged and tight grip of the chisel. There is nothing to prove that lead has a special predilection for any particular muscle or group of muscles.

This subject has been revived and is ably dealt with by Dr. Ludwig Teleky, of Vienna, in *Zur Kasuistik der Bleilähmungen*, in which he elaborates Edinger's theory of the influence of muscular work in determining the localization of paralysis. Teleky has had unusual opportunities of studying the question, since between November 1, 1905, and January 1, 1909, he examined and closely watched 40 cases of lead paralysis. He reminds us that in coarse work the muscles of the forearm and hand are used, but in finer work only those of the fingers and hands. Although quantitatively the smallest, it is the latter muscles which are most affected. They are required for prompt and accurate action. The human forearm is made for heavy work, the hands and fingers for lighter work. It is

¹ Oeller, *zur Pathol. Anal. der Bleilähmungen*.

not always easy to say what is light and what is heavy work. With his right hand the file cutter wields a heavy hammer, but it is his left thumb and index finger which become paralyzed through the prolonged strain of gripping a chisel the greater part of the working day. Painters, printers, typesetters, porcelain painters, and diamond cutters, whose work, though coarse, is yet of a fine character, suffer from paralysis involving the long extensors of the fingers, and especially, too, the muscles of the thumb, if this finger is particularly involved in the operations. The weight of the muscles is no criterion of the work they do and can do. Of 14 varnishers and painters treated by Teleky for paralysis, 3 only showed one-sided paralysis, viz, the right hand; in the remainder the paralysis was bilateral. While in dextrous people it is the right hand which suffers the more frequently and severely, in those with a sinister bend it is the left.

In children who become poisoned by lead the paralysis affects not the forearms, as in adults, but the legs, probably because they run about more and exercise these muscles more than do their seniors.

If lead has any predilection at all for muscles, it is for those which are most used, and therefore most liable to fatigue. But how does fatigue act? Fatigue has both a peripheral and a central explanation. The peripheral nerve endings in the muscles are affected by the waste products formed therein, while the circulation of the toxins in the blood impair for the time being the activity of the nerve cells in the brain and spinal cord. Fatigued muscles in a person whose general resistance is reduced, as in slowly developing plumbism, have a difficulty of getting rid of their waste products and of securing proper nutrition; the sensory nerve endings of the muscles become weakened, as do also the large cells in the central nervous system, so that when saturnine toxæmia takes place it is the muscles whose resistance is reduced and their associated nerve connections which first fall victims to the action of lead. Since, with the exception of size, the muscles are the same in adults and children, and yet in children the legs suffer while the forearms escape, it is rather a question of the amount of use to which the muscles are put. An engineer, aged 27, left-handed for hammering and screwing, but right-handed for writing, whose work consisted in joining iron plates with red-lead paste, developed plumbism with paralysis of both hands, but the loss of power of the left hand, which did the screwing work, was much more pronounced than that of the right hand. A lead worker was recently under my care on account of paralysis of the muscles which pronate the right hand. As these muscles alone were affected, it turned out that the man supplemented his income by acting as a lamplighter, and the muscles affected were those with which he extinguished the lights by means of a long staff.

"Wrist-drop" may develop suddenly between night and morning, or it may come on gradually. It may or may not be accompanied by pain. The affected muscles rapidly undergo atrophy. The loss of power is usually confined to the muscles of the hand and wrist, but the muscles of the upper arm and those of the shoulder may also become affected, likewise those of the feet and legs, giving rise to "ankle-drop." Paralysis of the muscles of all the limbs is a serious sign, for not only is the patient rendered completely helpless, but there is the possibility of the paralysis spreading to the muscles of the trunk and of respiration becoming arrested. In some instances speech is affected, and the symptoms resemble those met with in general paralysis. In a large percentage of lead-intoxicated persons there is distinct tremor of the labio-facial muscles, which is brought into view when they are asked to show their teeth. Some of the writer's lead-poisoned patients, when apparently progressing satisfactorily, have without warning suddenly become convulsed and thereafter delirious. For days their mental balance would be broken. Most of the patients under these circumstances recover, but acute delirium, attended by a rising temperature, is an unfavorable condition.

Although double "wrist-drop" is the commonest form of saturnine paralysis, the loss of power may be confined to the arm and leg on the same side only. *Tabes dorsalis*, or locomotor ataxia, is occasionally simulated by poisoning of the nervous system by lead. There may be well-marked incoordination, the patient being unable to stand or walk with his eyes closed, but the simulated differs from the classic form of the malady in being more amenable to treatment.

LEAD AND GOUT.

The association of lead poisoning and gout has long been known. Sir Alfred Garrod found that 33 per cent of his patients who were suffering from gout had been poisoned by lead, while Sir Dyce Duckworth states that of 136 patients who were the subjects of gout, 18 per cent showed signs of lead intoxication. In Newcastle-upon-Tyne the association of lead and gout is hardly known. Whether it is in consequence of our rigorous climatic conditions and the difference in their habits as regards food and alcoholic beverages, lead workers in the north of England seldom become gouty like their confreres in London and the Midlands.

The almost complete absence of gout among lead workers on Tyne-side is of considerable interest from a physiological point of view. Does lead per se determine gout, or is it that a gouty diathesis predisposes to plumbism? The late Sir William Roberts said he could hardly believe that lead poisoning produced the same constitutional



FIGS. 9 AND 10.—“WRIST-DROP.” TYPES OF LEAD PARALYSIS



FIGS. 11 AND 12.—“WRIST-DROP”

PLATE 18.



FIG. 13.—“ANKLE-DROP,” TYPE

diathesis as that which exists in true gout. He recognized that while the gouty constitution and lead poisoning differed in all other respects, they had one vice in common, and that is a gouty tendency or "uratosis." According to him, uratosis is a gouty tendency, which may become reenforced by plumbism, and saturnine uratosis is a particular form of lead intoxication, aggravated by a previously existing gouty diathesis. Taking the amount of urea eliminated daily as a measure of the proteid metabolism of the body, I have found in many of my lead patients before treatment that the urea rate fell to one-half, or 250 grains, for the day, but that under treatment the urea gradually rose to the normal, provided the kidneys were healthy. With a rise in the amounts of urea thrown off, severe headache previously complained of disappeared. As regards uric acid, the forerunner of gout, Prof. Bedson found in the samples of urine of my patients submitted for analysis that the daily quantities of this constituent of the urine was subject to considerable variation. Roughly speaking, in health a little less than half a gram (6 to 7 grains) of uric acid is eliminated daily by the kidneys. In some of my lead patients the amounts thrown off varied from 12 to 21 grains per diem, without any signs or symptoms of gout. In my efforts to ascertain whether there was any constant relationship between the daily elimination of urea, uric acid, and lead, the following data were obtained in the chemical laboratory of Armstrong College:

DAILY ELIMINATION OF UREA, URIC ACID, AND LEAD BY THE KIDNEYS FROM WORKERS IN LEAD.

Date.	Quantity of urine daily, in ounces.	Specific gravity.	Urea, in grains.	Uric acid, in grains.	Lead, in grains.
January 15	62	1010	328.0	5.23	.00386
16	64	1010	343.0	7.25	.00307
17	78	1014	417.0	5.84	.00374
18	68	1012	396.7	5.09	.00651
19	69	1010	467.1	3.31	Trace.
20	72	1012	488.8	2.07	Trace.
21	100	1012	665.4	.76	.....
22	80	.....	.....	.13	Nil.
23	88	1012	469.7	.50	.00957
24	82	.....	.....	1.89	.00394
25	105	1010	433.9	2.01	.00756
26	68	1012	338.6	.26	.00153

While according to the above there is no constant relationship between the two, it would almost appear as if the elimination of uric acid and lead is inversely related to each other.

DEATH CAUSED BY LEAD POISONING.

Since the passing of the Workmen's Compensation Act numerous coroners' inquiries have been held in regard to deaths of lead work-

ers. In the majority of cases there is given a history of the person who worked in lead having had colic and suffered from headache, or of having had paralysis, from some or all of which he perhaps had recovered and returned to work. Death of the workman may have been comparatively sudden and been due to cerebral hemorrhage, for apoplexy is a common mode of termination of life in chronic lead poisoning. At the autopsy the ruptured cerebral vessel is seen, the kidneys are found to be smaller than usual, and their capsule adherent, while the left ventricle of the heart is observed to be hypertrophied. The structural alterations of heart and arteries can be a consequence of chronic kidney disease, caused by other conditions and poisons than lead, but because lead induces interstitial nephritis, and the person is said to have worked in lead, compensation is usually awarded to the friends. Lead may or may not have given the impetus to the structural alterations of the kidneys. The presence of a blue line on the gums of a dead body would be supplementary evidence of plumbism. Apart from it the pathological findings above recorded are not per se positive proof of lead poisoning. Hereditary tendencies, alcoholic habits, and gout may, quite apart from lead, have initiated the kidney disease, the first link in the chain of morbid events, so that, unless lead is found in the internal organs or in the urine removed from the bladder after death, there is no absolute post mortem evidence of saturnine poisoning.

In the case of young lead workers dying from saturnine encephalopathy a few weeks or months after taking up the occupation, and in whose urine during life no albumen was detected, there may be, practically speaking, beyond a blue line on the gums no well-defined evidence at the post mortem examination of death having been due to plumbism. To the untrained eye all the organs appear to be healthy. An experienced pathologist on carefully looking at the brain may observe that it is shrunken, paler on section, and firmer to the touch than usual or that it is pale and watery as in uræmia. Such a brain, in the absence of albumen in the urine, is extremely suggestive of lead poisoning. If there has been an attack of acute colic before death the small intestine may be found extremely contracted in places, and in older patients there may be found small bluish-black patches on the mucous membrane. Although in acute lead poisoning the kidneys appear to the naked eye healthy, yet on microscopical examination the tubular epithelium may be observed to have undergone cloudy degeneration. Heart, lungs, and liver look healthy. Any urine in the bladder in a doubtful case should be removed for chemical analysis; so, too, ought portions of the brain, liver, and kidneys. Prof. Bedson made for the writer a chemical examination of the internal organs of several lead workers who

died in the Newcastle Infirmary, of which the following may be mentioned

Eliza T., aged 22, had worked two and one-half years in a white-lead factory. After the first three months she had colic and was off work for three weeks; returned to factory and worked seven weeks, when again obliged to desist on account of colic. A year afterwards, when still following her occupation, she had severe headache, which was followed by partial blindness. Sight was gradually regained. She returned to work in the white-lead factory, but again becoming ill, was admitted into the infirmary under my care, where she developed convulsions and died. The urine was free from albumen. At the post mortem examination, beyond a blue line on the gums, the body presented no external signs calling for comment. On examining the brain the dura mater was found to be adherent at the vertex; the subarachnoid fluid had accumulated to excess in the inter peduncular space; the pons and cerebellum were pale compared with the other parts of the brain. The surface of the brain was healthy and the blood vessels not unduly injected. The corpus callosum was pale, and the puncta hæmorrhagica were extremely few. Each lateral ventricle contained 2 or 3 drams of clear fluid. The membranes were healthy. The spinal cord felt hard and on section was paler than usual. Heart, liver, lungs, and kidneys call for no comment.

The distribution of lead in the internal organs of the bodies of this woman and of two of my other patients is shown in the following table drawn out by Prof. Bedson:¹

DISTRIBUTION OF LEAD IN THE INTERNAL ORGANS OF THREE PERSONS WHO DIED FROM LEAD POISONING.

Description of organs.	Lead found expressed as metallic lead, in parts per million.			Lead, in grains, calculated on total weight of organ.		
	I.	II.	III.	I.	II.	III.
Large intestine	14.6	37.70	.....	.....	.....	.....
Small intestine	9.2	.....	.....	.....	.....	.....
Muscle	3.1	.....	.....	.....	.....	.....
Lung	2.2	7.60	.....	.....	.....	.....
Heart	6.7	4.12	5.00	0.0243	0.0189	0.0164
Mammary gland	4.8	.....	.....	.....	.....	.....
Kidney	15.5	10.00	13.30	.0270	.0229	.0261
Spleen	14.7	12.00	39.00	.0193	.0341	.0853
Liver	47.7	37.80	41.60	.9180	1.0000	.7230
Cerebellum and pons	36.9	.....	.....	.....	.....	.....
Gray matter of basal ganglia	53.0	.....	.....	.....	.....	.....
Brain, gray matter of cortex	40.9	.....	.....	.....	.....	.....
Brain, white substance	18.9	.....	.....	.....	.....	.....
Spinal cord .....	.....	1.16	.....	.....	.....	.....
Brain .....	.....	9.80	21.60	.6880	.....	.....
Cerebellum .....	.....	24.80	8.59	.....	.....	.....
Pons .....	.....	22.60	.....	.....	.....	.....
Brain and cerebellum .....	.....	.....	.....	.....	.7790	.6340

¹ Dictionary of Applied Chemistry, T. E. Thorpe, vol. 2, p. 445.

A chemical examination of the internal organs of another of my patients, Charlotte R., gave spleen 1.3 parts of lead per million, heart 8.2, liver 20.4, kidney 1.9, and brain 1.7 per million.

In rabbits to which I administered lead in food the metal was found in the muscles, liver, stomach, brain, and kidneys. I am not in a position to state in what chemical form lead is present in the brain and in the tissues. The quantities found in my patients have therefore been expressed in terms of metallic lead. Sir William Gowers, in *Medical Ophthalmoscopy*, states that on one occasion 5 grains of lead were found in a human brain. The largest amount in any of my cases was 1 grain of metallic lead. To the presence of lead in that organ are attributed by some pathologists the convulsions and death in plumbism. It is believed that some highly complex chemical combination takes place between brain tissue and lead, whereby one of the hydrogen elements in a molecule of kephalin is replaced by lead. Brain cells thus impregnated with lead would become incapable of performing their functions normally. It is quite conceivable that lead under those circumstances might be the cause of the convulsive seizures, but even in lead workers the metal per se can not in every instance be the cause of convulsions and death, since in a young female white-lead worker under my care, who died from saturnine encephalopathy a few months after taking up her employment in a factory, no lead was found in the brain on the most careful chemical analysis.

The blood, too, has been frequently examined for lead. C. Oppenheimer¹ tells us that as far back as 1844 Cozz found lead in the blood. Chevalier found small quantities in the blood of a man who died from saturnine poisoning and Gusserow in a rabbit, the subject of experimental plumbism. Oppenheimer obtained the following results on analyzing the blood of two rabbits experimentally poisoned by lead:

ANALYSES OF THE BLOOD OF TWO RABBITS POISONED BY LEAD.

	I.	II.
	<i>Grams.</i>	<i>Grams.</i>
Quantity of blood	52.30500	29.10500
PbSO ₄ found .....	.00400	.00200
Pb found .....	.00237	.00137
100 grammes of blood contained PbSO ₄.....	.00765	.00690
100 grammes of blood contained Pb.....	.00522	.00471

These analyses show the presence of lead in a fairly considerable quantity in the blood, but as mention has already been made of lead affecting very severely the blood-making organs of the body, let us see what amounts of lead are stored up in the bones and marrow, for

¹Zur Kenntniss der Experimentellen Bleivergiftung. Berlin, Boas und Hesse, 1899.

it is in the marrow of bone that red-blood cells are formed. In 100 parts of bone there were found (a) 0.1138, (b) 0.00338, (c) 0.0803 gram of lead, while in marrow Oppenheimer found (a) 0.07689, (b) 0.07717, (c) 0.189 gram of metallic lead. Like the bones, marrow contains relatively a large amount of lead.

Lead early disturbs the functions of the kidneys and liver, and this in time is followed by alterations of structure. It is by the activity of these organs that lead is removed from the body in the urine and faeces. Before the liver and kidneys become structurally affected, lead in consequence of deranged function of these organs may not be thrown out, nor will there be eliminated the animal poisons which are normally produced within the body, so that over and above the possibilities of plumbism, there is also created an autointoxication, which probably contributes as much to the convulsive seizures observed in saturnine encephalopathy as the presence of lead itself.

As bearing upon the comparative absence of distinctive signs of lead poisoning in the body, the following case is worthy of being recorded: A plumber aged 35 was admitted into the Newcastle-upon-Tyne Royal Victoria Infirmary under the care of Dr. W. E. Hume, one of the writer's colleagues, in a state of unconsciousness, on November 30, 1908. On the evening of November 27, on his way home from work, this man was seized with severe headache, but he returned to work next morning, although not feeling well. When at work he fell down in a slight convulsion. Recovering within an hour, he walked home, where he had another convulsion. This was followed by loss of consciousness. In this condition he was admitted into the infirmary. (It was subsequently ascertained that patient in the early part of the year had been treated at the eye infirmary on account of defective vision.) Knee jerks were present on both sides. The right arm and leg lay rigid and motionless; the left arm and leg were moved convulsively. Babinski's sign was absent on the right, but present on the left side. There was marked optic neuritis in the right eye, less in the left. Urine had a specific gravity of 1.020, and did not contain albumen or sugar. Heart was healthy; blood pressure 105 millimeters Hg. As the coma deepened it was decided to trephine the skull in order to give relief to pressure. One of the assistant surgeons trephined the left side of the skull, but found that beyond oedema the brain was healthy. Patient recovered from the effects of the operation, but the coma increasing, he died on December 4. The writer was present at the autopsy. The liver, spleen, heart, lungs, and kidneys were found to be healthy. The oedematous condition of the side of the brain which had not been operated upon along with a slightly thickened but not adherent pia-rachnoid membrane, the history of the man's occupation, and the

absence to the naked eye of signs of disease in the other internal organs, led me to suggest to the pathologist that the internal organs should be examined for lead. Portions of the internal organs along with urine removed from the bladder were sent to the chemical laboratory with the following result: Urine contains lead; brain contains 3 parts, liver contains 6 parts, kidney contains 50 parts, and spleen contains 40 parts of lead per million of tissue. But for the chemical examination of the internal organs in this case, the diagnosis would not have been possible. Plumbism might have been surmised, but it would not have been confirmed by even a microscopical examination of the kidneys, since in them nothing abnormal was found. An interesting point in this case is that notwithstanding the fact of a general cause such as toxæmia being in operation the paralysis was limited to one-half of the body.

EFFECT OF OCCUPATION ON THE FORM OF LEAD POISONING.

In discussing lead paralysis mention was made of fatigue and the important part it played in determining the location of the weakness and loss of muscular power. Compositors employed in the printing shops of Vienna are said by Teleky to suffer infrequently from colic and the severer types of the malady, a statement to which both Sternberg and Hirt subscribe. Only in 8 out of 1,000 printers did Sternberg find a blue line on the gums. Teleky found it in 23 out of 157 compositors whom he examined. While printers are less liable to plumbism than is generally believed, they have a greater tendency to diseases of the lungs and kidneys than men occupied in most other occupations which bring them into contact with lead. The discussion of this circumstance a few pages back suggested the question as to whether lead by being slowly absorbed did not act so imperceptibly upon the internal organs of the men as to render them more liable to other forms of disease, as witness the special tendency of printers to pulmonary tuberculosis.

In Great Britain lead colic is not frequently complained of by compositors and printers, but in Vienna gastrointestinal derangements are common. These, as well as affections of the cardio-vascular system, are attributed to the slow rate at which lead in very minute doses is absorbed into the system. Dr. T. M. Legge finds that the industries in which the most serious forms of plumbism occur are brass, plumbing, printing, file cutting, tinning, glass cutting, and ship painting, and that the form of paralysis which lead poisoning produces under these circumstances is generally above the average in severity, also that in white lead, red lead, litho transfers, enameling, electric accumulators, paints, colors, and coach painting the symptoms are generally colic rather than a high degree of paralysis. The differences depend upon the nature of the employment, with which

is naturally associated the age of the worker and the opportunity of inhaling lead dust.

When lead poisoning is induced rapidly it is more likely to cause colic or encephalopathy than paralysis. The slowness of the onset of symptoms in brass workers, plumbers, printers, file cutters, and tanners is, according to Legge, rather the result of inhalation of fumes or of metallic lead dust than of salts of lead. Saturnine encephalopathy is more than twice as frequent in females than males. In hand file cutters the paralysis affects mainly the muscles of the left thumb and hand, since it is these which are most exposed to fatigue. Bond, in alluding to the making of lead capsules for bottles by women, speaks of the freedom of the workers from lead colic and internal troubles, a statement not confirmed by other physicians, nearly all of whom, however, agree as to the liability of the women to anæmia and to optic neuritis, and who, if pregnant, usually miscarry. Where no group of muscles is exposed to fatigue more than other muscles of the body, it can not be said that occupation per se determines the form paralysis will take.

As for the rapidity with which anæmia, colic, and wrist drop develop, it is largely a question of the amount of lead to which the workers are exposed and its mode of entrance into the body. While some writers maintain that the slower and more insidious forms of saturnine poisoning are brought about by handling metallic lead; and that the absorption of lead compounds in the form in which they are present in paints produces more serious symptoms than when there is absorption of lead in the form of fume and dust, there is really no unanimity of opinion as to whether lead as vapor is less or more dangerous than lead in the form of dust. Teleky draws attention to a type of nervous symptoms which he has observed on three occasions in young painters and which he calls hysterical colic. Its peculiar features are its long duration, its divergence from the classic type, its yielding to cold-water cure, and to faradism. Where the dyeing of silk black by means of acetate of lead is carried on as a home industry there is a higher percentage of kidney disease among young women thus employed than in those engaged in other lead processes; but this is hardly to be wondered at, for they live in an atmosphere heavily charged with lead dust, judging from the appearance of the living and sleeping rooms, so that here again it is a question of the amount of lead dust inhaled.

WHAT CONSTITUTES INDUSTRIAL LEAD POISONING.

In other words, when is a worker really suffering from lead poisoning? The blue line on the gums, present in fully 25 per cent of workers, according to the nature of their occupation, is not, unless

it is accompanied by other symptoms, a proof per se of lead poisoning, for a similar blue line, exactly located as in plumbism, close to the teeth, may be found under other circumstances, as, for example, in one of my own empyema patients who had his pleural cavity injected with bismuth paste in order to check suppuration and favor closure of the cavity. A greenish-blue line is also observed in copper workers. Yet in the case of a person with an unmistakable Burtonian line on the gums, such a line, when attended by obscure symptoms becomes of considerable assistance in diagnosis and especially so if the occupation is known. After all, the cases in which bismuth and nitrate of silver show a blue line on the gums are few when compared with lead. In previous parts of this monograph I have alluded to the presence of lead in the urine. What significance is to be attached to this circumstance? Prof. Bedson has made for me a chemical analysis of urine passed by 20 male lead workers in the morning before going to the white-lead factory, also of three paint grinders in another factory.

SERIES OF URINE EXAMINATIONS FOR LEAD IN MALE WHITE-LEAD AND RED-LEAD WORKERS AND IN PAINT GRINDERS, MAY 31 TO JUNE 15, 1910.

WHITE-LEAD AND RED-LEAD WORKERS.

No.	Age.	Occupation.	Years of employment.	Urine per million parts, amount of lead.
1....	30	White-lead worker.....	1	0.64
2....	23	.....do.....	2	1.83
3....	25	.....do.....	2	2.40
4....	56	.....do.....	2	1.20
5....	43	.....do.....	8	1.20
6....	25	.....do.....	7	.64
7....	36	.....do.....	11	.80
8....	40	.....do.....	12	2.00
9....	41	.....do.....	12½	1.83
10....	36	.....do.....	13	1.48
11....	36	.....do.....	13	1.92
12....	68	.....do.....	14	1.60
13....	43	.....do.....	16	.90
14....	35	.....do.....	17	.80
15....	38	.....do.....	20	.40
16....	45	.....do.....	20	1.82
17....	47	.....do.....	20	2.40
18....	48	White and red lead worker.....	30	1.84
19....	64	.....do.....	30	1.08
20....	58	.....do.....	33	2.75

PAINT GRINDERS.

No.	Age.	Occupation.	Number of years—		Urine per million parts, amount of lead.
			In firm.	In mill.	
1.....	44	Grinding lead and oil	26	2	0.88
2.....	42	.....do.....	16	6	1.20
3.....	52	.....do.....	29	9	1.60

The amount of lead in the urine of the three paint grinders is proportional to the length of time the men have been employed in the mill, but this remark does not apply with such regularity to the white and red lead workers; partly because the men are not exposed to equal risks. So far as the presence of lead in the urine is concerned it is to be remembered that long after a person who has suffered from saturnine intoxication has retired from working in a lead factory, traces of the metal may still be found in the urine, especially after the administration of iodide of potassium. In one of my patients, a red-lead worker, suffering from double-wrist drop, lead was found in the urine to the extent of 1.76 per million 16 months after he had given up work, a larger amount than was present in the urine of paint grinder No. 3 in the above table, who at the time of the examination was working in lead and with possible opportunities therefore of absorbing it. In the urine of a female aged 55, who 11 years ago had been a white-lead worker and who was admitted under my care in the infirmary (July, 1910) for gangrene of the toes of the right foot and arteriosclerosis, 3 parts of lead per million were found.

By none of the 23 men, the analysis of whose urine is recorded above, was there the slightest complaint as to the state of his health. But suppose one of them had complained of colic or of weakness of the muscles of the hands, and a blue line had been observed on his gums, would the detection of lead in his urine not have been pretty conclusive evidence of lead poisoning? I think it would. Is it symptoms alone which constitute plumbism, or is it symptoms plus evidence of the presence of lead in the body and in the secretions? Many persons are the subjects of serious illness without experiencing discomfort. An applicant for life insurance is on medical examination found to have a diseased heart; he is ignorant of the fact because he has never found any inconvenience from it. He is in the same position as a lead-intoxicated person who has no symptoms. A patient looks and says he feels quite well, and that he is as fit for work as ever, but he has a slight cough, and in his sputum on bacteriological examination tubercle bacilli are found. Is such a person suffering from tuberculosis, or is he only on the road to it? He is a menace to others, because he is a bacillus carrier. A miner has had ankylostomiasis or what is known as the hookworm disease. So severe were the symptoms that in consequence of abstraction of blood by the intestinal parasite and the accompanying toxæmia the man just escaped death. Under treatment perhaps all the worms were got rid of, but he has become reinfected, and yet he has no symptoms, nor does he complain, for he has become immune to ankylostomiasis. Although he looks well nourished, does not complain, and is fit for hard work, yet his feces swarm with the ova of the

hookworm. If such symptoms as anæmia, breathlessness on exertion, debility, gastrointestinal derangements, and swelling of the feet constitute the disease, then the miner in question is not suffering from ankylostomiasis although he is harboring the parasite, and may by his carelessness infect a mine, and through it many of his fellow workmen. It would seem therefore that although Koch's bacillus is the cause of tuberculosis and the presence of the hookworm in the intestine is the cause of ankylostomiasis, yet for a particular individual concerned something more is required than the organism special to the disease, something purely personal over and above the organism, even although without the organism the disease could not exist at all. A malady may be latent and may be only awaiting the fall of a spark to light it into activity. If from the cerebral exudate of a person whose illness lasted only a few days a bacteriologist obtains a particular organism, the finding of which gives its name to the disease, shall the detection of lead in the urine and tissues on chemical examination not stand in a similar relationship to the disease and be regarded as the cause of death? Lead in the urine means lead in the system, and the possibility at any moment not only of symptoms of saturnine intoxication breaking forth, but of its influence in deleteriously modifying the course of any disease which may supervene other than plumbism.

The power for harm of unrevealed plumbism, or where no symptoms are exhibited, is shown in the terrible toll of infant life in the numerous miscarriages and stillbirths due to latent saturnine poisoning of the female lead worker. It is not necessary that in order to destroy the product of conception a female lead worker should either before or after impregnation have exhibited the classic symptoms of lead poisoning. She may never have shown signs of plumbism, and yet without the slightest doubt her child dies from plumbism by direct maternal transmission. Like the plumber whose case I reported a few pages back, although the appearance of the brain at the post mortem examination might to an expert pathologist have suggested the probability of saturnine encephalopathy, it was the detection of lead in the tissues on chemical analysis which made the diagnosis absolute.

None of the above-mentioned 23 lead workers whose urine contains lead may die from plumbism, and yet some of them may succumb to its ulterior consequences; on the other hand, all of them would probably have their recovery from any incidental illness retarded by the lead which is present in their system. There are therefore two forms of plumbism; the actual, which gives rise to symptoms, and the potential, which awaits the arrival of a tertium quid, the development of something unusual within the individual himself, consequent upon an alteration of his internal chemistry,

before symptoms can be lit up. Is the potential form of plumbism to be regarded as a disease under the Workmen's Compensation Act? It may never become actual, and to that extent it may never give rise to the ordinary signs of plumbism. Yet all the same, pathological changes are silently taking place within the body, the consequences of which may be even more disastrous ultimately than where the malady has revealed itself by symptoms and can be treated. It is well before concluding from a chemical examination of the urine that a particular patient is suffering from plumbism to bear in mind the possibility of the presence of other metals, such as bismuth, arsenic, silver, antimony, copper, and mercury, and especially should this be remembered when a claim for compensation is advanced by a workman or his friends.

The following table published by Legge¹ shows the relative frequency of the particular form of plumbism and the organs affected in the several groups of industries, also the average ages at death, when due to acute or chronic lead poisoning:

MAIN SYMPTOMS APPEARING AS THE CAUSE IN 264 DEATH CERTIFICATES OF LEAD POISONING.

Industry.	Encephalopathy.	Bright's disease.	Cerebral hemorrhage.	Paralysis.	Lead poisoning.	Phthisis.	Pneumonia, bronchitis, heart failure, colic, hernia, apæurism.
Smelting of metals	1	6	.....	3	5	1	1
Brass works .....	.....	3	.....	1	1	.....	1
Sheet lead and lead piping .....	.....	1	.....	.....	1	.....	1
Plumbing, soldering	2	3	.....	1	2	1	2
Printing	3	3	.....	2	5	1	3
File cutting	1	11	2	2	2	1	.....
Tinning, enameling .....	.....	1	.....	.....	1	.....	.....
White lead	13	2	2	4	2	1	3
China, earthenware	8	24	14	3	6	2	.....
Glass cutting	1	6	.....	.....	1	.....	1
Electric accumulators	2	1	.....	1	2	.....	2
Paints and colors	4	1	.....	.....	.....	.....	3
Coach making	1	3	5	6	10	3	4
Shipbuilding	1	4	.....	.....	1	.....	.....
Paints used in other industries .....	.....	3	1	4	6	1	2
Other industries	1	2	1	.....	11	.....	2
Total	33	79	26	27	56	13	25
Average age at death	32	43	47	43	44	38	40

The largest number of cases of saturnine encephalopathy occurs in the white-lead industry and in pottery manufacture. Workers in china and earthenware, also file cutters, die in greater proportion than other workers in lead from disease of the kidneys; coach painters follow closely upon these.

¹ Annual Report of the Chief Inspector of Factories and Workshops [of Great Britain] for the year 1909, p. 197.

LEAD POISONING AND THE BRITISH WORKMEN'S COMPENSATION ACT OF 1906.

In Great Britain lead poisoning is one of the industrial diseases scheduled in the act of 1906 for compensation. The act provides that a workman shall be entitled to compensation as for an injury by accident, when it can be shown that he is disabled from work by having contracted lead poisoning due to his employment in any process involving the use of lead or its preparations or compounds. He must (1) produce a certificate from the local certifying surgeon under the Factory and Workshop Act, 1901, or (2) prove that he has actually been suspended from his usual employment on account of plumbism, or (3) when a workman dies, his death must be proved to be due to saturnine poisoning. Compensation is payable from the date of the workman's suspension or disablement from work, but if at the time of entering the employment a workman willfully represented himself in writing as not having previously suffered from lead poisoning, when in fact he had so suffered, he deprives himself of the right of compensation. During total or partial incapacity for work the compensation is 50 per cent of the workman's average weekly earnings. As in the case of accident, if the incapacity lasts less than two weeks no compensation is to be payable in respect of the first week, but if the incapacity lasts for two weeks or more compensation is paid from the date of the incapacity the result of the illness.

For several years previously to the passing of the Workmen's Compensation Act in Great Britain a similar problem had been grappled with by France. At almost every congress of hygiene, too, in Europe the question had been from time to time discussed as to whether industrial diseases should not, for compensation purposes, be placed in the same category as accidents. It was held by jurists that as an accident is something which happens suddenly on a particular day, is fortuitous and unexpected, industrial diseases could not be included in the same category, since it can not be said that they are altogether unexpected.

In Great Britain this distinction broke down when on a case of anthrax a workman, by operating upon a particular bale of infected hair, became poisoned by the bacilli of anthrax and died a few hours afterwards. Here was illness due to infection caught by a workman while performing a distinct and specific act, at a certain hour on a particular day, whereby unexpectedly a fatal blow was struck by microorganisms just as suddenly as if he had received a stroke from an injury. Under these circumstances anthrax could not be regarded as other than an accident, nor could it be disregarded as a disease. It is both.

Occupational diseases usually develop slowly; they are a consequence of employment. To that extent, therefore, they are not unexpected, and in many instances they are preventable. There are occasions, however, in which even with the greatest care they can not be prevented, as where men when at work are immediately overpowered by the sudden escape of noxious gas, such as sulphureted hydrogen or carbon monoxide, and are killed as rapidly by the poison as if they had received a serious accident in the ordinary sense of the term. There are cases, too, as in lead poisoning, where an industrial disease develops so slowly that for a time it does not interfere with a man's ability to follow his occupation, until something suddenly occurs in the factory, such as a breakdown in the ventilation, when as a consequence of fresh inhalation of dust there is a sudden accession of poison to the system, followed by symptoms of acute saturnine intoxication, thereby more permanently damaging the workman's health than if he had sustained a fractured limb. It is only right, therefore, that persons suffering from lead poisoning due to their occupation should receive compensation, especially if it can be shown not to have arisen through any fault of their own.

This raises the question of how far a workman engaged in lead processes and who has become the subject of plumbism is entitled to compensation when, after having been warned, he has persisted in using tobacco during working hours. I do not raise the debatable point as to whether the practice is a safeguard against plumbism, as many of the men believe, for the experience of the owners of the factory at Nantes, mentioned earlier (p. 89) in this monograph, points to the contrary, but I do say that tobacco taken out of an open waistcoat pocket, or out of a metal case, handled by dirty fingers, bitten by dust-stained teeth, and gripped by similarly soiled lips by men when at work, becomes a vehicle for the introduction of lead into the system. The same applies to the smoking of cigarettes when at work. Whether the chewing of tobacco is indulged in or not, saturnine poisoning may develop, but it is certainly much more likely to be precipitated by men when at work indulging in the obnoxious habit than by abstaining from it. Persistent disregard of instructions after receipt of a warning in writing as to the use of tobacco by men when at work should, in the event of lead poisoning taking place, become a reason for reducing the amount of compensation awarded.

It is needless to add that, like many beneficent movements, the Workmen's Compensation Act has been much abused. Lead poisoning is not always easy of recognition. In some instances the symptoms are largely subjective and can be simulated by other diseases. There is a tendency when lead workers fall ill from any cause to attribute their indisposition to their occupation, since, if the two

circumstances can be correlated, the patients can abstain from work, knowing that their means of sustenance will not be altogether cut off. Medical men have therefore to be on their guard. They must not in this matter be partisans, but with a perfectly open mind take such a comprehensive view of the case as the situation demands, trying faithfully to discharge a duty alike to the employer and to the employed.

Lead workers seek medical advice for the most trivial aches in their limbs and chest to an extent which was not done a few years ago, and they invite reassurance that they are suffering from lead poisoning in order to obtain benefits under the act.

As illustrations of a few doubtful cases referred to the writer for an opinion as possibly coming within the sphere of the Workmen's Compensation Act, the following may be quoted:

(1) A man who was "holding up" an iron plate on a ship was suddenly burnt by hot red paint. He was taken to the local hospital, where his wounds were dressed. In a few days he developed acute lead poisoning, from which he made a slower recovery than from the burns.

(2) A painter, aged 46, was sent to me on account of weakness and numbness of the legs which rendered walking difficult. There was incoordination of movement, and as a consequence he had fallen on a few occasions. There was no blue line on the gums; patient had never had colic; there was no albumen in the urine; the knee jerks were exaggerated. No syphilitic history was obtainable. In the physical signs there was nothing specially pointing to lead, and yet lead was found in the urine.

(3) A man, aged 26, employed as a plumber by a water company to make joints with white lead and to melt down old pipes began to lose flesh; he subsequently developed influenza. The case was regarded as plumbism by his medical man. There had never been colic. In this man I found simple dilatation of the stomach. As no lead was found in the urine, the theory of plumbism was discarded, the stomach was treated and with satisfactory results.

(4) A painter, 37 years of age, gave a history of colic three years previously. A year afterwards he had headache and influenza, followed by rheumatism in his feet and toes, and as a consequence walking became a matter of difficulty. There was no blue line on the gums nor albumen in the urine, and yet the urine contained lead, a circumstance which showed that his infirmity was largely the result of his occupation.

(5) A healthy man, a white-lead worker, aged 36, who had served in the South African War, began to experience severe headache on returning home from the factory in the evenings. On reaching home he often had to go to bed. He continued to follow his employment,

but the headaches becoming more severe and accompanied by vomiting, he gradually became unable to stand through loss of power to balance his head, and was obliged to remain in bed. There was no paralysis, but there was a faint blue line on the gums. The urine was free from albumen. Knee jerks were present. The optic disks were pale and showed signs of commencing atrophy. There was nothing in the symptoms apart from the history of the occupation except the faint blue line to warrant the diagnosis of plumbism, until on examination the urine was found to contain lead. Treatment for plumbism was begun, and in a few weeks the man was convalescent.

(6) A ship's painter, aged 43, gave a history of having been seized with pain in his side after lifting with a fellow workman a heavy box. Patient claimed compensation on the ground that he was suffering from lead poisoning, but on careful examination I could find nothing to suggest plumbism, and as no lead was found in the urine the claim did not receive support.

Some of these cases are illustrations of ill-defined and atypical forms of plumbism, where the health had been lowered by the poison and where but for the presence of lead in the urine it would have been difficult to prove or disprove that the patient was suffering from saturnine poisoning.

In two of the above cases, Nos. 3 and 6, an attempt was made to obtain compensation for indispositions in no way the result of occupation. Men and women working in lead are liable to the same maladies as persons following other occupations. There are certain trades, such as type founding, printing, and pottery manufacture, where the danger comes not so much from lead itself as that those employed become more prone to tuberculosis than persons following other trades. It is difficult to know how to compensate, if at all, in these cases, for admitting that there is a causal relationship between lead, the particular occupation, and pulmonary disease, the fact that tuberculosis is widely spread, Koch's bacillus being ubiquitous, and that possibilities of infection meet one almost everywhere, in the street, the home, and in places of public resort, all of these make it practically impossible, unless the lung disease take the form of pneumoconiosis, to assign to occupation its share in the production of pulmonary disease.

In cases of industrial lead poisoning, where one-half of the wages is allowed as compensation to the sick workman, it might well be asked whether under the circumstances this is enough, for if a man is, in consequence of lead poisoning, thrown out of work for any length of time, he will be obliged, as a result of receiving only half of his wages, to go into poorer rooms, and he will have less money to purchase food, neither of which will help him to regain his health. There is, therefore, a tendency for a wage earner who is threatened

with plumbism to go on working and to conceal his symptoms, knowing what awaits him should he perchance be suspended or obliged to give up work. Insufficient compensation and the possibility of dismissal are discouraging prospects to lead workers on the advent of plumbism. Since certain diseases alone have been scheduled and not others, the act only partly meets the pathological events of industrial life. It is circumstances such as those recorded above which have raised the question, Whether Great Britain should not embark upon a complete system of sickness and invalidity insurance, contributory in character, like that in Germany, by which all workmen ill from any cause would be placed beyond the pale of absolute poverty, the influence of which in all sickness, but especially that which we have been discussing, is to retard recovery?

In view of possible claims arising out of the workman's compensation act for the death of a relative from supposed plumbism, the following question presents itself: Does lead normally exist in the human body? Orfila was of the affirmative opinion. Armand Gautier maintained that even in healthy persons who were not eating food cooked or preserved in utensils soldered by or enameled with lead, or drinking aerated water out of siphons, as much as half a milligram of lead entered the alimentary canal daily. G. Meillère,¹ as a result of an experimental inquiry, concluded that the organs of the human body contain the merest but still indisputable traces of lead. Admitting this possibility, there can not be in the human body, so long as the eliminating organs are healthy, any such thing as lead present in physiological quantities in the same sense as that in which arsenic and iodine are found, for lead is not a constant element of the body. It is not necessary to any of its functions; it is entirely accidental to the organs and at the best is badly tolerated.

Another point calling for consideration is insurance under the Workmen's Compensation Act. Although in Great Britain there has been during recent years a decline in the mortality from plumbism in several of the lead trades, the same can not be said of house and coach painting. In Germany, on the contrary, while there has been a decrease in the amount of plumbism in painters, the sick rate has increased in white-lead workers and color grinders. Between 1905 and 1906 the percentage of cases of lead poisoning in painters fell from 35.4 to 31.8, and in 1908 to 29, whereas in white-lead workers and color grinders the percentages were for 1904, 12.2, and for 1908, 19.1.² Experience of the Workmen's Compensation Act has obliged British insurance companies to raise their premiums.

¹ Le Saturnisme. Étude historique, physiologique, clinique et prophylactique. Thèse, Paris, 1903.

² Der Stand der Bleivergiftungen in den Gewerblichen Betrieben Preussens. Leipzig, F. C. W. Vogel, 1910.

In consequence of lead poisoning in painters not being compulsorily notifiable to the Home Office, there must be several cases of plumbism which do not come within the cognizance of the chief inspector of factories, but which have yet to be dealt with by the funds of the friendly societies. This increases the difficulty of obtaining exact statistical information. In Prussia a similar thing is noted as regards hospital statistics and those of the sick funds. In Berlin, according to the sick funds of the various trades, there were in 1904, 879 cases; 1905, 748; 1906, 653; and in 1907, 572 persons suffering from metallic poisoning, mostly lead, while in the various hospitals the figures for the same years were 178, 167, 151, and 146, respectively; that is to say, the number of cases which received hospital treatment compared with those existing stood in the ratio of 1 to 4. In Vienna only one-fourth of the cases of lead poisoning go into the hospitals for treatment. In Newcastle-upon-Tyne the ratio is about the same. The figures of the Prussian sick funds show that one-third of the workpeople claiming benefits from lead poisoning are painters, and that in the painters of Berlin alone are included fully one-third of all the cases of plumbism occurring in Prussia.

Since the experience of British offices as regards the insurance of workpeople for plumbism has not been quite satisfactory, some of them now require 1.5 per cent to insure against the risks of lead poisoning and accidents to painters. The reason of this can be seen from a perusal of the comparative mortality figures recently supplied to a correspondent by the statistical department of Somerset House.

NUMBER OF DEATHS OF WORKMEN IN CERTAIN OCCUPATIONS DURING SPECIFIED PERIODS.

Occupation.	1890-1892	1900-1902
Lead workers.....	243	108
File makers.....	87	57
Potters.....	19	9
Painters.....	22	22
All occupied males 25 to 65 years.....	1	1

TREATMENT OF LEAD POISONING.

The treatment of lead poisoning is preventive and curative. We shall deal with the latter first. One of the commonest complaints calling for treatment is colic. As this is usually attended by constipation, the administration of aperients is frequently but not always followed by relief. Magnesium sulphate with tincture of belladonna and carminatives answer well, or castor oil may be administered. Should these fail to empty the bowel, an enema of olive oil and warm water may be administered. Hot applications may be

applied to the abdomen if the pain does not subside, or a hot bath taken by the patient. Even after these the pain may still continue and require the administration of morphia hypodermically. One or other of these methods of treatment may be supplemented with advantage by monosulphite of soda, one-half to 3 grains thrice daily. Dr. Stephens, of Swansea, found that half-grain doses of calcium permanganate in a paraffin capsule twice or thrice daily gave great relief to the abdominal pains complained of by lead workers. If there is sickness, an effervescing mixture of soda and magnesium carbonate, with or without liquor bismuthi, may be administered. Because iodide of potassium favors the elimination of lead there is a tendency on the part of medical practitioners to administer the drug in all stages of lead poisoning. It is not a safe procedure. The medicine should be given cautiously, for experience has confirmed Melsen's teaching that the drug, by redissolving lead stored up in the tissues, may aggravate symptoms. In the case of chronic lead intoxication without active signs of the malady the indiscriminate administration of potassium iodide has occasionally lit up symptoms of acute poisoning and caused death. The drug increases the amount of lead thrown off in the urine. In some of the writer's patients it has also brought on albuminuria and severe headache, both of which ceased on discontinuing the medicine and returned on recommencing it. As the white corpuscles of the blood and pus have a special affinity for lead, injections of turpentine into the skin have been recommended by Dr. Jacques Carles, of Bordeaux,¹ with the view of setting up an abscess. The pus which is removed from the abscess is extremely rich in lead, there having been found in it as much as 0.005 to 0.08 grams of sulphide of lead. In dogs the subjects of chronic plumbism and to which no lead had been given for two months prior to the injection of turpentine, Carles found more lead in the pus than in the internal organs, and from the pus of an artificially induced abscess in a painter who was suffering from tremor and paralysis, but who had not been near lead for three months, 2½ milligrams of lead were recovered. In this way considerable quantities of lead can be removed from the system in acute plumbism. The drawback to this method of treatment is the pain experienced by the patient.

For paralysis, electric baths and massage with the internal administration of liquor strychniæ or tinctura nucis vomicæ give the best results. As the return of power to the paralyzed muscles is slow, the treatment may have to be continued for weeks or months. In the case of one of the writer's lead-poisoned rabbits paralysis of the limbs disappeared entirely under the use of the electric bath. On the

¹ Bulletin Général de Théraputique, 8 fév. 1909, p. 161.

aluminum electrodes as well as in the bath water lead was found, a circumstance which showed that lead is extracted from the body by means of electricity. Treatment of lead paralysis by the electric bath has been carried out with successful results in the potteries for several years past. In some cases iodide of potassium may be administered first in small doses, combined with magnesium sulphate and tincture of *nux vomica*. For the anæmia of plumbism small doses of iron may be given. Iron in the form of hæmaboloids or hæmatogen is worthy of a trial, or for these bone marrow may be substituted. The treatment of chronic plumbism with accompanying disease of the kidneys must be conducted on general lines. For the convulsions of saturnine encephalopathy inhalation of nitrite of amyl, with or without lumbar puncture, and the removal of cerebro-spinal fluid may be resorted to.

MEANS OF PREVENTION OF INDUSTRIAL LEAD POISONING.

IMPORTANCE OF CLEANLINESS.

The prevention of industrial lead poisoning is largely summed up in attention to the regulations which have been drawn up by the factory department of each country for employers and employed. These regulations appear as an appendix to this monograph. The value of cleanliness of the individual and of the workshop can not be too much insisted upon. No food should be eaten in the workshop and never at any time or in any place until after the hands and face have been well washed, also the mouth and throat well rinsed with an alkaline mouth wash. In Neuwied the men employed in the sugar-of-lead works rinse the mouth with 0.2 per cent solution of sulphite of soda. These men keep in good health.

In one of the best conducted white-lead works with which the writer is familiar, the firm provides chocolate-coated tabloids containing 5 grains of hyposulphite of soda. The men of their own accord take sometimes two or three of these tabloids daily, and although on the gums of some of the men there is a well-marked blue line, and in their urine lead has been found, yet in none of the men are there symptoms of lead poisoning. These tabloids are preferable to the sulphur lozenges, which are sometimes prescribed, and they are more reliable than the sulphuric-acid lemonade, which in some factories the workmen are still encouraged to drink in the belief that the acid converts any lead present in the stomach into sulphate, erroneously believed to be more insoluble; for, as Goadby's experiments have shown, lead sulphate is even more soluble in gastric juice than the carbonate and oxide.

No work in a lead factory should ever be begun for the day without the workpeople having had food. The preventive influence of milk

is beyond question. Employers would only be considering their own interests if they saw or knew that their workpeople had partaken of food before beginning work for the day. Lavatory basins with hot and cold water and plenty of towels should be provided by the employers. Washing appliances should be ample and the bathrooms of such cleanliness that any self-respecting workman can use them.

SOAP.

Various kinds of soap have been recommended. In Burgbrohl the workmen use with benefit soap containing pumice stone. Akremnine soap, evidently a sulphur combination, is recommended on the ground that it removes traces of lead from the hands. Opinions are divided as regards its utility. Tried in a German factory, the men discontinued its use, because it did not lather. In other factories the men stopped using it because it affected the skin. The diamond cutters of Amsterdam objected to it on the ground that it blackened their hands. In one of the districts of Holland, the workmen after a thorough and repeated washing with ordinary soap, used immediately afterwards akremnine soap with the result that the skin became brown, showing that the skin still contained traces of lead. The same experiment was made in two printing shops where the men worked with type, and as a similar result was obtained the men were encouraged to try akremnine soap a little longer, and since then their prejudice in regard to it has gone. In other places where it has been tried it has been discontinued on account of the discoloration of the skin which it causes, its disagreeable odor, and expense, for akremnine soap retains its supposed good qualities for a short time only, and has therefore to be discarded.

USE OF RESPIRATORS.

Lead dust is readily caught in the respirators worn by persons working in lead processes. Objections, not without reason, are raised by the workpeople in regard to their use. They say they can not breathe easily when wearing a respirator, that they feel uncomfortably hot and perspire too freely. The late Dr. Dupré, chemical expert of the Home Office and to the members of the white-lead commission, analyzed the respirators worn by lead workers and found that they contained considerable quantities of lead. All respirators should be light and made of the simplest material, so that respiration may be embarrassed as little as possible and the air breathed be kept correspondingly cool. The numerous respirators on the market forbid a description of any of them.

As bearing upon the protection which respirators afford to the worker, the following information is of interest. Parry¹ gives the

¹ The Risks and Dangers of Various Occupations. Leonard A. Parry. London, Scott, Greenwood & Co., 1906.

result of the examination of new moist sponges which had been placed in the respirators worn by women working in a factory where yarns were dyed yellow by chromate of lead. The experiments were made (a) during ventilation of the workroom by a fan running and (b) when the fan was stopped. The data obtained convey also some idea of the clearing of the atmosphere effected by fans. Two periods of three hours' work were tried with exactly the same kinds of yarn and under precisely the same conditions, except that in one of the trials a powerful down draft from a fan was in action, while in the other the fan was stopped and the work was allowed to proceed with only such natural means of ventilation as open windows. Dr. A. Stüder, who carried out the experiments, reported as follows:

(a) Where the fan was working the sponge of the respirator was found to contain 0.0034 gram of metallic lead. The yellow color of the dust on the sponge was only slightly noticeable; (b) where the fan was stopped the sponge was found to contain 0.02 gram of metalloid lead, and the sponge was colored yellow by the dust. The atmosphere of the room in which the "noddling" of the yarn was carried on by the women was clouded with yellow dust. These figures, drawn from an examination of the respirators worn by workpeople, show what can be done by dust-extracting arrangements to render the atmosphere of a workroom clear, but even with the best of fans there will always remain suspended in the air of a workroom a certain amount of fine dust. Wherever practicable, all work in a lead factory done by hand should as far as possible be replaced by dust-proof machinery.

MEDICAL EXAMINATION OF THE WORKERS.

Experience confirms the value of periodical medical inspection of workers in lead processes and of the reexamination by certifying factory surgeons of workers who have been suspended on account of plumbism. Notwithstanding the benefits obtained, the value and the protection afforded by the medical examination have been questioned because workpeople have died from unmistakable signs of plumbism a few days after the examination. It is desirable that the examination should be carefully conducted, for experience shows how subtle lead poisoning is and how quickly latent plumbism may become active. Workers in lead who have suffered from recurrent attacks of colic would be well advised if they gave up their occupation or sought for some other work in the factory which does not bring them into close contact with lead.

CONCLUSION.

In bringing to a close this contribution to the literature of lead poisoning, it may be said that, while factory legislation has already accomplished much, there yet remains much to be done in order to still further protect the health of the workers. The abolition of female

labor in the dangerous processes of lead factories has been an incalculable boon to humanity. It would seem as if in this question of industrial lead poisoning a climax has been reached and a time has come when further good may be effected by employers instructing their workpeople in the dangers to which occupation exposes them and by the employees loyally cooperating with employers, doctors, and factory inspectors so as to insure that regulations shall be carried into effect. Owing to the importance which this subject is assuming in all progressive countries, medical men should have greater opportunities of studying diseases of occupation and, with the interests of the employers properly safeguarded, of following up their inquiries in a reasonable manner into the factories, so that they might become familiar with the peculiar circumstances under which industrial diseases arise.

The city of Milan has set the example of establishing a clinical institution for the study of industrial diseases. It remains to be seen what other countries will do in this matter. Hungary has in Budapest founded a museum of social service where old and dangerous processes of manufacture can be contrasted with those of modern date and healthier nature, and where lectures upon occupation diseases are given to the industrial classes. In Amsterdam there is also a museum of safety appliances. From the report of the chief inspector of British factories for 1909 we learn that during the last 10 years, including painters and plumbers, 8,973 cases of plumbism were reported to the Home Office, and that during this period there occurred 667 deaths from industrial lead poisoning. These figures do not include all who have suffered, for notification of lead poisoning in painters and plumbers is not compulsory in Great Britain. From Prussia comes the equally sad tale by Dr. Kaup of 21,000 days of sickness spent by workpeople in the hospitals in 1908 as the result of plumbism, and of the total number of days spent in the hospitals during 1908 and the four years preceding reaching 122,000. Since the cases of plumbism which do not enter hospitals are more than three times greater in number than those which seek hospital treatment, the statistics for western Europe, including those of the British Isles, are such as call for thoughtful reflection. What a loss of life, weakening of energy, and check to national welfare industrial lead poisoning is still causing! Shall this be allowed to continue when we know so much can be done to prevent it?

APPENDIX.

REGULATIONS FOR FACTORIES AND WORKSHOPS IN CERTAIN INDUSTRIES USING LEAD.

GREAT BRITAIN.

PART I—REGULATIONS.

FOR THE PROCESS OF FILE CUTTING BY HAND.²

1903. No. 507.

Whereas the process of file cutting by hand has been certified in pursuance of section 79 of the Factory and Workshop Act, 1901,³ to be dangerous:

I hereby, in pursuance of the powers conferred on me by that act, make the following regulations, and direct that they shall apply to all factories and workshops (including tenement factories and tenement workshops) or parts thereof in which the process of file cutting by hand is carried on: *Provided*, That the chief inspector of factories may, by certificate in writing, exempt from all or any of these regulations any factory or workshop in which he is satisfied that the beds used are of such composition as not to entail danger to the health of the persons employed.

1. The number of stocks in any room shall not be more than one stock for every 350 cubic feet of air space in the room; and in calculating air space for the purpose of this regulation any space more than 10 feet above the floor of the room shall not be reckoned.

2. After the 1st day of January, 1904, the distance between the stocks measured from the center of one stock to the center of the next shall not be less than 2 feet 6 inches, and after the 1st day of January, 1905, the said distance shall not be less than 3 feet.

3. Every room shall have a substantial floor, the whole of which shall be covered with a washable material, save that it shall be optional to leave a space not exceeding 6 inches in width around the base of each stock.

The floor of every room shall be kept in good repair.

4. Efficient inlet and outlet ventilators shall be provided in every room. The inlet ventilators shall be so arranged and placed as not to cause a direct draft of incoming air to fall on the workmen employed at the stocks.

The ventilators shall be kept in good repair and in working order.

5. No person shall interfere with or impede the working of the ventilators.

6. Sufficient and suitable washing conveniences shall be provided and maintained for the use of the file cutters. The washing conveniences shall be under cover and shall comprise at least one fixed basin for every 10 or less stocks.

¹ Factory and Workshop Acts. Dangerous and Unhealthy Industries. Regulations and Special Rules in force on January 1, 1908. London, 1907.

NOTE.—This print contains the codes of regulations and special rules (subject to the exception mentioned on p. 150) in force on January 1, 1908, in places under the factory acts. The regulations appear in Part I of the print. They have been made under the procedure enacted by the Factory and Workshop Act, 1901 (secs. 79–86), in substitution for the “special rules” procedure of the earlier factory and workshop acts. Regulations apply automatically to all places of the class for which they are made. The special rules appear in Part II. They are made under the procedure enacted in the Factory and Workshop Acts, 1891 and 1895, and are not in force at a factory or workshop until they have been established individually for that factory or workshop. The codes of special rules are being gradually replaced by regulations under the act of 1901.

² These regulations were granted June 23, 1903.

³ 1 Edw. 7, ch. 22.

Every basin shall be fitted with a waste pipe discharging over a drain or into some receptacle of a capacity at least equal to 1 gallon for every file cutter using the basin. Water shall be laid on to every basin either from the main or from a tank of a capacity of not less than $1\frac{1}{2}$ gallons to every worker supplied from such tank. A supply of clean water shall be kept in the said tank while work is going on at least sufficient to enable every worker supplied from such tank to wash.

7. The walls and ceiling of every room, except such parts as are painted or varnished or made of glazed brick, shall be limewashed once in every six months ending the 30th of June and once in every six months ending the 31st of December.

8. The floor and such parts of the walls and ceiling as are not limewashed and the benches shall be cleansed once a week.

9. If the factory or workshop is situated in a dwelling house, the work of file cutting shall not be carried on in any room which is used as a sleeping place or for cooking or eating meals.

10. Every file cutter shall when at work wear a long apron reaching from the shoulders and neck to below the knees. The apron shall be kept in a cleanly state.

11. A copy of these regulations and an abstract of the provisions of the Factory and Workshop Act, 1901,¹ shall be kept affixed in the factory or workshop in a conspicuous place.

12. It shall be the duty of the occupier to carry out regulations 1, 2, 3, 4, 6, 7, and 11, except that, in any room in a tenement factory or tenement workshop which is let to more than one occupier, it shall be the duty of the owner to carry out these regulations, except the last clause of regulation 6, which shall be carried out by the occupiers.

It shall be the duty of the occupier or occupiers to carry out regulation 8.

It shall be the duty of the occupier or occupiers and of every workman to observe regulations 5, 9, and 10.

These regulations shall come into force on the 1st day of September, 1903.

HOME OFFICE, WHITEHALL, *June 19, 1903.*

FOR THE MANUFACTURE OF ELECTRIC ACCUMULATORS.²

1903. No. 1004

Whereas the manufacture of electric accumulators has been certified in pursuance of section 79 of the Factory and Workshop Act, 1901,¹ to be dangerous:

I hereby, in pursuance of the powers conferred on me by that act, make the following regulations, and direct that they shall apply to all factories and workshops or parts thereof in which electric accumulators are manufactured.

In these regulations "lead process" means pasting, casting, lead burning, or any work involving contact with dry compounds of lead.

Any approval given by the chief inspector of factories in pursuance of these regulations shall be given in writing, and may at any time be revoked by notice in writing signed by him.

Duties of occupier.

1. Every room in which casting, pasting, or lead burning is carried on shall contain at least 500 cubic feet of air space for each person employed therein, and in computing this air space no height above 14 feet shall be taken into account.

These rooms and that in which the plates are formed shall be capable of through ventilation. They shall be provided with windows made to open.

2. Each of the following processes shall be carried on in such manner and under such conditions as to secure effectual separation from one another and from any other process:

- (a) Manipulation of dry compounds of lead.
- (b) Pasting.
- (c) Formation and lead burning necessarily carried on therewith.
- (d) Melting down of old plates.

Provided, That manipulation of dry compounds of lead carried on as in regulation 5 (b) need not be separated from pasting.

¹ 1 Edw. 7, ch. 22.

² These regulations were gazetted November 24, 1903.

3. The floors of the rooms in which manipulation of dry compounds of lead or pasting is carried on shall be of cement or similar impervious material and shall be kept constantly moist while work is being done.

The floors of these rooms shall be washed with a hose pipe daily.

4. Every melting pot shall be covered with a hood and shaft so arranged as to remove the fumes and hot air from the workrooms.

Lead ashes and old plates shall be kept in receptacles specially provided for the purpose.

5. Manipulation of dry compounds of lead in the mixing of the paste or other processes shall not be done except (a) in an apparatus so closed or so arranged with an exhaust draft as to prevent the escape of dust into the workroom, or (b) at a bench provided with (1) efficient exhaust draft and air guide so arranged as to draw the dust away from the worker, and (2) a grating on which each receptacle of the compound of lead in use at the time shall stand.

6. The benches at which pasting is done shall be covered with sheet lead or other impervious material and shall have raised edges.

7. No woman, young person, or child shall be employed in the manipulation of dry compounds of lead or in pasting.

8. (a) A duly qualified medical practitioner (in these regulations referred to as the "appointed surgeon"), who may be the certifying surgeon, shall be appointed by the occupier, such appointment, unless held by the certifying surgeon to be subject to the approval of the chief inspector of factories.

(b) Every person employed in a lead process shall be examined once a month by the appointed surgeon, who shall have power to suspend from employment in any lead process.

(c) No person, after such suspension, shall be employed in a lead process without written sanction entered in the health register by the appointed surgeon. It shall be sufficient compliance with this regulation for a written certificate to be given by the appointed surgeon and attached to the health register, such certificate to be replaced by a proper entry in the health register at the appointed surgeon's next visit.

(d) A health register in a form approved by the chief inspector of factories shall be kept, and shall contain a list of all persons employed in lead processes. The appointed surgeon will enter in the health register the dates and results of his examinations of the persons employed and particulars of any directions given by him. He shall on a prescribed form furnish to the chief inspector of factories on the 1st day of January in each year a list of the persons suspended by him during the previous year, the cause and duration of such suspension, and the number of examinations made.

The health register shall be produced at any time when required by His Majesty's inspectors of factories or by the certifying surgeon or by the appointed surgeon.

9. Overalls shall be provided for all persons employed in manipulating dry compounds of lead or in pasting.

The overalls shall be washed or renewed once every week.

10. The occupier shall provide and maintain—

(a) A cloakroom in which workers can deposit clothing put off during working hours. Separate and suitable arrangements shall be made for the storage of the overalls required in regulation 9.

(b) A dining room unless the factory is closed during meal hours.

11. No person shall be allowed to introduce, keep, prepare, or partake of any food, drink, or tobacco in any room in which a lead process is carried on. Suitable provisions shall be made for the deposit of food brought by the workers.

This regulation shall not apply to any sanitary drink provided by the occupier and approved by the appointed surgeon.

12. The occupier shall provide and maintain for the use of the persons employed in lead processes a lavatory, with soap, nailbrushes, towels, and at least one lavatory basin for every five such persons. Each such basin shall be provided with a waste pipe, or the basins shall be placed on a trough fitted with a waste pipe. There shall be a constant supply of hot and cold water laid on to each basin.

Or, in the place of basins the occupier shall provide and maintain troughs of enamel or similar smooth impervious material, in good repair, of a total length of 2 feet for every five persons employed, fitted with waste pipes, and without plugs, with a sufficient supply of warm water constantly available.

The lavatory shall be kept thoroughly cleansed and shall be supplied with a sufficient quantity of clean towels once every day.

13. Before each meal and before the end of the day's work at least 10 minutes, in addition to the regular meal times, shall be allowed for washing to each person who has been employed in the manipulation of dry compounds of lead or in pasting.

Provided, That if the lavatory accommodation specially reserved for such persons exceeds that required by regulation 12, the time allowance may be proportionately reduced, and that if there be one basin or 2 feet of trough for each such person this regulation shall not apply.

14. Sufficient bath accommodation shall be provided for all persons engaged in the manipulation of dry compounds of lead or in pasting, with hot and cold water laid on, and a sufficient supply of soap and towels.

This rule shall not apply if in consideration of the special circumstances of any particular case, the chief inspector of factories approves the use of local public baths when conveniently near, under the conditions (if any) named in such approval.

15. The floors and benches of each workroom shall be thoroughly cleansed daily, at a time when no other work is being carried on in the room.

Duties of persons employed.

16. All persons employed in lead processes shall present themselves at the appointed times for examination by the appointed surgeon as provided in regulation 8.

No person after suspension shall work in a lead process, in any factory or workshop in which electric accumulators are manufactured, without written sanction entered in the health register by the appointed surgeon.

17. Every person employed in the manipulation of dry compounds of lead or in pasting shall wear the overalls provided under regulation 9. The overalls, when not being worn, and clothing put off during working hours, shall be deposited in the places provided under regulation 10.

18. No person shall introduce, keep, prepare, or partake of any food, drink (other than any sanitary drink provided by the occupier and approved by the appointed surgeon), or tobacco, in any room in which a lead process is carried on.

19. No person employed in a lead process shall leave the premises or partake of meals without previously and carefully cleansing and washing the hands.

20. Every person employed in the manipulation of dry compounds of lead or in pasting shall take a bath at least once a week.

21. No person shall in any way interfere, without the concurrence of the occupier or manager, with the means and appliances provided for the removal of the dust or fumes, and for the carrying out of these regulations.

These regulations shall come into force on the 1st day of January, 1904.

HOME OFFICE, WHITEHALL, *November 21, 1903.*

FOR THE MANUFACTURE OF PAINTS AND COLORS.¹

1907. No. 17.

Whereas the manufacture of paints and colors has been certified in pursuance of section 79 of the Factory and Workshop Act, 1901,² to be dangerous;

I hereby, in pursuance of the powers conferred on me by that act, make the following regulations, and direct that they shall apply to all factories and workshops in which dry carbonate of lead or red lead is used in the manufacture of paints and colors or chromate of lead is produced by boiling: *Provided as follows:*

(1) The regulations shall not apply to factories and workshops in which paints and colors are manufactured not for sale but solely for use in the business of the occupier; or to factories or workshops in which only the manufacture of artists' colors is carried on; or to the manufacture of varnish paints.

(2) Regulation 2, and so much of regulation 3 as prevents the employment of a woman in manufacturing lead color, shall not apply to the packing in parcels or kegs not exceeding 14 pounds in weight, unless and until so required by notice in writing from the chief inspector of factories.

¹ These regulations were gazetted January 25, 1907.

² Edw. 7, ch. 22.

(3) Regulations 4, 5, 6, 11, and 12 shall not apply to factories or workshops in which the grinding of lead color occupies less than three hours in any week, unless and until so required by notice in writing from the chief inspector of factories.

Definitions.

For the purpose of these regulations—

“Lead color” means dry carbonate of lead and red lead, and any color into which either of these substances enters.

“Lead process” means any process involving the mixing, crushing, sifting, grinding in oil, or any other manipulation of lead color giving rise to dust; or the manufacture and manipulation of chromate of lead produced by boiling in the color house.

It shall be the duty of the occupier to observe Part I of these regulations.

It shall be the duty of all persons employed to observe Part II of these regulations.

PART I.—Duties of employers.

1. No lead color shall be placed in any hopper or shoot without an efficient exhaust draft and air guide so arranged as to draw the dust away from the worker as near as possible to the point of origin.

2. No lead process shall be carried on, save either—

(a) With an efficient exhaust draft and air guide so arranged as to carry away the dust or steam as near as possible to the point of origin; or

(b) In the case of processes giving rise to dust, in an apparatus so closed as to prevent the escape of dust.

Provided, That this regulation shall not apply to the immersion and manipulation of lead color in water.

3. No woman, young person, or child shall be employed in manipulating lead color.

4. Every person employed in a lead process or at the roller mills connected with the grinding in oil of lead color (hereinafter referred to as the roller mills) shall once in each calendar month, on a date of which notice shall be given to every such person, be examined by the certifying surgeon of the district or other duly qualified medical practitioner (hereinafter referred to as the appointed surgeon) if appointed for the purpose by the chief inspector of factories by a certificate under his hand and subject to such conditions as may be specified in that certificate.

The certifying or appointed surgeon shall have power to suspend from employment in any lead process or at the roller mills.

5. No person after suspension, in accordance with regulation 4, shall be employed in any lead process or at the roller mills without written sanction entered in the health register by the certifying or appointed surgeon.

6. A health register in a form approved by the chief inspector of factories shall be kept and shall contain a list of all persons employed in any lead process or at the roller mills. The certifying or appointed surgeon will enter therein the dates and results of his examinations of such persons with particulars of any directions given by him.

The health register shall be produced at any time when required by any of His Majesty's inspectors of factories or by the certifying or appointed surgeon.

7. Overalls shall be provided for all persons employed in lead processes or at the roller mills; and shall be washed or renewed at least once every week.

8. The occupier shall provide and maintain for the use of all persons employed in lead processes or at the roller mills—

(a) A cloakroom or other suitable place in which such person can deposit clothing put off during working hours, and separate and suitable arrangements for the storage of overalls required by regulation 7;

(b) A dining room, unless all workers leave the factory during meal hours.

9. No person shall be allowed to introduce, keep, prepare, or partake of any food, drink (other than a medicine provided by the occupier and approved by the certifying or appointed surgeon), or tobacco in any room in which a lead process is carried on. Suitable provision shall be made for the deposit of food brought by persons employed.

10. The occupier shall provide and maintain in a cleanly state and in good repair for the use of persons employed in lead processes or at the roller mills a lavatory containing either—

(a) At least one lavatory basin for every five such persons, fitted with a waste pipe, or placed in a trough having a waste pipe, and having a constant

supply of cold water laid on and a sufficient supply of hot water constantly available; or

(b) Troughs of enamel or similar smooth impervious material, fitted with waste pipes without plugs, and having a constant supply of warm water laid on. The length of such troughs shall be in a proportion of not less than 2 feet for every five persons employed in lead processes or at the roller mills.

He shall also provide in the lavatory soap, nailbrushes, and a sufficient supply of clean towels renewed daily.

PART II.—Duties of persons employed.

11. All persons employed in lead processes or at the roller mills shall present themselves at the appointed time for examination by the certifying or appointed surgeon as provided in regulation 4.

12. No person after suspension under regulation 4 shall work in a lead process or at the roller mills in any paint and color factory or workshop to which these regulations apply without written sanction entered in the health register by the certifying or appointed surgeon.

13. All persons employed in lead processes or at the roller mills shall wear the overalls provided under regulation 7 and shall deposit such overalls and any clothing put off during working hours in the places provided under regulation 8.

The overalls shall not be removed by persons employed from the factory or workshop.

14. No person shall introduce, keep, prepare, or partake of any food, drink (other than a medicine provided by the occupier and approved by the certifying or appointed surgeon), or tobacco in any room in which a lead process is carried on.

15. All persons employed in lead processes or at the roller mills shall carefully clean and wash their hands before leaving the premises or partaking of any food.

16. No person shall, without the permission of the occupier or manager, interfere in any way with the means and appliances provided for the removal of dust, steam, or fumes and for the carrying out of these regulations.

These regulations shall come into force on the 1st February, 1907.

HOME OFFICE, WHITEHALL, January 21, 1907.

FOR THE HEADING OF YARN DYED BY MEANS OF A LEAD COMPOUND.¹

1907. No. 616.

Whereas the process of heading of yarn dyed by means of a lead compound has been certified in pursuance of section 79 of the Factory and Workshop Act, 1901,² to be dangerous;

I hereby, in pursuance of the powers conferred on me by that act, make the following regulations, and direct that they shall apply to all factories in which the said process is carried on.

Provided, That if the chief inspector of factories is satisfied, with regard to any such factory, that the heading of yarn dyed by means of a lead compound will not occupy more than three hours in any week, he may, by certificate, suspend regulations 2, 3, 4, 7 (a), and 8 (a), or any of them. Every such certificate shall be in writing, signed by the chief inspector of factories, and shall be revocable at any time by further certificate.

Definitions.

“Heading” means the manipulation of yarn dyed by means of a lead compound over a bar or post, and includes picking, making-up, and noddling.

“Employed” means employed in heading of yarn dyed by means of a lead compound.

“Surgeon” means the certifying factory surgeon of the district or a duly qualified medical practitioner appointed by certificate under the hand of the chief inspector of factories, which appointment shall be subject to such conditions as may be specified in that certificate.

“Suspension” means suspension by written certificate in the health register, signed by the surgeon, from employment in heading of yarn dyed by means of a lead compound.

¹ These regulations were gazetted August 13, 1907.

² 1 Edw. 7, ch. 22.

Duties.

It shall be the duty of the occupier to observe Part I of these regulations.

It shall be the duty of all persons employed to observe Part II of these regulations.

PART I.—Duties of employers.

1. No yarn dyed by means of a lead compound shall be headed unless there be an efficient exhaust draft so arranged as to draw the dust away from the worker, as near as possible to the point of origin. The speed of the draft at the exhaust opening shall be determined at least once in every three months and recorded in the general register.

2. No person under 16 years of age shall be employed.

3. A health register, containing the names of all persons employed, shall be kept in a form approved by the chief inspector of factories.

4. Every person employed shall be examined by the surgeon once in every three months (or at shorter intervals if and as required in writing by the chief inspector of factories) on a date of which due notice shall be given to all concerned.

The surgeon shall have power of suspension as regards all persons employed, and no person after suspension shall be employed without written sanction from the surgeon entered in the health register.

5. There shall be provided and maintained for the use of all persons employed—

(a) A suitable cloakroom for clothing put off during working hours;

(b) A suitable meal room separate from any room in which heading of yarn dyed by means of a lead compound is carried on, unless the works are closed during meal hours;

and, if so required by notice in writing from the chief inspector of factories,

(c) Suitable overalls and head coverings which shall be collected at the end of every day's work, and be washed and renewed at least once every week;

(d) A suitable place, separate from the cloakroom and meal room, for the storage of the overalls and head coverings.

6. There shall be provided and maintained in a cleanly state and in good repair, for the use of all persons employed, a lavatory, under cover, with a sufficient supply of clean towels renewed daily, and of soap and nail brushes, and with either—

(a) A trough with a smooth impervious surface, fitted with a waste pipe without plug, and of such length as to allow at least 2 feet for every five such persons, and having a constant supply of warm water from taps or jets above the trough at intervals of not more than 2 feet; or

(b) At least one lavatory basin for every five such persons, fitted with a waste pipe and plug or placed in a trough having a waste pipe, and having either a constant supply of hot and cold water or warm water laid on, or (if a constant supply of heated water be not reasonably practicable) a constant supply of cold water laid on and a supply of hot water always at hand when required for use by persons employed.

PART II.—Duties of persons employed.

7. Every person employed shall—

(a) Present himself at the appointed time for examination by the surgeon as provided in regulation 4;

(b) Wear the overall and head covering (provided in pursuance of regulation 5 (c) while at work, and shall remove them before partaking of food or leaving the premises, and shall deposit in the cloakroom, provided in pursuance of regulation 5 (a), clothing put off during working hours;

(c) Wash the hands before partaking of food or leaving the premises.

8. No person shall—

(a) Work in heading of yarn dyed by means of a lead compound after suspension without written sanction from the surgeon entered in the health register.

(b) Introduce, keep, prepare, or partake of any food or drink, or tobacco in any room in which heading of yarn dyed by means of a lead compound is carried on;

(c) Interfere in any way, without the concurrence of the occupier or manager, with the means and appliances provided for the removal of the dust, and for the carrying out of these regulations.

HOME OFFICE, WHITEHALL, August 6, 1907.

PART II.—SPECIAL RULES.

FOR THE MANUFACTURE AND DECORATION OF EARTHENWARE AND CHINA.¹

Amended special rules established, after arbitration, by the awards of the umpire, Lord James of Hereford, dated December 30, 1901, and November 28, 1903.

Duties of occupiers.

1. Deleted.

2. After the first day of February, 1904, no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 5 per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described below.

A weighed quantity of dried material is to be continuously shaken for one hour at the common temperature, with 1,000 times its weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of HCl. This solution is thereafter to be allowed to stand for one hour and to be passed through a filter. The lead salt contained in an aliquot portion of the clear filtrate is then to be precipitated as lead sulphide and weighed as lead sulphate.

If any occupier shall give notice in writing to the inspector for the district that he desires to use a glaze which does not conform to the above-mentioned conditions, and to adopt in his factory the scheme of compensation prescribed in schedule B, and shall affix and keep the same affixed in his factory, the above provisions shall not apply to his factory but instead thereof the following provisions shall apply.

All persons employed in any process included in schedule A other than china scouring shall be examined before the commencement of their employment or at the first subsequent visit of the certifying surgeon, and once in each calendar month by the certifying surgeon of the district.

The certifying surgeon may at any time order by signed certificate the suspension of any such person from employment in any process included in schedule A other than china scouring, if such certifying surgeon is of opinion that such person by continuous work in lead will incur special danger from the effects of plumbism, and no person after such suspension shall be allowed to work in any process included in schedule A other than china scouring without a certificate of fitness from the certifying surgeon entered in the register.

Any workman who, by reason of his employment being intermittent or casual, or of his being in regular employment for more than one employer, is unable to present himself regularly for examination by the certifying surgeon, may procure himself at his own expense to be examined once a month by a certifying surgeon, and such examination shall be a sufficient compliance with this rule. The result of such examination shall be entered by the certifying surgeon in a book to be kept in the possession of the workman. He shall produce and show the said book to a factory inspector or to any employer on demand, and he shall not make any entry or erasure therein.

If the occupier of any factory to which this rule applies fails duly to observe the conditions of the said scheme, or if any such factory shall by reason of the occurrence of cases of lead poisoning appear to the secretary of state to be in an unsatisfactory condition, he may, after an inquiry, at which the occupier shall have an opportunity of being heard, prohibit the use of lead for such time and subject to such conditions as he may prescribe.

All persons employed in the processes included in schedule A other than china scouring shall present themselves at the appointed time for examination by the certifying surgeon; as prescribed in this rule.

In addition to the examinations at the appointed times, any person so employed may at any time present himself to the certifying surgeon for examination, and shall be examined on paying the prescribed fee.

All persons shall obey any directions given by the certifying surgeon.

No person after suspension by the certifying surgeon shall work in any process included in schedule A other than china scouring without a certificate of fitness from the certifying surgeon entered in the register. Any operative who fails without reasonable cause to attend any monthly examination shall procure himself, at his own expense, to be examined within 14 days thereafter by the certifying surgeon, and shall himself pay the prescribed fee.

¹ This code superseded those of 1894, 1898, and 1901, which, however, are still in force in a few works. The question of making regulations to supersede all four codes is under consideration.

A register in the form which has been prescribed by the secretary of state for use in earthenware and china works shall be kept, and in it the certifying surgeon shall enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed in the processes included in schedule A, or in emptying china biscuit ware, and shall be produced at any time when required by His Majesty's inspector of factories or by the certifying surgeon.

3. The occupier shall allow any of His Majesty's inspectors of factories to take at any time sufficient samples for analysis of any material in use or mixed for use:

Provided, That the occupier may at the time when the sample is taken, and on providing the necessary appliances, require the inspector to take, seal, and deliver to him a duplicate sample.

But no analytical result shall be disclosed or published in any way except such as shall be necessary to establish a breach of these rules.

4. No woman, young person, or child shall be employed in the mixing of unfritted lead compounds in the preparation or manufacture of fritts, glazes, or colors.

5. No person under 15 years of age shall be employed in any process included in schedule A, or in emptying china biscuit ware.

Thimble-picking, or threading-up, or looking-over biscuit ware shall not be carried on except in a place sufficiently separated from any process included in schedule A.

6. All women and young persons employed in any process included in schedule A shall be examined once in each calendar month by the certifying surgeon for the district.

The certifying surgeon may order by signed certificate in the register the suspension of any such woman or young persons from employment in any process included in schedule A, and no person after such suspension shall be allowed to work in any process included in schedule A without a certificate of fitness from the certifying surgeon entered in the register.

7. A register, in the form which has been prescribed by the secretary of state for use in earthenware and china works, shall be kept, and in it the certifying surgeon shall enter the dates and results of his visits, the number of persons examined in pursuance of rule 6 as amended, and particulars of any directions given by him. This register shall contain a list of all persons employed in the processes included in schedule A, or in emptying china biscuit ware, and shall be produced at any time when required by His Majesty's inspector of factories or by the certifying surgeon.

8. The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in the processes included in the schedule A, or in emptying china biscuit ware.

No person shall be allowed to work in any process included in the schedule, or in emptying china biscuit ware, without wearing suitable overalls and head coverings: *Provided*, That nothing in this rule shall render it obligatory on any person engaged in drawing glost ovens to wear overalls and head coverings.

All overalls, head coverings, and respirators, when not in use or being washed or repaired, shall be kept by the occupier in proper custody. They shall be washed or renewed at least once a week, and suitable arrangements shall be made by the occupier for carrying out these requirements.

A suitable place, other than that provided for the keeping of overalls, head coverings, and respirators, in which all the above workers can deposit clothing put off during working hours, shall be provided by the occupier.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

9. No person shall be allowed to keep, or prepare, or partake of any food, or drink, or tobacco, or to remain during meal times, in a place in which is carried on any process included in schedule A.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during meal times of persons employed in such places or processes, with a right of appeal to the chief inspector of factories. Such accommodation shall not be provided in any room or rooms in which any process included in schedule A is carried on, and no washing conveniences mentioned hereafter in rule 13 shall be maintained in any room or rooms provided for such accommodation.

Suitable provision shall be made for the deposit of food brought by the workers.

10. The processes of—

The towing of earthenware,

China scouring,

Ground laying,

Ware cleaning after the dipper,

Color dusting, whether on-glaze or under-glaze,

Color blowing, whether on-glaze or under-glaze,

Glaze blowing, or

Transfer making,

shall not be carried on without the use of exhaust fans, or other efficient means for the effectual removal of dust, to be approved in each particular case by the secretary of state, and under such conditions as he may from time to time prescribe.

In the process of ware cleaning after the dipper, sufficient arrangements shall be made for any glaze scraped off which is not removed by the fan, or the other efficient means, to fall into water.

In the process of ware cleaning of earthenware after the dipper, damp sponges or other damp material shall be provided in addition to the knife or other instrument, and shall be used wherever practicable.

Flat-knocking and fired-flint-sifting shall be carried on only in inclosed receptacles, which shall be connected with an efficient fan or other efficient draft unless so contrived as to prevent effectually the escape of injurious dust.

In all processes the occupier shall, as far as practicable, adopt efficient measures for the removal of dust and for the prevention of any injurious effects arising therefrom.

11. No person shall be employed in the mixing of unfritted lead compounds, in the preparation or manufacture of fritts, glazes, or colors containing lead without wearing a suitable and efficient respirator provided and maintained by the employer; unless the mixing is performed in a closed machine or the materials are in such a condition that no dust is produced.

Each respirator shall bear the distinguishing mark of the worker to whom it is supplied.

12. All drying stoves as well as all workshops and all parts of factories shall be effectually ventilated to the reasonable satisfaction of the inspector in charge of the district.

13. The occupier shall provide and continually maintain sufficient and suitable washing conveniences for all persons employed in the processes included in schedule A, as near as practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nailbrushes, and towels, and at least one wash (hand) basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

There shall be in front of each washing basin, or convenience, a space for standing room which shall not be less in any direction than 21 inches.

14. The occupier shall see that the floors of workshops and of such stoves as are entered by the workpeople are sprinkled and swept daily; that all dust, scraps, ashes, and dirt are removed daily, and that the mangles, workbenches, and stairs leading to workshops are cleansed weekly.

When so required by the inspector in charge of the district, by notice in writing, any such floors, mangles, workbenches, and stairs shall be cleansed in such manner and at such times as may be directed in such notice.

As regards every potters' shop and stove, and every place in which any process included in schedule A is carried on, the occupier shall cause the sufficient cleansing of floors to be done at the time when no other work is being carried on in such room, and in the case of potters' shops, stoves, dipping houses, and majolica painting rooms, by an adult male:

Provided, That in the case of rooms in which ground laying or glost placing is carried on, or in the china dippers' drying room, the cleansing prescribed by this rule may be done before work commences for the day, but in no case shall any work be carried on in the room within one hour after any such cleansing as aforesaid has ceased.

15. The occupier shall cause the boards used in the dipping house, dippers' drying room, or glost-placing shop to be cleansed every week, and shall not allow them to be used in any other department, except after being cleansed.

When so required by the inspector in charge of the district, by notice in writing, any such boards shall be washed at such times as may be directed in such notice.

Duties of persons employed.

16. All women and young persons employed in the processes included in schedule A shall present themselves at the appointed time for examination by the certifying surgeon, as provided in rule 6 as amended.

No person after suspension by the certifying surgeon shall work in any process included in the schedule without a certificate of fitness from the certifying surgeon entered in the register.

17. Every person employed in any process included in schedule A, or in emptying china biscuit ware, shall, when at work, wear a suitable overall and head covering, and also a respirator when so required by rule 11 as amended, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed or repaired. Such overall and head covering shall be in proper repair and duly washed.

The hair must be so arranged as to be fully protected from dust by the head covering.

The overalls, head coverings, and respirators, when not being worn, and clothing put off during working hours, shall be deposited in the respective places provided by the occupier for such purposes under rule 8 as amended.

18. No person shall remain during meal times in any place in which is carried on any process included in schedule A, or introduce, keep, prepare, or partake of any food or drink, or tobacco therein at any time.

19. No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and stoves, and for the removal of dust.

20. No person included in any process included in schedule A shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

No person employed shall remove or damage the washing basins or conveniences provided under rule 13.

20a. The persons appointed by the occupiers shall cleanse the several parts of the factory regularly, as prescribed in rule 14.

Every worker shall so conduct his or her work as to avoid, as far as practicable, making or scattering dust, dirt, or refuse, or causing accumulation of such.

21. The boards used in the dipping house, dippers' drying room, or glost-placing shop shall not be used in any other department, except after being cleansed, as directed in rule 15.

22. If the occupier of a factory to which these rules apply gives with reference to any process included in schedule A, other than china scouring, an undertaking that no lead or lead compound or other poisonous material shall be used, the chief inspector may approve in writing of the suspension of the operation of rules 4, 5, 6, 7, 8, 15, 16, 17, and 21, or any of them in such process; and thereupon such rules shall be suspended as regards the process named in the chief inspector's approval, and in lieu thereof the following rule shall take effect, viz, no lead or lead compound or other poisonous material shall be used in any process so named.

For the purpose of this rule, materials that contain no more than 1 per cent of lead shall be regarded as free from lead.

SUPPLEMENTARY SPECIAL RULES FOR THE MANUFACTURE OF EARTHENWARE AND CHINA IN FORCE IN CERTAIN WORKS.

23. If the occupier of any factory to which these rules apply gives an undertaking in writing either to the effect that—

(a) No glaze shall be used which yields to a dilute solution of hydrochloric acid more than 5 per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described in rule 2, paragraph 2.

or to the effect that—

(b) No ware shall be cleaned after the application of glaze by dipping or other process except in the moist condition;

The chief inspector of factories may, if satisfied that the other conditions are sufficient for the safety of the persons employed, approve in writing of the suspension in the factory or part of the factory of so much of rule 10 as requires the provision of a fan or other efficient means, to be approved by the secretary of state, for the removal of dust in the process of ware cleaning; and thereupon the said part of rule 10 shall be suspended accordingly, and the said undertaking shall be deemed to be a special rule established in the factory.

24. If the occupier of any factory to which these rules apply gives an undertaking in writing to the effect that no glaze shall be used which yields to a dilute solution of hydrochloric acid more than 2 per cent of its dry weight of a soluble lead compound calculated as lead monoxide when determined in the manner described in rule 2, paragraph 2, the chief inspector of factories may, if satisfied that the other conditions are sufficient for the safety of the persons employed, approve in writing of the modification of rule 5 in so far as it applies to the processes of dipping, drying after dipping, and ware cleaning, in the factory or part of the factory, by the substitution of 14 years for 15 years of age, and thereupon rule 5 shall be modified accordingly, and the said undertaking shall be deemed to be a special rule established in the factory.

Any approval granted under rules 23 and 24 is liable to revocation in case it shall appear to the secretary of state that, owing to the occurrence of lead poisoning in any factory, such revocation is desirable.

25. No ware shall be cleaned after the application of glaze by dipping or other process, except in the moist state, or with damp sponge or other similar damp material, or with the use of an efficient exhaust draft.

So much of rule 10 as requires the provision of a fan or other efficient means for the removal of dust in the process of ware cleaning after the dipper shall not apply.

SCHEDULE A.

Dipping or other process carried on in the dipping house.

Glaze blowing.

Painting in majolica or other glaze.

Drying after dipping.

Ware cleaning after the application of glaze by dipping or other process.

China scouring.

Glost placing.

Ground laying.

Color dusting

Color blowing } whether on-glaze or under-glaze.

Lithographic transfer making.

Making or mixing of fritts, glazes, or colors containing lead.

Any other process in which materials containing lead are used or handled in the dry state, or in the form of spray, or in suspension in liquid other than oil or similar medium.

SCHEDULE B.¹

NOTICE TO WORKMEN EMPLOYED IN PROCESSES NAMED IN SCHEDULE A, OTHER THAN CHINA SCOURING.

Conditions of compensation.

1. Where a workman is suspended from working by a certifying surgeon of the district on the ground that he is of opinion that such person by continued work in lead will incur special danger from the effects of plumbism, and the certifying surgeon shall certify that in his opinion he is suffering from plumbism arising out of his employment, he shall, subject as hereinafter mentioned, be entitled to compensation from his employer as hereinafter provided.

(a) If any workman who has been suspended as aforesaid dies within nine calendar months from the date of such certificate of suspension, by reason of plumbism contracted before the said date, there shall be paid to such of his dependents as are wholly dependent upon his earnings at the time of his death or upon the weekly compensation payable under this scheme, a sum

¹ Provision has since been made for compensation in case of lead poisoning by section 8 of the Workmen's Compensation Act, 1906.

equal to the amount he has earned during a period of three years next preceding the date of the said certificate, such sum not to be more than £300 [\$1,459.95] nor less than £150 [\$729.98] for an adult male, £100 [\$486.65] for an adult female, and £75 [\$364.99] for a young person.

(b) If the workman does not leave any dependents wholly dependent as aforesaid, but leaves any dependents in part dependent as aforesaid, a reasonable part of that sum.

(c) If he leaves no dependents, the reasonable expenses of his medical attendance and burial, not exceeding £10 [\$48.67].

2. With respect to such payments the following provisions shall apply:

(a) All sums paid to the workman as compensation since the date of the said certificate shall be deducted from the sums payable to the dependents.

(b) The payment shall, in case of death, be made to the legal personal representative of the workman, or, if he has no legal personal representative, to or for the benefit of his dependents, or, if he leaves no dependents, to the person to whom the expenses are due; and if made to the legal personal representative shall be paid by him to or for the benefit of the dependents or other person entitled thereto.

(c) Any question as to who is a dependant, or as to the amount payable to each dependent, shall in default of agreement be settled by arbitration as hereinafter provided in clause 9.

(d) The sum allotted as compensation to a dependent may be invested or otherwise applied for the benefit of the person entitled thereto, as agreed, or as ordered by the arbitrator.

(e) Any sum which is agreed or is ordered by the arbitrator to be invested may be invested in whole or in part in the Post-Office Savings Bank.

3. Where a workman has been suspended and certified as provided in condition 1, and while he is totally or partially prevented from earning a living by reason of such suspension, he shall be entitled to a weekly payment not exceeding 50 per cent of his average weekly earnings at the time of such suspension, such payment not to exceed £1 [\$4.87]. The average may be taken over such period, not exceeding 12 months, as appears fair or reasonable, having regard to all the circumstances of the case.

4. In fixing these weekly payments, regard shall be had to the difference between the amount of the average weekly earnings of the workman at the time of his suspension and the average amount, if any, which it is estimated that he will be able to earn afterwards in any occupation or employment, and to any payments (not being wages) which he may have received from the employer in respect to the suspension, and to all the circumstances of the case, including his age and expectation of life.

5. If it shall appear that any workman has persistently disobeyed the special rules or the directions given for his protection by his employers, and that such disobedience has conducted to his suspension, or has not presented himself for examination by the certifying surgeon, or has failed to give full information and assistance as provided in condition 6, his conduct may be taken into consideration in assessing the amount of the weekly payments.

6. It shall be the duty of every workman at all times to submit to medical examination when required and to give full information to the certifying surgeon and to assist to the best of his power in the obtaining of all facts necessary to enable his physical condition to be ascertained.

7. Any weekly payment may be reviewed at the request either of the employer or of the workman, and on such review may be ended, diminished, or increased, subject to the maximum above provided, and the amount of payments shall, in default of agreement, be settled by arbitration.

8. Any workman receiving weekly payments under this scheme shall submit himself if required for examination by a duly qualified medical practitioner provided and paid by the employer.

If the workman refuses to submit himself to such examination, or in any way obstructs the same, his right to such weekly payments shall be suspended until such examination has taken place.

9. If any dispute shall arise as to any certificate of the certifying surgeon or as to the amount of compensation payable as herein provided, or otherwise in relation to these provisions, the same shall be decided by an arbitrator to be appointed by the employer and workman, or in default of agreement by the secretary of state. The said arbitrator shall have all the powers of an arbitrator under the arbitration act, and his decision shall be final.

The fee of the arbitrator shall be fixed by the secretary of state, and shall be paid as the arbitrator shall direct.

10. No compensation shall be payable under these provisions unless a claim in writing is made within six weeks of the date of the certificate of suspension, or of the death: *Provided*, That the want of such notice shall not bar the claim if in the opinion of the arbitrator there was reasonable excuse for the want of it.

A claim for compensation by any workman whose employment is intermittent, or casual, or who is regularly employed by more than one employer, shall only arise against the employers for whom he has worked in a process included in schedule A within one month prior to his suspension. The said employers shall bear the compensation among them in such proportion as in default or agreement shall be determined by an arbitrator as herein provided.

11. "Employer" includes an occupier, a corporation, and the legal representatives of a deceased employer. "Workman" includes every person, male or female, whether his agreement be one of service or apprenticeship or otherwise, and is expressed or implied, orally or in writing, and shall include the personal representatives of a deceased workman. "Dependents" has the same meaning as in the Workmen's Compensation Act, 1897.¹

The terms contained in this notice shall be deemed to be part of the contract of employment of all workmen in the above-named processes.

(Occupier's signature.) ————

FOR THE MANUFACTURE OF TRANSFERS FOR EARTHENWARE AND CHINA.

Duties of occupiers.

1. No person under 15 years of age shall be employed in making transfers for earthenware or china.

2. All women and young persons employed shall be examined once a month by the certifying surgeon for the district, who shall after May 1, 1899, have power to order suspension from employment.

No person after such suspension shall be allowed to work without the written sanction of the certifying surgeon.

3. A register, in the form which has been prescribed by the secretary of state for use in earthenware and china works, shall be kept, and in it the certifying surgeon will enter the dates and results of his visits, the number of persons examined, and particulars of any directions given by him. This register shall contain a list of all persons employed, and shall be produced at any time when required by His Majesty's inspector of factories or by the certifying surgeon.

4. The occupier shall provide and maintain suitable overalls and head coverings for all women and young persons employed in rooms in which color processes are carried on.

All overalls and head coverings shall be kept by the occupier in proper custody and shall be washed at least once a week, and suitable arrangements shall be made for carrying out these requirements.

A suitable place shall be provided in which the above workers can deposit clothing put off during working hours.

It shall be a sufficient compliance with the requirements of this rule as to head coverings if they are made of suitable glazed paper and renewed once a week. The head coverings shall be made so as completely to cover the hair and to the satisfaction of the inspector.

5. No person shall be allowed to prepare or partake of any food or drink, or to remain during mealtimes, in any place in which is carried on the making of transfers.

The occupier shall make suitable provision to the reasonable satisfaction of the inspector in charge of the district for the accommodation during mealtimes of persons employed in such places or processes, with a right of appeal to the chief inspector of factories.

6. Transfer making shall not be carried on without the use of exhaust fans for the effectual removal of dust, or other efficient means for the effectual removal of dust, to be approved in each particular case by the secretary of state, and under such conditions as he may from time to time prescribe.

¹ 60, 61 Vict., ch. 37.

7. The occupier shall provide and maintain sufficient and suitable washing conveniences for all persons employed, as near as is practicable to the places in which such persons are employed.

The washing conveniences shall comprise soap, nailbrushes, and towels, and at least one wash hand basin for every five persons employed as above, with a constant supply of water laid on, with one tap at least for every two basins, and conveniences for emptying the same and running off the waste water on the spot down a waste pipe.

Duties of persons employed.

8. All women and young persons employed shall present themselves at the appointed time for examination by the certifying surgeon as provided in rule 2.

No person after suspension by the certifying surgeon shall work without the written sanction of the certifying surgeon.

9. Every person employed in any room in which color processes are carried on shall, when at work, wear an overall suit and head covering, which shall not be worn outside the factory or workshop, and which shall not be removed therefrom except for the purpose of being washed. All overalls and head coverings shall be washed or renewed at least once a week.

The overalls and head coverings, when not being worn, shall be deposited in the place provided for the purpose under rule 4.

Clothing put off during working hours shall be deposited in the place provided for the purpose under rule 4.

It shall be a sufficient compliance with the requirements of this rule as to head coverings if they are made of suitable glazed paper and renewed once a week. The head coverings shall be made so as completely to cover the hair and to the satisfaction of the inspector.

10. No person shall remain during mealtimes in any place in which is carried on the making of transfers; or prepare or partake of any food or drink therein at any time.

11. No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided by the employers for the ventilation of the workshops and for the removal of dust.

12. No person employed shall leave the works or partake of meals without previously and carefully cleaning and washing his or her hands.

FOR THE MANUFACTURE OF WHITE LEAD.

In these rules "persons employed in a lead process" means a person who is employed in any work or process involving exposure to white lead, or to lead or lead compounds used in its manufacture, or who is admitted to any room or part of the factory where such process is carried on.

Any approval given by the chief inspector of factories in pursuance of rules 2, 4, 6, 9, or 12 shall be given in writing, and may at any time be revoked by notice in writing signed by him.

Duties of occupiers.

1. On and after July 1, 1899, no part of a white-lead factory shall be constructed, structurally altered, or newly used, for any process in which white lead is manufactured or prepared for sale, unless the plans have previously been submitted to and approved in writing by the chief inspector of factories.

2. (a) Every stack shall be provided with a standpipe and movable hose, and an adequate supply of water distributed by a rose.

(b) Every white bed shall, on the removal of the covering boards, be effectually damped by the means mentioned above.

Where it is shown to the satisfaction of the chief inspector of factories that there is no available public water service in the district, it shall be a sufficient compliance with this rule if each white bed is, on the removal of the covering boards, effectually damped by means of a watering can.

3. Where white lead is made by the chamber process, the chamber shall be kept moist while the process is in operation, and the corrosions shall be effectually moistened before the chamber is emptied.

4. (a) Corrosions shall not be carried except in trays of impervious material.

(b) No person shall be allowed to carry on his head or shoulder a tray of corrosions which has been allowed to rest directly upon the corrosions, or upon any surface where there is white lead.

(c) All corrosions before being put into the rollers or wash becks shall be effectually damped, either by dipping the tray containing them in a trough of water or by some other method approved by the chief inspector of factories.

5. The flooring round the rollers shall either be of smooth cement or be covered with sheet lead, and shall be kept constantly moist.

6. On and after January 1, 1901, except as hereinafter provided:

(a) Every stove shall have a window, or windows, with a total area of not less than 8 square feet, made to open, and so placed as to admit of effectual through ventilation.

(b) In no stove shall bowls be placed on a rack which is more than 10 feet from the floor.

(c) Each bowl shall rest upon the rack and not upon another bowl.

(d) No stove shall be entered for the purpose of drawing until the temperature at a height of 5 feet from the floor has fallen either to 70° F., or to a point not more than 10° F. above the temperature of the air outside.

(e) In drawing any stove or part of a stove there shall not be more than one stage or standing place above the level of the floor.

Provided, That if the chief inspector approves of any other means of ventilating a stove, as allowing of effectual through ventilation, such means may be adopted, notwithstanding paragraph (a) of this rule; and if he approves of any other method of setting and drawing the stoves, as effectually preventing white lead from falling upon any worker, such method may be followed, notwithstanding paragraphs (b) and (e) of this rule.

7. No person shall be employed in drawing Dutch stoves on more than two days in any week.

8. No dry white lead shall be deposited in any place that is not provided either with a cover or with a fan effectually removing the dust from the worker.

9. On and after January 1, 1900, the packing of dry white lead shall be done only under conditions which secure the effectual removal of dust, either by exhaust fans or by other efficient means approved in each case by the chief inspector of factories.

This rule shall not apply where the packing is effected by mechanical means entirely closed in.

10. The floor of any place where packing of dry white lead is carried on shall be of cement, or of stone set in cement.

11. No woman shall be employed or allowed 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.

12. (a) A duly qualified medical practitioner (in these rules referred to as the "appointed surgeon") shall be appointed by the occupier for each factory, such appointment to be subject to the approval of the chief inspector.

(b) No person shall be employed in a lead process for more than a week without a certificate of fitness granted after examination by the appointed surgeon.

(c) Every person employed in a lead process shall be examined once a week by the appointed surgeon, who shall have power to order suspension from employment in any place or process.

(d) No person, after such suspension, shall be employed in a lead process without the written sanction of the appointed surgeon.

(e) A register in a form approved by the chief inspector of factories shall be kept, and shall contain a list of all persons employed in lead processes. The appointed surgeon will enter in the register the dates and results of his examinations of the persons employed, and particulars of any directions given by him. The registers shall be produced at any time when required by His Majesty's inspectors of factories or by the certifying surgeon or by the appointed surgeon.

13. Upon any person employed in a lead process complaining of being unwell, the occupier shall, with the least possible delay, give an order upon a duly qualified medical practitioner.

14. The occupier shall provide and maintain sufficient and suitable respirators, overalls, and head coverings, and shall cause them to be worn as directed in rule 29.

At the end of every day's work they shall be collected and kept in proper custody in a suitable place set apart for the purpose.

They shall be thoroughly washed or renewed every week; and those which have been used in the stoves, and all respirators, shall be washed or renewed daily.

15. The occupier shall provide and maintain a dining room and a cloakroom in which workers can deposit clothing put off during working hours.

16. No person employed in a lead process shall be allowed to prepare or partake of any food or drink except in the dining room or kitchen.

17. A supply of a suitable sanitary drink, to be approved by the appointed surgeon, shall be kept for the use of the workers.

18. The occupier shall provide and maintain a lavatory for the use of the workers, with soap, nailbrushes, and at least one lavatory basin for every five persons employed. Each such basin shall be fitted with a waste pipe. There shall be a constant supply of hot and cold water laid on, except where there is no available public water service, in which case the provision of hot and cold water shall be such as shall satisfy the inspector in charge of the district.¹

The lavatory shall be thoroughly cleaned and supplied with clean towels after every meal.

There shall, in addition, be means of washing in close proximity to the workers of each department, if required by notice in writing from the inspector in charge of the district.

There shall be facilities, to the satisfaction of the inspector in charge of the district, for the workers to wash out their mouths.

19. Before each meal and before the end of the day's work at least 10 minutes in addition to the regular meal times shall be allowed to each worker for washing.

A notice to this effect shall be affixed in each department.

20. The occupier shall provide and maintain sufficient baths and dressing rooms for all persons employed in lead processes, with hot and cold water, soap, and towels, and shall cause each such person to take a bath once a week at the factory.

A bath register shall be kept, containing a list of all persons employed in lead processes, and an entry of the date when each person takes a bath.

This register shall be produced at any time when required by His Majesty's inspectors of factories or by the certifying surgeon or by the appointed surgeon.

21. The dressing rooms, baths, and water-closets shall be cleaned daily.

22. The floor of each workroom shall be cleaned daily, after being thoroughly damped.

Duties of persons employed.

23. No person shall strip a white bed or empty a chamber without previously effectually damping as directed in rules 2 and 3.

24. No person shall carry corrosions or put them into the rollers or wash becks otherwise than as permitted by rule 4.

25. No person shall set or draw a stove otherwise than as permitted by rules 6 and 7.

26. No person shall deposit or pack dry white lead otherwise than as permitted by rules 8 and 9.

27. Every person employed in a lead process shall present himself at the appointed times for examination by the appointed surgeon, as provided in rule 12.

28. No person, after suspension by the appointed surgeon, shall work in a lead process without his written sanction.

29. Every person engaged in—

White beds,
Emptying chambers,
Rollers, wash becks, or grinding,
Setting or drawing stoves,
Packing,

¹ The following rule is in force in certain works in substitution for paragraph 1 of rule 18:

"The occupier shall provide and maintain in a cleanly state and in good repair for the use of persons employed a lavatory containing either—

"(a) At least one lavatory basin for every five such persons, fitted with a waste pipe, or placed in a trough having a waste pipe, and having a constant supply of hot and cold water, or warm water, laid on; or

"(b) Troughs of enamel or similar smooth impervious material, fitted with waste pipes without plugs, and having a constant supply of hot and cold water, or warm water, laid on. The length of such troughs shall be in a proportion of not less than two feet for every five persons employed.

"He shall also provide in the lavatory, soap, nailbrushes, and a sufficient supply of towels."

Paint mixing,

Handling dry white lead,

or in any work involving exposure to white-lead dust, shall, while so occupied, wear an overall suit and head covering.

Every person engaged in stripping white beds, or in emptying chambers, or in drawing stoves, or in packing, shall in addition wear a respirator while so occupied.

30. Every person engaged in any place or process named in rule 29 shall, before partaking of meals or leaving the premises, deposit the overalls, head coverings, and respirators in the place appointed by the occupier for the purpose, and shall thoroughly wash face and hands in the lavatory.

31. Every person employed in a lead process shall take a bath at the factory at least once a week, and wash in the lavatory before bathing; having done so, he shall at once sign his name in the bath register, with the date.

32. No person employed in a lead process shall smoke or use tobacco in any form, or partake of food or drink, elsewhere than in the dining room or kitchen.

33. No person shall in any way interfere, without the knowledge and concurrence of the occupier or manager, with the means and appliances provided for the removal of dust.

34. The foreman shall report to the manager, and the manager shall report to the occupier, any instance coming under his notice of a worker neglecting to observe these rules.

35. No person shall obtain employment under an assumed name or under any false pretense.

FOR THE MANUFACTURE OF RED AND ORANGE LEAD.

Duties of occupiers.

In drawing charges of massicot, or of red lead, or of orange lead, from the furnace, they shall not allow the charges of massicot, or of red lead, or of orange lead to be discharged onto the floor of the factory or workshop, but shall arrange that it be shoveled, not raked, into wagons.

They shall arrange that no red or orange lead shall be packed in the room or rooms where the manufacture is actually carried on.

They shall arrange that no red or orange lead shall be packed in casks or other receptacles except in a place provided with a hood connected with a fan, or shall provide other suitable means to create an effective draft.

They shall provide sufficient bath accommodation for all persons employed in the manipulation of red and orange lead, and lavatories, with a good supply of hot water, soap, nailbrushes, and towels for the use of such persons.

They shall arrange for a monthly visit by a medical man who shall examine every worker individually, and who shall enter the result of each examination in a register book to be provided by the said occupiers.

They shall provide a sufficient supply of approved sanitary drink for the workers.

Duties of persons employed.

In cases where the cooperation of the workers is required for carrying out the foregoing rules, and where such cooperation is not given, the workers shall be held liable in accordance with the Factory and Workshop Act, 1891,¹ section 9, which runs as follows:

"If any person who is bound to observe any special rules established for any factory or workshop under this act, acts in contravention of, or fails to comply with, any such special rule, he shall be liable on summary conviction to a fine not exceeding £2" [\$9.73].

FOR THE MANUFACTURE OF YELLOW LEAD.

Duties of occupiers.

They shall provide washing conveniences, with a sufficient supply of hot and cold water, soap, nailbrushes, and towels.

They shall provide respirators and overall suits for the persons employed in all dry processes.

¹ 54 and 55 Vict., ch. 75.

They shall provide fans or other suitable means of ventilation wherever dust is generated in the process of manufacture.

They shall provide a sufficient supply of Epsom salts and of an approved sanitary drink.

Duties of persons employed.

In cases where the cooperation of the workers is required for carrying out the foregoing rules and where such cooperation is not given, the workers shall be held liable, in accordance with the Factory and Workshop Act, 1891,¹ section 9, which runs as follows:

"If any person who is bound to observe any special rules established for any factory or workshop under this act, acts in contravention of, or fails to comply with, any such special rule, he shall be liable on summary conviction to a fine not exceeding £2" [\$9.73].

Respirators.—A good respirator is a cambric bag with or without a thin flexible wire made to fit over the nose.

Sanitary drink suggested.—Sulphate of magnesia, 2 ounces; water, 1 gallon; essence of lemon, sufficient to flavor.

FOR LEAD SMELTING.

Duties of occupiers.

They shall provide respirators and overall suits for the use of all persons employed in cleaning the flues, and take means to see that the same are used.

They shall arrange that no person be allowed to remain at work more than two hours at a time in a flue. (A rest of half an hour before reentering will be deemed sufficient.)

They shall provide sufficient bath accommodation for all persons employed in cleaning the flues, and everyone so employed shall take a bath before leaving the works.

They shall provide washing conveniences, with a sufficient supply of hot and cold water, soap, nailbrushes, and towels.

Duties of persons employed.

In cases where the cooperation of the workers is required for carrying out the foregoing rules, and where such cooperation is not given, the workers shall be held liable, in accordance with the Factory and Workshop Act, 1891,¹ section 9, which runs as follows:

"If any person who is bound to observe any special rules established for any factory or workshop under this act, acts in contravention of, or fails to comply with, any such special rule, he shall be liable on summary conviction to a fine not exceeding £2" [\$9.73].

FOR THE ENAMELING OF IRON PLATES WITH USE OF LEAD, ARSENIC, OR ANTIMONY.²

Duties of occupiers.

1. They shall provide washing conveniences with a sufficient supply of hot and cold water, soap, nailbrushes, and towels, and take measures to secure that every worker wash face and hands before meals and before leaving the works.

2. They shall provide suitable respirators, overall suits, and head coverings for all workers employed in the processes of grinding, dusting, and brushing.

3. They shall adopt measures on and after the 1st day of October, 1894, in the dusting and brushing processes for the removal of all superfluous dust, by the use of perforated benches or tables supplied with fans to carry the dust down through the apertures of such benches or tables, the underpart of which must be boxed in.

4. They shall provide a sufficient supply of approved sanitary drink, and shall cause the workpeople to take it.

5. They shall arrange for a medical inspection of all persons employed, at least once a month.

¹ 54 and 55 Vict., ch. 75.

² The question of making regulations to supersede these special rules is under consideration.

They shall see that no female is employed without previous examination and a certificate of fitness from the medical attendant of the works.

They shall see that no person who has been absent from work through illness shall be reemployed without a medical certificate to the effect that he or she has recovered.

6. Upon any person employed in the works complaining of being unwell, the occupier shall, with the least possible delay, and at his own expense, give an order upon a doctor for professional attendance and medicine. It is to be understood that this rule will not apply to persons suffering from complaints which have not been contracted in the process of manufacture.

7. They shall provide a place or places free from dust and damp in which the operatives can hang up the clothes in which they do not work.

(It is recommended that they shall provide for each female before the day's work begins some light refreshment, such as a half pint of milk and a biscuit.)

Duties of persons employed.

8. Every person to whom is supplied a respirator or overall and head covering shall wear the same when at the work for which such are provided.

9. Every person shall carefully clean and wash hands and face before meals and before leaving the works.

10. No food shall be eaten by any person in any part of the works except in the apartment specially provided for the purpose.

11. No person may seek employment under an assumed name or under any false pretense.

Respirators.—A good respirator is a cambric bag with or without a thin flexible wire made to fit over the nose.

Sanitary drink suggested.—Sulphate of magnesia, 2 ounces; water, 1 gallon; essence of lemon, sufficient to flavor.

FOR THE TINNING AND ENAMELING OF METAL HOLLOW WARE AND COOKING UTENSILS WITH USE OF LEAD OR ARSENIC.¹

Duties of occupiers.

They shall provide washing conveniences with a sufficient supply of hot and cold water, soap, nailbrushes, and towels; and take measures to secure that every worker wash face and hands before meals and before leaving the works.

They shall see that no food is eaten in any room where the process of tinning or enameling is carried on.²

Duties of persons employed.

Every worker shall wash face and hands before meals and before leaving the works.

No worker shall eat food in any room where the process of tinning or enameling is carried on.³

FOR THE TINNING AND ENAMELING OF IRON HOLLOW WARE WITH USE OF LEAD OR ARSENIC.¹

Duties of occupiers.

They shall provide washing conveniences with a sufficient supply of hot and cold water, soap, nailbrushes, and towels; and take measures to secure that every worker wash face and hands before meals and before leaving the works.

They shall see that no food is eaten in any room where the process of tinning or enameling is carried on.

¹ The question of making regulations to supersede these special rules is under consideration.

² The following rules are in force in certain works in substitution for the second and fourth rules, respectively:

"2. They shall not allow the persons employed in tinning to eat food in any room at the time the process of tinning is being carried on.

"4. The workers employed in tinning shall not eat food in any room at the time the process of tinning is being carried on."

Duties of persons employed.

In cases where the cooperation of the workers is required for carrying out the foregoing rules, and where such cooperation is not given, the workers shall be held liable, in accordance with the Factory and Workshop Act, 1891,^a section 9, which runs as follows:

"If any person who is bound to observe any special rules established for any factory or workshop under this act, acts in contravention of, or fails to comply with, any such special rule, he shall be liable on summary conviction to a fine not exceeding 2 pounds" [\$9.73].

FACTORY AND WORKSHOP ACT, 1901.

REGULATIONS FOR THE SMELTING OF MATERIALS CONTAINING LEAD, THE MANUFACTURE OF RED OR ORANGE LEAD, AND THE MANUFACTURE OF FLAKED LITHARGE.

With further reference to the Home Office circular of February 14, 1911, the chief inspector of factories begs to forward a copy of the regulations as above, made by the secretary of state on August 12, 1911. A memorandum explaining certain of the requirements, and other papers, are also inclosed.

The regulations, based upon the report of Dr. E. L. Collis, medical inspector of factories,^b were issued in draft in February, 1911. The objections received in pursuance of section 80³ were considered by the secretary of state, and an amended draft was issued in May, 1911, to which no objections, other than those subsequently withdrawn, were made.

The regulations apply automatically to all works in which the processes named above are carried on, and come into force on October 1, 1911, except that so much of regulations 2 and 3 as requires provision of efficient exhaust draft is deferred until May 1, 1912. They supersede the existing special rules for lead smelting and for the manufacture of red and orange lead and yellow lead. The special rules for the manufacture of white lead are unaffected by the new code; both codes may be in force in the same works, each being limited, however, to the particular manufacture concerned.

The following are the principal points on which the regulations differ from the draft of February, 1911:

(1) Extension of time as regards the exhaust ventilation required by regulations 2 and 3.

(2) Modification of the definition of "lead material" so as to exempt zinc ore, and material resulting from the treatment thereof, containing less than 2 per cent of lead. Sulphide ores, therefore, it should be noted, are exempted only prior to calcination.

(3) A proviso has been added to regulation 2 allowing lead material to be moved to a furnace by persons wearing suitable respirators when damping, exhaust ventilation, and inclosing, so as to prevent the escape of dust, are none of them practicable.

(4) Under regulation 5 as modified the use of a covered receptacle in removal of lead material from the exhaust draft is only required if vapor containing lead is given off.

HOME OFFICE, *September, 1911.*

FACTORY AND WORKSHOP ACT, 1901.

MEMORANDUM RELATING TO REGULATIONS FOR THE SMELTING OF MATERIALS CONTAINING LEAD, THE MANUFACTURE OF RED OR ORANGE LEAD, AND THE MANUFACTURE OF FLAKED LITHARGE.

The secretary of state has made regulations, the terms of which appear in the inclosed placard (Form 957), for the above processes. The regulations apply automatically to all works in which the said processes are carried on. For convenience of reference the defined terms are printed in italics.

Part I specifies the duties of the occupier, and Part II those of the persons employed; but with regard to the latter the factory act, 1901 (sec. 85⁴), places concurrent responsibility upon the occupier to take all reasonable means by publishing and to the best of his power enforcing the regulations to prevent contravention or noncompliance.

^a 54 and 55 Vict., ch. 75.

^b Special Report on Dangerous or Injurious Processes in the Smelting of Materials containing Lead and in the Manufacture of Red and Orange Lead and Flaked Litharge. London: Wyman & Sons (Ltd.), 1910.

A copy of the regulations must be kept affixed in a conspicuous place in the works, and the occupier is required (sec. 86³, 1901) to give a copy to any person in his employment on application. For the latter purpose the smaller edition of the code in pamphlet form will be more convenient than the placard. In Wales and Monmouthshire a copy of the regulations in Welsh must also be affixed. The regulations must be noted in Part I of the general register.

For the purposes of regulations 13 and 17 it will be necessary for the occupier to make arrangements for regular monthly examination (on dates fixed in advance and made known to the workers concerned) by the surgeon; that is, either by the certifying surgeon for the district, whose name and address appear on the abstract, or by some other duly qualified medical practitioner appointed by the chief inspector. In general, it is desirable that the certifying surgeon should undertake the duty, and he is required by departmental instructions to do so if called upon; apart from the regulations, he has to visit the works officially in connection with certificates of fitness, accidents, and cases of poisoning, and these duties rest with him even if another surgeon be appointed for the purposes of the regulations. In the absence of intimation to the contrary, it will be assumed that the certifying surgeon will act as surgeon under the regulations, and in that case no formal appointment is necessary. It is, however, open to the occupier to apply to the chief inspector for appointment of another practitioner as surgeon; any such application should state the name, address, and qualifications of the practitioner proposed for appointment, and whether he is prepared to undertake the duties subject to the conditions which would necessarily be attached, namely:

1. The duties are to be performed by the surgeon personally or, in his absence, by a duly qualified medical practitioner temporarily appointed by the chief inspector.^a

2. In the first week of January in each year he will forward to the superintending inspector a return on Form 845^b of the examinations and suspensions made during the previous year by him or by a practitioner temporarily appointed as above.

3. He will perform such duties, under the Workmen's Compensation Act, 1906, as are required from an appointed surgeon by that act or by the instructions of the secretary of state; and in particular he will, if required to do so by the employer or by any workman concerned, make such examination and give such certificates as are required on the part of the appointed surgeon under section 8 of that act with regard to cases of industrial disease.

4. The certificate of appointment will be revocable at any time by notice in writing signed by the chief inspector.

5. A copy of the certificate^b of appointment is to be kept in the general register unless and until revoked.

Regulation 18 provides that a workman who has been suspended under any code of regulations or special rules applicable to lead processes shall not be employed in a lead process (as defined in this code) without certificate from the surgeon. The codes in question are those for the manufacture of white lead, earthenware and china (or transfers for such ware), electric accumulators, paints and colors, and for heading of yarn (with use of lead), vitreous enameling, and tinning of metals. If a workman previously employed in any of those industries is engaged, it should be ascertained whether he has been suspended, and the attention of the surgeon should be called to any such previous employment.

The fees to the surgeon for duties arising under the regulations are payable to him by the occupier. Where the surgeon is the certifying surgeon of the district the scale is prescribed as follows, by order of the secretary of state, dated March 2, 1904:

For each visit, including such examinations, entries in registers, issue of certificates, and other duties as may be required by the regulations—

- (a) When the examination is at a factory or workshop within a mile from the certifying surgeon's central point, 2s. 6d. [61 cents] for each visit, and 6d. [12 cents] for each person after the first five presented at that visit.

- (b) When the examination is at a factory or workshop more than a mile from the central point, the above fees with an additional 1s. [24 cents] for each mile or portion of a mile beyond the first mile.

^a Application for such temporary appointment is to be made to the superintending inspector, on Form 194, copies of which will be supplied.

^b Copies will be supplied for the purpose.

Opportunity should be given the surgeon to become acquainted with the processes. Signs of illness detected at the periodic examination may afford important indications of inadequate precautions or defective appliances.

Regulation 13b requires that a health register shall be kept, in a form approved by the chief inspector. A copy of the approved register (Form 605) is inclosed herewith. It is the duty of the occupier to enter therein the names of all persons employed in any lead process.

The regulations aim at prevention of lead poisoning, which is contracted much more from inhalation of lead fumes and dust than in any other way. Although no appreciable fume containing lead comes off until pure lead is heated and stirred at a temperature of about 500° C. [932° F.], incidence of poisoning on persons engaged with molten lead (especially scrap lead) at temperatures below this is considerable, and the symptoms are often very severe. Such poisoning is probably due to the dust arising in the operations necessary for skimming the surface. Skimmings should never be deposited on the floor by the side of the bath, but in a receptacle, and it is of the utmost importance that this receptacle should be placed inside a hood with exhaust draft.

The "efficient exhaust draft" required for the purpose of regulation 3 is defined in such terms as to allow of the use of a heated flue or of propelling or exhaust fans, if sufficient to remove smoke generated at the point where the fumes or dust originate.*

Where heat alone is relied on to secure an efficient exhaust draft (regulation 3)—

(1) A hood should be applied, leaving the smallest possible opening consistent with proper working;

(2) Where the hood is not attached to the top of the furnace door, or not connected up by a duct with the main chimney stack or furnace flue, an air channel or duct at least 18 feet in height and of ample bore (in general not less than 24 inches in diameter) should be carried vertically upward to the outer air; and

(3) The air channel or duct should terminate in such a way as to facilitate, whatever the direction of the wind, the free escape of heated air. A duct should end in a wind screen having the form of a large cone, so fixed that its lower edge is below the upper edge of the duct and the annular free space between the cone and the duct rather greater than the capacity of the duct itself.

Frequently the diameter of a duct is too small, and mere increase in size will often convert an indifferent draft into a good one.

A heated flue alone would not be adequate for removal of dust created in feeding hoppers with or in packing compounds of lead (regulation 3).

Regulations 9 and 13c require use of respirators in certain processes. A simple and efficient form of respirator is a pad, about 3 inches by 4 inches, of ordinary nonabsorbent cotton wool (absorbent cotton wool quickly becomes sodden) placed over the mouth and nostrils and kept in position by elastic bands passed around the ears. The pad should be burnt after use.

Regulation 11a requires a suitable meal room, unless the works are closed during meal hours. The meal room should be well lighted, the floor space should be ample for each person likely to occupy it at any one time, and provision should be made for storage and warming of food. As regards the walls (of mess rooms, cloakrooms, and lavatories), a smooth washable surface (e. g. paint, tiles, or enameled iron) for a height of 3 to 4 feet is desirable.

Regulations 11b and 11c require provision of suitable places for deposit of outdoor clothing and overalls, respectively, which may be as near to the work place as is desired, if the garments so deposited are not exposed to dust or fumes. For obvious reasons the overalls must not be kept in the meal room, and the place for storing them (11c) must be kept apart from that provided for storage of outdoor clothing (11b). The same room (if apart from the meal room) may, however, suffice for both 11b and 11c, if numbered pegs on one side of a room or wide passage are reserved for clothing and pegs on the other side, correspondingly numbered, for the overalls.

Under Regulation 12 the alternative of an enameled iron trough, with overhead jets of warm water, will probably be found the most effective. An installation of this kind is accepted in lieu of a bath under Regulation 12b.

* The smoke test may conveniently be made by means of special paper prepared by dipping blotting paper in a solution of nitre and subsequently (after drying) in a solution of pitch in benzine. Such paper, when dry, smolders and makes a thick smoke.

Stands for holding washbasins, if of wood, present usually a very uninviting appearance. Douche baths have several advantages over slipper baths, in cost of installation, economy in space, economy in water, and economy in time required for bathing.

It is most important that full advantage should be taken of the arrangements required by Regulations 8 to 12, and to insure this some one should be made responsible for their cleanliness and proper maintenance.

FACTORY DEPARTMENT, HOME OFFICE, *September, 1911.*

STATUTORY RULES AND ORDERS, 1911.

No. 752.

FACTORY AND WORKSHOP—DANGEROUS AND UNHEALTHY INDUSTRIES.

REGULATIONS, DATED AUGUST 12, 1911, MADE BY THE SECRETARY OF STATE, FOR THE SMELTING OF MATERIALS CONTAINING LEAD, THE MANUFACTURE OF RED OR ORANGE LEAD, AND THE MANUFACTURE OF FLAKED LITHARGE.

In pursuance of section 79 of the Factory and Workshop Act, 1901, I hereby make the following regulations, and direct that they shall apply to all factories and workshops or parts thereof (other than laboratories), in which any of the following processes are carried on:

The smelting of materials containing lead;

The manufacture of red or orange lead;

The manufacture of flaked litharge.

These regulations shall come into force on October 1, 1911, except that so much of regulations 2 and 3 as requires the provision of efficient exhaust draught shall come into force on May 1, 1912.

DEFINITIONS.^a

In these regulations—

"Lead material" means—

(i) Material containing not less than 5 per cent of lead, including lead ore, bullion ore (lead ore rich in precious metals), red lead, orange lead, and flaked litharge; and

(ii) Zinc ore, and material resulting from the treatment thereof, containing not less than 2 per cent of lead; except ores which contain lead only in the form of sulphide of lead.

"Furnace," "melting pot," "retort," "condensing chamber" mean structures as aforesaid which are used in the treatment of *lead material*.

"Flue" means a flue leading from a *furnace*.

"Lead process" means—

(i) Manipulation, movement, or other treatment of *lead material*, whether by means of any *furnace, melting pot, retort, condensing chamber, flue*, or otherwise; and

(ii) Cleaning or demolition of any *furnace, melting pot, retort, condensing chamber, flue*, or part thereof; or reconstruction thereof with material which has formed part of any such structure.

"Surgeon" means the certifying factory surgeon of the district or a duly qualified medical practitioner appointed by written certificate of the chief inspector of factories, which appointment shall be subject to such conditions as may be specified in that certificate.

"Suspension" means suspension from employment in any *lead process* by written certificate in the health register, signed by the *surgeon*, who shall have power of suspension as regards all persons employed in any *local process*

"Damp" means sufficiently moist to prevent the escape of dust.

"Efficient exhaust draft" means localized ventilation effected by heat or mechanical means, for the removal of gas, vapor, fumes, or dust so as to prevent them (as far as practicable under the atmospheric conditions usually prevailing) from escaping into the air of any place in which work is carried on. No draft shall be deemed efficient which fails so to remove smoke generated at the point where such gas, vapor, fumes, or dust originate.

^a Terms to which defined meanings are given are printed throughout the regulations in italics.

DUTIES.

It shall be the duty of the occupier to observe Part I of these regulations.

It shall be the duty of every person employed to observe Part II of these regulations.

PART I.—*Duties of occupiers.*

1. Where a *lead process* is carried on so as to give rise to dust or fumes.

(a) The floor, other than sand beds, shall be maintained in good condition; and

(b) The floor, except such portion as is permanently set apart for the deposit of *lead material*, shall be sprayed with water at least once a day.

2. (1) No *lead material* (other than ingots of metal) shall be deposited or allowed to remain on any part of the floor not permanently set apart for the purpose, and no *lead material* (other than ingots of metal) shall be moved to a furnace, unless such *lead material* is—

(a) *Damp*; or

(b) Under an *efficient exhaust draft*; or

(c) So inclosed as to prevent the escape of dust into the air of any place in which work is carried on.

(2) *Provided, however*, That where none of the above conditions are practicable, *lead material* may be moved to a furnace by persons wearing suitable respirators.

3. None of the following processes shall be carried on except with an *efficient exhaust draft*:

Melting old or dirty scrap lead;

Heating *lead material* so that vapor containing lead is given off;

Cooling molten flaked litharge;

or, unless carried on in such manner as to prevent escape of gas, vapor, fumes, or dust into any place in which work is carried on—

Feeding any furnace or retort;

Manipulating *lead material* in any furnace or retort;

Removing *lead material* from any furnace or retort;

Placing in any hopper or shoot or packing red or orange lead or flaked litharge.

4. No sack which has contained *lead material* shall be cleaned, and, except in the process of sampling, no *lead material* shall be broken up, crushed, or ground, unless such sack or *lead material* is *damp* or is placed in an apparatus so inclosed as to prevent the escape of dust.

5. No *lead material* giving off vapor containing lead shall be removed from the *efficient exhaust draft* required by regulation 3 unless in a receptacle with an efficient cover.

6. No person shall be allowed to enter any furnace, melting pot, retort, condensing chamber, or flue until it has been ventilated.

7. No person shall be allowed to remain in any flue (unless *damp*) or condensing chamber for more than three hours without an interval of at least half an hour.

8. There shall be provided suitable overalls for the use of all persons employed in any of the following processes, which overalls, when required for such use, shall be washed, cleaned, or renewed at least once every week:

(a) Cleaning any flue (unless *damp*) or condensing chamber;

(b) Demolishing any part of a furnace, melting pot, retort, condensing chamber, or flue, unless either *damp* or under an *efficient exhaust draft*;

(c) Reconstructing any part of a furnace, melting pot, retort, condensing chamber, or flue with material which has formed part of any such structure unless *damp*;

(d) Breaking up, crushing, or grinding, in the process of sampling, *lead material* unless either *damp* or placed in an apparatus so inclosed as to prevent the escape of dust;

(e) Placing in any hopper or shoot or packing red or orange lead or flaked litharge.

9. There shall be provided suitable respirators for the use of all persons employed in any process named in regulation 2 (2) or in regulation 8; which respirators, when required for such use, shall be washed or renewed at least once every day.

10. No person under 16 years of age and no female shall be employed in any *lead process*.

11. There shall be provided and maintained for the use of all persons employed in any *lead process*—

(a) A suitable meal room, unless the works are closed during meal hours;

(b) A suitable place or places for clothing put off during working hours; and

(c) A suitable place or places for the storage of overalls provided in pursuance of regulation 8, which place or places shall be separate from those required by paragraphs (a) and (b) of this regulation; all of which shall be so located as not to be exposed to dust or fumes from any manufacturing process.

12. There shall be provided and maintained in a cleanly state and in good repair for the use of all persons employed in any *lead process*—

(a) A lavatory, under cover, with a sufficient supply of clean towels, renewed daily, and of soap and nail brushes, and with either—

(i) A trough with a smooth, impervious surface, fitted with a waste pipe without plug, and of such length as to allow at least 2 feet for every five such persons employed at any one time, and having a constant supply of warm water from taps or jets above the trough at intervals of not more than 2 feet; or

(ii) At least one lavatory basin for every five such persons employed at any one time, fitted with a waste pipe and plug, and having either a constant supply of hot and cold water or warm water laid on, or (if a constant supply of heated water be not reasonably practicable) a constant supply of cold water laid on, and a supply of hot water always at hand when required for use by such persons; and

(b) Sufficient and suitable bath accommodation (douche or other) with hot water laid on, unless the water supply provided under paragraph (a) is so arranged that a warm douche for the face, neck, and arms can be taken.

Provided that, When the number of persons so employed at any one time is temporarily increased by reason of *flue* cleaning it shall not be necessary to provide (by reason only of such temporary increase) additional accommodation in pursuance of paragraph (a) of this regulation if adequate time is allowed to all such persons for washing immediately before each meal (in addition to the regular meal times) and immediately before the end of the day's work.

13. (a) Every person employed in a *lead process* shall be examined by the *surgeon* once in every calendar month (or at such shorter or longer intervals as may be prescribed in writing by the chief inspector of factories) on a date of which due notice shall be given.

(b) A health register containing the names of all persons employed in any *lead process* shall be kept in a form approved by the chief inspector of factories.

(c) No person after *suspension* shall be employed in any *lead process* without written sanction from the *surgeon*, entered in the health register.

PART II.—*Duties of persons employed.*

14 (a) Every person employed in any *lead process* shall deposit in the place or places provided in pursuance of regulation 11 (b) all clothing put off during working hours.

(b) Every person for whose use an overall is provided in pursuance of regulation 8 shall wear the overall when employed in any process named in that regulation, and remove it before partaking of food or leaving the premises, and deposit it in the place provided under regulation 11 (c).

(c) Every person for whose use a respirator is provided in pursuance of regulation 9 shall wear the respirator while employed in any process to which regulation 2 (2) or regulation 8 applies.

15. No person employed shall introduce, keep, prepare, or partake of any food or drink (other than a nonalcoholic drink approved by the *surgeon*), or make use of tobacco, in any place in which any *lead process* is carried on.

Provided that, Except in processes named in regulation 8, this regulation shall not prevent any person from using tobacco, other than a cigar or cigarette, if his hands are free from lead.

16. Every person employed in any *lead process*, or in any place where any *lead process* is being carried on, shall, before partaking of food, wash the face and hands, and before leaving the premises wash the face, neck, and arms, in the lavatory provided in pursuance of regulation 12.

17. Every person employed in any *lead process* shall present himself at the appointed time for examination by the *surgeon* in pursuance of regulation 13 (a).

18. No person employed shall, after *suspension* under these regulations or under any other regulations or special rules applying to factories or workshops where any process involving the use of lead is carried on, work in any *lead process* without written sanction from the *surgeon*, entered in the health register.

19. No person employed shall interfere in any way, without the concurrence of the occupier or manager, with the means provided for the removal of gas, vapor, fumes, and dust, and for the carrying out of these regulations.

W. S. CHURCHILL,

One of His Majesty's Principal Secretaries of State.

HOME OFFICE, WHITEHALL, 12th August, 1911.

GERMANY.

STATEMENT OF THE FACTORY REGULATIONS OF THE CHANCELLOR OF THE GERMAN EMPIRE REGARDING LEAD AND ITS PRODUCTS.¹

1. May 26, 1903, reerection and general management of dye works using lead, including white lead, chromate, red oxide of lead, ordinary oxide of lead, iodide, and all pigments containing lead.

Lead smelting works are under different regulations to those which follow.

2. Workrooms for production and packing must be spacious and high; must have a constant current of air passing through them; the floor level and solid, so that dust can be removed by swilling. At least once a day the floors must be cleaned by moisture, if not kept moist all the time. The walls must have a smooth surface and be washable or oil painted and be limewashed at least once a year.

3. The entrance into adjoining workrooms of dust, gas or vapor containing lead must be prevented as far as possible by suitable arrangements. Where this is not feasible, the rooms thus exposed must be separated from each other.

4. Melting pots for lead must be provided with a hood and a good draft leading into the open.

5. The inner walls of oxidizing chambers must be as smooth as possible and not porous; the wooden framework must be kept moist during the time the sheets of lead are being hung upon it. Before and after entering these chambers the temperature must have been allowed to fall; there must have been thorough ventilation and the air moistened by steam. The converted white lead is to be syringed off the framework by a powerful spray of water. All the time work is being carried on therein the light in the oxidizing chambers must be good.

During the transport of the converted lead to the washing room the material must be kept moist.

The walls of the oxidizing chambers as well as the framework must be properly cleaned by playing upon them with a hose or by washing away the white lead before the chambers are refilled.

Employers must instruct foremen and head workers acquainted with the regulations to supervise the workmen during the hours of labor and to see that some person in accordance with 151 of the factory regulations is made responsible for the regulations being strictly adhered to.

6. In the transport and specially in the washing and grinding of wet-lead colors all handwork must be replaced by mechanical methods, so that soiling of the hands and clothes of the workmen is reduced to the lowest possible minimum.

The pressing of white-lead pulp must only take place after all the soluble lead salts have been removed.

7. The interior of drying chambers must be smooth and as little porous as possible.

8. In grinding, sifting, or sieving, in the packing of materials containing lead, in the emptying of oxide ovens, and wherever there is dust, sufficient ventilation must be provided.

9. Machinery which creates dust must be so constituted that lead dust can no longer escape.

10. Female workers may be allowed to take part in the manufacture of paints of chemical lead products like white lead, acetate and iodide of lead, etc., so long as they are not exposed to dust, or to gases or vapors containing lead and do not come into immediate contact with lead products.

¹ Die Gewerbe-Ordnung von D. F. Hoffmann, Berlin, Carl Heymanns Verlag. 1910.

In factories where there are produced exclusively or mainly lead paints or other lead products youthful workers must not be employed.

These regulations are to be in force until July, 1913.

11. An employer is only allowed to employ such persons in making and packing the above lead products who bring medical certificates stating that they are neither physically weak nor suffering from pulmonary disease, kidney troubles, or disease of the digestive organs, and that they do not indulge to excess in alcohol. These certificates must be kept and shown, when required, to the medical and factory inspectors.

12. An employer must only employ for the filling and emptying of oxidizing chambers such persons as are fully conversant with the dangers of the occupation, and these persons must not be occupied more than eight hours per day. If the work continues more than six hours it must be interrupted by three intervals of one hour each; if of shorter duration the workmen must have one hour free after every two hours of work.

Workmen must not be employed more than eight hours per day when engaged in packing lead paints or pigments containing lead compounds in the dry state or in closing casks filled with these. If the packing is done by machinery provided with necessary exhausts this rule may be abrogated.

Young persons under 18 years of age must not be employed in Nos. 1 and 2, but if the paints contain very little lead and the packing is only done in small quantities, such youths may be employed by permission. Other workmen not specified above but coming into contact with lead must not be employed for more than 10 hours per 24.

13. Every employer must supply to all men whose work brings them into contact with lead, also materials containing lead, a perfectly fitting overall, a cap, and to those occupied in emptying oxidizing chambers properly fitting boots.

14. An employer must only allow work to be carried on where much dust is developed and which can not be completely removed, so long as the men are wearing respirators or wet sponges applied to nose and mouth.

15. In factories where the men come into contact with lead salts in solution, the work can be carried on only after the employer has seen that the men have greased their hands properly or are provided with impermeable gloves.

16. Employers must furnish to the men working clothes, respirators, sponges, and gloves in sufficient quantity and of an appropriate character. They must see that these things are made use of by the workmen according to the particular kind of work they are employed in and are worn only by the workmen to whom they have been supplied; that the things are kept clean and are washed once a week, also that respirators, sponges, and gloves are kept in a special place assigned to each article, and that they are washed on each occasion before being used.

17. In a part of the factory free from dust there must be arranged for the workmen coming into contact with lead suitable washing and dressing rooms, separated from the dining room. Both must be kept clean, free from dust, and must be heated in the cold seasons of the year. In the dining room or other suitable place there must be the necessary arrangements for warming the workmen's food.

In the washing and dressing room there must be water and vessels for rinsing the mouth, suitable nailbrushes, soap, and towels, as well as cupboards for the workman's clothes and for such other portions of clothing as are removed before going into the workrooms.

18. Employers must from a health point of view allow all workmen occupied in lead and lead products to be supervised by a factory as well as a medical inspector. These shall have power to examine for signs of lead poisoning all workmen in the factory at least twice every month.

Employers must not permit any workman who is doubtfully the subject of lead poisoning to engage in any occupation involving the use of lead or lead products until such doubt has been removed, and any workman who is known to be especially susceptible to lead must be entirely excluded from the occupation.

19. Employers are obliged to keep a register of workmen, of the date of their entrance into the factory, and the date of their leaving it, also of the days on which they are brought into contact with lead and of their removal from it. They will be held responsible for the completeness and correctness of

the entries in the register, so long as they are not made by the doctor. The register must contain the following:

- (1) Name of the bookkeeper.
- (2) Name of visiting factory surgeon.
- (3) Surname and Christian name, age, address, date of admission and leaving of every workman, as well as the nature of the occupation.
- (4) Date and nature of the indisposition of every workman.
- (5) Date of recovery.
- (6) Dates and results of the general medical examinations prescribed in paragraph 18.

The sick register must be presented from time to time to the factory and medical inspector.

20. An employer must draw up rules for all workmen coming into contact with lead or lead products. These regulations must contain instructions for young persons mentioned in paragraphs 13, 14, and 15.

- (1) Workmen must not bring into the factory alcoholic drinks.
- (2) Workmen must not take food into the workrooms. Meals must only be taken in the dining room, unless in fine weather when out of doors altogether.
- (3) Workmen must only enter the dining room, take meals, or leave the factory after having removed their working clothes, cleaned their hair from dust, carefully washed their hands and face, and cleaned their nostrils.
- (4) Workmen must use the working clothes, respirators, mouth sponges, and gloves in those departments in the factory for which they have been prescribed by employers.

(5) Smoking, snuffing, and chewing of tobacco are prohibited during work.

(6) The baths in the factory must be used daily at the close of the day's work by those employed in emptying the oxidizing chambers and by the other workmen occupied in lead or with lead products twice per week. It is stipulated in these regulations that if any workman in spite of repeated warnings continues to act contrary to the rules, he shall be dismissed before the expiration of his contract and without notice.

21. In every dining room, dressing room, and workroom there must be hung up in a place where it can be easily read, a printed or written copy of the preceding regulations Nos. 1-20.

The employer is held responsible for paragraph 20, also for the introduction of alcoholic drinks into the works. He must set aside a foreman to see that the regulations in paragraph 20 and paragraphs 3 and 6 are carried out, and that a foreman is made responsible for these. An employer must dismiss workmen when in spite of repeated warnings they bring alcoholic drinks into the factory.

22. New factories for the manufacture of lead and lead products must be inspected before being used.

23. The preceding regulations apply to those factories wherein at present the regulations of the imperial chancellor of July 8, 1893, apply, also those which came into force on July 1, 1903.

These regulations annul all others previously in force.

REGULATIONS OF THE IMPERIAL CHANCELLOR CONCERNING THE ERECTION AND MANAGEMENT OF LEAD SMELTING WORKS. (JUNE 16, 1905.)

GENERAL REGULATIONS.

1. The rooms wherein lead is roasted, raked out, and worked, where lead containing silver is ladled off, where oxides and other lead compounds are made, ground, sieved, and stored or packed, also where zinc scum is distilled, must be spacious, high, and so arranged that there is a sufficient and continuous exchange of air.

The rooms must be provided with a level and solid floor, permitting of an easy removal of dust by wet methods.

The walls must have a smooth surface so as to prevent accumulation of dust and must be washed or whitewashed at least once a year. In roasting sheds with wooden walls this regulation is not enforced.

2. For the workmen engaged at the furnaces and melting pots there must be a sufficient supply of drinking water in a convenient and completely protected place.

In the neighborhood of the furnace there must be arrangements for spraying the ground.

The floors of all the rooms mentioned in No. 1 are to be cleaned once a day in the moist state.

3. Lead ore and smelted products containing lead, if not moist, are to be crushed in machinery so constructed that dust will as far as possible be prevented entering the workrooms. This does not apply to the roasted materials removed from the converters.

Sacks in which lead ore or lead products have been packed must only be cleaned in closed apparatus.

4. Materials containing lead oxides, if dusty, must be moistened before being mixed with other materials preparatory to being placed in the furnace.

5. Dust, gases, and lead fumes escaping from furnaces, converters, gutters, and receiving pots, from sump, slag, slag wagons, slag heaps, and from the glowing remains removed from the furnaces, as well as from the refining pots, must be caught near their point of origin and removed.

Flues and furnaces must be properly cooled and ventilated before workmen enter.

SPECIAL REGULATIONS WHERE LEAD COLORS ARE PRODUCED.

6. Where the grinding, sieving, and packing of lead products are done, during the filling and emptying of oxidizing chambers, also the packing of red lead into bladders, and in all processes where dust containing lead is produced, there must be exhaust draft for the removal of the dust and means used to prevent extension of the dust into the workrooms.

7. Machinery which causes dust must be so constructed that no dust can escape.

In such machinery care must be taken that the tension of air within is not greater than that of the air without. Such machinery must only be opened after the dust has settled and the machinery cooled down.

SPECIAL REGULATIONS REGARDING ZINC SKIMMING.

8. For new forms of zinc-scum smelting furnaces permission of the authorities must be obtained. They must be so arranged that (1) in the front of the place at which they are filled there shall be an open and well-lit space of 3 yards, and (2) the passage below it must be fully 4 yards high, well lit, and airy.

9. Any dust, gases, and fumes escaping from zinc-scum distillation furnaces must be removed.

There must be also proper arrangements to prevent the escape of smoke and gas from the furnaces.

10. The sifting and packing of the by-products of zinc-scum distillation must be carried on in rooms separated from other rooms. Vide regulations, paragraph 1.

The sifting must be done in machinery which does not evolve dust.

EMPLOYMENT OF WORKMEN.

11. Females and young persons are not admitted into the rooms mentioned in paragraph 1, nor into the flues, nor into places where flue dust is being transported.

12. In the places mentioned in paragraph 1 and in the flues only such new hands can be employed as are in possession of a medical certificate confirmed by a recognized authority that the occupation will not be injurious to health. These certificates are to be filed and kept at the disposal of the medical and factory inspectors.

13. Men employed at the smelting furnaces must not be occupied more than eight hours per day. This regulation equally applies to workmen occupied inside cooled-down chambers or in clearing out flues.

In the clearing out of flues which contain dry dust, the men who work within them are not allowed to be employed more than four hours, and the men employed in clearing away and transporting the dust must not be employed more than eight hours.

Altogether workmen employed in rooms mentioned in paragraph 1 must not be occupied more than 10 hours exclusive of intervals.

Workmen employed on Sunday labor do not come within the scope of the above regulations.

WORKMEN'S CLOTHES AND WASHING ACCOMMODATION.

14. Employers must provide workmen engaged in cleaning flues, mending cooled-down furnaces, occupied in grinding, sieving, and the packing of the oxides and other lead products with close-fitting overalls, caps, and respirators.

15. Processes which require workmen to manipulate soluble lead salts must not be carried on without previous smearing of the hands with grease or by the men wearing india-rubber gloves.

16. The overalls, respirators, and gloves, etc., mentioned in paragraphs 14 and 15 must be provided by the employer in sufficient number and appropriate to the purpose for which they are intended. The employer is responsible for the articles only being worn by the workmen to whom they have been given; also, that they are cleaned at certain intervals, viz, overalls once a week, respirators and gloves before being used, also during the time they are not in use that they are kept in proper places.

17. In a part of the factory, free from dust, there must be a dining room; there must also be a washing and dressing room separated from the dining room. Both rooms must be kept clean and free from dust and warmed during the cold seasons of the year. At a convenient place there must be opportunity provided for the warming of food.

In the washing and dressing rooms there must be water, soap, and towels, as well as convenient arrangements for keeping separately the working clothes and also those put off before commencing work.

Employers must provide warm baths daily for the workmen occupied in cleaning flues and mending cooled-down furnaces, and they must see that all others working with oxidized lead products take a warm bath once a week, during working hours, in a suitable place capable of being heated in cold weather.

SUPERVISION OF HEALTH CONDITIONS.

18. Employers must hand over the supervision of the health conditions of the workmen to a medical man authorized by the higher administrative authority and whose name has been conveyed to the factory inspector. This factory surgeon must examine the workers at least once a month in the factory, and must specially be on the outlook for signs of lead poisoning.

Employers are not allowed to engage men in the cleaning of flues, mending cooled-down furnaces, or transporting flue dust who are, according to medical opinion, suspiciously the subjects of plumbism, until they have fully regained their health. Such workmen who show themselves to be specially sensitive to lead must be excluded from the occupation for all time.

19. Employers are obliged to keep a control book, in which shall be entered changes of workmen and the state of their health, and they are held responsible for the accuracy and completeness of the entries, so long as they have not been made by the doctor.

This control book must contain:

- (a) Name of the bookkeeper.
 - (b) Name of factory surgeon.
 - (c) Christian and family name of each workman, age, address, date of entering upon and of giving up each kind of work, as well as the nature of the occupation.
 - (d) Date and nature of illness of workmen.
 - (e) Date of recovery from illness.
 - (f) Date and results of medical examinations, mentioned in paragraph 18.
- The register is to be shown to the factory inspector and to the certifying factory surgeon.

FINAL RECOMMENDATIONS.

20. Employers must exhibit the following notices to the workmen:

- (a) Workmen are not allowed to take food into the workrooms; the taking of food is only allowed outside the workrooms.
- (b) Workmen are not allowed to enter the dining room, partake of meals, or leave the smelting works until after having taken off their working clothes and carefully washed their hands and face.
- (c) Workmen must use the overalls, respirators, and gloves both in the workrooms and in those processes for which they are provided.
- (d) Smoking of cigars and cigarettes, etc., is forbidden during work.

(e) Baths must be taken daily after work by the men employed in cleaning flues and cooled-down furnaces and once a week by other workmen coming into contact with lead products. This prescription does not apply to those workmen for whom bathing is considered unsuitable by the factory surgeon. It is also to be mentioned that workmen who after repeated warnings act contrary to the above regulations, may be dismissed before the end of the contract and without notice.

If for any smelting works other regulations have been published, the above are to be incorporated.

21. A copy of these regulations must be placed in every workroom, dressing room, and dining room in an accessible place and where it can be easily read.

Employers are held responsible for the carrying out of rule (a) in paragraph 20. They must intrust a foreman to see that rules (b) and (c) in paragraph 20 are carried out, and that the foreman is responsible for the same.

22. New lead smelting works can only be opened after their erection has been duly notified to the factory inspector. After receipt of a notice the inspector must examine the works, so as to see whether the buildings and the arrangements are in keeping with the requirements of the regulations.

23. The above regulations to become law on January 1, 1906.

In any case where considerable structural alterations are required, the time may be extended to January 1, 1908.

Where reasons of public interest are concerned, the Government may grant a respite to January 1, 1912.

REGULATIONS OF THE IMPERIAL CHANCELLOR CONCERNING THE ERECTION AND MANAGEMENT OF PRINTING WORKS AND TYPE FOUNDRY WORKS FROM JULY 31, 1897, ALTERED IN THE REGULATIONS OF JULY 5, 1907, AND IN THOSE OF DECEMBER 22, 1908.

On the basis of paragraph 120 (e) of the factory act the Bundesrath has decided upon the following regulations for the above:

I. The following regulations are to be in force for workrooms in which persons are employed in setting up type or in stereotyping:

(1) The floor of the workroom must not be more than half a meter [1.64 feet] below the roadway. Exceptions may be permitted if, through satisfactory isolation of the ground and through sufficient light and air, health requirements are otherwise complied with.

Workrooms underneath a roof can only be made use of so long as the roof is lined with wood or plaster.

(2) In workrooms wherein letters or stereotype plates are made, the number of persons occupied must be such that each person shall have 15 cubic meters [529.72 cubic feet] of air space. In rooms in which persons are employed in other processes, 12 cubic meters [423.77 cubic feet] of air space at least must be provided.

On occasions, when owing to a temporary stress of work more persons are required than for a maximum of 30 days in the year, 10 cubic meters [353.14 cubic feet] may be allowed.

(3) The workrooms must be at least 2.6 meters [8.53 feet] high, when 15 cubic meters [529.72 cubic feet] of air space are allowed to each person; in all other instances they must be 3 meters [9.84 feet] in height.

The rooms must be provided with windows in sufficient numbers and size so as to allow the maximum of light into all places where work is carried on. The windows must be so constructed as to allow of being opened for the purpose of ventilation.

Workrooms with a slanting ceiling must have an average height, as mentioned in section 1 of paragraph 3.

(4) The workrooms must be provided with hard and nonporous floors, so as to permit of the ready removal of dust in a moist manner. If the floors are of wood, they must be well planed and not allow of the absorption of liquid.

Where the walls and ceilings are not paneled or painted with oil, they must be whitewashed at least once a year. Paneled and oil-painted walls must be washed at least once a year; oil-painted walls if varnished must be revarnished at least once in every 10 years, and if not revarnished, must be repainted every 5 years.

The stands of typesetters and the shelves for the cases which hold the type must either be so fixed to the floor that no dust can accumulate below them, or they must be provided with such high feet that cleaning of the floor beneath them can be easily carried out.

(5) Workrooms must be thoroughly ventilated at least once a day. Care must also be taken that a sufficient change of air is obtained during the working hours.

(6) The melting pots for type and stereotype metal must be provided with proper exhausts and hoods.

The fusion of mixed type metals and the remelting of scums must be carried on in special workrooms. If these do not exist, the work must be done in the absence of all the other hands who are not concerned.

(7) The workrooms and all furnishings, but especially walls, shelves, and window sills must be thoroughly cleaned at least twice a year.

The floors must be thoroughly cleaned once a day, either by washing or by mopping, so as to keep them free from dust.

In the case of wooden floors, or where there is linoleum smeared with an absorbing oil (a nondrying mineral oil), washing may be disallowed, but a daily sweeping will be necessary. The smearing with oil must be renewed in the case of wooden floors at least every eight weeks and in the case of linoleum-covered floors at least every two weeks.

(8) Type cases before being used and as long as they are being used must be cleaned at least twice a year.

The dusting of these cases must be done in the open air by means of bellows, and must not be attempted by young persons.

(9) Spitting on the floor is forbidden. Spittoons containing water must be provided in the ratio of one for every five men.

(10) For typesetters as well as for type founders, polishers, and grinders there must be provided either in the workrooms or in suitable rooms close at hand sufficient washing conveniences, including soap and one clean towel, for each person at least once a week.

If there is no running water, there must be one washstand for at least every five workmen. The water must be of sufficient quantity, and there must be means of emptying it.

Employers must exercise strict vigilance that no food is taken into the factory, and they must see that no man leaves without first having had a wash.

(11) The home clothes of the workmen must be kept outside of the workrooms during working hours. The retention of these in the workrooms is only permitted if there are dust-proof cupboards protected by a curtain or cupboards kept closed during working hours.

(12) All lighting arrangements which give rise to considerable heat must be provided with necessary exhausts.

(13) Employers must draw out regulations for the carrying out of paragraphs 8, 9, 10, and 11.

In any factory where there are at least 20 workmen employed the above rules must be incorporated with the regulations of the factory.

II. In every workroom there shall be hung up a notice signed by the local authority stating:

(a) The length, breadth, and height of the workroom.

(b) The cubic capacity of the room.

(c) The number of men allowed to work in the room.

In every workroom there must be, in addition, a notice giving in easily read characters the regulations of No. I.

III. Exemptions from the regulations under No. I may be granted by the administrative authorities, when there are not more than five workmen employed.

IV. The above regulations come into force immediately for all new factories.

For all factories which are in existence at the time of the announcement paragraphs 5, 7, and 9 of No. I come immediately into force and the remainder a year after the publication of the regulation.

PUBLICATION OF THE IMPERIAL CHANCELLOR CONCERNING THE ERECTION AND MANAGEMENT OF FACTORIES FOR THE MANUFACTURE OF ELECTRICAL ACCUMULATORS CONTAINING LEAD OR LEAD COMPOUNDS (MAY 6, 1908).

On the basis of paragraph 123 of the factory act, the Upper House has drawn out the following regulations for the erection and management of factories of electrical accumulators in which lead and lead products are used:

1. In works where electrical accumulators are made from lead or lead compounds the workrooms in which the products are manipulated must have a

height of at least 3 meters [9.84 feet] and have a sufficient number of windows which can be opened for the purpose of ventilation.

2. In rooms in which there is dust or where lead or lead compounds are split the floors must be impermeable to water, and the walls and ceiling of these rooms, unless covered with smooth, washable paneling or oil painted, must be washed at least once a year.

The use of wood, soft asphalt, or linoleum for floors, also papered walls, are not permitted in these rooms.

3. Melting pots for lead must be provided with effective hoods and exhausts leading into the open air.

4. Where, in the mechanical manufacture of lead plates, saws and planes are used care must be taken that all dust and particles of lead are carried away from the place of their origin.

5. Machinery creating lead dust must be so constructed that no dust can escape either during the running of the machinery or in the emptying of it.

6. All sieving, mixing, and moistening of materials intended for filling in the lead plates, so long as they contain lead or lead compounds; the removal of the covers of the dried plates, as well as all manipulations creating dust during the handling of the dry or dried material for filling, must only take place under effective exhausts or in such apparatus as will prevent the escape of dust into other workrooms.

7. Open receptacles containing lead dust or lead compounds must be placed upon a grating provided with a trough below, so arranged that all loose material is received therein.

8. The following operations must be carried out in a special room separated from the others:

(a) The mechanical treatment of lead plates, frames or grids.

(b) Production of metallic lead dust, vide paragraph 5.

(c) The production and mixing of the filling material or paste (par. 6), as far as it is done by machinery.

9. The tables upon which the paste is rubbed or pressed into the lead plates, frames, or grids must have a smooth and closely joined surface and must be cleaned at least once a day by moisture.

10. All soldering by means of a blast of hydrogen or coal gas must be done in special workrooms under an effective exhaust.

11. The zinc used for making hydrogen gas and likewise the sulphuric acid for the same purpose must be pure.

12. Workrooms are to be kept free from all soiling with lead or lead compounds.

The floors of the rooms mentioned in paragraph 2 must be cleaned by moist methods at least once a day after the day's work is over.

13. Employers must place at the disposal of workmen occupied in making electrical accumulators overalls and caps in sufficient number and appropriate for the purpose.

They must see, by means of rules and inspection, that the overalls are used only by those men to whom they are given, that they are washed at least every week, and that when not in use they are kept in suitable places specially adapted for the purpose.

14. In a part of the factory free from dust there must be reserved for the workmen washing and dressing rooms and separated from these a dining room. These rooms must be kept clean and free from dust and be heated during the cold season of the year.

In the washing and dressing rooms there must be water, vessels for rinsing the mouth, brushes for the hands, soap and towels, as well as provision made for keeping the ordinary wearing clothes of the men when at work.

Employers must afford opportunities for a warm bath to be taken at least once a week.

15. Employment of females and young persons is forbidden in all departments where lead or lead products are used.

16. Employers are only allowed to give employment in accumulator works to such persons as bring a certificate of fitness from a medical practitioner empowered to grant such by law. These certificates must be retained and shown to the factory inspector when required.

17. The making and mixing of the paste as well as the filling in of the plates, frames, or grids with it must be so arranged that—

(a) The hours of work do not exceed eight per day, and that they are interrupted by a break of at least one and one-half hours.

(b) The hours of work do not exceed six per day, and are not interrupted for the purpose of taking food.

If the work is arranged as under (b), the workmen can be occupied in other departments of the factory, so long as they do not come into contact with lead or lead products, and so long as they are granted a break of at least two hours between the two different kinds of occupation.

Employers must notify the local authorities within a week of opening their factory which of the two plans of working they have adopted, and they are not allowed to alter their plans without giving notice.

18. Employers must intrust an approved medical practitioner with the care of the health of the workmen, who have to be examined for signs of lead poisoning at least once a month.

Workmen showing signs of lead poisoning are by order of the medical practitioner kept away from contact with lead until they have recovered, and such workmen as appear specially susceptible to lead must be permanently kept away from it.

19. Employers must keep a register of their workmen and of their health. They are responsible for the entries except those made by the factory surgeon. It must contain—

(1) Name of bookkeeper.

(2) Name of factory surgeon.

(3) Christian and family name, age, address, date of each workman entering the factory and leaving it, also a note as to which department he was employed in.

(4) Date and nature of illness of every workman.

(5) Date of recovery.

(6) Dates and results of medical examinations.

The register must be shown to the factory inspector and certifying factory surgeon when required.

20. Employers must issue the following regulations, and these shall be binding:

(1) Workmen must not bring food into the workrooms. The introduction of alcoholic drinks is also forbidden.

(2) Workmen must make use of the overalls in accordance with instructions.

(3) Workmen can only enter the dining room to take food therein, or leave the factory after having removed their working clothes, carefully washed themselves, rinsed their mouth, and put on their ordinary wearing clothes.

(4) Smoking, snuffing, and chewing of tobacco are forbidden during working hours.

In the regulations it must be stated that workmen continuing to act contrary to them are liable, after repeated warning, to instant dismissal.

If in any factory there are already regulations dealing with the conditions of work in that factory the above regulations are to be included.

21. A copy of the regulations, paragraphs 1 to 20 inclusive, must be hung up in the dining room, dressing room, and in every workroom.

22. In the event of employers acting contrary to the regulations the police are empowered to interpose and stop the factory.

23. These regulations come into force on July 1, 1908, and annul those of May 11, 1908.

REGULATIONS OF THE IMPERIAL CHANCELLOR CONCERNING TRADES IN WHICH PAINTS CONTAINING LEAD ARE USED. (JUNE 27, 1905.)

I.—REGULATIONS.

1. In the grinding, mixing, and other processes concerning white lead and other lead paints when dry workmen must not come into immediate contact with these. The men must be protected against dust.

2. The mixing of white lead with oil must not be done by hand, but by mechanical means and the receivers so arranged that the dust can not enter the workrooms. This also holds good for the other lead paints. These, however, may be mixed by hand, if only men are employed above 18 years of age, and the quantity dealt with does not exceed 1 kilogram [2.20 pounds] of red lead per day and for other colors 100 grams [3.53 ounces] per day.

3. The rubbing off of dry paint which can not be proved to be free from lead must only be done after previous moistening.

4. Employers must see that the workmen occupied in lead paints or in mixing lead paints wear suitable overalls and caps.

5. All workmen occupied in painting with lead paints or their compounds must be provided with suitable washing appliances, brushes, soap, and towels.

In the case of new buildings workmen must be given a place wherein they can keep their clothes and have opportunities for washing in a place protected from the colds of winter.

6. Employers must indicate to workmen the dangers to health from lead paints and hand them a copy of the following instructions:

II.—INSTRUCTIONS FOR PLACES WHEREIN THE WORK OF PAINTING AND DECORATING IS CARRIED ON AT THE SAME TIME AS OTHER OCCUPATIONS.

7. If the work concerns a factory or shipping wharf, then the following paragraphs 8 to 11 come into force.

8. Workmen must have a special room in which to wash and dress. It must be kept clean and heated during the cold season and contain a place for keeping their clothes.

9. Employers must publish regulations for the workmen thus occupied, and the regulations must contain the following:

(1) No alcoholic drinks must be consumed in the workrooms.

(2) Workmen are only allowed to take food and drink after having left the workroom, taken off their working clothes, and carefully washed their hands.

(3) Workmen must wear the special clothes for the particular kind of work the clothes were given.

(4) The use of tobacco in any form is forbidden during work.

The following special notice is to be added: Workmen continuing to break these regulations after having been repeatedly warned may be dismissed without notice.

If in any factory regulations for work have been previously published the above are to be incorporated.

10. Workmen must be medically inspected once every six months. When a workman has been suspended on account of lead poisoning he must be given other occupation which does not bring him into contact with lead.

11. Employers must keep a register in which shall be stated the changes and the state of health of the workmen. They are responsible for the accuracy and completeness of the entries, so long as they have not been made by the factory surgeon.

The register must contain:

(1) Name of the bookkeeper.

(2) Name of factory surgeon.

(3) Christian and family name, age, address of each workman, date of entering upon and of leaving the factory, as well as the nature of his occupation.

(4) Date and nature of the illness of each workman.

(5) Date of his recovery.

(6) Dates and results of medical examination.

The register to be handed to the factory inspector and certifying factory surgeon when required.

12. These regulations come into force January 1, 1906.

NOTICE REGARDING LEAD.

How do painters, decorators, varnishers and all persons working in lead protect themselves from lead poisoning?

ALL LEAD PAINTS ARE POISONOUS.

Painters and all persons working in lead are exposed to the risk of poisoning. Plumbism occurs through the entrance by the mouth and nose of small quantities of lead. The poison is introduced by soiled hands, from the beard and clothing, by eating, drinking, smoking, and snuffing, also by inhalation.

The effects are not immediate, but are the results of accumulation, it may be, of years.

HOW DOES LEAD POISONING MANIFEST ITSELF?

The first sign of lead poisoning is usually the presence of a bluish line on the gums, also of pallor of face and lips pointing to anæmia. Further symptoms are diverse, mostly colic; the patient experiences violent cramp-like pains

commencing at the navel; the abdomen is hard and retracted. Accompanying these there are frequent vomiting and constipation; diarrhea is rare. In other cases there is paralysis affecting usually the muscles by which extension of the fingers is made, generally of both hands, exceptionally of the muscles of the arms, legs, and throat. Sometimes there is complaint of pain in the joints, usually the knees; less frequently is there pain in the upper limbs. In specially severe cases the brain is affected (violent headache, general convulsions, complete unconsciousness, or great restlessness and blindness). Finally lead poisoning is associated with atrophied kidneys and has a causal connection with gout. Many women who are the subjects of lead poisoning miscarry; stillbirths are frequent. Of the children born alive the mortality is great. Children reared at the breast by mothers suffering from lead poisoning are injured by the milk. Apart from the severe forms of encephalopathy which often end fatally, lead poisoning can usually be recovered from if the sufferers can be removed early from their occupation which exposes them to lead. Recovery comes weeks after, but in severe cases only after many months.

THE PREVENTION OF LEAD POISONING.

The widespread belief that the regular use of certain medicines (potassium iodide, magnesium sulphate, and other drugs) or the taking of milk is sufficient to prevent lead poisoning is not substantiated. On the other hand, proper food rich in fat, and in this milk is included, is said to possess some value. The most effective protectives against plumbism are cleanliness and sobriety. Persons who without being alcoholics are in the habit of taking alcoholic drinks rather freely are more exposed to the danger of lead poisoning than those who are more abstemious. Alcoholic stimulants should not be taken during working hours. With reference to cleanliness all persons coming into contact with lead paints can not be too careful; they ought to observe the following:

(1) Hands and working clothes should come into contact with lead paints as little as possible.

(2) Whilst the hands can not be kept absolutely free from touching lead, the smoking and chewing of tobacco and the habit of snuffing can certainly be avoided during work.

(3) Workmen should only take food and drink, or leave the workroom after having taken off their working clothes, washed their hands with soap and water, or with pumice stone or marble soap. The face and beard require similar treatment if they have been soiled during work. If drinking can not be avoided during working hours, the edges of the vessel should not be touched by the hands.

(4) The working clothes specially provided by the employer should be properly used.

In order to prevent the breathing of dust containing lead, all the items of the regulations should be strictly followed; especially should the grinding of white lead with oil or varnish not be done by hand, but in inclosed machinery. All old lead paint ought not to be rubbed off without having been previously moistened.

A workman who has been brought into contact with lead, and who despite all preventive measures has become ill with symptoms suggesting plumbism ought immediately to consult a doctor both in his own interest as well as that of his family, and he ought at the same time to inform the medical practitioner that he has been working in lead or with its compounds.

FRANCE.

WHITE LEAD.

DECREE OF JULY 17, 1902, CONCERNING THE USE OF WHITE LEAD IN HOUSE PAINTING.

The President of the Republic on the report of the minister of commerce, industry, post, and telegraphs, with reference to article 3 of the law of June 12, 1893, decrees.

ARTICLE 1. That white lead must only be used in a pasty condition in house painting.

ART. 2. It is forbidden in all house-painting operations to manipulate with the bare hands any material containing white lead.

ART. 3. Scraping off of white-lead paints by the dry method is forbidden.

ART. 4. In all moist scraping off, and generally in all painting with white lead, employers must provide overalls exclusively for the work, and they must insist upon these being worn. They must also see that the overalls are kept clean and in good condition.

Necessary facilities for cleanliness must be provided for workmen at the place of work.

All working tools must be kept clean; the cleaning must not be done in the dry state.

ART. 5. Employers must see that the text of the present decree is hung up in the places where the workmen are engaged, and where they receive their wages.

ART. 6. The minister of commerce, industry, post, and telegraphs is empowered to see that the present decree is carried out. It will be published in the Bulletin des Lois and in the Journal Officiel of the French Republic.

DECREE OF JULY 15, 1904; EXTENSION OF THE DECREE OF JULY 17, 1902, TO ALL PAINTING.

The President of the French Republic decrees—

1. That the terms of the decree of July 18, 1902, regulating the use of white lead in house painting are extended to all painting.

2. That the minister of commerce, industry, post, and telegraphs is empowered to see that they are given effect to. The decree will be published in the Bulletin des Lois and in the Journal Officiel of the French Republic.

LAW OF JULY 20, 1909, CONCERNING THE USE OF WHITE LEAD IN ALL PAINTING OPERATIONS WHETHER ON THE OUTSIDE OR IN THE INSIDE OF BUILDINGS.

The Senate and the Chamber of Deputies have adopted and the President of the French Republic issues the following law:

ARTICLE 1. In workshops, on wharfs, in buildings in the course of construction or during repair, and generally in all places where the painting of buildings is carried on, employers, directors, or managers are obliged, independently of the regulations prescribed by law of June 12, 1893, concerning the health and protection of workmen, to conform to the following regulations:

ART. 2. At the end of the fifth year, after promulgation of the present law, the use of white lead, of linseed oil mixed with lead, and of all specialized products containing white lead will be forbidden in all painting, no matter its nature, carried out by working painters either on the outside or in the inside of buildings.

ART. 3. A public health order on the advice of the consultative committee of arts and manufactures and of the committee of industrial hygiene shall indicate, if need be, the special kinds of work in which the preceding regulation can be abrogated.

ART. 4. Factory inspectors are intrusted with power to insure the execution of the present law. For this purpose they may enter any establishment coming under article 1, but in any case where painting is carried on in inhabited houses the inspector can only enter after having received permission from the occupier.

ART. 5. Articles 5 and 7 (pars. 1 and 3), also 9 and 12 of the law of June 12, 1893, are applicable in cases where the law is disobeyed and where obstacles are placed in the way of its execution.

The present law discussed and adopted by the Senate and Chamber of Deputies will be carried out as a State law.

LEAD INDUSTRIES.

DECREE OF APRIL 23, 1908, PRESCRIBING SPECIAL REGULATIONS FOR THE HYGIENE OF INDUSTRIES IN WHICH WORKMEN ARE EXPOSED TO LEAD POISONING.

The President of the Republic, acting upon the advice of the consultative committee of arts and manufactures, and on the strength of the report of the minister of public works and protection of workers, concerning the law of June 12, 1893, which deals with the health and safety of workmen in industrial establishments, as modified by the law of July 11, 1903, chiefly article 3, decrees:

ARTICLE 1. That in the lead industries hereafter mentioned, the metallurgy and cupellation or argentiferous lead, the manufacture of accumulators and of lead glass, manufacture of lead enamels and their application, manufacture of pottery, painting of porcelain and earthenware, ceramic chromolithography, manufacture of alloys, oxides, salts, and paints made from lead, employers, directors, or managers are instructed independently of the general regulations prescribed by the decree of November 29, 1904, to take special measures for safety and health as indicated in the following articles:

ART. 2. Lead-melting pots must be installed in airy places, separated from the other workshops.

Hoods or any other efficient means for the removal of fumes shall be installed—

(a) Above the sink containing the molten lead and slag in the metallurgy of lead.

(b) Before the doors of the furnaces in the manufacture of lead oxides.

(c) Above the melting pots of lead or its alloys in the other industries mentioned in article 1.

ART. 3. All work which deals with oxides and other lead compounds liable to give off dust must be carried on as far as possible in the moist state.

If this is impracticable in the presence of water or other liquid, the work must be carried on mechanically in a closed and air-tight compartment.

Where one or other of the regulations of the first two paragraphs of the present article are unable to be carried out, the work in question must be done under a powerful exhaust installed in such a manner that the harmful products are arrested by suitably placed appliances.

Finally, if none of these methods can be adopted, the workmen must wear respirators.

ART. 4. Workmen are forbidden to handle with their bare hands lead oxides or other lead compounds, whether these are in a dry or moist state, in suspension or in solution. The employer is obliged to provide gratuitously to his workmen engaged in all of the above processes gloves made of an impermeable substance like caoutchouc, or suitable tools, and to see to their upkeep and frequent cleaning.

ART. 5. The tables upon which these products are manipulated must be covered with an impermeable substance and maintained in a water-tight condition.

The same remark applies to the floor of workrooms, which moreover must be kept moist. The floor must be slightly inclined toward a water-tight reservoir where, too, the lead-refuse drainage can be received.

The work must be organized in such a manner that no spluttering of dirt shall occur.

The tables, floor, and walls must be washed at least once a week.

ART. 6. Without in any way acting in contradiction to the regulations mentioned in article 3, the grinding of lead products, the mixing and manipulation of these in the form of powder shall be carried on in special rooms, wherein a powerful exhaust is installed. If it is impossible to moisten the products the workmen must wear respirators.

ART. 7. The dipping of pottery with bare hands in liquids containing litharge or red oxide, chromate, or carbonate of lead in suspension is forbidden.

ART. 8. The introduction of food or drink into workrooms is forbidden.

ART. 9. Employers are obliged to place at the disposal of the workmen, and to maintain gratuitously, overalls and other clothing to be exclusively used in the work, also gloves and respirators.

ART. 10. In a part of the factory separated from the workrooms there must be for the use of workmen exposed to dust or any other lead emanations a well-kept dressing and washing room, provided with taps and basins in sufficient number and with an abundant supply of water as well as soap, and for each workman one towel, to be renewed at least once a week.

The dressing room must be provided with cupboards and boxes capable of being closed with a key or padlock, the home clothes being kept separate from the working apparel.

ART. 11. A warm bath or spray shall be at the disposal of workmen exposed to dust or to other lead emanations, once a week.

At the close of each day's work an opportunity of taking a warm bath or of having a warm spray must be offered to every workman occupied in emptying or cleaning chambers and flues, also in the repairing of furnaces in lead factories, in the packing of red lead, in transporting lead from the melting places into the white-lead factories, in the grinding of lead enamels, and in all dry grinding.

ART. 12. Employers must hang up in readily accessible places a copy of the regulations which impose upon the workmen the following requirements: They must make use of the tools, gloves, respirators, and working overalls provided at the expense of the employers, and must not introduce into the workrooms either food or drink; they must take care that before each meal their mouth, hands, and nostrils are properly cleansed, and that they take weekly or daily the baths stated in article 11.

ART. 13. The minister of public works and social welfare can, in consequence of a decision made upon the advice of the consultative committee of arts and manufactures, grant to an establishment for a limited period dispensation of all parts of the regulations included in article 2, paragraphs *a*, *b*, *c*, in article 5, paragraph 2, and in article 6, paragraph 1, where it is obvious that the application of the regulations is practically impossible, and the health and the safety of the workmen are secured by conditions at least equivalent to those detailed in the present decree.

ART. 14. With the exception of supplementary delays granted by the minister on the strength of article 6 of the law of June 12, 1893, modified by the law of July 11, 1903, the delay in the carrying out of alterations provided for in the present law is limited to one year from the date of its publication.

ART. 15. The minister of public works and social welfare is empowered with the execution of the present decree, which will be published in the *Journal Officiel* of the French Republic and in the *Bulletin des Lois*.

In "*Lois, Décrets, Arrêtés concernant la Réglementation du Travail, etc.*," of April, 1910, there are published tables of the various industries in which lead or its compounds are used, and in which persons under 18 years of age, girls under age, and women generally are forbidden to work. Of these trades the following are scheduled: Manufacture of white lead; goldsmith's work in which lead is used; chloride of lead; steeping of lace in white lead; the melting and making of lead grids; manufacture of red lead (litharge, massicot, minium); the separation of lead from such other metals as zinc or copper; manufacture of electrical accumulators; also chromolithography. Under certain conditions young persons may be employed in electrical accumulator works, in the manufacture of boxes for preserved meats and fruits, but not in the soldering processes, in potteries, and several other industries in which lead is used, but only so long as they are not allowed to come into contact with lead or its compounds.

! BELGIUM.

TRANSLATION OF A NOTE BY THE BELGIAN MINISTRY OF INDUSTRY AND LABOR, BRUSSELS, NOVEMBER 9, 1908.¹

In Belgium the laws and regulations concerning work carried on in the manufacture of pottery and ceramic goods relate to—

1. The work of women, young persons, and children.
2. The health and safety of the workers.

So far as the work of women, young persons, and children is concerned, the manufactures in question are subject to the law of December 13, 1889. Article 7 of this law has, however, been repealed and replaced by articles 9 and 10 of the law of July 17, 1905, relating to rest on Sunday.

The period of daily work, as well as the intervals for rest for young workers engaged in the manufacture of pottery and faience, in the manufacture of refractory products, as well as in brick fields and handmade-tile works, are fixed by the special royal decrees of December 26, 1892, and September 22, 1896, in accordance with article 4 of the above-named law of December 13, 1889. On the other hand, article 7 of the royal decree of February 19, 1895, made in pursuance of the same law, forbids the presence and the work of children under 14 in those parts of porcelain and faience works where dust generated in grinding or sifting is given off freely.

From the point of view of the health and safety of the staff of operatives of all ages and of either sex, the carrying on of the manufactures in question is subject to the requirements of the general regulation of March 30, 1905, which applies to industrial and commercial enterprises within the scope of the

¹ Reprinted from the Report of the Departmental Committee Appointed to Inquire into the Dangers Attendant on the Use of Lead in the Manufacture of Earthenware and China, Vol. II, Appendixes, 1910. Wyman & Sons (Ltd.), Fetter Lane, London.

law of December 24, 1903, relating to compensation for injuries resulting from industrial accidents.

Moreover, manufactures connected with the making of pottery and ceramic products are included for the most part among the work classified as dangerous, unhealthy, or likely to cause a nuisance, and are therefore subject to the royal decree of January 29, 1863, dealing with the manner of licensing and the supervision of these establishments. It follows from this that (independently of the general regulations set forth above) the proper authority may in every case make the license to carry on a particular factory conditional on the special reservations and conditions which are deemed necessary in the interests of the safety, health, and convenience of the public, as well as in the interests of the workers attached to that factory.

SUMMARY OF LAWS AND DECREES REFERRED TO IN THE ABOVE NOTE.

A.—LAW OF DECEMBER 13, 1889.

ARTICLE 2. Employment of children under 12 years of age forbidden.

ART. 3. Power to forbid the employment of children or young persons under 16, and girls or women between 16 and 21, at work beyond their strength, or which might involve danger for them.

Similar power to forbid, or only to license for a limited number of hours per day for a limited number of days, the employment of children or young persons under 16, and girls or women between 16 and 21, at work recognized as unhealthy.

ART. 4. General powers to limit, by decree, the period of daily work of children or young persons under 16, and girls or women between 16 and 21. (See decree marked "B," below.)

ART. 5. Women shall not be employed on work during the four weeks following confinement.

ART. 6. Children and young persons under 16, as well as girls or women between 16 and 21, shall not be employed at work after 9 p. m. or before 5 a. m. (Subject to certain exceptions.)

B.—ROYAL DECREE OF DECEMBER 26, 1892.

Manufacture of pottery and faience; and manufacture of refractory products. Extended to porcelain works (Sept. 22, 1899), and to earthen-pipe factories (Feb. 25, 1901).

ARTICLE 2. The period of actual work for children and young persons under 16, as well as for girls or women between 16 and 21, shall not exceed 10 hours per day.

ART. 3. The period of employment shall be interrupted by at least three intervals of rest, the total duration of which shall not be less than one hour and a half.

The midday rest shall not be less than one hour in length.

C.—ROYAL DECREE OF SEPTEMBER 22, 1896.

Deals only with brickyards, and tile works without power.

D.—ROYAL DECREE OF FEBRUARY 19, 1895.

ARTICLE 7. In manufactories of faience and porcelain, the presence and work of children are forbidden in places where dust generated in grinding or sifting is given off freely.

E.—LAW OF JULY 17, 1905.

ARTICLE 2. It is forbidden to employ any persons to work more than six days per week, the day of rest being Sunday. (Subject to certain exceptions.)

F.—GENERAL REGULATION OF MARCH 30, 1905 (ROYAL DECREE).

ARTICLE 2. It is forbidden to use damp places regularly as workrooms.

ART. 3. In every workroom there shall be at least 10 cubic meters (about 353 cubic feet) of space for each operative. The rooms shall be at least 2½ meters (8 feet 2½ inches) high; they shall be at all times suitably ventilated; for this purpose arrangements shall be adopted for introducing fresh air and

exhausting polluted air at the rate of at least 30 cubic meters (about 1,059 cubic feet) per hour per worker. In the workrooms of establishments in which work of a specially unhealthy character is carried on, the renewal of the air shall be at the rate of at least 60 cubic meters (about 2,119 cubic feet) per hour per worker.

Nevertheless, establishments in use at the date of publication of this decree, in which the workrooms would not be capable of being altered in such a way as to conform to the above requirements, may be maintained in their present state under the following reservations:

(1) That measures be taken to secure ventilation under the best possible conditions.

(2) That the number of workers therein employed be not increased.

(3) That no poisonous materials be handled therein, and that they present no other gravely unhealthy character. * * *

ART. 4. During intervals of work, if circumstances permit, the atmosphere of the work places shall be renewed by currents of air.

ART. 5. Such measures as are necessary shall be taken to prevent fumes, vapors, gas, or noxious dusts from being diffused in the workrooms.

ARTS. 6 and 7. Lighting of workrooms to be sufficient.

ART. 8. During the cold season the work places shall be suitably warmed. In summer they shall be safeguarded, as far as possible, against undue rise of temperature.

ART. 9. The workers shall be protected against excessive radiation from lighting apparatus, hearths, furnaces, and any other source of heat.

ART. 10. The work places and adjoining parts of the factory shall be kept in a good state of repair and cleanliness.

ART. 11. Waste products, manufacturing residuals, waste from raw material, sweepings, and generally all debris liable to ferment, decompose, or become harmful in any way shall be removed daily from the workrooms, put aside and regularly cleared away, burnt, or buried, so that no nuisance may arise.

ART. 12. The cleansing of the work places shall be done in such a way as to avoid creating dust, and, as far as possible, out of working hours.

ART. 13. In places where considerable quantities of liquids may be scattered about, the floor shall be impervious, and so constructed as to obviate any accumulation.

ART. 14. In places where work of an unhealthy character is carried on the workers shall wear a working garment, which they shall take off before leaving the establishment.

A cloakroom, with lavatories, shall be placed at their disposal.

The occupiers or managers shall prohibit their workers from taking food in places used for handling poisonous materials.

ARTS. 15 and 16. Sanitary conveniences.

ART. 17. Either water of good quality, or a hygienic drink, shall be put at the disposal of the staff.

ART. 18. No polluted water shall be used in the workrooms, either for grinding or sprinkling.

G.—ROYAL DECREE OF JANUARY 29, 1863.

Procedure for issuing licenses to establishments classified as dangerous, unhealthy, or likely to cause a nuisance.

H.—LAW OF DECEMBER 24, 1903.

Compensation for injuries resulting from industrial accidents.

NETHERLANDS.

TRANSLATION OF EXTRACT FROM ROYAL DECREE OF JULY 13, 1906, REPEALING THE ROYAL DECREE OF MARCH 16, 1903, AS FINALLY AMENDED BY THE ROYAL DECREE OF MAY 8, 1906, AND ESTABLISHING A REGULATION FOR GENERAL ADMINISTRATION, IN ACCORDANCE WITH ARTICLE 4 OF THE LABOR LAW.

ARTICLE 1. The work places in factories and workshops are classified, as regards the provisions contained in articles 2 to 9, inclusive, into categories A, B, C, D, E, F, and G.

Category A includes the places wherein, as a preliminary to the manufacture of ceramic goods, enamels, or enameled articles, materials are regularly prepared or worked which contain more than one-half per cent of their weight in

the dry state of lead or compounds of lead other than sulphide of lead (galena, lead ore), or where these materials are regularly applied to articles, or where injurious effects may arise from the applied materials in the opinion of the authorized inspector.

ART. 2. It is forbidden to employ a person under 16 years of age or a woman in a work place included in category A of article 1, unless the following provisions are observed:

1. In the work place there must not be present—

(a) Materials which contain lead compounds and which have not been vitrified by fusion;

(b) Materials which contain lead compounds and which yield as lead monoxide more than 2½ per cent of the weight of the dried material when treated with a weak solution of hydrochloric acid in the manner hereafter described.

One portion by weight of the dry material is to be shaken for an hour, at the ordinary temperature, with 1,000 portions by weight of an aqueous solution of hydrochloric acid which contains 0.25 per cent of hydrochloric acid. This mixture is to be allowed to stand for one hour and is then to be filtered. From the clear filtrate the lead is to be precipitated as lead sulphide and weighed as lead sulphate.

2. The principal or manager of the works or undertaking is required—

(a) So far as concerns the young persons or women, to be in possession of a certificate setting forth that the constitution of each person or woman is not of such a nature as to expose him or her to special danger in consequence of this work. The certificate must, after examination, be given, in the form decreed by the minister charged with the execution of this decree,¹ by a doctor appointed by the said minister, and can not remain valid for more than two months.

(b) To produce this certificate immediately on demand by one of the officials named in the first paragraph of section 18 of the labor law.

(c) To provide a place for the examination, which is deemed to be suitable by the authorized inspector, after consultation with the appointed doctor.

(d) If, in the opinion of the authorized inspector, after consultation (if necessary) with the doctor nominated by the minister charged with the execution of this decree,¹ dangers of poisoning exist in the work place, to carry out the regulation prescribed by the said inspector to remove the dangers.

3. The work place must, if the mean height is 3 meters [9.84 feet] or over, contain a free air space for each worker of at least 7 cubic meters [247.20 cubic feet]. If the mean height is 2.10 meters [6.89 feet] or over, but less than 3 meters [9.84 feet], the free air space for each worker must not be less than that given by the formula—

$$A = \frac{2.80 \ h}{h - 180}$$

If the mean height is less than 2.10 meters [6.89 feet] the free air space for each worker must not be less than 25 cubic meters [882.86 cubic feet].

By mean height is meant, in this article, the mean height between the floor and the ceiling, or, if there is no ceiling, the roof.

In the formula set out in this article, A denotes the free air space in cubic meters and h the height in centimeters.

4. In the factory or workshop wherein the work place is situated there must be provided, inside the building, suitable washing conveniences, separated for the sexes, to the number of at least one for every 5 young persons or women who have simultaneous intervals for rest or meals. In each washing convenience must be provided soap, nailbrushes, and towels; there must be provision for the water which has been used to run off, and there must be a supply of fresh water and of warmed water if the authorized inspector deems it necessary. The washing conveniences must, moreover, be installed in accordance with the instructions given by the authorized inspector.

5. Sufficient time must be allowed to young persons and women immediately before the conclusion of each period of work to enable them to make use of a washing convenience, as set forth in subsection 4.

6. These young persons or women must not take their meals in the work place.

7. The floor of the work place must be scrubbed or mopped at least once a week.

¹ According to the final clause of the decree this is the minister of agriculture, industry, and trade.

8. The floor of the work place must be suitably constructed and so arranged that it can be kept properly clean and, if necessary, disinfected.

9. At the commencement of the morning and of the afternoon periods of employment there shall be placed at the disposal of these young persons and women an overall suitably washed and dried and which has not been used after having been washed.

ART. 9. Exemptions may be granted by or in the name of our minister charged with the execution of this decree from the provisions set forth in article 2, subsection 3, paragraphs 1, 2, and 3, and subsection 4.

ART. 10. (Gives general powers to inspectors to take samples.)

ART. 11. (Gives general powers to deal with dust and fumes in factories and workshops.)

ART. 13. This decree comes into force on the second day after its publication in the *Staatsblad* and *Staatscourant*.

Date of publication, August 1, 1906, *Staatscourant* No. 177; *Staatsblad* No. 204.

French translation, *Annuaire de la Législation du Travail*, publié par l'Office du Travail de Belgique, 10^e année, 1906, p. 373.

TRANSLATION OF PARAGRAPH 5 OF THE ROYAL DECREE OF AUGUST 10, 1909, REPEALING THE ROYAL DECREE OF JULY 13, 1906, AS FINALLY AMENDED BY THE ROYAL DECREE OF SEPTEMBER 17, 1906, AND ESTABLISHING A REGULATION FOR GENERAL ADMINISTRATION, IN ACCORDANCE WITH ARTICLE 4 OF THE LABOR LAW.

PARAGRAPH 5.—*Factories and workshops in which ceramic industries are carried on.*

ARTICLE 33. The provisions of this paragraph relate to work performed in factories and workshops where ceramic industries are carried on, in so far as lead compounds are prepared, applied, or used which contain more lead than one-half per cent of the weight in a dry condition, in a form other than sulphide of lead (galena, lead ore), or in so far as objects are therein treated to which such lead compounds are applied.

This work is classified into categories A, B, C, D, E, F, G, and H.

Category A comprises work in rooms where, or where as a rule, the preparation of glaze takes place, including grinding, sifting, mixing, and making of glaze.

Category B: Glazing (dipping biscuit into the dipping tub or applying glaze in any other manner, e. g., by spraying).

Category C: Work other than that belonging to the preceding category, which is performed when applying glaze to articles, namely:

- (1) Putting up (the regular handing of biscuit to the dipper).
- (2) Taking off (the receiving of dipped articles).
- (3) Giving of finishing touches to the coating of glaze or removing of superfluous glaze, in so far as this is not done in glost placing.
- (4) Carrying away (taking of dipped articles to the glost-placing shop).
- (5) Washing of boards, cleaning of tubs.
- (6) The taking of saggars to the oven.

Category D: The work which is performed in glost placing (placing of dipped articles in saggars) or, when no saggars are used, the work consisting in the placing of dipped articles in the ovens.

Category E: The work consisting in the preparation, grinding, and mixing of ceramic colors.

Category F: The work consisting in—

- (1) The decoration of glazed articles;
 - (2) The application of ceramic colors to articles by spraying or dusting;
- when either is done in a manner which is considered dangerous by the principal inspector for the district in consultation with a medical officer of the labor-inspection department.

Category G: The work consisting in—

- (1) The application of ceramic colors to biscuit or glost ware by printing or painting;
 - (2) The decoration of dipped articles or the application of ceramic colors to articles by spraying or dusting;
- when either is done in a manner which is considered but little dangerous by the principal inspector for the district in consultation with a medical officer of the labor-inspection department.

Category H: Work not mentioned in the foregoing categories carried on in rooms where work belonging to one or more of the foregoing categories is done and in circumstances in which there is danger of poisoning in the opinion of the principal inspector for the district in consultation with a medical officer of the labor-inspection department.

For purposes of this paragraph there shall be understood—

By biscuit, baked ware not covered with varnish or glaze.

By glaze, the mass with which biscuit is covered in order to obtain a vitreous coating by heating.

By glost ware, the earthenware on which the glaze has been changed into a vitreous coating by heating.

ART. 34. It is forbidden to cause a person under 16 years of age, or a woman, to perform work belonging to categories A, B, E, or F of article 33.

ART. 35. It is forbidden to cause a person under 16 years of age, or a married woman, to perform work belonging to category C of article 33.

It is forbidden to cause an unmarried woman to perform such work, unless, in respect of her, the provisions of article 21, subsections 4, 5, and 7, and of article 25, subsection 1, as also the following provisions, are observed:

1. The glaze to be applied shall contain no lead compounds which have not been vitrified by fusion.

2. When treated with an aqueous solution of hydrochloric acid containing 0.25 per cent of hydrochloric acid, in accordance with the method indicated in the last paragraph [of this article], the glaze to be applied shall not yield more than 2½ per cent of monoxide of lead in solution.

3. There must be available in the factory or workshop a dated certificate showing that the bodily condition of the woman is not of such a nature that this work would involve special danger for her.

This certificate must be issued either by a medical officer of the labor-inspection department nominated by our minister, or by another medical man nominated by our minister, and it must be entered in a register of the form prescribed by our minister, and which must be kept in the manner also to be determined by our minister.

The certificate shall not be older than three months; it may be withdrawn at any time by the medical officer of the labor-inspection department nominated in pursuance of the preceding paragraph.

The register must be immediately produced for perusal upon the application of one of the officials mentioned in the first paragraph of article 13 of the labor law.

For the purpose of the medical examination a room must be available which is suitable for the purpose in the opinion of the principal inspector for the district, after consultation with the nominated medical officer of the labor-inspection department.

4. In the factory or workshop no food shall be eaten by the woman, nor shall she remain during a mealtime, except in a room set apart for meals and fitted up in accordance with the requirements made by the principal inspector for the district.

The method mentioned in the second paragraph, subsection 2, is as follows: One part by weight (if possible 1 gram) of the substance dried at 100° C. [212° F.] to a constant weight is shaken for 1 hour with 1,000 parts by weight of an aqueous solution of hydrochloric acid containing 0.25 per cent of hydrochloric acid. The mixture is then allowed to settle for 1 hour, after which the liquid, which is settled as much as possible, is drawn off by a siphon and completely clarified by filtration. In a known part of the clear filtrate, which must, however, not contain less than three-fourths of the original quantity of liquid, the lead is precipitated as sulphide of lead by means of sulphuretted hydrogen. The sulphide of lead is next dissolved by heating with dilute nitric acid (s. g. 1.2). After removing the excess of nitric acid by evaporation on the water bath, the lead is precipitated as lead sulphate by means of an excess of dilute sulphuric acid with the addition of double the volume of alcohol. If besides the lead sulphate, other salts, which are precipitable by alcohol, are contained in the solution, no alcohol is added. After at least 12 hours have elapsed the lead sulphate is separated by filtration; if precipitated by means of alcohol it is washed with this liquid, and if no alcohol was added for precipitation, first with dilute sulphuric acid and afterwards with alcohol. The weight of the precipitate is next ascertained after heating it to a dull-red heat and cooling it down in the desiccator. Finally the weight of monoxide of lead is calculated from the weight of lead sulphate found.

ART. 36. It is forbidden to cause a person under 16 years of age to perform work belonging to category D of article 33.

It is forbidden to cause a woman to perform such work unless the provisions of article 21, subsections 4, 5, and 7; of article 25, subsection 1; and of article 35, subsections 1, 2, 3, and 4, are observed in regard to her.

ART. 37. It is forbidden to cause a person under 16 years of age, or a woman, to perform work belonging to category G of article 33, unless the provisions of article 21, subsection 7, are observed in regard to him or her.

ART. 38. It is forbidden to cause a person under 16 years of age, or a woman, to perform work belonging to category H of article 33, unless, in regard to him or her, the provisions of article 21, subsections 4, 5, and 7, and of article 35, subsections 3 and 4, are observed in so far as compliance with those provisions is necessary in the opinion of the authorized principal inspector for the district.

SUMMARY OF REQUIREMENTS IN SUBSECTIONS IN ARTICLES 21 AND 25 REFERRED TO.

ARTICLE 21. Subsection 4. Weekly provision of a clean overall for young persons under 16, and women, marked for the exclusive use of the worker to whom it is supplied.

The district inspector may prescribe more frequent provision of a clean overall, and the shape and manner of marking the overalls.

Subsection 5. Cloakroom for outdoor clothing put off during working hours.

Subsection 7. Washing accommodation within the building, separated according to the sexes; the number of washing places to be so large that not more than 5 persons having simultaneous periods of rest need make use of the same washing place. Soap, nailbrushes, and towels to be available. Provision to be made for escape of dirty water and supply of clean water. (Warm water to be supplied if considered necessary by the district inspector.) Sufficient time to be allowed at the termination of each period of work for the use of the washing place.

ART. 25. Subsection 1. Free air space for each worker of at least 10 cubic meters [353.14 cubic feet]; in calculating the free air space only those parts of the room of which the height amounts to 3 meters [9.84 feet] or more to be taken into account.

Date of publication of this decree, August 12, 1909, Staatsblad No. 290.

THE WHITE-LEAD INDUSTRY IN THE UNITED STATES, WITH AN APPENDIX ON THE LEAD-OXIDE INDUSTRY.

BY ALICE HAMILTON, M. A., M. D.

INTRODUCTION.

This study of the white-lead industry in the United States, made in the first half of the present year, covers all of the 25 factories known to be manufacturing white lead, with the exception of two on the Pacific coast and one in New Jersey, the owner of the latter having refused admission to the investigator. Although inspection of this factory was not permitted the writer gathered what information was possible from workmen about conditions there and made the same search for cases of lead poisoning contracted there as in the other factories. The figures given later include the cases in this factory.

The other 22 factories were inspected usually more than once to see the conditions under which the work was carried on, and then an effort was made to discover the extent of lead poisoning among the employees. This involved a study of hospital and dispensary records and also interviews with local physicians and druggists and with the workmen.

As a result of this investigation 358 specific cases of lead poisoning, 16 of them resulting in death, are known to have occurred in the 16 months from January 1, 1910, to April 30, 1911, in these 23 white-lead factories.¹ The regular force required to run these factories is only about 1,600 men, but a far larger number than this, perhaps even five times as many, pass in and out of the white-lead industry in the course of a year. It is certain that these figures much understate the actual extent of lead poisoning, for the labor in white-lead factories is largely unskilled, foreign, and very shifting in character, and cases of lead poisoning of workmen who have left the employment are extremely difficult to trace.

The white-lead industry in the United States differs much from that in England, although the process used in most American factories is the same as that used in the English. While individual factories may differ fairly widely they yet resemble each other more than they resemble English factories. Still greater is the difference between the American and the German factories, because the chamber process used in Germany is never seen over here. The country that uses methods most nearly like ours is Belgium. The essential difference between American methods and the English and the

¹ For cases of poisoning among lead-oxide workers, see p. 258.

German methods is that in America the white carbonate of lead is separated from the unchanged metallic lead which has escaped corrosion by a dry process, while in England and in Germany the process is wet. As dust is the great danger in work with white lead, it follows that an American factory even at its best is much more dangerous than an English or a German factory.

There was until very recently no legislative control of the white-lead industry in the United States aside from the laws governing all factories, and even now special legislation has been passed in one State only, namely, Illinois. Much has been done voluntarily by employers to protect their men from the dangers of this work, but when protection depends altogether on the good will of the employer it is obvious that very bad conditions may go uncorrected. This is especially true when the factory is not under the direct control of the owner.

Many of the men acting as managers and superintendents in white-lead plants were greatly interested in the suggestions offered for making the work safer, but it was evident, especially in the case of men who had been a long time in this sort of work, that lead poisoning had been regarded by them as inevitable and it had not occurred to them to look for its causes and try to remove them.

In going through these factories the writer was often struck by the apparent blindness of the superintendent and foreman to very obvious dangers, to quite unnecessary dust production. This proved to be due partly to long habit, partly to curious ideas concerning the hygiene of white-lead work. Some apparently well-meaning men would declare that tobacco chewing was the best preventive for lead poisoning and complain because they found difficulty in teaching the habit to their Italian workmen. English and German laws, of course, forbid tobacco chewing in any factory where poisonous lead compounds are handled. One foreman explained that there was no hot water in the lavatory because hot water would melt the white lead on the men's hands and drive it in through the pores, though he admitted that cold water was practically useless for cleansing purposes. Many foremen asserted that gloves were the best protection, being under the impression that white lead is absorbed through the skin, and consequently these men ignored dust.

Even more striking was the ignorance shown by owners or managers as to actual sickness among their men. Several times men apparently quite sincere maintained that there was no lead poisoning at all in their factories. In one instance the manager said that they had had but two cases in 7 years; 17 cases were found in the hospital records of some 15 months. Another manager challenged the writer to find one case for which his factory was responsible, and 21 were found scattered through two years' time. This manager promptly installed

a physician as medical examiner, a measure he had up to that time considered quite superfluous.

American white-lead men have for the most part no knowledge of the industry as carried on in other countries; some do not seem even to know about the methods used in American factories other than their own, and when a criticism is made of an obviously bad feature they seem to have no idea that it is possible to do the work in any other way. It is plain that uniform legislation, establishing a certain standard of safety and cleanliness, would be of value not only in compelling backward owners to adopt the same measures that their more progressive competitors have taken of their own free will, but also in educating the men in charge of the work. The necessary improvements do not in most cases involve expensive reconstruction. What is especially needed is intelligent control of the work—control based upon knowledge of the dangers inherent in handling white lead.

American factories are often large and finely constructed; in fact, much better built and more lavishly equipped than the English or the German factories. In the most recent ones machinery has been developed to a very high point. Yet, even in the best of them, one finds now and then a neglected spot, a relic perhaps of the old factory, in the shape of a room with an old dusty floor, or an unprotected opening through which dry white lead must be thrown, or some similar neglect of an essential detail. There may even be found a lack of ordinary housekeeping, as when in an otherwise admirable factory no place has been provided for poorly corroded lead or for an excess of scrap lead, so that it sometimes happens that great heaps of this poisonous stuff lie about exposed to drafts and to the passage of the men to and fro.

The lack of legislative control makes possible the survival of old, overcrowded, outworn factories in which there may be hardly a single place where it is safe to work. Fortunately more and more of these are being abandoned and the tendency is toward concentration of the white-lead industry in a few large factories with modern equipment. Of the 22 white-lead plants which were inspected 9 are of modern construction with machinery displacing hand labor to a great extent; three are older and not so well equipped; and 10 are old with handwork chiefly. It would not, however, be fair to assume that the newest plants are the safest or that the old are necessarily dangerous. One of the best constructed of the new factories was, when first seen, quite as dangerous to work in as all but the worst of the old ones, and several of the oldest had been made safer than the majority of better built factories by scrupulous attention to cleanliness and to the avoidance of dust.

The hygiene of a factory really depends much more upon the management than upon the construction. For instance, careless management of a beautiful new factory brought about such a condition of things that during the fourth and fifth months of its operation 11 men out of a pay roll of 50 developed severe lead poisoning. In contrast to this, one of the oldest factories, employing 75 men, had only one case of acute lead poisoning during the four months just preceding the writer's inspection. This difference could not be attributed to anything but the difference in management and control.

The essentials of good construction of a white-lead factory are the following: The floors must be of some impermeable material (cement, stone, or sheet metal), not of wood. There must be ample space so that the dusty processes are not crowded in with the nondusty. There must be light enough to show dust and dirt. The water supply must be abundant and well distributed, so that the floors can be easily sprinkled. The ventilation required depends upon the character of the work. It is seldom that there are many people working in one room; and if there is much dry powder about, the wind from open windows adds to the danger. An efficient and ample dust-collecting system is essential.

Since in all of the 22 factories visited a cordial reception was given to the investigator and comment was invited upon conditions in the factory and suggestions as to the care of the men, it seemed better to comply with this request at once rather than to wait for the publication of this report. Therefore the notes made during the inspection, supplemented by information gained from the outside, were always discussed with the manager or superintendent of the factory shortly after the inspection was made. The employers showed themselves not only ready but eager for suggestions, and in most instances prompt in carrying them out. Eleven of the 22 factories have already put in improvements which in several instances required a large outlay of money. Five have indicated an intention to make important changes, four are regarded as probably to be abandoned before long, and there are only three which are apparently to continue operating as before without making any radical improvement in hygienic conditions.

Because of the great improvement that has taken place during the last 18 months in the 11 factories mentioned it is only fair to give two descriptions of each, showing the state of things not only at the time the inspection was made, but also at the time of writing. The National Lead Co., which is variously stated to produce from two-thirds to three-fourths of the total output of white lead in the United States, has the great advantage of being able to profit by the experiments carried on in all its factories in the matter of dustless work and of hygienic regulations. The independent owners have naturally

a harder problem, for each has only his own experience to go by, yet several of them had at the time this study was made brought their factories up to as high a standard as any in the country.

OLD DUTCH PROCESS.

The old Dutch process is that most commonly used in the United States, all but 5 of the 23 factories that form the subject of this report making their white lead by this process.¹ It consists in changing metallic lead to the basic carbonate, "white lead," by subjecting it to the vapors of acetic acid, water, and carbon dioxide, in the presence of heat, for a period of about 90 days. For this purpose sheets of metallic lead are buried together with acetic acid in spent tanbark, the fermentation of which produces the carbon dioxide and the amount of heat needed to favor chemical action.

The process begins with the casting of plates of lead which are known as "blue buckles." These are thin plates about 5 or 6 inches in diameter and a quarter to an eighth of an inch thick which, with their circular rim and cross bars, resemble in shape an old-fashioned shoe buckle. In the United States casting is always mechanical. The melted lead flows out into molds which pass rapidly along on an endless belt, and as the belt turns over the buckles fall off. The casting room is usually quite separate from the rest of the factory, but not always. The kettle or kettles are usually hooded to catch the fumes which may escape. When pig lead only is melted there is not much danger from fumes, but it is customary to use also for casting dross from the kettle and scrap lead from the mill; that is, the cores of uncorroded lead, which always have some white lead clinging to them and are bad to handle and bad to melt. In some factories the scrap is dampened before it is conveyed to the casting room and is added to the kettle while still moist. This, however, takes care and skill, for if too much damp scrap is thrown in at once and sinks to the bottom of the kettle the sudden evolution of steam may cause an explosion. For this reason many foremen insist that it is impossible to melt wet scrap although it is being done all the time in several American factories. One manager is experimenting with oil, which keeps down the dust effectively and which, he believes, is safer to handle than water. The presence of dry scrap is often the greatest source of danger in the casting room when it is allowed to lie in heaps on the floor and no precautions are taken in handling it. Another possible source of dust is the dross skimmed from the kettle. The men often drop this on the floor around the kettle and later scrape it up and sweep the floor without sprinkling. If the scrap is handled wet, if dross is dropped into a receptacle and not on the floor, and if

¹ One of the five factories uses both the old Dutch and a precipitation process.

these are added cautiously to the kettle or melted only at night when no one is working in the room, there need be no danger of poisoning the men in the casting room. The blue buckles are handled either with pitchforks or with gloved hands because they are hot.

The following is a description of a model casting room: The casting is done in a separate building in the yard which has a cement floor. The ventilation is ample; the two kettles are well hooded. Scrap lead from the mill is conveyed by traveling crane in large trucks and left in these trucks till it is needed. The scrap is kept slightly damp so that there is no escape of dust when it is handled, and it is added in small quantities at a time to the kettles. The cement floor is perfectly clean, all skimmings of dross being dropped into a metal receptacle. The blue buckles fall from the casting machine directly into cars which are carried by traveling crane to the stacks.

In contrast to this is the following: The casting room is a small shed in the center of the stack house and therefore without any direct ventilation. Great heaps of scrap lead, quite dry and dusty, lie over the floor. One man was throwing them from a shovel to the side of the room next the kettle and another man was shoveling them into the kettle. The air was full of dust; the men walked to and fro over this scrap lead and no effort was made to keep the floor clean or to prevent dust. The kettle is, however, well hooded. Not far from this casting room, within the stack house, is a second kettle for experimental work. This also has heaps of dry scrap lying about and the place is rendered still dustier by the close proximity of an experimental separating machine, which is imperfectly inclosed and allows dust to escape.

STACK HOUSE OR YARD.

Either on a traveling crane or by wheeling in trucks or barrows the blue buckles are carried to the stack house or corroding shed. This is a large one-story building, divided into chambers or stacks, which in the older factories are built of planks and in newer ones of cement and planks. The chambers sometimes open directly into the yard, but more often they open on a central corridor, roofed over, forming a part of the stack house. "Setting" or "building" a stack, which is done by the "setting gang," consists in placing the blue buckles in porous earthenware jars which contain dilute acetic acid, and in standing these jars side by side in rows on a layer of spent tanbark from the tanneries. Each jar is furnished with a small narrow compartment at the bottom, which contains the acid, and the lead buckles are placed in the upper part so that only the vapor from the acid reaches them. When the layer of pots is complete it is covered with planks, tanbark is heaped on the planks, and another layer of

jars is placed on this tanbark, and so on, layer by layer, until the stack has been built up to the desired height. There is always sufficient ventilation at the top of the stack. Here the buckles are left to undergo corrosion for a period of about 90 days. If the stack is set with fresh buckles only, the work is attended with very little risk, for there is no dust; and the most ordinary cleanliness is sufficient to protect a man against poisoning from the metallic lead which may cling to his fingers. Unfortunately it is the almost universal custom to mix in with the fresh buckles the larger pieces of scrap lead which have escaped corrosion in a former stack. These are covered more or less thickly with white lead and can not be handled without danger from dust unless they are first dampened. In some few factories the scrap is handled damp, but as a usual thing it is dry. Even when damp it is a source of risk unless the men wash carefully the poisonous white lead from their hands before eating.

So far there has been nothing in the work necessarily and unavoidably dangerous, but the opening and emptying of the ripe stacks as done at present in the United States is always and necessarily dangerous. This part of the work is known as "stripping" or "drawing" or "discharging" a stack. After shoveling off the tanbark, which contains scraps of white lead and which must be treated by washing or burning to recover the lead, the pots of white buckles or corruptions must be lifted and emptied into open wheelbarrows, cars, or pails. No method has been devised for protecting the workmen who do this from the dust which inevitably rises. In England and in Germany stacks or chambers must be thoroughly sprinkled before the corruptions are removed, but American methods make that impossible because the corroded buckles must go dry into the separating machine. In some factories the stacks are solidly built and the side exposed when discharging is going on opens into the stack house. In others the construction is not so solid and the exposed side opens into the yard or even on the outside of the building. Such a stack is much more open to the wind, and therefore more dusty.

In the very best factories where machinery is being carried to its greatest development and every protective device against dust introduced, there still remains the stack house with its primitive hand-work. The picture is practically the same in all. In a partly-inclosed chamber four to eight men lift pots of white buckles, sometimes slightly damp, but not enough so to prevent dust, and empty them into a large receptacle which stands near, always knocking the pot against the side of the latter to dislodge the last particles. With each pot emptied comes a cloud of dust, and there are hundreds of pots. Only in one or two details is any difference in methods seen. For instance, there may be two acts of emptying, doubling the

amount of dust—that is, instead of dropping the white buckles directly into a car in which they are to be transported, the pots may be first emptied into pails which are carried to the edge of the stack and which are then emptied into a car standing outside. Here, of course, there is more dust than where there is only one handling.

If work is in the top layers of the stack, there is an escape for the dust, but in the bottom layers when the stacks open into a central corridor the dust is not carried out. It is a question, however, whether the more exposed stacks are not worse than the closed ones, for the wind can enter, drying the corrosions and stirring up the dust. Just as street sweeping is dustier on a windy than on a still day, a windy stack is worse than one more shut in. One of the most dangerous stack houses to work in is situated in the open country, exposed to all the winds, and so built that the outer wall is the one taken down in stripping.

Aside from the act of emptying the pots, stack discharging involves several other processes less dangerous, but not altogether free from peril. The tanbark which is left over after the pots have been emptied is full of particles of white lead. This must be put into receptacles and transported either to the oxide department, if there is one; or more often to a trough or washing box, where the tanbark is floated off and the carbonate falls to the bottom. The planks upon which each layer of pots rested also have particles of white lead sticking to them, and the workmen habitually knock the planks against the side of the stack to get them clean. Then the empty pots have white lead clinging to them and in handling them the men become smeared with it. Still worse is the method often employed of treating buckles which for some reason have undergone imperfect corrosion and are hard and “off color.” These are usually picked out by hand as the pots are emptied and thrown into a special receptacle. The separation of this off-color lead from its inner core is done by hand either inside the stack or more often out in the yard. This is exceedingly dusty work.

THE DUMP.

It is the duty of the men employed in the stack house to convey the white corroded buckles either by hand, in wheelbarrows or boxes, or by traveling crane to the machine known as the separator. Here the white carbonate is crushed to a powder and the particles of still uncorroded lead (scrap) are flattened out by means of rolls so that they can be caught by a succession of screens and removed. These uncorroded pieces, or returns, are known by various names. The largest ones are sometimes called “old buckles,” or simply scrap; the ones removed by the second screen are known as “nickels”; and those from the third as “fines,” or sometimes “tailings.”

The important features of the separator are: The place where the white buckles are thrown in, the "dump"; the places where the returns are thrown out; and the way in which the machine is inclosed. The dump is usually out of doors, in the side of the mill building; less often in the mill itself. White buckles are conveyed to it either by hand in an open wheelbarrow—rarely in a two-handled box carried by two men—or, in the more modern factories, by traveling crane. Hand trucking is open to serious objections, for the dust from the buckles blows back in the workman's face.

In one or two new factories the whole process of conveying and emptying the car of white buckles is mechanical, being controlled by a man at a safe distance. Many factories, however, which have machinery for carrying the cars, still require the presence of a man at the dump to detach the car, tip it over, and reattach it, and therefore the construction of the dump is a matter of great importance. In the older factories, where the work in the yard is done by hand, the dump may be one of the dangerous spots. A great many devices are used to carry off the dust which escapes when the white buckles are emptied into the separator, but none is absolutely satisfactory. A well-constructed dump is provided with a hood and a strong exhaust to suck in the dust. The opening is of the same shape as the car and a little smaller, so that the inverted car fits over it, and in addition there is a strong air exhaust into the separator. The whole thing is then inclosed in a chamber or shed, so that the workman can roll in the car, tip it over, and immediately step out, closing the door behind him. Unfortunately, it is very rare to find all of these safeguards in any one factory, and in some there is no protection at all against dust.

The following is a description of a fairly good example of a hand-operated dump in one of the older factories: The dump is outside the mill building in a small wooden house; the traveling crane brings the truck of white buckles to the door of this house; two men push it in, tip it on one side at the opening, and then come out. The white buckles work down very slowly through a large opening, which is furnished with a wide pipe containing an air exhaust and situated directly above the opening. Except for the cloud of dust which rises when the truck is first tipped over, there is no dust, and the shed, which is 2 years old, shows very little white lead on the walls.

As an instance of a very dangerous dump the following may be given: In one of the rooms of the mill, which serves also for other purposes, is the opening into the separator. A very large truckful of white corrosions stands about 6 feet from this dump and two workmen stand between the truck and the dump lifting the white lead in shovels, and stirring up dust as they do it, then throwing it into a wide opening, where it slides down an inclined plane to the first

roller. The lead feeds slowly into this roller and it also sticks to the slide, so the men must keep poking and pounding it with their shovels to hasten its passage. Over this dump is a hood with a good exhaust, but it is about 6 feet from the floor, so that only part of the dust is caught by it, and as it does not extend over the car all the dust raised by shoveling escapes into the room. The top of the hood, the floor, the walls and ceiling are white with dust, as are the men's clothes. Other men are at work in this same room. This mill is now in course of reconstruction and conditions are being greatly improved.

THE SEPARATING MACHINE.

An additional source of danger at the dump is the proximity of the vents to the separating machine through which fall the different-sized fragments of uncorroded lead. Usually these vents are close beside the dump. There is a great difference in the efficiency of different separating machines, and one sees scrap lead which is almost clean and scrap lead covered with white lead dust. In mills where no precautions are taken the scrap is a source of much danger. The best arrangement is to be seen in one factory where mechanical devices are unusually well developed. The largest scrap drops into cars which go automatically to discharge into the melting pot or into a storage hopper. The "nickels" and "fines" run through pipes to closed receptacles outside the building. More usual is some such device as the following: Near the dump is a triple hopper which catches the cores, nickels, and fines from the separator, each in a special compartment. Each compartment has a door and the workman opens it, rakes out the contents and shovels them into open cars, with clouds of dust. The small returns are taken to the melting pot, the large to the stacks for resetting, all being handled dry. The side of the mill at this place is all white with dust.

While inside the separator the white lead does not need to be handled, nor is there any escape of dust if the separator is properly inclosed, as it usually is. Only when the machinery gets clogged or out of order must it be opened, and this is recognized as very dangerous work. In a few of the oldest factories the separators leak somewhat, and if they are not in separate rooms they contaminate the air of the mill. The machine should always be housed separately, for otherwise when it must be repaired the dust spreads into the rooms where the men are working.

THE WATER-MILL SYSTEM.

From the separator the ground white lead is discharged directly into water and goes through many processes of washing, grinding, straining, and settling to rid it of fragments of tanbark, of lead

acetate, of uncorroded lead, and of the neutral carbonate or "sandy lead." In all but the oldest mills the discharge from the separator is so arranged that the powder falls into water with no escape of dust. From here it passes to the water mills, then usually into tubs, where it is agitated to keep the powder from settling while it is being pumped to shaker screens or bolters, where the tan bark and the coarsest particles are removed. The fine powder which has passed the screens goes to the drag box and then to the rake tubs, or mixing tubs, in all of which more of the coarse residue is removed, and finally to settling tubs, where it remains till pumped to the drying pans. The coarse particles removed during this process and known as "tailings" are usually handled wet and are not a source of danger. Their ultimate destination is an oxide factory.

All this time the lead is in water and this part of the mill can be quite free from danger if the simplest precautions are used, for unless tubs leak or spill and the overflow is allowed to dry on the floor there is no possible source of dust. Accidents sometimes occur when in agitating the suspension of white lead and water the mixture suddenly foams up and spreads over the tanks and floor; ordinary carefulness would require that this be removed before it has time to dry, but this is not always done and then the work of cleaning up is very bad.

Two contrasting descriptions of the water-mill system in typical factories follow: The mill is scrupulously clean, even the walls, which are made of rough brick, are free from white dust. The smooth cement floors are swept with wet sawdust. The separator is inclosed in separate rooms. It is impossible to guess from the appearance of the water-mill rooms what material is being handled there.

The second factory is quite different. No dry processes are carried on in these rooms, yet they are as dusty as many drying rooms. The floor is of old wood, worn rough, evidently swept dry, and very dusty. The ceilings and walls are white with dust. The only explanation of this condition given by the foreman was that the tubs leaked pretty badly. Another source of dust is to be seen at the window, the sides and sill of which are crusted with white lead. It is the custom of the workmen to throw the tailings out of this window in such a way that they splash over the edges and sill. On the ground outside lies a heap of these tailings waiting transportation in freight cars to an oxide factory. The side of the mill here is crusted with white lead and the place must be a source of dust on a dry, windy day. This last feature, however, has already been abolished in this factory, for the manager recognized that it was both wasteful and dangerous.

THE DRY-PAN ROOM OR "KILN."

When pulp lead is made the lead and water mixture from the settling tubs is simply ground with oil without drying, the oil gradually displacing the water. This is the ideal process considered from the hygienic point of view, but unfortunately there is but one factory producing nothing but pulp lead; the others all deal in dry white lead as well and in lead ground dry in oil. In order to obtain this dry lead the product of the settling tubs is pumped into great double jacketed copper drying pans, placed one over the other in the drying room. In some factories this room is kept very hot, with the windows closed; in others it is abundantly ventilated, the amount of air depending upon the theories of evaporation held by different superintendents. This drying room or "kilm" is always the most dangerous part of a white-lead factory and is so recognized. Some rooms are worse than others, but essentially they are very similar and always bad. When a pan is to be emptied the windows are opened and the men enter and shovel the dry powder usually into open trucks, sometimes into barrels, sometimes directly into openings in the floor.

In addition to the inevitable dangers, there are quite unnecessary sources of dust in many factories. Thus, instead of giving the workmen long-handled shovels and instructing them to lay the powder carefully in the car, they are given short shovels and are allowed to pitch the powder to the car, standing a distance away. The floor may be of rough material and swept dry, which process always raises clouds of dust. The full trucks of dry white lead may be emptied into unhooded dumps in the floor. The greater the number of tiers of pans the greater the danger, because the man has a greater distance to throw the dry lead; yet three or four tiers are the rule, a single tier the exception. The work is so bad that in most places no precautions are attempted except to expose the men as short a time as possible. If the same men are employed continually, they are often given shorter hours, but more often the men take turns at the work, emptying pans for a few days or a week or four weeks and then going back to safer outdoor work, such as shoveling tanbark. Other factories make it a rule not to use their regular help for this work, but hire outsiders by the day whenever a pan is ready to be discharged. The attitude of the employer is that the work is bad and there is no use trying to make it safe.

How scrupulous care may diminish the danger is shown by the following instance: The dry-pan room is the cleanest in the United States. It is almost impossible to believe that the walls and ceiling have not just been cleaned, for though the walls are of rough brick and the ceiling of dark stained wood no white-lead dust is visible. Yet pans have been emptied in this room for the past 18 years. The

floor is scrupulously clean. Care in handling the lead must be responsible for the freedom from dust, because there are no new devices. The pans are emptied by shovels, and there are three tiers of pans. The foreman of the mill has worked here for 22 years, and states that he always personally supervises the work in the pan room and does not allow the men to raise dust, nor does he ever put entirely new men to work at the pans, but employs mill hands.

An unusually deplorable state of affairs was seen in a factory much newer than the above, but under careless management. The dry-pan room is very bad. The floor is covered with white lead and is swept without sprinkling. There are two connecting rooms, with three tiers of pans. Six men were at work emptying pans, and one sweeping, and as a strong wind blew through the open windows the air was cloudy with dust. The trucks of dry white lead are emptied through unprotected holes in the floor, which are then covered with badly fitting trapdoors that allow the dust to escape through cracks. The men are powdered with white lead, their hair, eyebrows, mustaches, and nostrils all white.

The general recognition of the dangers inherent in dry-pan work has led to many experiments to devise some substitute for this method of drying white lead. So far no experiment has been successful, but certain modifications in the mode of emptying the pans are apparently proving useful and practical, and will result, if their use becomes general, in decidedly diminishing the dangers in this part of the factory. These devices are still trade secrets and can not yet be described in a public document.

The lead from the drying pan may now go through one of several processes, according as it is to be ground in oil or sold dry.

GRINDING LEAD IN OIL.

In well-constructed factories the danger in this part of the work is very slight. In poor factories it is often great, for primitive methods of handling this dry lead are still rather common. In the newest and best-equipped factories the white lead from the pans is mechanically conveyed to a weighing hopper and then on to the oil mixer, known as the "chaser," which is well covered, so that exposure to dust is avoided. Once inside the chaser, the lead becomes incorporated in oil and there is no more danger from dust.

Even in less modern factories, this part of the work may be very well managed, as in the following instance: Open trucks of dry lead from the kiln are carried by elevator directly to the chaser room, where the powder is shoveled by hand into chasers, well inclosed in cast iron, with an opening sufficiently large to admit the shovel only. There is a good air exhaust within the chaser which draws the dust

in, and the room is fairly dust free. The two men working here had pads of moist cheesecloth over the nose and mouth.

In contrast to this is the following chaser room: In the large grinding room moist and dusty processes are carried on. The water mills are there, the chaser, the oil mixers, and a large putty machine. There are three bins, or rather small wooden rooms, for the dry, white lead, which are filled through holes in the ceiling from the drying room above. In addition to the lead in these rooms there are great heaps of it lying on the floor near the chaser and at the door of one of the bins. There is no apparent necessity for this, since at the time it was seen one of the bins was far from full. The chaser stands beside two open windows; it is covered and has but one opening. A man stood beside it filling it with white lead from the pile beside the window. Quite near him was another man filling small kegs with lead and oil, but exposed to the dust from the chaser work almost as much as the chaser man himself.

PACKING DRY LEAD.

The lead from the drying pans which is not to be ground in oil is, in a few instances, packed directly in barrels without pulverizing. More often it is placed in a pulverizer and passes directly to a mechanical barrel packer. If sold dry in small kegs, the kegs must be packed by hand, an admittedly dangerous piece of work, which, fortunately, is not common. When the mechanical packer is used the work need not be dusty, but in practice it usually is, and the evil is increased if the dusty pulverizer and packer are placed in the same room with other parts of the machinery, such as the oil mills, for then a larger number of men are exposed to the dust. The dusty work, when it is dusty, consists in filling the pulverizer, managing the mechanical barrel packer, rolling the barrel away when it is full, and "heading it up," i. e., putting on the lid. All these processes may be dustless or dusty, according to the care taken. The following is a description of the work under careful management:

Dry lead from the pan room is carried mechanically along a closed conveyor to the disintegrator or pulverizer, which connects with the barrel packer on the floor below. The latter is inclosed on three sides with wooden walls and the inclosure is ventilated by a pipe with an electric fan which runs to the outer wall of the building. The barrel stands on a low, wheeled truck on which it is easily rolled away when full. The work was managed very carefully by a man who wore a respirator. He wheeled away the full barrel, evened off the top with a scoop, folded down the strong paper with which the barrel was lined, placed another layer of paper on top, and then closed the barrel with no visible escape of dust, and not till then was the barrel rolled off the truck.

An instance of careless management is the following: The barrel packer stands uninclosed in the storage room. All around over the floor lie heaps of white-lead dust. The pulverizer is filled through an unprotected hole in the dry-pan room above. The barrels are not lined. When the barrel is full it is standing on a level with the floor, but as there is no device to facilitate its removal it must be grasped by the workman, tipped a little, and rolled off. Each time he does this he spills white lead on his clothes and on the floor. Heading-up produces clouds of dust, and then the barrel is rolled over the dust-covered floor and out to the shipping room, leaving a track of white behind it. Even the large, airy, shipping room is dusty because of the presence of these smeared barrels.

DUST-COLLECTING SYSTEM.

Unless a factory is overcrowded and dusty work carried on in close proximity to nondusty work there are no other danger spots in a white-lead factory with the exception of the dust-collecting system, which is peculiar to American and Belgian factories, and is necessitated by the dry separation used in these countries. The dust collectors are more or less extensive and elaborate, varying greatly in this respect. The system is connected with the separator always, and usually with the dump and vents from the separator, with the pulverizer and barrel packer, with the chasers, and in a few instances with the dump from the dry pans and with the dry pans themselves. The system may be either wet or dry. In the former case the dust is driven by fans along pipes to a chamber, which is usually on the roof, where it is driven against sloping shelves over which run streams of water. This is a very safe variety of dust collector, which is unfortunately not usually seen and is being gradually replaced altogether by the dry system. This last consists in collections of strong canvas bags, long and narrow, suspended from the ceiling. The dust is driven in at the top of the bags and settles in them. As it clings to the sides it must be dislodged by shaking or beating the bags. The bags terminate either free, with their ends knotted, or more often in a bin or hopper into which the dust falls. Sometimes bags hang in the open room, sometimes in a closed compartment. Shaking and beating is of course productive of a good deal of dust, except in the rare instances where the bags are inclosed and a long-handled stick is used, enabling the workman to stand outside the inclosure while he does this. The bags break and tear from time to time and must be repaired, and the danger of this work is greater the more closely the bags are packed together. The best arrangement is to hang the bags in rows not more than three deep, which makes access to them easy.

The following is the description of an excellent dust-collecting system: The dust room is a carefully sealed wooden chamber, the ceiling of which is perforated with numerous holes and to each hole is fastened the upper end of a large muslin bag 30 feet long and 6 inches in diameter. These bags, 56 in number, end in a hopper which has a pipe running down into a water tank so that the dust is collected under water. There is a strong air exhaust inside the dust house and therefore it seldom needs cleaning. The bags are shaken once a month by a man who enters the room for that purpose.

As a contrast this description will serve: Beside the pulverizer and barrel packer is an old tubular dust collector with the bags hanging free, their ends merely knotted. In order to empty them, a workman rolls a car underneath, unties the ends of the bags and shakes each bag to make the dust fall down. The floor is several inches deep in dust and the walls, ceiling, and machinery are all covered with it.

SUMMARY.

To recapitulate briefly the special features of white-lead manufacture in the United States by the old Dutch process:

The methods of manufacture in the United States are of such a character as to make the work necessarily more dangerous than in England and Germany, for it is impossible to control the dust as completely when dry separation is used as when the separation is effected under water. Dry separation involves emptying the stacks without sprinkling; it involves the discharge of dry returns from the separator and the installing of an elaborate dust-collecting system, none of which features are present in English and German factories. Moreover, the American method of drying the ground white lead in great open pans which must be emptied by hand is more productive of dust than the English and German methods of drying. Consequently, in the very best and most carefully managed American factories there are always at least two danger spots—the white beds and the dry pans. The indications are that the experimental work now being carried on in some of the first-class factories will result in eliminating, or at least greatly improving, these two dangerous processes, but in the average American factory there remain a good many dusty places. In fact, all of the following processes are usually attended with danger:

Handling scrap.

Discharging stacks.

Dumping white buckles into the separator.

Repairing and cleaning separator.

Emptying dry pans.

Filling chasers.

Filling and heading up barrels.

Emptying and cleaning the dust collectors.

In a carelessly managed and crowded factory there may not be one room free from dust and really safe to work in, and in the absence of legislative control it is hardly to be hoped that all the evils described above will be done away with. As can readily be seen from the instances of bad management that were given, it is not a matter so much of raising the standard of factory construction by legislation as of raising the standard of factory control.

Before leaving the old Dutch process factories it is necessary to state that a certain modification in method has been introduced and is now in an experimental stage. This consists in eliminating the wet grinding and substituting dry grinding in a cyclone mill, where the heavier particles fall to the bottom and the light powder is driven on by fans into proper receptacles. The lead is corroded in the usual way and passed through the usual form of separator, but the dry-pan room with its dangers is eliminated. On the other hand the fact that the white lead is dry throughout opens the door for many possible risks. In the two factories where this process was seen in use it was evident that the machinery was still in the experimental stage, involving much repairing and alteration and therefore quantities of dust, but that is of course a temporary evil. Such a factory will, however, always need an extensive dust-collecting system, which is a disadvantage, but with satisfactory machinery and care it should be possible to control the dust, and the method has the advantage of requiring a smaller working force.

CARTER PROCESS.

The description just given of the white-lead industry in the United States applies to the 19 factories east of the Pacific coast that use the old Dutch process. In order to make it complete, a description must be given of the three factories using a rapid modification of the old Dutch process, known as the Carter process, the one using the so-called Matheson process, and the one which uses a nonacid or Mild process.

The Carter process is a rapid way of producing the basic carbonate from pig lead by the action of acetic acid, water vapor, and carbon dioxide. That is, it is essentially the same as the old Dutch process but it is so modified as to do away with the use of tanbark and reduce the corroding time from 90 days to 12 or 15 days. Corrosion is also said to be more complete than by the old Dutch process.

The process begins in the blowing room. Pig lead is melted in a large kettle, from which it flows in a little stream to a receptacle where it is met by a blast of superheated steam that atomizes it to a

fine powder and drives it on into receptacles so arranged as to throw the powdered lead to the bottom. It is this fine, more or less fluffy powder that takes the place of the blue buckles in the old Dutch process and, therefore, there is at the outset a new element of danger in the Carter process. This powder was, at the time the inspection of these three factories was made, shoveled out from the receptacle or allowed to fall from it to the floor where it lay in a great heap from which open trucks were filled. These trucks were then wheeled by hand for some distance, in one instance across the yard, and emptied. The atomized lead is light and blows about easily, and it was admitted by the foremen that the men who did this work, "blue truckers" they are called, suffered as much from lead poisoning as the men in the white-lead departments. It is only fair to say that after the unnecessary dangers inherent in this work were brought to the attention of the manager of the best of these factories, he succeeded in eliminating much of the danger by allowing the blue lead to fall directly into a truck instead of on the floor. As there is a strong air exhaust in the vent of the atomizer the powder which rises is partly drawn back into it. The full truck is also well sprinkled with water so as to keep the dust from blowing back into the trucker's face. A second factory using the Carter process has promised to introduce this last precaution.

The atomized lead is then wheeled into the corroding room and emptied into a cylinder or reel. This room is filled with cylinders, which are large barrels placed on the side and revolving very slowly so that the blue powder is turned over and over. Streams of carbon dioxide are driven into the cylinder and a spray of acetic acid is introduced from time to time through the opening in the front of the cylinder by a man known as the "sprinkler." The lead tends to cake on the sides of the cylinder, and must be removed by pounding with wooden hammers on the outer surface, either by hand or mechanically. The first corroding period lasts five or six days, and the lead is then in little balls of carbonate with uncorroded particles in the center. This must now be ground and corroded again. The cylinder is stopped and the lead allowed to run through a hole in the bottom into a truck and then taken off to the "thresher" or "thrasher."

The room containing the cylinders or reels is not necessarily dusty, and in the best of the three Carter process factories it is fairly clean. It all depends upon the care taken in handling the lead as it goes into and comes out of the cylinders. In all three factories the blue lead is poured into the cylinders through a canvas bag which extends from the vent in the bottom of the truck to the dump in the top of the cylinder, and which is designed to prevent the escape of dust. There is, however, no such device in two of the factories to prevent the

escape of dust when the half-corroded and the fully corroded lead is taken out of the cylinders, and these two factories have a great deal of dust in their corroding rooms. It would not be possible to wet down the first corrosions, for the thrasher would get clogged with the wet lead, but the fully corroded lead is to be ground in water and there is no reason why it should not be removed from the cylinders already wet and thus one source of dust be avoided. This is already the practice in the best Carter process factory.

The greatest danger in the corroding room comes from the necessity of scraping off the lead which sticks to the inside of the cylinders when they are being emptied. For this purpose a man must climb in through the manhole in the front of the cylinder and stand inside while he scrapes the sides clean. This is looked upon as about the most dangerous piece of work in the factory, and in two of the three these cylinder cleaners enjoy special protection and are given short hours of work. In the third no special care is taken of them.

The thrasher rooms in all these factories are dusty and are bad places to work in, though the evil is in large part avoidable. The work consists in emptying half-corroded dry lead into the thrasher, where it is ground to a fine powder, and then conveying it back to the cylinders. The danger is at the dump into the thrasher, at the vent from the thrasher, and in wheeling open trucks of dry powder back to the cylinders and discharging it into the latter. There is also a more or less elaborate dust-collecting system connected with the thrasher, which must be emptied from time to time.

The following is a description of the method used in the best of these factories: Under the corroding room is a cement-floored basement, very clean. From the ceiling are suspended small hoppers with pipes which lead, each one, to a cylinder on the floor above. When a cylinder is in course of being emptied a truck with a strong canvas bag attached to the edges is brought under the pipe, an opening in the bag is fastened to the end of the pipe, and thus the lead falls down without any escape of dust. Another pipe beside this one runs up to the dust collector and carries off the air which is displaced by the falling white lead. The threshing machine runs through four stories, all with wooden floors which are clean. Covered trucks from the corroding room with half-corroded lead are pushed into a closed iron compartment which has an exhaust connected with the dust collector, the door of the compartment is drawn down to within a couple of feet of the floor, and by means of a handle the valve in the bottom of the truck is opened and the lead discharged into the thrasher. In the first floor of the thrasher building is the opening of the hopper where the pulverized, semicorroded lead is caught and from which it is discharged through a canvas bag into trucks and taken back to the corroding room.

A contrast to this is the method in use in another factory: At the end of the first corroding period the semicorroded lead is discharged dry into trucks which are run under the cylinder. There is no canvas bag used here, consequently there must be some escape of dust. The trucks with the semicorroded lead go to a building which is old and extremely dusty. Accumulations of old white-lead dust lie everywhere. The trucks go on an elevator to the top of the thresher and are dumped into an opening in the floor which has absolutely no protection. In this thresher the lead is ground to a fine powder for its second corrosion. The fine dry powder is discharged in a small, frightfully dusty room. There is an air exhaust in this room, but in spite of this fine dust flies everywhere. A man rolls a truck into this room, waits until it has been filled from the thresher, then rolls it out again.

The fully corroded lead is discharged dry or wet, as the case may be, into trucks and taken to the water mills. From here on, the lead which is undergoing grinding and drying is handled in essentially the same way as in an old Dutch process factory, and no further description is needed.

This process is more dangerous for the workmen than the old Dutch process because it is dustier. This fact has been recognized in two of these factories, where greater care is taken of the men than in any other white-lead factories in the United States. The result is that the men in these two factories do not shift as much as in most old Dutch process factories, partly because they are better taken care of, partly because the work requires more skill and the pay is higher. A comparison of the records kept by physicians in charge of two of the Carter process factories with those kept by physicians in charge of two old Dutch process factories shows that while the Carter process factories have a higher percentage of lead poisoning the length of exposure of the lead-poisoned men is much greater in the former than in the latter.¹

Recently these two Carter process factories have adopted the English and German system of care for their workmen, including compulsory use of washing facilities, lunch room, and overalls. They have also made a great effort to instruct their men, and the following is a copy of the rules displayed in these factories in the languages used by the 13 different nationalities of workmen:

FACTORY RULES.

1. Respirators must always be worn where there is dust. Keep them clean. Shave frequently so that respirator fits snugly.
2. Washing: Before eating and before leaving factory at night, employees must thoroughly scrub their hands, clean their finger nails and brush their teeth.

¹ See p. 225.

3. Clothes: Employees must make a complete change of clothing, including hat and shoes, upon coming to work and again at the close of the day's work. Working clothes must not be worn outside the factory grounds.

4. Baths shall be taken daily (on the company's time) before changing into street clothes.

5. Complaints: The company furnishes, free of charge, respirators, sponges, tooth and nail brushes, soap, towels, and individual lockers, and has equipped the plant with bathing facilities and sanitary devices. Any failure to furnish the above supplies, and any defect in the operation or sanitary condition of the machinery or equipment of the factory observed by any employee shall be called at once to the attention of the foreman in charge, and if not remedied in 24 hours complaint shall be made directly to the superintendent.

6. Company's doctor: Employees shall report to the company's doctor every ailment, no matter how slight, as soon as discovered, and shall be present at the weekly examination. The company's doctor will attend to employees for all ailments without charge.

7. It is forbidden to eat in any part of the factory except the lunch room; to bring beer or alcoholic liquors on the premises; to smoke in or about any factory building.

8. Recommendations: Eat a hearty breakfast before coming to work.

Milk, eggs and onions are the best food for workers in lead.

Whisky, gin, wine, beer and other alcoholic drinks are especially harmful to workers in lead.

Do not get lead in your mouth from dirty hands or dusty clothes.

Never carry chewing tobacco in your working clothes, or touch it with dirty or dusty hands.

Keep clean.

By obeying the above rules, and keeping lead, which is a poison, from entering the mouth and nose, employees can keep well and lessen the risk of lead poisoning, which they assume in entering the employ of this company.

The third Carter process factory, one of the dustiest factories seen, has not as yet adopted any precautions in the care of its men beyond offering them milk free during the noon hour and paying 5 cents to each man who takes a bath. There is no medical inspection, although 17 hospital cases of lead poisoning were found occurring since January, 1910. The manager believes in hiring the men for short periods only, hoping to be able to discharge them before they have been injured by the work. Suggestions for improving conditions were requested by the manager and were submitted, but the company is apparently not yet impressed with the importance of the reforms.

MATHESON PROCESS.

What is known as the Matheson process is used on a large scale in only one factory, though a process very similar to it may be seen on a small scale in an oxide factory where the white lead needed for the production of orange mineral is corroded in practically this way. It is a rapid precipitation process, depending upon the action of acetic

acid, air, and coal gas on lead in a state of division. Melted lead is taken up from the kettle in large ladles and thrown into a tank of water, which scatters it so that it falls to the bottom in the form of "feathers." This feathered lead is subjected to the action of water, acetic acid, and streams of air, which change it to a mixture of oxide and carbonate. In a second series of tanks, streams of coal gas are passed through. The basic carbonate settles and is pumped to filter presses, where the acid solution is squeezed out. The paste is then dropped again into water, washed and neutralized. After this the procedure is the same as that in the old Dutch process factory—pulp grinding, or drying, pulverizing and packing, or grinding in oil and packing. The Matheson process is far safer than the old Dutch process, avoiding as it does stack stripping and all the processes connected with dry separation.

MILD PROCESS.

The Mild process is also a wet and therefore a safe process. No acetic acid is used in this process. The atomized lead passes directly from the blower into water without ever being handled and from there passes on to a series of tanks or cylinders where by the action of water, air, and coal gas it is changed first to the oxide and finally to the basic carbonate. The whole process is moist, up to the final drying and packing, and the dusty work in the factory consists simply in emptying the dry pans into barrels and heading up the barrels. The single factory that uses this process does not pulverize the dry lead nor grind it in oil.

CARE OF THE WORKMEN.

In the care of their workmen American white-lead factories differ enormously, as might be expected, for this is a matter determined solely by the character of the individual in charge. Of late the National Lead Co. has established a standard for the factories under its control, and it is stated that conditions in all these factories will shortly be made to conform to this standard. Several independent plants also have provided admirably for the care of their men, but in others there is a surprising indifference displayed. The matter does not depend upon the newness of the factory, nor upon the excellence of its construction, and it is impossible to guess from the general aspect of the place whether it is provided with a clean, comfortable wash room or one mean and squalid.

The essentials for the care of the men in a white-lead factory, aside from the control of the conditions of work, are: First, washing facilities, which means ample provision of hot and cold water, soap and towels for ordinary washing, with an adequate number of shower or tub baths for the men engaged in the dustier work, and enough time to use them. Second, a separate lunch room, clean and attractive and

preferably provided with a stove that can be used to heat food. Third, a clean place for the men's street clothes. Fourth, overalls, completely covering the men's underwear, a cap to cover the hair, and some form of respirator. Fifth, regular examination of all the men at frequent intervals by a good physician.

The following is a description of the provision made in one of the new, expensively constructed factories: A separate building for the men's wash room, locker room, and lunch room is so placed that the men must pass through it in entering and leaving the factory. It is very well built, pleasant and attractive. There is a large beautiful lavatory with a cement floor and individual porcelain-lined wash basins with hot and cold water. Soap is provided, but no towels. The shower baths have hot and cold water. They are not separated by partitions and no towels are provided. The lockers for the men's clothes are double, so that street and working clothes hang separate. The company does not provide overalls. The lunch room is large and pleasant, provided with tables and chairs.

Luxurious and expensive as this equipment is, it does not answer the purpose as well as some that are far simpler and less expensive but more carefully planned, such as the following: This is an old factory, employing colored and white help. The rooms used for washing, dressing, and eating have had to be taken from the mill and adapted as well as possible to their new use. It is of course necessary to have separate places for negroes and white men. The washing facilities and lunch room for the negroes employed in the yard are not luxurious, but are entirely sufficient. The lunch room is rather dark, but very clean, with a well-scrubbed table and benches and a stove which is used for heating food. There are well-ventilated lockers for the men's clothes. The wash room has nine shower baths, hot and cold water, towels, and soap. For ordinary washing, there is a long porcelain-lined sink, without stoppers, with hot and cold water, soap, and towels. In the mill, where white men are employed, there is a large room with linoleum covering the old floor, which is used as lunch room and wash room both. For washing, there are long porcelain-lined sinks, with wire frames, on which stand small white-enameled wash basins so arranged that they can be tipped over easily. Nail brushes are chained to the sink and soap and towels provided. There are 24 shower baths, with canvas curtains. The hot water and cold water here are already mixed, so there is no chance of scalding. The manager states that he has no trouble in persuading the men to use the baths or the lunch room. There is a very small kitchen attached to the lunch room, where coffee is made and sold to the men at a cent and a half a cup, including milk and sugar. The company furnishes overalls and canvas caps to the men employed in the white lead department. They have installed their own laundry, for they find that the overalls last very well when they are properly laundered.

There is far more thought and understanding shown in the second of these factories than in the first. It is not necessary to have expensive plumbing and lockers, but it is essential to provide towels, nail brushes, and clean overalls. A lunch room need not be expensively furnished, but it should be attractive, and it is a great advantage to have a cook stove, and still better to provide hot coffee and milk, or milk alone.

Unfortunately in some factories little if any thought has been given to the care of the workmen, as the following instances will show: This is a new, admirably constructed factory, which has been in operation only a few months. There is a good lavatory inside the mill and a lunch room as well, but the men in the yard, 20 to 30 of them, have no place to wash except a bare cold room with cold water, which is of no use in washing away white lead. No soap or towels. The factory is 5 or 10 minutes' walk from the nearest of the workmen's houses; and as they have only 30 minutes at noon, they do not go home for lunch, but eat in the stack house, seldom even making an attempt to wash their hands in the cold water. Many of them wear no overalls at all.

An older factory has the following conditions: There is practically no way in which the men can get clean. In the mill there is one dirty sink on the first floor, with one faucet of cold water, no soap or towels. The men in the yard, if they wash at all, must get pails of water for themselves, or go into the boiler house, where there is another sink with cold water. Sixty-five men are employed here. There is no lunch room. The noon hour came while the inspection was being made, and the men in the yard were seen to leave work and begin eating their lunch without washing their hands. Of 16 men who were closely observed, only 3 were wearing overalls.

The question of respirators is one which gives a good deal of thought and trouble to the conscientious manager of a white-lead factory. There are two factories in the country where the managers and foremen have actually succeeded in inducing or forcing all their men to wear rubber and sponge respirators all the time that they are at work. There are several factories where the use of some form of respirator is fairly general. In such places the men are often given their choice between the more bulky and uncomfortable, but also more efficient, rubber and sponge respirator and the simple cloth or cloth and sponge respirator. Many of them can be induced to wear one of the latter when it would be very difficult to make them consent to the heavier. In the majority of American factories the management contents itself with the announcement that respirators will be furnished on application, and sometimes this statement is true, sometimes it is not. In three factories the workmen who were asked

why they were not wearing respirators said that there were not enough to go round. In England they lay very little stress upon respirators, because they insist that the best are only partially protective, and that the thing to do is to abolish dust, but in America we are so far from being able to abolish dust as yet that it is highly important to protect our workmen as well as possible against it. It is impossible to say as yet what is the best kind of respirator, but certainly a fairly good one worn continuously is better than a very good one which is worn only now and then.

DISCIPLINE IN THE FACTORY.

It is not enough to provide washing facilities, lockers, overalls, respirators, and lunch room for the workmen. With the very best equipment a factory may have a great deal of lead poisoning among the workmen, more indeed than a place in which the equipment is more primitive but in which there is good shop discipline and a continual conscientious effort to train the men in the care of themselves. For instance, during two months of the past year there were seven men sent to public hospitals with lead poisoning and three treated by a physician, from the yard gang of a large new factory which has an excellent wash room and lunch room. The men stated that they had never been told to wash nor shown where they could do so, that they knew nothing about a lunch room, and had always eaten their lunch in the stack house. They were non-English-speaking Poles, and it was evident that the yard foreman, who did not speak Polish, had not troubled to give them any instructions or warnings.

In discussing the discipline in an American factory, it must not be forgotten that the American foreman has a much harder problem than the German or English. During the spring and summer always, and often during fall and winter as well, there is a scarcity of unskilled labor, and the foreman finds it very hard to hire all the help he needs. Naturally under these circumstances his threat to discharge a man for disobedience does not carry so much weight as it does in countries where other work is hard to find, nor is he as willing to make such a threat as he would be if he felt sure of filling the insubordinate workman's place. In fact, it may happen, especially in the Middle West, that foremen feel obliged to make concessions to their men, such as granting a 15 minutes' pause in the middle of the forenoon and afternoon and shutting their eyes to the fact that the time is used to buy beer. Two physicians employed in white-lead factories said that they had tried to have all the alcoholic workmen discharged, but they could not because the foreman said that it was impossible to fill the empty places. Nevertheless the ex-

perience of a few managers who have resolutely and persistently enforced rules of cleanliness and careful work shows that it is possible to train the men to take care of themselves and avoid endangering their fellow workmen. One old, only fairly well-equipped factory, which has had for several years an intelligent and conscientious manager, had but 11 ascertainable cases of lead poisoning among its men during a period of 16 months, while another old factory, in which there is absolutely no care for the men, had 25 cases, 6 of them fatal, during the same time. There was about the same working force in the two factories.

MEDICAL INSPECTION.

In England and Germany medical inspection of the employees of a white-lead factory is prescribed by law. The physician may be chosen by the employer and is paid by him, but must be approved by the Government. The law decides how often he must visit the factory and in what form he must make out his records, which records are either the property of the Government or are open to inspection.

In the United States the medical care of the men in a white-lead factory has been left entirely to the discretion of the employer, until very recently, and even now the only legislation on the subject is in Illinois. The first regular weekly medical inspection of all employees in any white-lead factory was established in January, 1910, although in one or two of the factories medical treatment was available to those who were sick before that date. Other factories have introduced weekly inspection more recently, some in the fall of 1910, some in January, 1911, and some within the last few months. At the present time the majority of American white-lead manufacturers employ physicians to give more or less regular care to their employees. The method varies somewhat. In most of the factories of the National Lead Co. and in some of the independent plants the system is the same as that required abroad; that is, a regular weekly—rarely fortnightly—inspection of all the men and a record of the condition of all who are not in perfect health. There are still factories in which no medical care at all is provided and others that employ a physician only for the men who complain of being sick or whom the foreman suspects of being in need of medical care. This kind of medical supervision is, of course, much better than none, but it is open to several objections. It leaves the diagnosis of lead poisoning to the foreman, and he is not likely to discover early cases which with proper care might not result in a severe attack. Then, too, in times when work is scarce the workman will try to conceal the fact that he is sick, because he is afraid of being laid off, and, on the other hand, when labor is scarce, the foreman can hardly be expected to look carefully for signs of sickness in his men.

When the first inspection was made by the writer the 23 factories stood in the following classification in regard to the medical care of their men:

First class.—Regular medical inspection of all the men, six factories.

Second class.—A physician paid by the company to take care of accident and lead poisoning cases, eight factories. In three of these the care afforded was perfunctory and the company doctor saw only a minority of the cases.

Third class.—No medical care, nine factories.

At the time of the first inspection the managers who had not as yet installed physicians in their factories or whose system of medical control was inadequate were urged to have weekly inspections of their men by competent physicians, and since that time a great improvement has taken place in this respect. The first class now contains 13 factories, 4 of those that were formerly in the third class and 3 from the second having passed up into the first. The second class now contains 5 factories and the third 5, at least one of which will probably soon join the first class. The last factory has a system that works admirably, though it does not employ a physician to see all the men each week or fortnight. The men are all entitled to a sick benefit if they suffer from accident or occupational disease, and they are therefore very prompt to consult the company doctor as soon as they feel any symptoms from the lead.

CHARACTER OF WORKMEN.

The men employed in white-lead work are for the most part unskilled laborers. In St. Louis, East St. Louis, Cincinnati, and Philadelphia many Negroes are employed, and also many Slavs. In Omaha, Chicago, Pittsburgh, Perth Amboy, and Camden Slavs predominate. Italians are found in almost all white-lead factories, but not in large numbers except in West Pullman, Philadelphia, Brooklyn, Long Island City, and Staten Island. A few Greeks are found in St. Louis, West Pullman, Chicago, Omaha, and Pittsburgh. Very few American-born workmen, aside from Negroes, and not many immigrants from the north of Europe are found in the factories of the Middle West. Indeed, there are some factories in this part of the country that have hardly any English-speaking workmen. On the Atlantic seaboard more American-born and English-speaking workmen are found in the white-lead factories, but in many cases these men say that they have taken up the work only as an emergency job during a temporary lack of other employment. It is not work that attracts experienced or intelligent men, except for a few skilled jobs in the mill.

In a certain factory employing 50 men only 12 were even experienced workmen, the others all unskilled. In another, employing 70 men, 7 were skilled workmen, 9 more had some skill or at least experience; the others were hired afresh all the time.

The following is a fairly typical working force in an average factory; that is, in one of the older factories where much of the work is still done by hand.

1. Casting room: Three men, one skilled, the 2 others only truckers.

2. Yard gang: About 50 men, including the setting gang, discharging gang, and a few skilled men.

(a) Setting gang: Three gangs of 8 men each, setting or building stacks. These men are often employed by the day as they are needed and laid off or discharged in the intervals of setting stacks, but a few are usually retained and kept at other work, for stack building requires some experience, and it is better to have a few men familiar with the work beside the foreman. The two men trucking blue buckles from the casting room may belong to the setting gang.

(b) Discharging gang: Two gangs of 8 men each, discharging or stripping stacks. This is absolutely simple, unskilled work, requiring very little instruction, and as it is also highly dangerous work the discharging gang is made up usually of a shifting class of workmen. In many factories the statement is made that the stack strippers average only from 10 days' to 2 weeks' employment in any one factory, and it is very exceptional to find a foreman who makes an effort to keep these men as steady employees. It is here and in the dry-pan room that the danger is acknowledged to be great, and most foremen feel that they are only acting humanely if they let their men go after a short time and engage new ones. It is here also unfortunately that the greatest neglect of hygienic care is most often found, even in factories which are otherwise excellent. The skilled men who complete the yard gang are foremen, carpenters, and a weighmaster.

3. Mill hands: About 15 to 20 men.

(a) Unskilled workmen: Two to three men in the dry-pan room or "kiln." These are unskilled and are often hired by the day only. In some factories the men in the yard take turns emptying the pans, working from a few days to several weeks at a stretch and then going back to outdoor work. In others the mill hands take turns at this work, but the more common way is to employ new men as they are needed and pay them by the piece. The work is rightly regarded as the worst in the factory, and though the pay is not higher the hours are often shorter, i. e., a man may earn the usual wage in 4 to 6 hours. It is seldom that one finds any evidence of special care for the dry-pan men except in giving them shorter hours and not encouraging them to stay. Their washing facilities are often very poor.

(b) The other work in the mill requires more or less skill, or at least some experience. This is as follows:

Chaser men: One or two men who shovel dry lead into the oil-mixing machine. This work is sometimes as dusty as any work in the factory.

Water mill: One or two on the water mills.

Packers: One or two packing barrels with dry white lead. There is often an old experienced workman on the barrel packer, and if skillfully managed this may be fairly dustless work. One man packing dry lead by hand in small kegs. This is irregular work; it is not done in all factories, and it never takes all of one man's time.

Keg men: Three filling kegs with lead in oil. Three or four young men or boys labeling and handling full kegs.

Pulp-machine man: One on the pulp machine.

Repairers: Two men. These are highly skilled, and their work is usually dusty and dangerous.

Mill dresser: This man is not usually in the regular employ of the company but comes in when needed. He is a highly skilled workman. In dressing the millstones he is exposed to white-lead dust.

There is in addition a mill foreman with, it may be, an assistant foreman.

WAGES AND HOURS OF LABOR.

The wages paid run from \$1.15 to \$2 a day for all but the skilled work, the last figure being very exceptional; \$9 to \$11 a week is usual, but it may fall somewhat below this figure or rise above it, according to the state of the labor market. In the Middle West wages usually keep pace with those paid in railroad construction or ordinary excavation work, for the Slavs, Greeks, and Italians tend to drop out of the factory to outdoor work and return again to the factory after a few months. During the spring and summer, when unskilled labor is in great demand not only in railroad work but on the seaboard and along the Mississippi River, wages often undergo a temporary rise. On the whole the pay is lower in Philadelphia and about New York than in the Middle West.

The workday is 10 hours, with 30 minutes at noon, but it is seldom that objection is made to the men taking a little time off in the middle of the morning or afternoon. Discipline is not very strict in a white-lead factory, and the men do not seem to be hurried much nor even kept very steadily at a task unless this is absolutely necessary. In most places the men are allowed, in some really encouraged, to leave work now and then and go to the lavatory for a thorough wash. Seldom is objection made to a man quitting work 5 minutes or more before the noon hour or closing time in order to clean up. A few factories regularly allow from 5 to 10 minutes for this purpose. The

custom of granting 15 minutes' recess morning and afternoon is frankly a concession to the foreign workmen, and is mostly utilized by them for beer drinking. As stated above, pieceworkers, such as the dry-pan men, and in some places the setting and discharging gangs, may work only from 4 to 7 hours a day. There are, however, factories in which even the dry-pan men work the full 10 hours.

SHIFTING CHARACTER OF LABOR.

It has already been said that the white-lead workers are a very shifting class of labor. Of the 23 factories which form the subject of this report, only three state that their working force is even fairly steady. Usually the foreman says that about 20 per cent new men have to be hired each week. The following are quotations from the statements made by different managers:

"The regular pay roll is 58, but there were 250 men on the books in the last six months."

"Fifty men are needed for the regular force. In the last two weeks (spring) 108 men were employed."

"The pay roll is only 65, but the stripping gang and dry-pan men shift all the time, and probably nearly 400 men are employed in the course of a year, though some of these may be former employees returning after a longer or shorter absence."

"We employ 125 men, but must take from 18 to 20 new ones each week, and a still larger number in the spring when street and railroad construction begin."

"Fifty-five men are employed; 10 to 16 new men are hired each week."

"We do not keep more than 6 men regularly employed, hiring the other 14 to 28 men by the day as they are needed."

"We make no effort to keep a steady force of laborers, encouraging the unskilled men to leave after a few weeks because we think it prevents them from becoming poisoned."

The last two statements express the feeling which is very general among foremen, if not among managers, and is strongly defended by them. It is contended that, as most men develop lead poisoning only after an exposure of several months, the kindest and most humane method is to employ men in the more dangerous work for short periods only, then let them go and hire new ones. There are several arguments against this position.

In the first place, English and German statistics show that lead poisoning in a factory is in direct proportion to the number of casual workmen employed. The new employee knows little or nothing of the risks of the work and practically nothing of the means of protection. As he is to stay so short a time it is argued that there is no use in attempting to teach him anything. It would be too much to expect of a foreman that he should spend much time instructing a gang of non-English-speaking foreigners whom he expects to lose in a month's time or even at the end of a week. The consequence is

that the more unsteady the men the less effort is made to protect them. If, indeed, it were possible to know just how long a man may be exposed to white-lead dust without risk and to discharge him before the expiration of this period, there might be much to be said for this method, but such knowledge is impossible. Men may become poisoned after two or three days' exposure, as shown by the statistics as to length of exposure given further on.

A certain proportion of all men (Hirt puts it at between 15 and 20 per cent) are unduly susceptible to lead, and will become poisoned very soon after exposure. Now, if the working force in a factory is continually changing, these oversusceptible men will be continually entering and falling sick, while if the force is steady, they can be eliminated at the outset. It is also obvious that only with a steady force of men can any sort of shop discipline and real control be attained. Fortunately, many managers are beginning to recognize this fact, and are striving to so change conditions that their workmen will remain with them.

The mere fact that the great majority of white-lead workers in the United States are foreigners who understand little or no English increases very much the amount of lead poisoning in an American factory. Even if the workmen are warned by cards of instruction printed in their own language, telling them of the dangers of the work and what measures of protection to take, the difference of language is still a great handicap. Many of them can not read, and, what is still more important, printed instructions can never cover every detail of the work. In going over a factory the investigators frequently saw the foreman or even the superintendent go to a foreign workman who was raising clouds of dust as he worked and show him how to do the same work without dust. But, in the absence of explanation, it was quite evident that the man did not understand what he was being criticized for or how the foreman's method differed from his own.

LEAD POISONING IN THE WHITE-LEAD AND LEAD-OXIDE INDUSTRY.

This part of the study has been attended with enormous difficulties. When one considers that there is no compulsory registration of cases of lead poisoning in the United States, that the victims of this disease are largely foreigners with no fixed abode, that there are no union sick-benefit records to consult, and that the insurance companies can give no help, one can readily see that it is impossible to gain any accurate knowledge of the full extent of lead poisoning in this industry throughout the country. The better-managed factories, those that have competent physicians in regular charge of their employees, can give information very nearly complete, but never quite

complete, for a careful search always reveals a few cases that have escaped observation. There are always some suspicious foreigners or Negroes who have an unreasoning distrust of the company doctor.

Even at the best, regular medical inspection, including records of all the men examined, is of very recent date. Only one factory instituted this system as long ago as January, 1910, when it came under the control of a man who had had experience in white-lead work under the English law. The other factories have come into line more recently, some in the autumn months of 1910, some in January, 1911, and some only within the last few months. But insufficient as these records are, it is in those factories which furnish only emergency medical care, or none at all, that the greatest difficulty is encountered, and these are often, as might be expected, the factories in which there is most opportunity for lead poisoning.

It sounds paradoxical to say that the largest number of cases of lead poisoning are found in the best-managed factories, but this is true, except in the case of three unusually bad ones. Of course, this does not mean that the greatest number of cases occur in well-managed factories, but only that the cases occurring are more easily found. A careful manager knows the cases of lead poisoning among his men and is perfectly willing to present for inspection the full records made by the company doctor, while a factory managed without attention to the health of the men has no information to give that is of the least value. The men in such a plant do not receive any attention until they are really sick and consult a physician of their own accord or go to a hospital. This means, of course, that the milder cases of poisoning are never detected as they are in a place where all the men pass regularly under the doctor's eyes. The only way to discover the cases of lead poisoning in these neglected factories is to search for cases in hospitals, dispensaries, doctors' records, and by interviews with workmen, and the data gained in this way are never complete. Hospital history sheets and dispensary records give the diagnosis and the fact that the man was a "lead worker," but they seldom give the real nature of his employment, and still less often the place where he worked. Then, when an effort is made to track down each case and fill in the necessary information, it is often found that the man has left the city, or that the name given was not his real name, or was unintelligible to the clerk, or that he gave a false address. These difficulties were very great when the attempt was made to trace Italians, Poles, or Hungarians. For instance, 25 cases, mostly Poles and Italians, were collected from the hospital and dispensary records of a town in which there is one white and red lead factory. Thirteen of these were traced to this factory; the other 12 could not be found at all. In all probability they, too, worked in

this plant, but they are useless as far as our factory records go. Out of 106 probable white-lead cases found in hospital records in Philadelphia, only 67 could be traced, and out of 101 in St. Louis, only 44.

Information given by physicians is usually only general in character. They know if a factory has much lead poisoning, and they can give an estimate of the number of cases they see in a month or a year, but they can hardly ever give the names of individuals, so that, although their evidence is valuable as confirming the impression gained by the investigator, it does not usually help in making statistics. For instance, a certain Polish doctor said that he saw from three to five new cases of lead poisoning every month from among the Slavic workmen in a certain white-lead factory, but he could not remember any names except of the last three. That meant that only three cases, instead of some fifty-odd, could be added to the records.

It seems certainly safe to say, in view of the foregoing, that the statements made in this report as to the amount of plumbism in the white-lead industry in the United States fall much below the actual truth. The figures given throughout the report always mean individual cases which have had a physician's diagnosis of lead poisoning.

The facts most important to ascertain were the number of men suffering from plumbism and their relation to the number of men employed, the severity of the disease, the length of time the men in question had been employed, how long an exposure was necessary before the first symptoms appeared, and the particular work in which the men were engaged. The last point, however, had to be abandoned, for the doctors who took the histories of these cases were so unfamiliar with industrial employments that the descriptions they gave were usually unintelligible. All the information that was gained on the questions given above is very far from complete, and it is offered only as a tentative beginning of a statistical study on lead poisoning in one industry.

Among the workmen in white and red lead factories a total of 388 cases of lead poisoning were found, all having occurred after January 1, 1910, and before May 1, 1911, a period of 16 months. The records for the first four months of 1911 are not complete, for several hospitals could not give information about cases occurring later than January 1, 1911, as they do not systematize their histories more than once a year. As will be shown later,¹ at least 30 of the 388 men were working in oxides, not in white lead. The number of men needed to fill the pay rolls of the 23 white-lead factories east of the Pacific coast is about 1,600, but it is plain from what was said above that this does not nearly represent the number of men employed throughout the year. If the statements of foremen can be taken,

¹ See pp. 258 and 259.

about 15 to 20 per cent new men are taken on each week, which would mean that between 10,000 and 15,000 men enter the white-lead industry every year. But this is probably far too large a number. Some of the new men are old employees returning to work and some are men from other white-lead factories, for it is not at all unusual to find a man who has worked in two or three different white-lead plants. The truth is that no exact and complete statement can be made in regard to the relation of the number of cases of lead poisoning to the number of men employed. All that can be said is that in a period of 16 months 388 cases of lead poisoning are known to have occurred in white and red lead factories, and that these 388 cases do not represent by any means all the cases of lead poisoning from these factories.

A somewhat clearer picture of the amount of plumbism in this trade can be gained by studying the doctors' records in those factories where complete records are kept, but this source is also only partly satisfactory, owing to the fact that different doctors have different standards, and what is a suspicious case to one doctor is a case of plumbism to another. The following instances are given for what they are worth. They throw some light upon the question, even if they do not clear it up.

No. 12. An old, crowded factory, employing between 60 and 70 men and taking on about 20 per cent new ones each week. The doctor's records for one month ending October 15, 1910, covered 128 men, 16 of whom were found suffering from plumbism, and 3 more were considered suspicious. This did not mean that all 16 men had had lead colic during that month, but that they showed the effects of the lead sufficiently to require medical care.

This would mean 12.5 per cent, not counting the 3 suspicious cases, who were recorded as suffering from constipation, indigestion, or anæmia.

No. 15. An old, not at all carefully managed factory, but rather cleaner than No. 12. The doctor's records for the month of November, 1910, gave 8 cases of plumbism and 1 suspicious case out of 73 men examined, or 11 per cent.

No. 6. An old, crowded, but well-managed factory, where very careful supervision is given the men, and the help is unusually steady. The doctor's records for three months, January 1 to March 31, 1911, cover 112 men, of whom only 1 had suffered from lead poisoning during that time, or less than 1 per cent. Seven more were, however, regarded as suspicious cases, showing the "lead line," anæmia, constipation, or digestive disturbances, and were receiving medical treatment. If these 7 were counted it would bring the percentage up to

7.1 per cent, but if we adhere strictly to the doctor's diagnosis this factory should be credited with only 1 per cent.

The three above are all factories that use the old Dutch process. The two following use the Carter process, and though the work is more dangerous, the men in these factories receive unusually good care, and average a longer period of employment than do the men in the old Dutch factories.

No. 21. In this factory 170 men came under the doctor's observation between January 1, 1910, and December 31, 1910. Of these 170, 60 had had lead poisoning, or 35.3 per cent, but not all had suffered from acute symptoms during that time. They were, however, all receiving medical care for some trouble due to the absorption of lead.

No. 20. This factory is newer and less dusty than No. 21. The records covering the six months preceding April 1, 1911, showed 37 men who had never suffered from plumbism and 14 who had, or 27.5 per cent. Among them was the foreman, who had had two attacks during the 32 years of his work in white lead, but who insisted at the time that he was entirely well.

The one factory using the Mild process has very full records, and, owing to the fact that they pay sick benefits to their workmen who suffer from any occupational disease, they discover the cases in a very early stage, for the workmen have every incentive to report themselves to the doctor instead of concealing the fact that they are sick from fear of losing their places. This system of insurance has been in force since January 1, 1904. The records for 1910 cover 150 men, 17 of whom were treated for lead poisoning, or 11.3 per cent. In the first four months of 1911 there were 7 cases.

To sum up these results: The three old Dutch factories had, respectively, 12.5 per cent in one month's time, 11 per cent in one month's time, and 1 per cent (or 7.1 per cent) in three months' time. The two Carter process factories had 35.3 per cent in one year and 27.5 per cent in six months. The one Mild process factory had 11.3 per cent in one year. It is probable that this last figure is of all the one most nearly accurate, as the Mild process is much less dusty than any other except the Matheson, and the fact that 11.3 per cent of the men here employed suffered from plumbism makes it probable that a much higher percentage suffer in the old Dutch process factories and often escape detection because they purposely do not complain to the doctor. It is not easy to detect the early stages of plumbism if the patient denies that he feels ill in any way.

LENGTH OF EMPLOYMENT.

The length of employment could be ascertained in 228 of the cases of lead poisoning. Of these, only 108 had been employed for as long a time as one year.

LENGTH OF EMPLOYMENT OF WHITE-LEAD WORKERS PREVIOUS TO LEAD POISONING.

Length of employment.	Cases of lead poisoning.	Length of employment.	Cases of lead poisoning.
Less than 1 week.....	1	1 and under 2 years.....	15
1 and under 2 weeks.....	1	2 and under 3 years.....	10
2 and under 3 weeks.....	11	3 and under 4 years.....	5
3 and under 4 weeks.....	8	4 and under 5 years.....	7
1 and under 2 months.....	23	5 and under 6 years.....	8
2 and under 3 months.....	19	6 and under 7 years.....	4
3 and under 4 months.....	10	7 and under 8 years.....	1
4 and under 5 months.....	4	8 and under 9 years.....	1
5 and under 6 months.....	4	9 and under 10 years.....	5
6 and under 7 months.....	6	Over 10 years.....	11
7 and under 8 months.....	8	Over 1 year, but exact time not specified.	41
8 and under 9 months.....	3		
9 and under 10 months.....	1	Total, 1 year and over.....	108
10 and under 11 months.....	3		
Under 3 months.....	18	Grand total.....	228
Between 3 months and 1 year.....			
Total, less than 1 year.....	120		

LENGTH OF EXPOSURE BEFORE POISONING.

It would have been still more interesting to know how long was the period of exposure to the lead in each case before the first symptoms developed, but this could be learned in only 120 instances. Of this number 31 had been exposed for a year or more and 89 for less than a year, as follows:

LENGTH OF EXPOSURE OF WHITE-LEAD WORKERS PREVIOUS TO LEAD POISONING.

Length of exposure.	Cases of lead poisoning.	Length of exposure.	Cases of lead poisoning.
Less than 1 week.....	1	1 and under 2 years.....	13
1 and under 2 weeks.....	7	2 and under 3 years.....	6
2 and under 3 weeks.....	16	3 and under 4 years.....	3
3 and under 4 weeks.....	12	4 and under 5 years.....	2
1 and under 2 months.....	25	5 and under 6 years.....	2
2 and under 3 months.....	7	6 and under 7 years.....	2
3 and under 4 months.....	6	7 and under 8 years.....	
4 and under 5 months.....	5	8 and under 9 years.....	
5 and under 6 months.....	3	9 and under 10 years.....	1
6 and under 7 months.....	4	Over 10 years.....	2
7 and under 8 months.....	1		
8 and under 9 months.....		Total, 1 year and over.....	31
9 and under 10 months.....	2		
Total, less than 1 year.....	89	Grand total.....	120

Probably these statements were not absolutely accurate. The fact that only two men gave the period of exposure as over 8 months and under 12 months would seem to mean that when it was beyond 8 months it was given as "about a year." It will be noticed that the

exposure is often of very short duration and that 61 of all these cases were poisoned after an exposure of 2 months or less.

Care of the men not only diminishes the amount of lead poisoning but seems also to stave off an acute attack. Thus we find that the length of employment and the period of exposure before poisoning occurs are longer in a factory with good hygienic regulations than in one with bad. A few examples will serve to illustrate this. In a well-managed old Dutch process factory, in which there were records of 14 cases of lead poisoning, 10 of the men poisoned had been employed for long periods, averaging 11 years, and only 4 had been employed for shorter periods, averaging $2\frac{1}{2}$ months. One of them had sickened at the end of 2 weeks' exposure, another at the end of 3 weeks' exposure; probably both were unusually susceptible men.

In contrast to this may be quoted the hospital records of severe cases of lead poisoning that developed in an old, excessively dusty factory with no medical control. The hospital records in 15 cases gave the length of employment, and in only 2 was it as long as 1 year. These two had worked, respectively, 1 year and 18 months. The other 13 averaged 5 months' employment, the longest period being 10 months and the shortest 3 days. The period of exposure to the lead before the first symptoms were felt was stated in 8 of these 15 cases. It was 4 months in 1 case, 2 months in 3 cases, 3 weeks in 2 cases, and in the other 2 it was 6 and 3 days, respectively.

A similar contrast can be drawn between the hospital records of cases from a very dusty and neglected old Dutch process factory and the doctor's records of a Carter process factory that employs a physician and is careful with its men. In the old Dutch process factory 60 per cent of the cases of plumbism were those of persons who had been employed less than 3 months. In the Carter process factory only 7 per cent had been employed less than 3 months.

STUDY OF INDIVIDUAL CASES OF LEAD POISONING.

In order to illustrate the effects of lead poisoning, some cases have been selected. The selection has been made, not because these cases were unusually severe, but because the histories were given with more than usual fullness. It will be noticed that the greater number of these men are Irish or Scotch or American, but this simply means that they could give the fullest information.

No. 1. V. O., Italian, speaking no English. He worked for 36 days in the stripping gang of a new, very well-built factory. Nobody gave him any instructions nor explained to him the dangers of the work and the precautions he must take. He never saw a respirator and did not know there were such things or that he had a right to ask for one. The stack men had only cold water to wash with, no

soap or towels, and as the lunch period is only 30 minutes, they did not trouble to wash. He used to eat his lunch sitting on the tan bark in the stack house. He wore his usual clothes to work in. There was a great deal of dust in the stack, especially on windy days. One day an agonizing colic came upon him suddenly and he fell to the ground. He had not known that there was such a sickness as lead poisoning till an Italian doctor told him that he had it and sent him to the public hospital, where he remained for 2 weeks. After he returned home he had a relapse and was obliged to go back to the hospital. When seen 3 months later, he was not yet strong enough to work.

No. 2. C. W., a Negro, 39 years old. He worked for 2 months in the dry-pan room of an old dirty factory where dry sweeping is done and the dumps in the dry-pan room are very bad. After 3 or 4 weeks' work he began to feel sick. He had nothing to wash in except a pail of cold water. He did, however, wear a respirator. At the end of 2 months he went to the public hospital with nausea, vomiting, obstinate constipation, and pains in his back and limbs.

No. 3. C. H., worked in the same factory as No. 2, trucking lead from the drying pans to the dump. He was always careful to wash his hands before eating, and ate at a restaurant, but nevertheless he fell sick at the end of 2 weeks. He complained to the company doctor, who gave him medicine but allowed him to keep on at the same work. At the end of 5 weeks he was obliged to give up and go to the hospital.

No. 4. E. M., Negro, 27 years old. Worked in the dry-pan room of this same factory. He described the room as very hot and full of lead dust. The men worked for half an hour at a time, then were obliged to stop and go to the windows to get the air and cool off. There were buckets standing around with lead-encrusted cold water for the men to wash in. If a man wanted warm water he must go from the third floor to the boiler room on the first floor and get a bucket of warm water. The lunch room was practically the same as the work room, being a dusty little room opening directly out of the dry-pan room. After working 4 weeks, E. M. lost all appetite for food and after 2 weeks more he went to the city hospital with a typical attack of lead colic.

No. 5. J. K., Polish. Worked in the drying room of a large new factory, one of the best equipped in the country. After 3 weeks he had lead colic. He returned to the factory and was sent to shovel the tailings of white lead that lay in the yard and wheel them to the oxide department. After about a month more he became violently sick and went to the public hospital. He was not strong enough to work for 2 months after this.

No. 6. D. K., Polish. Worked for 6 weeks stripping stacks in the same factory as No. 5. He had no respirator, no overalls, and only one suit of clothes. The only place to wash his hands was a hydrant in the stack house, and as it was bitter winter weather, he ate his lunch with unwashed hands in the stack house. The factory employed a physician at that time, but D. K. had never been told this, and when he was taken with lead colic he appealed to a policeman, who called the ambulance and sent him to the public hospital.

No. 7. S. D., Slovak. Worked for the same factory stripping stacks. He gave the same description of conditions as did No. 6. He first felt sick at the end of 3 weeks' work, but he worked on for another week, then became violently sick and went to the public hospital. He was able to go to work for an express company 4 weeks later.

No. 8. D. L., Italian. Worked in an old but clean Dutch-process factory in the dry-pan room for 2 months. He had no respirator, but he was given instructions by the foreman to be careful not to raise dust and to wash before eating. Soap and towels were furnished and he ate out of doors, nevertheless he began to feel sick at the end of the first month, and at the end of 2 months he was sent to the city hospital with lead poisoning.

No. 9. M. M., Italian. Worked in the same factory as No. 8 and at the same work, but also out in the yard shoveling tan bark. He did not fall sick till after $2\frac{1}{2}$ years of work. Then he left and returned again. This happened repeatedly until finally he was put to work separating by hand the off-color lead and pounding it free from the uncorroded cores. This was after he had worked for 6 years, and he became so ill that he was obliged to go to the city hospital.

No. 10. V. M., Polish, 51 years old. He was employed in emptying drying pans and in yard work for 10 years in the same factory as No. 9. After 6 years' work he began to feel badly and for 4 years more he was sick a good deal of the time, having frequent attacks of abdominal pain. He had been well instructed as to the care he should take of himself, and was given opportunity to wash with soap and water, but he had to provide his own towels. He ate his lunch usually in the factory or yard. One day while at work he fell unconscious and was sent home and then to the hospital. After he recovered he again applied for work at the same place, but they refused to take him back.

No. 11. M. McF., Scotch, 69 years. Worked on and off for 4 years in a very dusty factory. He was never very well, and had one attack of colic soon after going to work. He was in the hospital with this for 10 weeks. After this he was continually troubled with constipation, nausea, vomiting, and sometimes diarrhea. Another attack came on after 2 years employment and again he went to the

hospital and then twice again during the following year. The hospital diagnosis made at his last entry, July to November, 1910, is as follows: "Lead anæmia and myocarditis, red coloring matter of the blood only 35 per cent, red corpuscles reduced to less than one-half. Loss of appetite, nausea, colic, diarrhea, weakness, emaciation, headache, and pains in the joints."

No. 12. H. D., Irish, 30 years. He was a strong man who had never been sick in his life before as far as he could remember. He worked for 1 year in the same factory as case 11. After 3 weeks he began to lose his health and during the year of his employment he had four attacks of colic, in the last of which he went to the hospital. The description on his history sheet is as follows: "Lead colic, constipation, suppression of urine, muscular pains, anæmia, red coloring matter 58 per cent."

No. 13. W. L., Irish, 45 years. From the same factory as the former two cases. Worked there only 10 weeks; is described by his friends as being a strong, healthy man before he went there. When he was sent to the hospital with lead poisoning he was described by the physician who took his history as an aged-looking man, emaciated, anæmic, with a foul, inflamed mouth, with colic, constipation, and acute nephritis.

No. 14. J. McC., Scotch, 32 years. Worked for 2 months in the worst part of this same factory, shoveling dry white lead in a room the air of which was white with dust. He was a strong, healthy man, but he drank alcohol to excess. At the end of 5 weeks he began to have pains in his abdomen and legs, a sweetish, disagreeable taste in his mouth, and a looseness of the bowels. After 3 weeks more he became partly paralyzed and went to the hospital. He is now described as a palsied wreck.

No. 15. J. L., Irish, 41 years. Worked in one of the dusty rooms in this same factory off and on for 2 years. It was only a few weeks before he began to feel sick, and during the time of his employment he had three or four attacks of lead poisoning. The foreman, he said, was very good to him, gave him instructions, gave him a respirator, which he always wore, and when he fell sick would give him salts, but always when he returned after a severe attack of sickness would take him on again. When he went to the city hospital he was said to have chronic lead poisoning with double wrist-drop, colic, and muscular pains.

No. 16. A. H., Polish, 44 years. Worked 4 years in this same factory. After 6 months he began to feel sick, but he worked on until severe pains in his shoulders and arms and weakness in the legs drove him to the hospital. Paralysis of the left arm soon came on, and later of the right arm. The weakness in the legs increased so

that he could walk with difficulty. When seen almost a year later his hands were still partly paralyzed, but not enough to prevent his doing laborer's work, as the paralysis is confined to a few fingers. He was still working occasionally in this same factory, although he suffered from attacks of colic every now and then.

No. 17. J. M., Irish, 54 years. Worked in the red-lead department of the same factory for 7 or 8 years off and on. He was a strong man, and even now in the intervals of his attacks he recovers his strength fairly well. He has had frequent attacks of lead poisoning, for one of which he was treated in the Philadelphia Hospital, April, 1910. During the later attacks his hands become stiff and painful, he has colic and is constipated, and his mind becomes slightly affected. His daughters believe that his mind is never quite clear, even in the intervals.

No. 18. H. McC., Irish, 50 years. Worked for only 4 weeks in a neglected, dusty factory, and then became troubled with obstinate constipation, and then with pains in the ankle joints and shoulders. After that he began to suffer pain after eating and lost 35 pounds in 6 weeks' time. Insomnia came on and weakness and numbness of the legs. He then went to the city hospital.

No. 19. J. K., Irish-American, 45 years. Went to work in this same factory in March, 1910. He would work in a very dusty room for 3 or 4 days and then at less dusty work for the same period. The first thing he noticed was that everything began to have a sickeningly sweet taste, so that he loathed his food and began to drink a great deal of beer, partly because it was the only thing that tasted right, partly because the other men told him it would carry off the lead. He worked only 3 weeks in June and 2 weeks in July. The first of August, while he was carrying some heavy lumber, he suddenly lost power in his legs and fell to the ground, the lumber injuring his shoulder. When he was taken to the city hospital he developed a typical attack of lead colic, with headache and pains in the joints.

No. 20. W. D., Irish, about 50 years. This man works in the red-lead department of this same factory, and has been there for the last 7 or 8 years, during which time he has had several attacks of lead poisoning and has been in three different hospitals. His wife stated that her husband now drinks a good deal because his throat and mouth are dry and he has an unpleasant, sweetish taste that only beer or whisky seems to relieve. The foreman and the manager do all they can to prevent the men drinking on the premises, but her husband has lost his appetite for food and often brings home his lunch untouched, so that he craves beer all the time. He has at present an ugly sore on his shin, which will not heal, and he often suffers from cramps and constipation.

No. 21. L. M., Austrian. This was a large, healthy young fellow of 18, who went to work in the white-lead department of this factory and at the end of 8 weeks became very ill with agonizing pain. He was taken to the hospital, but the record in the hospital gives no details.

No. 22. J. H., American. Worked in the red-lead department of this factory for 1 year. Began to feel sick at the end of 5 months and in spite of the fact that he wore a respirator and was careful to keep clean, he was obliged to leave work at the end of a year. He returned, but fell sick almost immediately and left to find outdoor work.

No. 23. E. O'B., Scotch, 45 years. Went to work in a Carter process factory in very dusty work. After 5 weeks he began to lose his appetite. He could not eat his breakfast or if he forced himself to do so, he would vomit. He kept on for 3 weeks more with gradually increasing weakness in his legs and arms and pain in the hip joint. Later he was obliged to go to the hospital with dizziness, headache, colic, and constipation.

No. 24. D. S., German, 34 years. This man was a carpenter and repairer in this same factory. He had never been ill in his life before. After about 2 months' work he began to feel sick. He wore a handkerchief over his mouth when the work was unusually dusty, and he washed thoroughly. When he told the foreman he was sick, the latter gave him some salts and told him to go home and rest. He returned to work and remained there 6 months in all, having two more attacks of cramps and weakness, the second of which was very severe. He has not yet recovered strength, but is doing outdoor work, having taken this job in the factory only because it was mid-winter and he could find no other work and had a wife and 7 children to support.

No. 25. T. I., Spanish half-breed, 32 years. Worked in the same Carter process factory for 6 months. He fell sick almost immediately, after about 3 days' exposure. After working off and on for 6 months he became severely poisoned and was sent to the hospital.

No. 26. L. D., West India Negro, 23 years. He was employed in very dusty work in this same factory for 8 weeks. At the end of about 7 weeks he began to have pain in his chest and abdomen, vomiting, and weakness of the legs. When sent to the city hospital at the end of the week with lead colic he was found to be very anæmic, the red corpuscles reduced to almost one-half of normal. He had a second attack of colic while in the hospital.

No. 27. A. P., Negro, 22 years. Worked in this same factory from 6 to 8 months. After a few weeks he fell sick and was obliged to go home. The foreman gave him some salts and told him to come back

when he was better. He did this several times, but became gradually weaker, and finally stopped because he said the work was killing him. He went to a private hospital with acute lead poisoning.

No. 28. H. W., American. Worked in this same factory, in almost all the departments, for 18 months. He did not suffer from lead colic nor any of the usual symptoms, except pains in the joints, but he lost 28 pounds and had a loathing for his food, so he left the factory for fear of serious illness.

No. 29. L. P., American, 27 years. Worked in the corroding department of this factory for 8 months. At the end of 6 weeks he had an attack of lead colic for which the foreman gave him salts and sent him home. During his 8 months' employment he had three attacks, for one of which he was sent to the hospital. He was then very anæmic, the red coloring matter 60 per cent. After he left the hospital he did not return to the factory and is now quite well.

No. 30. F. L., Spanish half-breed. Worked as trucker in this same factory for about a year. He wore a handkerchief over his mouth; he was careful to wash and even to take baths, but at the end of 4 months he began to feel sick. He worked on till the end of the year. When seen by the investigator a year later, May, 1911, he was pale and thin and still under the doctor's care. His landlady said that when he came to her a year ago he was a big, strong man.

No. 31. G. B., Russian, 28 years. He was employed in the yard of this factory for 7 months and did not consciously suffer from the work. Then he was put indoors in very dusty work for 9½ hours a day. After 1 week of this work he had lead colic and went to the hospital.

No. 32. Negro, 50 years. He worked for 6 or 7 months in this same factory. He had always been strong up to this time, and during the first part of his employment he worked outside. But after about 2 months he was sent to work in a very dusty room, where the men frequently become poisoned in a few days' time. He worked there for 3 days, then became violently poisoned, and was sent to a private hospital. After he came out he went to work again, but he was ill and became morose and slightly deranged. He was then sent to the public hospital, the record of which shows that he was brought there in convulsions, and was later confined for a time in the insane wards. He is now said to be quite sane again and is working as a sailor.

No. 33. Russian, 25 years. Worked in this same factory doing outside work for 4 months. Up to this time he had never been sick in his life. He was then put to work inside in the dust, and after 2 months he was sent to the city hospital with colic, which was described as very agonizing.

No. 34. A. H., American, 25 years. He has worked for 7 years off and on in the red-lead department of a white and red lead factory which is rather unusually dusty. During that time he has had several attacks of colic, two of them severe enough to send him to the hospital. He is a drinking man, he wears no respirator, but he is cleanly in his habits. He looks almost double his age.

No. 35. E. K., German. Worked for 2 years in a fairly clean factory where barrel packing is done in a very dusty place. He had charge of this part of the work, and though he kept himself as clean as possible he could not help breathing the dust raised by his own work and by some Poles who were working near him and who could not understand directions. As he turned the barrels to roll them from under the packer some of the lead would always spill and get on the floor and on his clothes. After 2 years' work he became poisoned. When he returned to the factory the foreman was good to him and gave him a job as night watchman, since which time he has been all right.

No. 36. G. G., American, about 50 years. He has been a foreman in the red-lead department of this same factory for several years and has worked there altogether 16 years. He has always been careful as to cleanliness, but not as to dust, and would not wear a respirator. His first attack of lead poisoning came in the form of colic after 5 or 6 years' employment. Since then he has had 3 severe attacks of arthritis. He was in the hospital with arthritis of the hips and knees at the time the investigation was made, April, 1911. The company paid his hospital expenses.

No. 37. M. M., Polish, 30 years. Worked in this same factory in the white-lead department 3 months. When he came to the hospital he had already been suffering for 2 weeks from constipation, loss of appetite, headache, weakness, and colic, and he stated that he had had a similar attack 2 months before, after only 4 weeks' employment. He was already anæmic; red coloring matter, 65 per cent.

No. 38. F. M., Polish, 32 years. This man went to the hospital with lead colic, emaciation, and anæmia; red coloring matter, 63 per cent, after only 3 weeks' employment in this same factory. He said that up to that time he had always been well.

No. 39. J. F., Negro, 40 years. Worked in an old, dusty, neglected factory for several years, during which time he had an attack of lead colic, but returned to work after it. He was sent to the hospital with colic, obstinate vomiting, headache, dizziness, and delirium. Later on he developed hallucinations and delusions and was transferred from the hospital to the insane asylum.

No. 40. A. W., American, 34 years. He worked in the red-lead department of a dusty factory, packing the dry red lead. There

was no water for washing purposes, but he used to go over to the white-lead mill and get a pail of warm water. This he was always careful to do. He felt the effects of the lead after 3 or 4 weeks, but he worked 16 months before he became too ill to keep on. After recovering from this first attack he went back, but could work only 7 or 8 weeks. Then he was obliged to go to the hospital. The diagnosis on the hospital history sheet was as follows: "Lead neuritis, vomiting, constipation alternating with diarrhea. No lead colic. Weakness of muscles of arms and legs, especially extensors. Congestion of fundus of both eyes. Attention poor, memory poor, especially for recent events. Speech slow and hesitating."

There were nine cases of encephalopathy. Another which was reported as such was more probably a case of apoplexy. This was a man who had been employed 27 years in white lead, had had colic three times, and died 2 hours after falling to the ground unconscious. The 9 cases include 5 white men, 3 Negroes, and one whose color was not stated. The following tabulation gives the main facts in these 9 cases:

Case No.	Length of employment.	History.
1	7 months.....	Colic once.
2	14 months.....	Sudden onset, no previous illness, fatal.
3	7 to 8 years.....	Frequent attacks of colic.
4	10 years.....	Frequent attacks of colic.
5	10 years.....	Sudden onset, no previous illness.
6	Several years.....	Colic twice, fatal.
7	Not stated.....	Colic once.
8	.....do.....	Not stated.
9	.....do.....	Not stated.

In 43 histories the statement was made that the men had had more than one attack of lead poisoning. Eight of these gave no specific number, using the expression "many attacks," or "frequent" or "repeated." The others gave the following figures: 21 men had 2 attacks; 7 men had 3 attacks; 4 men had 4 attacks; 1 man had 5 attacks; 1 man had 6 attacks; 1 man had 16 attacks.

FATAL CASES OF LEAD POISONING.

Owing to its incompleteness the following report on fatal cases of poisoning in the white and red lead industry is offered with some hesitation. A rather large number of fatal cases were reported by workmen and by doctors in the course of this investigation, but there were only 16 concerning whom it could be absolutely proven through hospital records or death certificates that lead poisoning had caused death or had contributed to the cause of death. How far below the truth this number falls the writer does not know. In interviews

with physicians it was sometimes stated that lead poisoning was not generally given as the cause of death in making out a certificate, and that it is more usual to give one of its results instead. In Illinois it was said that a certificate bearing the diagnosis "acute lead poisoning" would bring the case under the jurisdiction of the coroner and therefore physicians avoid this expression and instead write "acute gastro-enteritis" or "acute nephritis," etc.

The details that could be gathered with regard to these cases are given below:

No. 1. W. B., American. Employed 10 years off and on in white-lead work in a dusty factory. He suffered repeatedly from arthritis and died April, 1911, in the city hospital, aged 44 years, of plumbism, Bright's disease, and apoplexy.

No. 2. J. S., Irish. Employed for about 15 years in a very dusty factory, unhygienic in almost every respect. He seems to have gone to a hospital first in the fourteenth year of his employment. When he returned to the factory he was given outdoor work as a driver, but he continued to grow worse and was finally sent to the city hospital with lead poisoning and heart disease. Both hands were paralyzed, both ankles partly paralyzed. He was very much wasted and had almost continual abdominal pain. He remained in the hospital and almshouse for 3 years and then died in August, 1910, aged 48 years.

No. 3. J. G., Irish. Employed about 5 or 6 months in the same factory as J. S. He felt the effects of the work almost at once. He died in the city hospital October, 1910, of acute lead poisoning.

No. 4. A. J., English. Employed for 2 years in this same factory. He had three attacks of acute lead poisoning and finally died, January, 1911, at the city hospital of plumbism and alcoholism.

No. 5. J. C., Irish. Employed in this same factory off and on for 10 years. He was treated for acute lead poisoning once in the city hospital and once in a private hospital. When he went the second time to the city hospital the description on his history sheet was as follows: "Chronic lead poisoning, colic, constipation, vomiting, severe muscular pains, loss of power in the arms, stiffness of the wrists, weakness in the legs, hardening of the arteries, anæmia, red coloring matter 43 per cent. He has lost 25 pounds." He was in the hospital from January 8 to April 5, 1910, when he died, aged 43 years.

No. 6. B. McB., Irish. Employed as barrel packer in this same factory off and on for 6 or 7 months. Barrel packing in this place is very dusty, and the man was said to be a hard drinker. He began to feel ill after about 4 months' work and had at least one attack of lead poisoning before he was taken to the city hospital, in March, 1910, where he died the day after admission, aged 52 years. The diagnosis was lobar pneumonia, heart disease, and lead poisoning.

No. 7. J. J., Negro. Employed off and on 7 years in an old dusty factory, where the medical care is perfunctory. He had had two attacks of lead poisoning, and then suddenly he was taken unconscious and died at the city hospital of lead encephalopathy and valvular heart disease, aged 54 years. This was in March, 1911.

No. 8. J. S., American. Worked for 9 years in this same factory. He had repeated attacks of lead poisoning and finally developed heart disease and nephritis, for which he was obliged to go to the city hospital. He died in July, 1910, after 2 days in the hospital. The report of the autopsy was as follows: "Œdema of the lungs, œdema of the brain, chronic nephritis, chronic myocarditis, congestion of the liver, chronic gastritis, chronic plumbism."

No. 9. W. McC., Irish, a skilled workman. Employed as engineer and repairer for 2 years in a factory which is reported to be very dusty. He had several attacks of lead poisoning. He is said to have been always temperate, but he did not take many precautions against dust, and his work was necessarily often very dusty. He died of chronic lead poisoning February, 1910.

No. 10. C. O., Swede. Employed as furnace man in the red-lead department of the same factory as case No. 9 for not quite 3 years. He felt the effects of the lead after a short time, and he seems to have tried to take care of himself, being scrupulous about personal cleanliness, but the place he worked in was very dusty. He went to a private hospital with paralysis and died February, 1911, aged 34 years.

No. 11. W. B., American. No details could be learned about this case except that the man worked in the same factory as the preceding two cases; that he had been in a private hospital once before with lead poisoning, and that he died in this hospital from the effects of lead poisoning, July, 1910.

No. 12. J. M., German-American. No details could be learned of this man's history except that he had been in lead work for 27 years and at the time of his death was employed in a dusty old factory, where there was no medical care for the men. He had lead colic three times, and he died in a private hospital, probably from apoplexy, for he fell to the ground unconscious and died in 2 hours' time.

No. 13. F. B., Austrian. Employed one year and a half as barrel packer and in other work in a Carter-process factory. He had a very severe attack of acute lead poisoning, which proved fatal in 3 days' time. This occurred in May, 1910.

In addition to the foregoing 13 fatal cases from hospital and physicians' records, the 3 following were found, the cause of death in each case being traced clearly to employment in white-lead factories.

No. 14. J. S., American, 54 years. He had worked for short periods of 7 months, 4 months, and 3 months, but it can not be ascertained whether he stopped work in the intervals because of sickness. One morning he started to work feeling well, but while at work he had a sudden severe headache, as if a nail had been driven into his head. Then he fell unconscious; he was taken to the hospital in convulsions, and the examination of his blood showed a profound anæmia, the red coloring matter being 50 per cent, the red corpuscles less than half the normal number. He left the hospital in his right mind, but very weak, and died a few days after. Later on it was recollected that 3 weeks before this attack he had had headache and dizziness, but had paid no attention to it.

No. 15. M. F., Scotch. Worked in the mill of this same factory off and on for 2 years. He seems to have been an unusually susceptible man, for, though he was apparently strong and hearty when he went to work, he began to feel sick after 2 weeks' exposure. It was, however, a period of hard times and he could not find any other work, so he stayed on, taking what precautions he could, wearing a respirator and washing carefully. He had repeated attacks of lead poisoning and became a pale, tremulous shadow of himself. Finally the foreman told him that if he would undertake an unusually dangerous job, tamping down the dry lead as it was packed in the barrels, he would be given \$10 a week instead of the \$7.50 he was then earning. He did so, but for a very short time; then he was taken very sick and died. This history was not obtained from a hospital record, but from the man's widow.

No. 16. R. C., Irish, 36 years. Worked chiefly as barrel packer for about 12 years in this same factory. His landlady said that he was a strong man and very temperate. He suffered repeatedly from lead poisoning, for which he used to dose himself with laudanum. Gradually he grew thin and pale and was told by one physician that he had tuberculosis, by another that it was lead poisoning. He died without going to a hospital. This history was obtained from workmen and his landlady.

One factory was responsible for 8 of the 16 cases, a factory which was at that time probably the dustiest in the country, where washing facilities were very poor, and there was no medical care. Another factory was responsible for 3 cases, and this factory is reported to be very dusty, to provide only cold water, and to have no medical care. The actual facts regarding conditions in this factory are not known, because inspection was refused. A third old and dusty factory, with poor washing facilities and perfunctory medical supervision, was responsible for 2 of the 16 cases. The remaining 3 were scattered.

DESCRIPTION OF INDIVIDUAL WHITE-LEAD FACTORIES.

No. 1. This factory was still in course of construction at the time (April, 1911) the inspection was made by the writer, but work was being carried on in a more or less makeshift way. As a consequence, certain undesirable conditions existed. The stack house was in bad condition, with heaps of old lead and faulty and ripe corrosions scattered about uncovered. The basement was dusty, owing to leakage from a separator. There was no lunch room, and men ate their lunches in the stack house, sitting on heaps of tanbark or corrosions. No hot water, soap, or towels were furnished.

These conditions were regarded as only temporary, until the new building should be completed. This is to be of concrete throughout, both stacks and mill. Stack stripping will be done by hand, but the corrosions will be carried by traveling crane and the dump will be automatically controlled. Large scrap is to be automatically discharged into the melting pot, and that portion which is used to reset will be always handled damp. The mill is large, and wet and dusty processes are separated. The floors are concrete and no dry sweeping is allowed. Mechanical devices for doing away with much of the handwork, including that in the dry-pan room, have been installed, and apparently the only dusty work in this factory will be stack stripping and lifting the dry lead from the pans. A lavatory and lunch room are being erected, and a physician is to be employed to examine the men weekly. The factory employs 50 men.

The recommendations made in this case by the investigator were that during the progress of the work special care should be taken of the men, because until the structure is completed, there must necessarily be a good deal of dust in both yard and mill. It was also recommended that overalls be provided and laundered by the company and that the wearing of some form of respirator be made compulsory. The management expressed its intention to comply with these recommendations.

No. 2. This factory was not quite completed at the time the first inspection was made by the writer, although stacks were being set. It is a beautiful new building, so clean that one would hardly know what material was being handled there. The yard is of concrete and handwork is replaced by machinery wherever possible. Corrosions are conveyed and discharged automatically into the dump. The cores must, however, be shoveled into trucks. The mill is new and of concrete throughout, with the unfortunate exception of the dry-pan room that is left over from the old mill and has a wooden floor, but the management is experimenting with mechanical devices to lessen the danger of emptying pans. The rest of the work in the mill is done largely by machinery; conveying, weighing, and discharging

are automatic. The barrel packer is no improvement over the usual kind nor is it managed as carefully as in some places, and the smallest kegs are still packed by hand. The dust-collecting system is excellent. A large building containing the lunch room, wash room, and locker room for the men is so placed that the men must pass through it to check in and out. There are double lockers for street and work clothes; the wash room has a cement floor, shower baths with hot and cold water, and separate porcelain-lined basins with hot and cold water. At this time there was no medical inspection.

Some six months after this visit a second visit was paid to the factory in order to discover how it had happened that 10 cases of lead poisoning had occurred during October and November, 1910, in this factory. Seven of these men had gone to the public hospital and three had been treated by a Polish physician. Medical inspection had been introduced in November, 1910.

Those men who were interviewed said that they had been employed in the dry-pan room or in stack stripping, that they had had only cold water to wash with, had never heard of a lunch room, and did not know that there was a company doctor. It was evident that this was a case of trusting too much to the equipment of the factory and neglecting the care of the men.

The investigator recommended that the foreign laborers employed in the dry-pan room and in the stacks should be given careful instructions in their own language; should be taught to use the facilities provided for them; that the doctor's inspection should include all the men; and that the company should provide overalls and respirators and make the men use them.

The following is the last report received from the general superintendent of this factory: "The physicians come to the plant twice a week and inspect the men in all departments. The regular visit of the physicians began in its present thorough manner in January of this year [1911], after the completion of the comfort room. Their services are at the disposal of all of the men for any illness whatever, whether contracted on the premises or not. The company furnishes towels, soap, and nail brushes, which the men use freely, as they do also the shower room. The majority of the men use the lunch room, and those who do not go outside the factory for lunch. Overalls are furnished to the men at half cost; they are compelled to wear them during the day and leave them in the lockers before going home at night. The company launders the overalls. Instructions in eight languages are posted throughout the plant cautioning the men against the possible dangers in the handling of lead, and the foremen of all departments are instructed to look after the welfare of their men. Two kinds of respirators are in use, the Hurd or Covers, a rubber

muzzle with a sponge, and the Philadelphia respirator, a frame that holds a cloth. The men are required to use the respirators when working in dusty places. The men emptying drying pans change their clothes and take baths daily." The factory employs about 125 men.

No. 3. This is a new factory, employing 45 men, situated on the edge of the town. It is of concrete construction with ample light and air, and is kept scrupulously clean. The casting room is not above criticism, for scrap lead is handled dry and there is an escape of fumes from the kettle. There is a traveling crane in the yard and, although the dump is not automatically controlled, it is very well built and almost free from dust. The mill is very clean, the floors being swept with wet sawdust. There is no overcrowding, the separator is well inclosed, and the dry-pan room is by far the safest of any seen. We are not permitted to describe the construction of this room, but the result is that a very dangerous piece of work has been made fairly safe. The handling of "off-color" lead, of tanbark and lead, and of scrap lead from the separators is not ideal and could be made much better. Barrel packing is very well done, and could hardly be improved upon. The dust-collecting system is also good. On each floor of the mill there is a very good lavatory with porcelain basins, shower baths, washing soda, and hot water, but no towels. In addition there is a large wash room for the yard men, with ventilated lockers, a large sink, and washing soda, but only cold water and no towels. A lunch room is provided. The company furnishes overalls for all the mill hands, but not for the yard hands. One of the workmen is given 25 cents extra a day to distribute white unbleached muslin cloths to the men and to see that they wear them over the nose and mouth. The use of these cloths is very general.

There is no regular medical inspection for the men, but a physician is employed to treat, without charge, any man who is referred to him by the manager. This physician had 20 men sent to him in this way in the past year, but he stated that he was sure he did not see all the cases of lead poisoning, and interviews with local physicians confirmed his statement. There is evidently a desire in this factory to take care of the men and to prevent lead poisoning. The men are shifted as much as possible from dusty work to clean work if the manager suspects that they are beginning to suffer from the effects of the lead. There is no attempt made to keep the men who are employed as stack strippers; indeed they are advised to quit if they show any sign of ill health.

The recommendations made in this case were, that the physician be employed to make weekly inspection; that soap, towels, hot water, and overalls be provided for all the men, yard hands as well as mill hands; that the scrap be sprinkled before it is handled; and that the

escape of fume from the kettles be prevented. These recommendations are still under consideration.

No. 4. A large factory, new, roomy, clean, and abundantly ventilated. There is an excellent casting room. The stack house is a fine large building with traveling crane and the dump is fairly good, though it must be operated by hand. The vents from the separator are well hooded and fairly dust proof, but the returns must be shoveled into trucks, and are handled dry. The separator is tightly inclosed and the rooms containing it are perfectly clean. The dry room is no improvement over the ordinary one; it has a worn uneven wooden floor, covered with white lead, and, though the men are supposed to sprinkle before they sweep, this is practically of no use, for the heat dries the water immediately. Chasers are filled by hand, but through a small opening with a good exhaust, and the work is fairly dustless. The rest of the factory is very clean; the dust-collecting system is good.

Negroes and white men are employed here, numbering 132 at the time of the writer's visit. The former have a separate small building as a lunch room and lavatory. The washing facilities are insufficient and the room is dirty. There are no shower baths for the Negroes. The white men's lavatory is centrally situated and is very good; soap and towels are provided. They have also a lunch room, but they do not use it. The discipline in this factory is unusually good; the men are required to wear pads of moist cheesecloth over their faces while doing dusty work and it was evident that this rule was obeyed. The company employs a physician to take care of the men on their request, or on that of the foreman. Twenty-five cases came to him during a year's time, only four or five of whom were sick enough to be sent to a hospital. The company paid their hospital expenses. Interviews with local physicians showed that some of the men who had suffered from lead poisoning, especially the Negroes, had preferred to go to their own doctors instead of consulting the company doctor. Four such cases were found. One fatal case of encephalopathy during the last year was reported by a physician.

The recommendations made in this factory were that the doctor should see all of the men every week, so that he could detect incipient cases of plumbism. It was also recommended that the lavatory for the Negroes be improved, that they be furnished shower baths, and that a more abundant supply of towels and soap be provided; that the dry-pan room be rendered, as far as possible, free from dust; that the men be encouraged to use the lunch room; and that the scrap lead be sprinkled before it is handled.

The last report from a member of the management of this factory is as follows: "The supply of towels and soap for the Negroes is un-

limited, but requisitions are infrequent. The room is no doubt squalid, as would be any room in which some 25 or 30 Negroes change their clothes and eat their meals for a day, but it is in better order than when first inspected. There are two shower baths in this room for the Negroes, and practically all of them use the baths every day. There is another shower bath in the mill for the use of the Negroes in the pan room and chaser room. All these men bathe daily. The pan men are required to use a face-cloth and to sprinkle the floor before sweeping. The scrap is still handled dry. The men, especially those in any dusty department, always wash before eating and always leave the dusty rooms to eat their lunch. The physician is now [July, 1911] under contract to inspect all the men every Saturday."

No. 5. This factory was not quite finished at the time the first inspection was made. It is a beautiful new building of concrete construction. The corroding house is unusually open, which may be a disadvantage, as the place is very windy and unprotected. Setting and stripping are done by hand, of course; for stripping the outer wall is taken down and this allows the wind to enter the stack while it is being stripped. All conveying is done automatically. The kettle is apparently well hooded, but the scrap lead that is to be melted is handled dry. The dump is not well constructed. Trucks must be emptied by hand, and there is no hood. The separators are well inclosed, and there is a good arrangement for the reception and removal of scrap and tailings. The large cores are reset, the small melted. There is a very good dust-collecting system which ends in a pipe that discharges the dust under water. The drying room is no improvement on the old factories, except for the concrete floor, but the chasers are filled automatically and well inclosed. There is no reason why there should be dust in any other part of the factory except at the barrel packer and in packing small kegs by hand. The factory employs from 60 to 70 men.

It was stated that a lavatory was to be built in the corroding house with a large sink, shower baths, and lockers; that soap, towels, and overalls would be provided, the overalls laundered; and that respirators or some form of protection would be insisted upon in the case of the men employed in the dusty processes. There would also be a lavatory for the men in the mill. No medical inspection was provided for, but the men who were sick were to be sent to a doctor paid by the company.

The criticisms made of this factory were the open construction of the stacks, which certainly must admit too much wind, considering that the factory is in the open country, the lack of proper protection over the dump, the handling of dry scrap, the lack of a lunch room, and the lack of regular medical inspection.

Seven months later a second visit was made to the factory, which was now in full running order. During this time 13 cases of lead poisoning among the men employed here had been treated either in hospitals or by an Italian physician, and the visit was made in order to discover, if possible, how such things could happen in so new and well-constructed a factory. It was found that not only was the discipline of the men very lax, but the place was already extremely dusty—far dustier, in fact, than several old factories. Apparently only dry sweeping was employed, though the concrete floors could easily be swept clean with wet sawdust. The dump was found in a bad condition; the corrosions were evidently dropped on the floor by tipping over the truck and then shoveled into the unhooded opening. This room was white with dust. The method of emptying scrap from the separator was also productive of dust, and there was no protection over the dumps leading from the dry-pan room to the chasers.

Shortly after this a change in management was made, and the following recommendations were sent to the new manager: "Hot water, soap, and towels should be provided for the men in the stack house, who now have only cold water; cards of instruction in various languages should be posted in the factory, for the Italian workmen who were poisoned had never had any idea of the dangers of the work they were engaged in. Respirators and overalls should be provided and laundered for the men handling the white lead. There should be rules compelling the men to wash and bathe as often as necessary. They should not be allowed to eat in their workrooms. A doctor should be employed to see all of the men regularly each week or two."

The following is the latest report (July, 1911) from the superintendent of this factory: "Medical inspection is weekly; every individual is thoroughly examined and a careful record kept. If the medical inspector finds the least trace of any failing health, the employee is changed to some other position, or such action taken as will place him entirely free from any possible harm. Hot water, soap, and towels are furnished for all the men; cards of instruction for the prevention of lead poisoning are placed conspicuously about the factory, printed in the languages of the men employed; respirators and overalls are provided for the men handling white lead and are laundered by the company; washing and bathing are compulsory, and none of the men are allowed to eat their lunch in the mill or yard. Every effort is made to keep the place free from dust."

No. 6. This is an old factory, more or less overcrowded, with wooden floors and without much modern equipment, but it is under unusually intelligent management and the shop discipline is apparently better than in any other factory visited. The casting room is clean, the

kettles well hooded, and whatever scrap is melted is always handled wet. All the work in the yard is done by hand, and the dump leading into the separator is far from being dust free. The mill is a fairly clean building with wooden floors in good condition, and there are no unnecessary accumulations of white lead lying about. The separator is well inclosed, and there is careful separation of dusty processes from wet processes. The dust-collecting system is also good, except for the fact that the hoppers full of dust must be emptied by shoveling. The dry-pan room is unusually clean; no dry sweeping is allowed anywhere in the factory. There are, however, two very dusty rooms, one adjoining the dry-pan room with openings through which the dry white lead is shot down to the chaser room, and the other containing the pulverizer and barrel packer. In the yard there is a very good wash room for the men, with a cement floor and a porcelain-lined sink, and soap, but there are no towels, and in order to heat the water the sink must be filled and a current of steam sent into it, which probably means that several men wash in the same water. In the mill there is also a very good dressing room for the men, with a cement floor, but with the same equipment as that in the yard. One good feature of this factory is the granting of 10 minutes to the men before noon and before 6 p. m. so that they may wash. They are not allowed to leave the premises till the second whistle blows. Many of the men wear respirators, which are usually light wire frames covered with rubber and holding a cloth or a cloth and sponge. The company does not provide overalls, and the clothes worn by the men are often very dirty. A medical inspector was appointed in January, 1911, and now there is regular weekly medical inspection of all the men employed in the white-lead department. The workmen testify to the fact that every effort is made here to prevent dust, and that the men are all taught to watch each other and to interfere or complain as soon as a man is seen to be doing his work in such a way as to endanger his fellow workmen. The result of this careful supervision is seen in the fact that the help here employed is unusually steady and that there is little lead poisoning in the factory. The doctor's records for three months showed less than 1 per cent of lead poisoning, but the men who had a history of lead poisoning since January, 1910, numbered 13 in a total force of 75 in the white-lead department.

No. 7. This factory is not new and the floors are mostly of wood, but it is unusually clean and free from dust, although the rough brick walls and dark wood ceiling are admirably adapted to show dust if there were any. The casting room has two hooded kettles, and though the scrap is handled dry, it is all melted at night so that the dust and fumes do not endanger the other men. The setting and discharging men work alternately for half a day, so that no man is

discharging all day long. There is, however, more dust than usual in discharging because the pots are first emptied into pails, then the pails are carried to the edge of the stack and emptied into a truck. The corrossions are carried by traveling crane to the dump, which is well constructed and allows but little dust to escape. The removal of scrap from the separator is rather dusty, but separation is very complete and the returns are unusually clean. The mill is very clean. The casing for the separator does not allow of any leakage, and the dry-pan room is the cleanest of any inspected. It must be that the care used in handling the lead is responsible for this cleanliness, for the construction of the pans and dumps is the same as in most factories. All the floors are dampened before cleaning. Dust is, however, found at the barrel packer and in the storage room, where it has apparently come from leaking barrels.

This same factory has also a dry grinding department which is expected to be dust free when fully completed and to require the employment of less help. At the time the inspection was made it was still in the experimental stage, and was very dusty. Two forms of dust collection are used in this factory—one tightly inclosed and requiring to be emptied only once a year, the other consisting of tubular dust collectors which are not inclosed and which must be shaken and emptied once a day. The lavatory for the yardmen is clean, and has two long sinks with cold water, but at noon and at night hot water, towels, and soap are provided. The men have 15 minutes recess at 10 o'clock, at 3 o'clock, and before quitting at 6. In the mill there is a sink on each floor with hot and cold water, towels, and soap. No overalls are provided. The men may have respirators if they ask for them, but as a matter of fact they do not wear them. There are signs displayed in four languages explaining the dangers of lead poisoning and giving directions as to its avoidance. The physician employed by the company since November, 1910, examines the men once a week, and if a man needs hospital care the company bears his hospital expenses. The doctor's records for 5 months show 9 cases of lead poisoning in a force of 125 men; but the help in the yard shifts a great deal, and not all the cases are seen by the doctor. Five additional cases were found who had gone to their own physicians or who had been treated in a hospital. Other physicians reported frequent cases.

The recommendations made by the writer in regard to this factory were: The improvement of conditions in stack stripping, in barrel packing, and in the storage room. It was also recommended that the company provide overalls and that effort be made to get steadier help for the yard work. It was stated that these recommendations would be followed.

No. 8. This is a fairly old factory, which at the time of inspection was undergoing partial reconstruction. The stack house and casting room were being completely rebuilt in concrete. As work was going on at the same time, there was a good deal of accumulation in the way of off-color lead and dry scrap of all kinds, but this was a purely temporary condition. As a rule all the scrap is thoroughly drenched before it is handled. Traveling cranes carry the corrossions, and the dump, which is to be automatically operated, is even now very well constructed, being entirely inclosed so that the man has only to tip over the car and step out, shutting the door behind him. The mill has old wooden floors, but they are fairly clean, and the overcrowding which exists at present will be done away with when the building is completed. The separator machine is well inclosed and is said to require very little repairing. There are dusty places in this factory now from the leaking of tubs, from the escape of dust at the sluice box and at storage bins which receive the lead from the drying room, but these places are all to be remodeled. The chasers are open. The drying room has an extremely dusty old wooden floor, and the openings in the floor for the pulverizer and drying bin are unprotected. There is very little dust collection so far, and what dust there is is taken to a small, wet, dust collector.

There is practically no provision for the men to wash and no place for them to lunch, but the investigator was shown blue prints of a very well equipped comfort house which it was said will be built as soon as possible.

The management does not insist upon any precautions except that the men in the drying room, the man at the sluice box, and the man at the dump must wear rubber respirators; other men may wear these if they choose, but as a matter of fact they do not. The work is carefully planned, so as to allow of the men being shifted from dusty to clean work. The men are fairly steady, only five new men having been taken on in three months' time. Sixty-five men are employed. There is no regular medical inspection, but a physician is paid by the company to take care of the men who are sick. This doctor saw 11 men in three months' time, and according to the evidence gained from other physicians and from hospitals the men all go to this doctor. Only one other case could be discovered and he was a former employee suffering from lead palsy.

In this factory it was recommended by the investigator that the physician see all the men regularly whether or not they complain of sickness. It is stated that this change has already been made, and that the further recommendations as to the provision of towels, overalls, and respirators are to be carried out when the new comfort house is finished.

No. 9. This is a very large factory, unusually free from dust except in a few places. The casting room has a hooded kettle, and though the ventilation is poor the room is free from dust, for no scrap is used in casting here, and dross skimmings are dropped at once into a box and sent to the oxide works. The dump is badly constructed and very dusty, and the same is true of the vents for scrap lead. Dry white lead was caked on the edges of the water mills, bolters, and shakers, and dry powder could be seen all over the room. Two of the upper rooms also showed neglected accumulations of dust. With the exception of these places the factory is almost free from dust and is probably one of the safest of the old Dutch process factories. At the time of inspection only cold water was provided for washing, without either soap or towels. There was no lunch room and the men ate where they pleased. Plans were shown, however, for a new comfort house which is to be complete in every way, having both lavatory and lunch room. The use of strips of unbleached muslin as respirators is quite general, but the men's overalls are far from satisfactory. Signs are displayed about the factory in four languages warning the men of the dangers of the work and prescribing precautions. For the last five months (December, 1910, to March, 1911,) a physician has made weekly inspections of the men. His report showed that eight cases of lead poisoning had developed during that time out of a regular force of 110 men, about 15 per cent of whom change each week.

The dump and the storage hoppers of the separator are to be remodeled in the near future, it is said.

No. 10. This is a new factory, with a clean, well-ventilated stack house. The casting room is excellent, with concrete floor and hooded kettle. Conveying is done by traveling crane. The dump is inside the mill and is well protected by a low-hanging hood. Trucks are emptied by shoveling, but there is little escape of dust. The mill is of concrete construction, the separator well inclosed, and the scrap is discharged directly into trucks. The dry room is fairly clean, with a smooth wooden floor and only two tiers of pans. Dry lead is conveyed mechanically. The mill is not kept as clean as it could be. There is dust on the floor and a good deal of white lead and scrap is stored in the open rooms. The chaser room and the barrel packer are especially dusty, but the oil-grinding room is very clean. There is a good wash room in a separate building for the use of all the men. It contains ventilated lockers and is clean, but the washing facilities are insufficient; there is no hot water in summer, and there are no towels or soap. A few men wear handkerchiefs over their mouths, but no respirators were seen, and the overalls were dirty and only partly protected the men's clothes. There is a rule against

dry sweeping, but it is evidently sometimes done. Scrap is handled wet and the dust-collecting system is wet. No medical inspection.

The following recommendations were made by the investigator: The washing facilities for the men should be increased and should include hot water, towels, and soap. Overalls and respirators should be provided and their use made compulsory. A physician should be employed to make regular weekly inspection of the men. All unnecessary dust should be abolished. No dry sweeping should be allowed. The method of filling chasers and packing barrels should be changed so as to do away with the dust.

In response to these recommendations the owner states that he is having plans made for a new washhouse with concrete floor, shower baths with hot and cold water, long sinks with hot and cold water, and a sufficient number of faucets, so that the men need not wait for each other at the lunch hour. Towels and soap are to be provided and also overalls. A physician is to be engaged for regular work. He also states that his manager believes it to be possible to do away with the dust in chaser filling and barrel packing and to maintain a higher degree of cleanliness throughout the factory.

No. 11. This is a large factory with an excellent casting room, the best in the country, a large clean stack house, but a very dusty mill. Conveying is done by traveling crane and the dump is outside the mill building in a small wooden house, which is closed to prevent escape of dust while the truck is emptying itself. Separation is unusually good and the scrap comes back very free from dust. The mill is not nearly so well constructed, the floors are of wood, rough, and sometimes very dusty. There is dust on the walls and machinery, around the windows outside and on the passageways leading from building to building, as well as on all elevators, stairways, and halls. Barrels of tailings and sweepings stand unprotected by open windows, and there is not complete separation of wet from dusty processes. The dry-pan room is very bad; only dry sweeping is done here. The dumps in the floor are closed with imperfectly fitting trap doors which allow the dust to come up long after they have been closed. The dry lead falls into wooden rooms from which it must be removed in trucks for the chasers and pulverizer. Barrel packing and heading up of the barrels are unusually well done. The washing facilities for the men in the yard are only fair, and for the men in the mill very inadequate indeed. In the yard there is a large dirty room, furnished with wooden benches and a stove which can not be used for heating food. The lockers are in this room and are very good. Next to it is a poorly kept, unattractive wash room, which has two sinks with hot water in winter only. Soap is provided, but no towels. There are three shower baths without partitions. These are said to

be used very little. The workmen say this is because the room is cold in winter and there is no warm water in summer. For the men in the mill no hot water at all is provided, but in winter the men sometimes run steam into a pail of cold water to heat it, otherwise the men in the pan room and all over the mill have nothing to wash with but cold water, soap, and no towels. There is no lunch room for the mill hands and there is no rule against eating lunch in any part of the building. The company does not provide overalls and the men in the dry-pan room wore only the overalls with straps over the shoulders. Respirators are not seen anywhere, and only occasionally was a man seen with a handkerchief over his face. There is a company doctor whose office is on the other side of the city, who treats the men referred to him by the company. Apparently very little thought has been given to the care of the men, and yet there is an unusually good class of workmen here and they are fairly steady. Many of them do piecework and often leave as early as 2 or 3 o'clock in the afternoon. The men in the dry-pan room work there only one week out of six.

Nothing could be learned in the factory as to lead poisoning among the men. The physician had seen only four cases of lead poisoning during the four preceding months, all of these being mild. From interviews with other physicians and with workmen it was gathered that the majority of the men who become sick consult the city physician, who had seen 12 cases during the year, or private physicians. Many of them come from the country and go home again as soon as they are sick. Only 9 individual cases of lead poisoning besides the 4 reported by the doctor, could be traced to this factory, all of these being Americans, while the factory is said to employ twice as many foreigners as Americans.

The following recommendations were made to the manager of this factory: Improvement of conditions in the dry-pan and chaser rooms, improvement of cleanliness throughout the factory, the provision of better washing facilities for the men in both yard and mill, the provision of a lunch room for the mill hands, of overalls and respirators for all the men, and the appointment of a physician to make weekly inspections. The manager reports that the following changes have been made or will be made: The open chasers have been displaced by inclosed chasers filled directly from the dry-pan room and with the opening in the dry-pan room well protected with a hood and air exhaust. Experiment is being made with a new mechanical device to remove the dust raised in emptying pans. Conditions in the wash room will be improved, and the unnecessary accumulations of dust in the mill, and the barrels of cullings and sweepings have already been done away with.

No. 12. This is an old factory, crowded, dilapidated, dark, and poorly ventilated. At the time of the first inspection of this factory by the writer dusty processes were carried on in the same room with clean processes, thus exposing a needlessly large number of men. The dry product in all stages was wheeled in barrows from building to building, across the street, and from room to room. These open barrows stood about everywhere. There was apparently very little concern for the health of the men, and it seemed to be taken for granted that the majority would quit work after a few months. As the writer reached the plant a Negro was seen with a wheelbarrow of white buckles, which he was pushing across the street. He stated that he had worked there one year and had had lead colic five times, and that this was no unusual record. A friend of his had died the week before of lead poisoning, after one year and nine months' work. The casting room was very bad, being a small inclosure in the center of a big stack house and therefore with no outside ventilation. Heaps of dry scrap were lying all over the floor, and were thrown from one side of the room to the other and then into the melting pot by two men working with shovels. All work in the stack house was done by hand, and open trucks of dry corrosion and of dusty scrap were wheeled for a long distance. The dump was very bad, with no hood at all, and the vent for the scrap was right beside it, also unhooded. The separator was well inclosed and shut off from the rest of the mill. The mill had wooden floors, rough and dusty. Even the room with water mills, drag box, bolters, etc., was dusty. Dry processes were carried on in the same room with wet. The chasers were inclosed, but with large openings. The drying room was very dusty and the barrel packer had an accumulation of old white lead. Many of the men wore no overalls, and only 2 wore respirators, which were, however, provided by the company on request. In the yard was a dark and filthy washhouse for the Negroes, with 3 unscreened shower baths and a sink; no lockers. For the mill hands who are white, there were 2 very decent wash rooms, with 6 shower baths. No soap or towels were provided. The men were said to be very shifting. No medical care of any kind was provided.

It was recommended in this case that a physician be employed to examine all the men once a week; that all scrap be thoroughly sprinkled; that the trucks of corrossions and scrap be either covered or sprinkled before they are conveyed from place to place; that an efficient hood be placed over the dump and vents of the separator, and that the factory be rendered as free from dust as possible. It was also recommended that better washing facilities be provided in the yard; that the men be given towels, respirators, and overalls; and

that a strong attempt be made to teach them to take care of themselves.

On the occasion of the second visit of the writer, some six months later, a great improvement was noted. The casting room was very clean and all the scrap was well sprinkled. All trucks of corrosions were covered with canvas cloths, and all scrap was kept wet. The stack house was very tidy. A traveling crane is to be installed to do away with dry trucking. The dump to the separator and the vent from the separator were, however, unchanged. The mill was very clean; even the dry-pan room was far cleaner than is usual, for all the floors were mopped three or four times a day. In emptying the dry pans a long-handled shovel was used and the powder was laid in the trucks instead of being thrown there. The washing facilities and lunch room for the Negroes in the yard had been greatly improved. The lunch room was very clean, with well-scrubbed table and chairs and a stove which could be used for heating food. There were good ventilated lockers for the men's clothes. The wash room had nine shower baths, hot and cold water, soap, and towels. In the mill there was an attractive lunch room with a stove for heating food. There were porcelain-lined sinks, hot and cold water, soap, towels, and nail brushes, and 24 shower baths provided with canvas curtains. The company was selling coffee with sugar and milk to the men at cost. Overalls and canvas skull caps were provided and laundered by the company. The men were obliged to wear some form of respirator and were given their choice between several varieties. Since September, 1910, a physician has been employed to examine the men at least once a week and to treat them for all complaints. His report for the first month showed that 1 man in 8 was suffering from lead poisoning. The last report from this factory is that the company is substituting milk for coffee, with very good results.

No. 13. This factory is rather old, crowded, and dark, and only fairly ventilated, with the exception of the casting room, which is large, clean, and airy and has a concrete floor. The kettle is well hooded, but the scrap that is remelted is all handled dry. Conveying is done by hand. The yard is clean and there are no unnecessary accumulations of scrap or off-color lead. The dump is poorly constructed, without any hood, and the emptying of a truck lets clouds of dust escape. Beside it are the vents from the separator, hoppers from which the scrap falls to the ground, whence it must be shoveled into trucks. The mill has wooden floors throughout. The separator is housed in the general rooms. All the floors are rough and dusty; damp and dry processes go on in the same room. The dry-pan room is very dusty, and the dumps leading down into wooden chambers in the floor below are closed with imperfectly fitting trapdoors, which allow the escape of dust. The dust-collecting system is poor.

Chasers are filled by hand from the wooden chambers containing dry white lead; the chasers are closed. The barrel packer is fairly good. No room in the mill is really clean. The lavatory arrangements are primitive and insufficient; the yard men have only a sink out in the open air with cold water and soap, no towels. The workmen say that in winter they can not wash at all unless they go to the boiler house and get a pail of warm water. In the mill there is a very filthy little room opening into the dry-pan room with a cold-water sink and soap, no towels; here the men from the dry-pan room are supposed to hang their clothes, wash, and eat their lunch. If they wish warm water they must go down two flights and get a pail full from the boiler house. Only on one floor in the mill is there a sink with hot and cold water, and the Negroes in the dry-pan room are not allowed to use it. There is no lunch room, no overalls are provided, and practically the only respirators used are dirty handkerchiefs. Only 2 men out of the 65 employed wore respirators.

Since November, 1910, the company has employed a physician to look over all the men once a week. This man stands at the desk on pay day and observes the men as they come for their money. The inspection seems to be rather perfunctory; the records cover only 16 men, though the factory employs 65. Ten men had been found by this physician to be suffering from lead poisoning during a period of six months.

Fifteen additional cases, two of them fatal, have been discovered by the investigator among the men in this factory which have occurred since January 1, 1910. Ten of these were treated in the public hospital; one was a case of fatal encephalopathy. Recommendations for a more thorough medical examination and for a reform in the conditions within the mill and yard, including abolition of dust and provisions for cleanliness, were made to the company, but have not yet been acted upon.

No. 14. This is a very old factory. At the time of the writer's inspection it was one of the most dangerous factories in the country, for there was practically no effort to control the dust. The casting room is well ventilated. It has a stone and brick floor. There is no hood over the kettle, but as no scrap is melted there is no danger from white-lead dust. Conveying is done partly by traveling crane, partly by pushing trucks along runways. The dump is inside the mill. This building is of rather recent construction and the wooden floors are still in good condition, but there is apparently no effort made to control the dust. Piles of corrossions, of scrap, and of ground white lead are allowed to lie about exposed to drafts of air, and tramped over by the workmen. The dump is very bad, necessitating more handwork than any other inspected. The two men who work here shoveling and raking are in a cloud of dust all the time. The

vents from the separator open into small wooden chambers, closed with leaking doors, which allow puffs of dust to escape all the time. The dry-pan rooms have one very good feature, namely, a single tier of pans. In one the pan lies on the floor and fills the room so that the men must stand inside the pan when emptying. In the other the floor is fairly clean, and it is said that dry sweeping is not allowed here. The dump to the pulverizer is unprotected; the dry lead for the chasers is carried out in trucks and thrown on the floor beside the chaser. The barrel packer is in a small wooden room in the center of the dry-pan room, a bad arrangement necessitating work which should not be dusty in a room that must always be dusty. Inside the packer room are piles of dust, yet the mechanism for packing and removing the barrels seems good, and, as the barrels are lined with paper, heading up should not be dusty. In some cases tamping is done in this room. No place in this factory is really free from dust, except the room with the water mills that has a clean asphalt floor. There is only a small dust collector, which is emptied twice a year. The provision for cleanliness on the part of the men is very insufficient, consisting of sinks with cold water, but with no soap or towels. In the basement there is a steam pipe, which can be used for heating the wash water. There is a comfortable lunch room, but no provision for washing. Milk is given free to the men who ask for it. The company supplies rubber respirators on request, but only three were seen in use. The men are said to be very unsteady, necessitating the employment of 20 to 30 per cent of new men each week. There is no medical care for the men. Twenty-five cases of lead poisoning, all but four of them severe enough to be treated in hospitals and six of them fatal, were found to have occurred in this factory since January, 1910.

It was recommended by the investigator that a new method of dumping the corrosions into the separator be adopted, that changes be made in the method of filling the chasers and of packing barrels, and that the factory be thoroughly cleaned and then kept as free from dust as possible. It was also recommended that a physician be employed to make regular examinations of the men, that a strong effort be made to instruct them in the dangers of dusty work, that the company provide overalls and various kinds of respirators, that the lavatory facilities be increased, and that the men be obliged to wash thoroughly and to eat nowhere but in the lunch room.

The last report from one of the owners of this factory is as follows: "A physician has been appointed who makes weekly visits to the factory and examines all the men. Conditions at the dump, at the vents from the separator, and at the barrel packer have been so altered as to do away with much of the dust. Every effort is being made to keep the mill as free from dust as possible. Blue prints for

a new washhouse have been submitted, and this washhouse will be so placed that the men must pass through it in order to get to the lunch room. It will have a cement floor, shower baths, washstands with hot and cold water, towels, and soap. The company will provide overalls and respirators."

No. 15. This is an old, overcrowded, and dusty factory, soon to be abandoned. At the time of inspection the casting room was good; the kettle was hooded and all scrap was sprinkled before being handled. All the work about the stack, stripping, conveying, etc., was done by hand. Piles of white lead in various stages lay about the yard exposed to the wind. The mill had old wooden floors, but in spite of this the separator and grinding rooms were very clean. The chaser room was dusty, and the weighing, which was done by hand, was a very dusty job. The dry-pan room was bad; only dry sweeping was done here and the air was cloudy with powder. The packer room showed very little dust. All through the mill, trucks, barrels, or heaps of white lead were left uncovered until they should be conveyed elsewhere.

There was no lunch room and the men ate where they pleased. Washing facilities were inadequate, but soap, hot water, and paper towels were provided. No overalls were supplied, but respirators were furnished on request; only two were seen in use, but some men protected themselves with handkerchiefs. Weekly medical inspection was introduced into the factory in November, 1910. The physician's records showed 14 cases of plumbism occurring between November, 1910, and April, 1911, among the 65 men employed in the white-lead department at the time of this inspection. Altogether a total of 30 cases were found which occurred among the employees of the white-lead department of this factory between January 1, 1910, and April 30, 1911. One of these cases was fatal.

The owners of this factory were putting up a new concrete building with all modern mechanical appliances. They expected that this would be finished and the business be transferred to it from the old building by September, 1911.

No. 16. This is a large factory building containing both stacks and mill. The floors are of concrete, but there is a great deal of dust. Casting is done from a hooded kettle in a well-built room with concrete floor. The stacks are inside the building, and, though the ceiling is high, they are more inclosed than any other yet visited. Corrosions are emptied first into pails and then into trucks. The dump is bad; it is so constructed that the truck must be emptied by shoveling and quantities of white lead are spilled around. Scrap is handled dry, the larger scrap remelted, the smaller sent to the oxide department. Dry grinding is done here, and the room in which it takes place is very dusty. The dust-collecting system is well in-

closed, and the room need be emptied only twice a year. The room in which tailings are discharged from the mill is very bad, for they lie in heaps on the floor and must be shoveled into pails and carried to the oxide department. The finished product passes into a hopper and is discharged into a wooden box; a man scoops it up, weighs it, and fills it into a closed chaser. There is very little provision for washing, one dirty sink with cold water being all that is provided. There is no provision for lunching. It is stated that soap and towels are furnished the men on request. No attempt is made to keep a steady force of workmen, with the exception of five or six men. The others are hired by the day and no record is kept of them, nor is there any medical care.

It was not possible to gain any information about the employees in this factory beyond the fact that they were Poles and that they came and went all the time. The factory was not working at the time the inspection was made, and so the men could not be interviewed.

No. 17. This is an old factory, dark and overcrowded, soon to be abandoned. At the time of inspection, all the work about the stack was by hand, but the yard was unusually clean, and the conveying was done in rather small boxes which did not involve exposing the lead as much as in the ordinary trucks. The dump was poorly constructed and very dusty—nickles, tailings, etc., were handled without being sprinkled. Inside the mill the floors were old and dusty, and there seemed little effort to control dust. Dry and moist processes were carried on together. In the mixer room, floor, walls, and tanks were caked with white lead. Open tins of dry white lead stood near the chaser and in addition there was a large pile on the floor. All conveying of the white lead was done by shoveling and carrying in boxes. The chaser was covered.

There was no lunch room and the men ate where they chose. Washing facilities were very inadequate and neither soap nor towels were provided. No overalls were provided. There was no medical inspection, but a company doctor treated, free of charge, any man referred to him by the company.

A new factory was under process of construction at the time, and it was the intention, as this should be completed, to abandon the old building altogether.

No. 18. This is an old factory with a dark and crowded stack house and with very poor washing facilities for the yardmen. The mill building is old, but is under such careful management that it is without exception the cleanest factory visited, and this in spite of the fact that it has few modern devices in operation. There is no medical inspection. It is unnecessary to describe this factory in detail, for it is being abandoned and will shortly be closed down.

No. 19. The following description was given by workmen of the factory where admission was refused to the investigators. The old

Dutch process is used and there is a large oxide department as well. The dump is in a shed built on the outer wall of the mill, protected by a hood and not very dusty. The dry pans are in two tiers. Barrels are packed by hand in the dry-pan room. The work here is very dusty. There is a sink for washing, with cold water, steam connection, soap, but no towels. Rubber respirators are furnished on request, but few of the men use them. No medical care is provided.

The men employed are chiefly Poles and Italians, and they are very unsteady. The investigator had a great deal of difficulty in tracing them, for they were suspicious and apt to deny having been sick in a hospital. Thirteen cases, 3 of them fatal, were identified, but 12 others, who had been treated in the same hospital, could not be found or when found denied having had lead poisoning. The 13 had all contracted lead poisoning in this factory. The druggists and the hospital authorities knew of no other place in the city where lead poisoning was at all frequent and were inclined to believe that all 25 cases came from this factory.

LEAD-OXIDE INDUSTRY IN THE UNITED STATES.

The study of the lead-oxide industry is not complete. It comprises 1 factory where oxides alone are made and 8 in which an oxide department is carried on in connection with the white-lead department. A thorough inspection could not be made of all these 9 factories for 3 were temporarily closed down and only 6 could be seen in operation. Since the inspection was made, a large oxide factory with modern mechanical equipment has been opened and another is in course of construction. There are also 2 older oxide factories east of the Pacific coast that were not visited and 1 where admission was refused. The 9 factories that form the subject of this report employ something over 200 men, ranging from a force of 80 in the largest to 2 in the smallest. The range in equipment is almost as great, from highly developed machinery to almost nothing but handwork.

The description of the work in an oxide factory can not be given as fully in detail as in the case of a white-lead factory, for there are more trade secrets in connection with this industry; it will suffice to give an outline of the process and describe the parts that are dangerous to the men.

To produce the oxides known as litharge and red lead, pig lead (for the better grades) or scrap lead of all kinds (for the cheaper grades) is roasted in furnaces at a temperature of about 1,200° F. The furnace room is usually well ventilated and clean, but there are several sources of danger in this department, where the majority of the men are employed. In the ordinary furnace, the charge, or "batch" as the men call it, is introduced by hand through one of the

doors. When this charge is scrap lead the work of handling it may be very dusty, and one often sees piles of dry scrap, dross, and tailings lying on the floor of the furnace room. The danger here is perfectly avoidable for there is no reason at all why all scrap should not be kept wet, yet this is rarely done. In the ordinary furnace also the raking is all done by hand, the furnace man standing at the open door and working with a long-handled hoe. As a usual thing he stands at a distance of some 8 feet, but every now and then he steps close to the door to see how matters are going on, and when the furnace is to be emptied he always stands close to the door, raking out the charge into an open truck. If there is a good hood at the furnace door, large enough and low enough and with a sufficiently strong air exhaust, the fumes from the heated lead will not escape and poison the furnace man, but there are a good many unhooded furnaces in use and many more with inadequate hoods.

When the charge has been removed from the furnace, it has passed through the first stage of oxidation, and is now litharge or, if it is destined to be converted into red lead, it is known as "first burning."

This first stage takes about 36 hours. Sometimes the first burning goes without further treatment back into the furnaces for the second burning, but usually it is first ground and then burned. Grinding is either wet or dry. In either case the dump into the mill is almost always dusty and a bad place to work. The oxides are very light and fluffy, and an oxide department is usually dustier than most parts of the white-lead department under the same management. Wet grinding is not productive of dust, but has the disadvantage of necessitating the use of drying pans, like those described under white lead, the emptying of which is always dusty and dangerous. A bad arrangement consists in utilizing the top of the furnace as a drying pan, for, as the top is usually close to the ceiling, there is practically no escape for the dust raised by shoveling the dry powder. This powder is usually emptied into bins and then later on passed through a crusher or pulverizer and through screens.

Dry grinding is done in some of the larger factories, and may be fairly dustless if the machinery is well inclosed and there are a well-hooded dump leading into the mill and a proper dust-free receptacle for the ground powder. From the dry mills and from the crushing machine, if wet grinding is used, the powdered oxides are usually sent through bolting screens for the removal of large particles. Unfortunately, this is not always done continuously. In many cases the dry red lead and litharge are at various stages dumped into bins and stored there for a while before being taken through the next stage, a system which means another handling and more dust. The opening to the bolting screens is another danger point. Only in 1 of the 9 factories visited was this part of the process carried on auto-

matically, so that the red lead and litharge did not need to be handled during their progress through mills and screens. Probably the worst part of a good oxide factory, and one of the worst parts of a dusty factory, is the packing department. Barrels and kegs are still packed by hand in most cases, and the work is much dustier than the packing of white lead. Even where mechanical barrel packers are used the work is dusty, and small kegs are universally packed by hand.

Dust-collecting in an oxide factory is done by the same methods as in white-lead factories and does not need a separate description.

The following may serve as a brief description of the 9 factories visited:

No. 1. A large factory, well built and clean, equipped with mechanical devices, with an almost ideal mill and screen room and dust-collecting system, but with unhooded furnaces, dusty dumps, and very dusty packing. A poorly equipped lunch room and wash room are provided; no overalls nor respirators.

No. 2. A new, very clean, and carefully managed factory with fairly well-hooded furnaces, good dumps, well-inclosed mill, and screens. Barrel packing is done by hand, but mechanical devices are being experimented with. There is a good lavatory with towels and soap. There are no overalls, but every man wears a respirator. The dust-collecting system is good.

No. 3. A fairly clean, fairly well-equipped factory, with well-hooded furnaces, good dumps, well-inclosed dry mills, and screens. There is, however, wet grinding also, and dry pans on top of the furnaces. The mechanical barrel packers are dusty. The lavatory is poor; there are no overalls, no respirators.

No. 4. An old and very dusty factory. Furnaces unhooded; charging and withdrawing done by hand, but raking is mechanical. Weighing and packing are done in the furnace room, where open trucks of powder stand around, and the whole place is scarlet or orange colored. Wet grinding is done in this factory, and the drying room is very dusty. Pans are emptied by hand. Washing facilities are good, and the management provides respirators. This factory is soon to be abandoned and the work transferred to a new and modern building.

No. 5. A small oxide department designed to take care of the scrap lead from the white-lead department. It has an unhooded furnace, and all the work is done by hand. There is no lavatory or lunch room, no overalls or respirators.

No. 6. A large factory, which was not in operation at the time the inspection was made. As far as the evidence of walls, floor, and ceiling goes, the work is very dusty. There is no lavatory, the men being obliged to bring pails of water from the white-lead mill; no lunch room, no overalls.

No. 7. One of the oldest and dustiest of the oxide factories. The furnaces are unhooded, and the top of the furnace serves as a drying pan. The litharge is kept in bins and shoveled into open crushers, then back into other bins. The screen room is very dusty. All packing is done by hand, and the packing room is very dusty. There is no lavatory, no overalls or respirators. According to the manager, this oxide department is soon to be given up.

No. 8. This is an old but reconstructed factory, with mechanical improvements and a high standard of cleanliness. The furnaces are hooded and all charges handled wet, there being a water supply at each furnace. Mills and bolters are well inclosed; the dust-collecting system is unusually ample and good. Wet and dry grinding are both carried on, the product from the former being dried in the furnaces. Dumps are fairly dust free. There is a good lavatory and lunch room, and some of the men wear respirators; no overalls are provided.

No. 9. This is a small branch of a large white-lead factory. It is housed in a low basement, poorly ventilated. The furnaces are not hooded, and grinding, bolting, and hand packing are all done in the furnace room with a good deal of dust. The scrap lead is, however, handled wet, grinding is wet, and the paste is dried in the furnaces. There is cold water only. No soap or towels, no respirators or overalls.

It is impossible to say how much lead poisoning there is in lead-oxide work, for one can not disentangle the oxide men from the white-lead men, and as the white-lead department is always the larger it overshadows the oxide department and gets credit for all the cases in the factory. Out of the 388 cases of lead poisoning there are only 30 which are stated to have been contracted in red-lead work, and these came from 7 factories, employing a total of about 200 persons.

The following details can be given as to the length of employment in 25 of these cases:

Length of employment.	Cases of lead poisoning.	History.
3 weeks.....	1	
5 to 6 weeks.....	2	
7 weeks and under 6 months.....	2	
6 months.....	1	
7 months.....	1	
8 months.....	1	
1 and under 2 years.....	6	One of them fatal; one had two attacks.
2 and under 3 years.....	2	One fatal; one had four attacks.
3 and under 4 years.....	2	One had four attacks; one "several."
4 and under 5 years.....	1	Several attacks.
5 and under 6 years.....	2	One of them had six attacks, the other three.
6 and under 7 years.....	2	One of them had four attacks, the other "several."
7 and under 8 years.....	1	Four attacks.
16 years.....	1	
37 years.....	1	
Total.....	25	

The period of exposure, stated in only six instances, was 2 weeks, 3 and 4 weeks, 6 months, less than a year, and 3 years.

The workers in an oxide factory are for the most part skilled men employed at the furnaces. The wages paid are higher than in white lead and the class of men is decidedly superior, though there are always a few unskilled men doing laborer's work, such as trucking and packing, and receiving lower wages. These men are usually foreigners and not steady.

Both physicians and foremen in factories believe that there is more lead poisoning in the red-lead department than in white lead in proportion to the number of men employed, and the foremen usually explain this as being due to the longer period of employment in red-lead work. We have not much data on this subject, but the following figures from two plants in which the medical records of the white-lead men and the oxide men are kept separate, show that the rate of poisoning in these factories is actually higher in the oxide department, but that the average period of employment is rather shorter. In one of these factories there were 14 cases of lead poisoning among 65 men employed in the white-lead department, or 21.5 per cent, and 7 cases of lead poisoning in the oxide department among 12 men, or 58.3 per cent. The average period of employment was 4 years for the white-lead workers and only 1 year for the red-lead workers. In the other factory there were 4 cases of lead poisoning among 75 white-lead men, or 5.3 per cent, and 5 cases among the 37 men in the oxide department, or 13.5 per cent. The average period of employment of the white-lead men was $12\frac{1}{2}$ years, of the red-lead men 11 years.

It is probably the excessive dustiness of the work of shoveling, dumping, sweeping, and packing the light oxides that makes work in this department specially dangerous and not, as is so often stated, the long period of exposure. The steadier employees, the men at the furnaces, are not so apt to become poisoned as are the more shifting truckers and packers.

DEATHS FROM INDUSTRIAL LEAD POISONING (ACTUALLY REPORTED) IN NEW YORK STATE IN 1909 AND 1910.

BY JOHN B. ANDREWS, PH. D.

INTRODUCTION AND SUMMARY.

During the two years 1909 and 1910, in the State of New York, 60 certificates of death were written and signed by attending physicians, who thus formally reported that occupational lead poisoning was the immediate or the contributory cause of death. This does not mean that there were not more than 60 workmen in New York State during those two years who died as a result of industrial lead poisoning. It offers, moreover, only a very slight indication of the probable seriousness of this occupational disease. For every death actually recorded as due to this peculiar occupational hazard there are undoubtedly a very large number of cases of chronic lead poisoning,¹ and hundreds of cases where the poisonous dusts and fumes of lead temporarily weaken the resistance of the worker and invite other forms of disease. Finally, it is apparent to all who have made any serious study of the subject that the records of death, even in New York, where they are "comparatively good," are still far from satisfactory as indicating the effects of industry upon health. In spite of the efforts in recent years to secure in each case a more specific description of the occupation, the information as yet available from official sources is far from complete. It is a matter of some significance, therefore, that within two years 60 deaths were actually recorded in one State as due to the use of this one poison in industry.

These 60 fatal cases, as officially recorded, were distributed among the following occupations:

Thirty-seven were painters, 8 were laborers, 4 were printers, 2 were merchants, and there was 1 each from the machinists, molders, smelters, tinsmiths, salesmen, brush drawers, glaziers, porters, and coopers.

The 1 glazier, however, was also a painter; the 1 salesman was in reality a paint mixer; the machinist packed parts of machinery that were still wet with paint; of the 2 merchants 1 was a painter and mixer of paints and the other sifted white lead in a factory; of the 8 laborers, 1 was a house painter, a second was a painter who had

¹ A New York hospital which has had only 3 deaths from lead poisoning during the past seven and one-half years has on record for the same period 59 serious cases of lead poisoning.

also worked in a white-lead works, a third was a packer of machine parts still wet with paint, a fourth worked in a rubber-toy factory, 2 worked in a lead smelter, and 2 in an electric accumulator or storage-battery works; the brush drawer worked with pads coated with paint; the porter operated a press in a lead-pipe factory; of the tinsmith little can be learned, but the cooper was a stack hand and filler of barrels in a white-lead works. Of the 4 printers, one was a hand compositor on bookwork, one was a job printer doing all parts of the work of a printer, a third was a stèreotyper, and the fourth a linotype operator on newspaper work.

Briefly, then, 45, or 75 per cent, of the 60 worked with wet paint, 3 worked in a lead smelter, 4 in printing establishments, 3 had worked in white-lead factories,¹ 2 in a storage-battery plant, 1 in a tin shop, 1 in a rubber factory, and 1 in a lead-pipe factory.

LEAD PAINTING.

Of the 45 who were poisoned as a result of working with lead paint at least 2 were car painters, but the majority were house painters. Many of these were interior decorators, working in confined spaces, where, according to European authority and experience, zinc white might well be substituted for the white lead. Several were ordinary painters who smeared paint on the exteriors of buildings and in many cases were reported to be careless as to the matter of cleanliness. It should be remembered in this connection that we are woefully behind other countries in instructing workmen concerning the dangers of eating with lead on their hands, and equally remiss in failing to require employers to provide suitable wash places for the removal of the poison.

Several so-called painters were practically unskilled laborers who simply dipped manufactured articles into paint baths or handled the parts so immersed before they were dry. A striking example of this kind of occupational lead poisoning is case No. 13. This man was for 32 years a painter and tool-box packer. In the beginning he painted mowing machines with a hand brush. But in later years, when the machine parts received their coat of paint by being immersed in what is known as the dip tub, his daily task was to get in between the drying racks on which these machine parts hung and pack them in boxes for shipment. The still-wet paint dripped upon him from the racks and soaked through his clothing. He was continually smeared with the poison. He suffered terribly for five years, and for three years of that time was unable to do a day's work. Another instance of a similar nature is case No. 43, where the worker stood all day smearing himself to the elbows while dipping parts of treadmills into a paint bath.

¹ One of these three was also classed as a painter.

WHITE-LEAD MANUFACTURE.

Three of the 60 who died with lead-poisoning symptoms had worked in white-lead factories. One of these (case No. 11) had also been engaged in two other occupations where there was possible danger of lead poisoning. The second (case No. 57) had worked 25 years in a white-lead factory, in two of the most dangerous processes. As a stack hand he removed the corroded lead which had been transformed from thin metallic plates into white lead by the action of acetic acid in the fermenting tanbark stacks. Later, as a cooper, he filled and headed up the barrels of white lead. The third man sifted white lead in a factory and breathed the dust, which killed him at the age of 26.

SMELTING AND REFINING.

Three of the 60 deaths were in the smelting and refining industry. Under the occupational description of the death certificates two of these were recorded merely as laborers and only one as a smelter. Investigation traced all three to one smelting and refining establishment in New York City. The first of these (case No. 20) was a kettle man, attending the smelting pot. The second (case No. 26) was a furnace helper, carrying molten lead from the furnace to the molds. The third (case No. 39) was a furnace man, who "charged" the furnace and poured the molten metal into the molds.

This smelting and refining company has occupied its present quarters since 1900. Lead, tin, and zinc dross is here melted in three large furnaces and cast into "pigs" before the combination of metals is "sweated out" at a lower temperature in the refining furnace. The slabs of metal are afterwards combined according to the desired formulæ in several small "kettle" furnaces and again cast into smaller slabs of a weight and shape to suit commercial demands. The building extends the length of one city block and is completely shut in on two sides by walls which do not permit windows for light or ventilation. Skylights, however, furnish sufficient light for the work except in winter and on cloudy days, when gas is used for illumination. The open skylights also furnish good currents of air, but over the kettles and molds they are kept closed to avoid explosions that might otherwise occur as the result of accumulation of moisture in the molds. Each kettle is hooded to carry away the fumes from the melting pot, but the front section of the hood is constantly open to give access to the molten metal, which is ladled out without the use of machinery and poured into the molds.

All of the workmen are here exposed to the fumes and dust of lead from the molds, kettles, and furnaces. Dust flies from the dross when it is shoveled into the furnaces and skimmed from the kettles.

It is blown from the piles and barrels of junk and waste which are scattered about the room. It accumulates upon the floor. Aside from the simple means of ventilation described above no special precautions are taken by the management to protect the workmen against the dangers of lead poisoning, except to advise them to find other work when they have become "leaded" and to discharge them if they refuse or fail to do so.

METALLIC LEAD.

The porter of the death-certificate classification (case No. 50) was traced to a factory where for 18 years he had operated a lead-pipe machine and at intervals had polished shot with black lead. Melted lead here flowed from a kettle overhead and was conducted through an open cylinder to the pipe machine or press through which the lead was forced under great pressure in the making of ordinary lead pipe. The man in operating the press stood directly over the molten lead and also breathed the dust which arose as the dross, when skimmed from the surface of the melted lead in the high kettle, was thrown into a barrel on the floor. The polishing of shot was particularly dusty on account of the use of graphite, small particles of which are so light that they rise and float through the air upon the slightest disturbance.

STORAGE BATTERIES.

Two of the fatal cases under the classification of laborers were workers in an electrical accumulator or storage-battery plant. Each was only 30 years of age. One had been in this country four years and had worked less than a year with the lead; the other had been in the United States seven years and had worked with lead less than four months. They were both day laborers engaged in the sawing and the handling of lead plates which are used in the manufacture of storage batteries.

A physician who has practiced near this plant during the past eight years stated that he met with cases of both acute and chronic lead poisoning almost every week. All of the cases were from the one establishment. According to this physician, the men who handle the lead used in manufacturing these storage batteries, as a rule, have symptoms of lead poisoning within 30 days after they begin working in the plant. "When a man here has lead colic he is usually incapacitated for two or three weeks," stated the physician. "If he takes proper care of himself, and if he takes the right kind of medicine, he soon regains his health, providing he takes up some other occupation." The cost of each attack in these earlier stages is usually about \$15 to \$25 for medical attendance and about \$45 loss in wages.

This industry furnishes a striking illustration of what can be accomplished for the workers in some occupations by proper sanitary precautions. The establishment mentioned above burned down several months ago, and a new building with modern equipment and sanitary safeguards has taken its place. "Since the advent of the new building I have had no cases of lead colic," now states the same physician.

TYPESETTING AND STEREOTYPING.

Four of the 60 deaths actually reported were in the printing trade. One (case No. 27) was a job printer doing all of the different parts of the usual work of a job office, including the setting of type by hand; the second (case No. 7) was a printer who had charge of melting the metal and molding the type plates for the presses of one of the great metropolitan dailies; a third (case No. 35) worked for 12 years as a hand compositor and for 18 years as a linotype operator on another big newspaper; and a fourth (case No. 56) was a hand compositor in a book-publishing plant.

RUBBER-TOY MANUFACTURE.

One fatal case of lead poisoning among those classed as laborers was reported from a factory which manufactures rubber toys and rubber balls for children. This man (case No. 41) had been employed for about 18 years in various branches of the work. The manufacturer reports that the form of lead used in their compound is "sublimed white lead, basic lead sulphate."

TINSMITHING.

One of the deaths reported as due to lead poisoning (case No. 29) was that of a tinsmith only 18 years of age. The poisoning was reported by the physician as of 10 weeks' duration, and the young man was under medical attendance during the final 6 weeks.

CONJUGAL CONDITION, SEX, AGE, AND NATIVITY OF WORKERS.

Of these 60 people who lost their lives as a direct or indirect result of working with lead, 48 were married, 9 were single, and 3 were widowers. Only one (case No. 33) was a woman. The average age was 44½ years. The youngest of the 60 sufferers from lead poisoning was 18 years of age. Thirty-four were born in the United States, and 18 of these in New York; 6 were born in Germany, 4 in Ireland, 4 in Russia, 3 in Sweden, 2 in England, 2 in Norway, 2 in Austria, 1 in Scotland, 1 in Italy, and 1 in Switzerland. In some of the most dangerous processes, particularly where the work is unskilled, as in the storage battery plant, the men are often immigrants and ignorant

of the peculiar dangers involved. Moreover, in these instances the workers are often reluctant, on account of prejudices, to consult a physician until they become thoroughly leaded and obliged to give up work.

RATIO OF DEATHS TO TOTAL NUMBER OF CASES OF LEAD POISONING.

Thirty-seven of the 60 deaths actually reported occurred in New York City. Twenty-four of the 37 were hospital cases. Four hospitals had 2 cases each and 18 hospitals had only 1 fatal case each during the two years 1909 and 1910. One of these hospitals, which had only 3 fatal cases during a period of seven and one-half years, from January, 1904, to June, 1911, recorded during that period 59 serious cases of industrial lead poisoning. Twenty-eight of these were painters, 13 were either lead workers or employees in white-lead factories, 7 worked in paint factories, 2 were plumbers, 3 were effectually disguised under the title of "laborer," and there was one representative of each of the following occupations: Boiler maker, engraver, farmer, glazier, machinist, and wall-paper maker.

CASES OF LEAD POISONING RECORDED AT ONE NEW YORK HOSPITAL, JANUARY, 1904, TO JUNE, 1911.

Occupation.	Number of cases for the year—								Total.	Length of time exposed to lead (when reported).	Average age.
	1904	1905	1906	1907	1908	1909	1910	1911			
Painters (comprising house painters, carriage and sign painters).	4	5	.....	3	2	6	5	3	28	2½ weeks; 2 months; 8 years; 2 weeks; 2 months; 20 years; 26 years; 7 years; 22 years; 8 months; 1 year; 22 years; 40 years.	35
White-lead workers and lead-factory workers.	4	1	2	.....	2	2	2	.....	13	1 month; 4 years; several months; 6 years; 3 months; 4 years; 8 years; 5 months.	32
Paint-factory workers.	.....	1	1	2	2	1	.....	.....	7	8 weeks; 3 weeks; 1½ years; 6 weeks.	28
Plumbers.....	.....	2	.....	.....	.....	.....	.....	.....	2	.....	40
Miscellaneous (including 1 each of boiler makers, engravers, farmers, glaziers, machinists, wall-paper factory hands, and 3 laborers).	.....	1	.....	.....	1	2	5	.....	9	10 years; 20 years; 10 months; 6 years.	35
Total.....	8	10	3	5	7	11	12	3	59	.....	34

Without systematic reports from physicians it is impossible to determine even roughly the ratio between the number of deaths and the total number of cases of industrial lead poisoning. The Workmen's Sick and Death Benefit Fund of the United States, a small organization founded in 1884 by German refugees and still with less than 40,000 male members of all occupations, has paid in sick benefits on account of lead poisoning an average of \$661.33 per year during the past 12 years, with an average of about 26 cases a year.

The records do not indicate the total number of workers with lead in the organization, but the average number admitted per year of "painters, paper hangers, and varnishers" during the last 4 years is only 87.

CONCLUSION.

The need of special precautions for the protection of those who work with lead in our industries is apparent. Workmen should be informed concerning the peculiar risks they run, and they should be taught how to avoid unnecessary dangers. Employers should be informed of the most practicable devices for minimizing the dangers of industrial lead poisoning. Although it is not yet practicable in many kinds of work where lead is now used to prohibit absolutely its use, no effort should be spared to discover and use less harmful substitutes. Here again European experience points the way. American industries now using deadly poisons should be made at least as safe as are the same industries in any other country. It is not sufficient to inquire why workingmen do not leave such dangerous employments. The inertia which drags upon one in a position just sufficient to support a family, and the dread of being without a job under such circumstances, must be reckoned with. "I know the poison is in my system," said one young man. "I am holding this job at \$15 a week that killed my brother at the age of 39. I wouldn't stay here a week if I had anything else in sight. But what can a workman do? I have a family to take care of, and a laboring man nowadays can't throw up his position and go and take some one else by the arm and say 'I want a new job.'"

STATISTICAL SUMMARY.

The following table presents in chronological order the recorded deaths from occupational lead poisoning in the State of New York during the years 1909 and 1910, together with the birthplace, conjugal condition, age, occupation, and recorded cause of death:

DEATHS FROM OCCUPATIONAL LEAD POISONING REPORTED IN NEW YORK STATE, 1909 AND 1910.

[Data drawn from official certificates of death.]

Case No.	Residence.	Birthplace.	Con-jugal con-dition.	Date of death.	Age.	Occupation.	Cause of death.
				1909			
1	New York City..	Russia.....	M.	Jan. 26	46	Painter.....	Acute gastroenteritis; chronic lead poisoning.
2	.....do	New York....	M.	Feb. 10	39	.....do.....	Chronic interstitial nephritis; chronic lead poisoning; uremia.
3	Brooklyn.....	Russia.....	M.	Mar. 6	42	.....do.....	Chronic plumbism; chronic alcoholism; chronic bronchitis and inanition; pulmonary tuberculosis.

DEATHS FROM OCCUPATIONAL LEAD POISONING REPORTED IN NEW YORK STATE, 1909 AND 1910—Continued.

Case No.	Residence.	Birthplace.	Con- ju- gal con- di- tion.	Date of death.	Age.	Occupation.	Cause of death.
4	Hadley.....	New York....	M.	1909 Apr. 19	40	Painter.....	Acute gastritis, alcoholism, and plumbism (weeps) (11 days).
5	Bronx.....	.....do.....	M.	May 1	34	Merchant....	Convulsions; acute exacer- bation of chronic plumb- ism.
6	New York City..	Norway.....	M.	May 11	26	Painter.....	Respiratory paralysis and cardiac failure, due to lead poisoning.
7	Brooklyn.....	Pennsylvania.	M.	May 12	49	Printer.....	Occupational lead poisoning (cerebral type); patient also had pulmonary tuber- culosis; this, however, did not cause death.
8	Depew.....	Austria.....	S.	May 13	30	Laborer.....	Lead colic (about 30 days).
9	.....do.....	Russia.....	M.	May 20	30	.....do.....	Consumption; chronic lead poisoning.
10	New York City..	Delaware.....	M.	May 24	48	Painter.....	Lead palsy (10 months); uræmic convulsions.
11	Brooklyn.....	United States.	M.	May 25	45	Laborer.....	Saturnine toxæmia; cardiac asthenia; heart failure.
12	Queens.....	New Jersey..	M.	June 10	59	Molder.....	Chronic gastritis; chronic lead poisoning.
13	Auburn.....	New York....	M.	June 14	53	Laborer.....	Cardiac valvular disease and Bright's (2 years 11 months); lead poisoning from his occupation.
14	Buffalo.....	England.....	M.	July 10	60	Painter.....	Heart disease; painter's cramps.
15	South Schroon...	New York....	M.	July 12	49	Laborer.....	Heart failure, caused by nervous exhaustion; lead poisoning from paint.
16	Buffalo.....	Germany.....	M.	.....do.....	45	Painter.....	Lead intoxication; Bright's disease.
17	New York City..	Italy.....	M.	July 17	38	.....do.....	Chronic myocarditis, caused by chronic lead poisoning.
18	Bronx.....	United States.	M.	July 19	42	Salesman....	Chronic plumbism and chronic alcoholism.
19	Buffalo.....	Michigan.....	M.	Aug. 25	22	Painter.....	Chronic lead poisoning.
20	New York City..	Ireland.....	W.	Aug. 26	42	Laborer.....	Acute nephritis, secondary to plumbism, the imme- diate cause of death being œdema of lungs.
21	Brooklyn.....	United States.	S.	Sept. 4	34	Painter.....	Chronic lead poisoning; gen- eral neuritis; paralysis of heart.
22	New York City..	Germany.....	M.	Sept. 18	58	.....do.....	Chronic lead poisoning.
23	Albany.....	New York....	M.	Oct. 17	58	.....do.....	Lead anæmia; nephritis; lead poisoning.
24	Marion.....	.....do.....	M.	Nov. 11	43	Portrait painter.	Chronic lead poisoning (11 years).
25	Buffalo.....	.....do.....	W.	Nov. 12	50	Painter.....	Myocarditis; chronic lead poisoning.
26	New York City..	Ireland.....	M.	Nov. 13	40	Smelter.....	Chronic lead poisoning; lead colic.
27	Syracuse.....	New York....	M.	Nov. 14	28	Printer.....	Chronic endocarditis (120 days); secondary anæmia due to plumbism (one- third year).
28	Brooklyn.....	.....do.....	M.	Nov. 20	54	Painter.....	Asthenia; hemiplegia; cere- britis hemorrhagica; arte- riosclerosis; chronic lead poisoning.
29	Buffalo.....	.....do.....	S.	Nov. 23	18	Tinsmith...	Chronic lead poisoning (10 weeks).
30	Brooklyn.....	United States.	S.	Nov. 29	44	Painter.....	Chronic lead poisoning.
31	Hornell.....	New York....	M.	Dec. 9	44	.....do.....	Cerebral hemorrhage; pa- ralysis from lead poison- ing.
32	Syracuse.....	.....do.....	M.	Dec. 10	54	.....do.....	Uræmia (5 days); acute ex- acerbation of chronic lead poisoning and chronic ne- phritis; arteriosclerosis (100 days).

DEATHS FROM OCCUPATIONAL LEAD POISONING REPORTED IN NEW YORK STATE, 1909 AND 1910—Concluded.

Case No.	Residence.	Birthplace.	Con- ju- gal con- di- tion.	Date of death.	Age.	Occupation.	Cause of death.
33	Troy.....	New York....	M.	1909 Dec. 17	39	Brush drawer	Chronic poisoning from lead and tobacco (about 8 months); valvular heart disease (12 years).
34	Brooklyn.....	United States.	M.	Dec. 22	67	Painter.....	Gastric carcinoma; cardiac asthenia, following chronic plumbism.
35	New York City..	.....do.....	M.	1910 Jan. 21	49	Compositor.	Cerebral hemorrhage (chronic lead poisoning); albuminuria.
36	Rochester.....	Ohio.....	M.	Jan. 29	48	Machinist...	Chronic lead poisoning; paralysis.
37	New York City..	Switzerland...	M.	Mar. 2	68	Painter.....	Chronic lead poisoning; chronic nephritis; uræmia.
38	Brooklyn.....	United States.	M.	Mar. 11	36	.....do.....	Nephritis, complicating a lead colic.
39	New York City..	Ireland.....	M.	Mar. 19	45	Laborer.....	Chronic interstitial nephritis; chronic lead poisoning; congestion of the liver.
40	White Plains....	Scotland.....	S.	.....do.....	30	Painter.....	Painter's colic (1½ days).
41	Matteawan.....	New York....	M.	Mar. 27	44	Laborer.....	Edema, due to chronic lead poisoning.
42	Brooklyn.....	Sweden.....	M.	Apr. 2	45	Painter.....	Myocarditis; acute endocarditis; chronic lead poisoning.
43	Cobleskill.....	New York....	M.	Apr. 6	59	.....do.....	Apoplexy; chronic lead poisoning.
44	New York City..	Russia.....	M.	Apr. 21	34	.....do.....	Chronic lead poisoning; myocarditis.
45	.....do.....	Germany.....	M.	Apr. 26	44	.....do.....	Chronic lead palsy; nephritis; acute bronchitis.
46	Hobart.....	New York....	M.	May 2	62	Painter and paper hang- er.	Lead colic (died in 15 minutes); anæmia.
47	Brooklyn.....	Austria.....	M.	July 1	43	Painter.....	Chronic lead poisoning; arteriosclerosis and valvular heart disease.
48	New York City..	Norway.....	M.	July 8	65	.....do.....	Chronic diffuse myelitis; chronic plumbism.
49	Brocton.....	Sweden.....	M.	July 11	61	Painter and decorator.	Ulcerative gastroenteritis; paint poisoning.
50	Brooklyn.....	Ireland.....	M.	July 18	39	Porter.....	Paralysis of respiration, due to chronic lead poisoning, with cerebral disturbances.
51	.....do.....	Germany.....	W.	July 19	55	Painter.....	Acute diffuse nephritis, following plumbism.
52	New York City..	England.....	S.	Aug. 7	22	.....do.....	Chronic plumbism; acute endocarditis.
53	.....do.....	Germany.....	S.	Sept. 22	55	Glazier.....	Acute uræmia; chronic lead poisoning; chronic nephritis.
54	Brooklyn.....	United States.	M.	Sept. 26	38	Painter.....	Cardiac failure, from lead poisoning.
55	Queens.....	Germany.....	M.	Oct. 5	41	.....do.....	Lead poisoning; chronic nephritis.
56	Brooklyn.....	United States.	M.	Oct. 10	64	Compositor.	Cardiac asthma; chronic lead poisoning.
57	Richmond.....	.....do.....	M.	Oct. 22	51	Cooper.....	Intestinal hemorrhage, following lead poisoning.
58	Tonawanda.....	New York....	S.	Nov. 23	26	Merchant...	Lead poison; sifted white lead in a factory; dust of lead poisoned him.
59	Brooklyn.....	United States.	S.	Nov. 28	42	Painter.....	Painter's colic; lead poisoning; acute, fibrinous pleurisy, et acute pericarditis.
60	.....do.....	Sweden.....	M.	Dec. 5	40	.....do.....	Cirrhosis of the liver; chronic lead poisoning.

STUDY OF INDIVIDUAL CASES OF DEATH FROM LEAD POISONING.

In the following pages a more detailed account is given of each of these cases of lead poisoning. The facts were secured by means of careful inquiries from the family and friends and at the former place of work of the deceased. By such inquiries many additional particulars were secured which were important as throwing light on the relation between occupation and cause of death.

Case No. 1.—J—— D—— K—— died at the age of 46 on January 26, 1909, of "acute gastroenteritis and chronic lead poisoning." He was a house painter by trade, doing inside work. According to the history given by the physician who attended him, he had cramps in his stomach during several months, an ashy color in his face, and the characteristic blue line about the gums. He worked at this trade only 11 months. Then he suffered an acute attack of gastroenteritis, which terminated fatally at the end of the second day. In spite of physical suffering he lost only 2 days from his work, at which he earned from \$15 to \$18 per week.

Case No. 2.—A—— W—— died at the age of 39 on February 10, 1909, of "chronic interstitial nephritis, chronic lead poisoning, and uræmia." As a painter his special work was that of a letterer and striper, and he had worked at this trade in various car shops since he was 11 years old. He was a tall vigorous man weighing 186 pounds. His wage was \$2.60 per day, and he worked steadily until he entered the hospital 8 days before his death. The widow, with her three children, is now janitress of an apartment house, and says with some pride that they have never been any expense to the State.

The medical history of this case is unusually complete. The patient, according to the hospital records, lived in New York City all his life under fair hygienic conditions. He had always worked as a painter, and worked all day long in a shop. His appetite was good, he slept well, and until shortly before his death he had never had lead colic. He was temperate in his habits but now and then drank a little beer. Two weeks before entering the hospital he began to be very constipated. He noticed that the 10 minutes' walk which he took to work each morning made him "all in," and he felt "short of breath when he arrived at the 'L' stairs." He then began to have a feeling of tightness and drawing in the abdomen, which lasted for about 2 days. No real colic but continual "drawing pain." He then drank a bottle of olive oil with marked results. Pain in the abdomen ceased. He went to the dispensary for treatment. During the last 2 weeks he felt that his left eye was somewhat weaker than the right. He felt better under dispensary treatment, but was ad-

vised to go into the hospital for a week. He then had no weakness of wrists or ankles and no abdominal pains or headache.

Physical-examination record on February 2 indicated a fairly well-nourished man, though distinctly anæmic and with the appearance of one chronically ill. The teeth were in very poor condition, with gums slightly bluish at teeth margins. On February 4 urine examination was negative, but blood showed marked anæmia. During the next few days, which were his last, he was delirious a good deal of the time. An autopsy was granted and the anatomical diagnosis was as follows: "Chronic interstitial nephritis, hypertrophy of left heart, dilation of right heart, broncho-pneumonia, arteriosclerosis, lead poisoning (clinical), and œdema of lungs."

Case No. 3.—A—— S—— died at the age of 42 on March 6, 1909, of "chronic plumbism, chronic alcoholism, chronic bronchitis, inanition, and pulmonary tuberculosis." He was for many years a house painter by trade, and, according to the physician, in later years he opened a paint store. "His habits as to drinking were more than moderate, but chronic plumbism was the first and most important cause of his illness and death."

Case No. 4.—A—— C—— R—— died at the age of 40 on April 19, 1909, of "acute gastritis, alcoholism, and plumbism." The acute gastritis was of 11 days' duration, while the alcoholism and plumbism was a matter of many weeks. At his trade he painted both houses and carriages, and was also a calciminer and paper hanger. He mixed his own paints wherever he worked and part of the time slept in his workshop, where the paints were mixed. He was, according to the physician, very careless in his habits, uncleanly, and addicted to the use of liquors. "At various times during the last 5 years he suffered from colic. When these attacks came on he would use a sulphuric-acid lemonade, and the attacks would subside." He never was treated regularly, but for some time before his death the characteristic blue lines were present on his gums. There were also signs of neuritis, tremors, wrist drop, marked insomnia, and inability to remain quiet. One week before his death he became delirious and paralysis progressed rapidly. "In this case," says the physician, "it is somewhat difficult to separate the alcoholic symptoms from the lead symptoms, but I do not believe the gastritis and alcoholism alone would have caused his death."

Case No. 5.—F—— T—— R—— died at the age of 54 on May 1, 1909, of "convulsions and acute exacerbation of chronic plumbism." From the time he was 21 years old he worked as a house painter, doing both outside and inside work. In later years he went into business as a contractor and as a retailer of paints, which he mixed himself. He was careless in washing his hands, and as a patient was

difficult to control, according to the physician who treated him at intervals during the last 10 years of his life. He suffered with constipation and insomnia and had the blue line on his gums. Against orders, he drank beer secretly while ill. During the last three months he had occasional abdominal cramps, with extreme weakness and constipation. His complexion was sallow and he had frequent hallucinations. During the final 2 months he had several convulsions, the last of which proved fatal.

Case No. 6.—J—— O—— died at the age of 26 on May 11, 1909, of "respiratory paralysis and cardiac failure, due to lead poisoning." He was a house painter by trade and he had worked with paint only 2 years.

Case No. 7.—J—— H—— B—— died at the age of 49 on May 12, 1909, of "occupation lead poisoning (cerebral type)." He was a printer by trade. He worked in a newspaper composing room and had charge of melting the metal and molding the type plates used on the presses. "He had," says the physician, "chronic lead poisoning with the blue line on the gums and severe pain in the abdomen. He finally developed acute mania, living only a few days from the beginning of cerebral symptoms."

Case No. 8.—J—— R—— died at the age of 30 on May 13, 1909, of "lead colic; duration about 30 days." He was a Polish day laborer in a storage-battery works, where he had been employed about 1 year. The physician reports that he had all of the characteristic symptoms of lead poisoning, such as anæmia, vomiting, constipation, blue line on the gums, etc. He was a very hard drinker, taking considerable cheap whisky each day. His urine showed albumen, due to the action of lead on his kidneys. His general condition was very bad, due both to the lead and the cheap whisky which his system had absorbed. There was cloudy swelling and fatty degeneration of the kidneys, liver, and heart, due to the poisoning by lead. He did not realize his condition until he was in a very bad state. He was under a doctor's care only 2 weeks.

Case No. 9.—A—— K—— died at the age of 30 on May 20, 1909, of "consumption and chronic lead poisoning." He was a Polish day laborer in a storage-battery works, where he had been employed about 4 months. He had been feeling poorly for 2 months. investigation showed that he was suffering from chronic lead poisoning. The urine, according to the physician's records, showed albumen, due to fatty degeneration, and cloudy swelling in the kidneys as a result of the lead he was absorbing. He had had trouble with his stomach for almost 2 months. He vomited considerably and at times suffered with constipation and again with diarrhea. He was very anæmic, due to the action of lead on his blood corpuscles

and on his general system. He began to cough and to have fever and developed tuberculosis, from which he died. He was under the physician's care during only 10 days.

Case No. 10.—W—— H—— D—— died at the age of 48 on May 24, 1909, of "lead palsy (10 months) and uræmic convulsions." He was a carriage painter by trade. Fifteen years before he died he was first afflicted by the lead. He suffered most when sandpapering white work on wagons. "He went through all the stages of lead poisoning," declares the physician, "lead colic, wrist-drop, atrophy of the deltoid and extensors, chronic nephritis, and uræmia."

Case No. 11.—F—— L—— died at the age of 45 on May 25, 1909, of "saturnine toxæmia, cardiac asthenia, and heart failure." In his younger years he had worked in a white-lead factory and later as a painter. Then for 8 years he was a barkeeper. The last 2 years he worked at window cleaning. He drank pretty heavily of whisky and beer in earlier years. "Since he worked in three occupations very prone to lead poisoning," says the physician, "we can not tell which is to be blamed most for his condition. Barkeepers often take beer or ale early in the morning which has been in the pipe all night. The lead pipe sometimes loses its tin lining, the carbonic acid dissolving the lead."

During the last few years he had wrist-drop and his head would also drop forward. In late years he no longer suffered with colic but was anæmic.

Case No. 12.—D—— W—— B—— died at the age of 59 on June 10, 1909, of "chronic gastritis and chronic lead poisoning." According to the physician who treated him during the last 4 months he suffered the usual colicky pains and had a pronounced blue line on the gums. He was a bench molder.

Case No. 13.—W—— A—— M—— died at the age of 53 on June 14, 1909, of "cardiac valvular and Bright's disease (2 years and 11 months) and lead poisoning from his occupation." The physician who attended him during the last 3 years of his life reports that he worked for 16 years as a packer of machine parts, and that the parts of machinery were usually wet with lead paint.

Case No. 14.—J—— H—— F—— died at the age of 60 on July 10, 1909, of "heart disease and painter's cramps." He had lived in the United States 25 years and was a painter by trade, making a specialty of interior decoration.

Case No. 15.—A—— W—— died at the age of 49 on July 12, 1909, of "heart failure, caused by nervous exhaustion, and lead poisoning from paint." He had been engaged in painting some buildings shortly before his death and had kept at the work for days after he was completely exhausted, by "whipping up his strength with light stimulants."

Case No. 16.—R—— B—— died at the age of 45 on July 12, 1909, of "lead intoxication and Bright's disease." He was a painter by trade and for 20 years painted freight cars in a building constructed for that purpose by the railroad company. His wage was \$2.50 per day. "He suffered 10 months and he suffered awful hard," says the widow. The physician who attended him during the last four months has lost his records, but remembers the case as one of arteriosclerosis due to lead poisoning.

Case No. 17.—D—— R—— died at the age of 38 on July 17, 1909, of "chronic myocarditis caused by chronic lead poisoning." He was a painter by trade, living in a tenement on the lower East Side since coming to this country from Italy three years before his death.

Case No. 18.—W—— N—— died at the age of 42 on July 19, 1909, of "chronic plumbism and chronic alcoholism." He was a paint mixer by trade. During the last 10 years he had been a heavy drinker of whisky and beer and he smoked or chewed tobacco constantly. He suffered much with lead colic, and beginning about one year before his admission to the hospital he had muscular tremors of the extremities. During the 2 months before his death he lost control of his limbs. During the last 3 weeks he appeared to be awake continuously whereas previously he had continuously slept.

Case No. 19.—R—— C—— died at the age of 22 on August 25, 1909, of "chronic lead poisoning." He had worked as a house painter since he was 13 years old, doing fine frescoing and interior work on houses and churches in addition to exterior painting. He had also painted signs on glass windows. He usually mixed his own paints, and was doing exterior work on houses immediately before his last illness. He was admitted to the hospital on August 2, 23 days before his death, with colicky pains in the abdomen, and constipation. His family history so far as his sickness was concerned was negative. His personal history showed that he had never been sick before, apart from similar attacks less severe in nature covering a period of several years. His habits were moderate regarding the use of drink and tobacco. He entered the hospital with the diagnosis of intestinal obstruction, but under treatment for lead poisoning improved and was discharged. He returned in a few days suffering from a recurrence of the trouble. Examination showed the presence of wrist drop, blue lines around the gums, and some rigidity of abdominal muscles. His condition became gradually worse.

Case No. 20.—M—— W—— died at the age of 42 on August 26, 1909, of "acute nephritis secondary to plumbism, the immediate cause of death being oedema of the lungs." The death certificate reports him as a laborer. On the hospital records his occupation is given as metal worker, and investigation discloses the fact that he

attended the smelting pot in a lead smelting and refining plant. The records of the manufacturing company show that he worked at the smelter from February, 1900, to August, 1903, and from May, 1904, to July, 1909, at an average wage of \$16 a week. Nothing more definite can now be obtained. He entered the hospital August 24.

Case No. 21.—J—— C—— died at the age of 34 on September 4, 1909, of "chronic lead poisoning, general neuritis, and paralysis of the heart." He had been a house painter by trade for 15 years, doing both exterior and interior work. He was careless in habits of cleanliness and a moderate drinker but a steady worker. He was under treatment for lead poisoning during the last 9 months of his life and was unable to work during the last 3.

Case No. 22.—A—— O—— died at the age of 58 on September 18, 1909, of "chronic lead poisoning." He was a house painter by trade. He arrived at the hospital in a semicomatose condition and died 4 days later. He was a member of the painters' union, and through the Arbeiter Kranken und Sterbe Kasse funeral benefits were paid to the amount of \$250.

Case No. 23.—D—— R—— M—— died at the age of 58 on October 17, 1909, of "lead anæmia, nephritis, and lead poisoning." He was a house painter by trade, working on exteriors. He had worked at painting nearly all of his life, but was incapacitated by lead poisoning during the last 15 months, during which time only one person, a daughter, was able to earn a meager support for the family.

Case No. 24.—E—— E—— S—— died at the age of 43 on November 11, 1909, of "chronic lead poisoning (11 years' duration)." He attended school until 17 years old and was then "brought up to the business of drilling and operating oil wells, interspersed with intervals of portrait painting." In 1898 he established a studio in large, well-ventilated rooms and confined himself very closely to the work of portrait painting. He used lead in various forms in his painting, and in considerable quantities. He could not be induced to take much exercise. After a few years he appeared unable to do his work satisfactorily or to be certain in regard to its correctness. Then he suffered from dizziness, and during one year (1901) walked like a drunken man. "He could not walk between the rails on the railroad track without staggering out from between them." During the following year he improved and worked for a time on a fruit farm, but a chronic diarrhea, which nothing relieved for any length of time, combined with the effects of lead poisoning to lower his vitality.

The physician who attended him during the last 3 years states that he complained of being easily fatigued and that he was unable to concentrate his mind on anything. His gums, especially the

lower, were slightly darkened. He developed both wrist-drop and ankle-drop. At times he was mentally deranged. "He was an exceptionally well-informed, cleanly, gentlemanly man of Puritan descent, with no vices. It was," adds the physician, "a plain case of chronic lead poisoning."

Case No. 25.—J—— L—— died at the age of 50 on November 12, 1909, of "myocarditis and chronic lead poisoning." He was a painter by trade and had been under medical treatment for 5 years.

Case No. 26.—R—— H—— died at the age of 40 on November 13, 1909, of "chronic lead poisoning and lead colic." He worked from April 18, 1906, until November 12, 1909, the time of his death, in a lead smelting and refining works. As a furnace helper he carried molten lead from the furnace to the molds. His average wage, according to the statement of his employers, was \$14 a week. "He lost no time on account of sickness," states the superintendent. "He went quick."

Case No. 27.—F—— V—— B—— died at the age of 28 on November 14, 1909, of "chronic endocarditis (120 days) and secondary anæmia due to plumbism (one-third year)." He was a job printer by trade, doing all of the different kinds of work usually done in a job office, such as setting type, imposing, etc. The attending physician reports that there was a gradual onset of illness during 1 year previous to his death. The symptoms were progressive weakness, emaciation, and abdominal pain, and the medical attendant ascribes as the direct cause "eating luncheon without washing the hands carefully."

Case No. 28.—H—— F—— E—— died at the age of 54 on November 20, 1909, of "asthenia, hemiplegia, cerebritis hemorrhagica, arteriosclerosis, and chronic lead poisoning." He was an interior decorator and house painter by trade. He was not an excessive drinker of alcoholic liquors. He had been ailing for about 6 weeks previous to his death, but he had suffered attacks of lead colic some years earlier. He had worked spasmodically during the last 2 years, the irregularity being due to lack of work sometimes, but often to physical inability.

Case No. 29.—W—— R—— died at the age of 18 on November 23, 1909, of "chronic lead poisoning (10 weeks' duration)." He was a tinsmith by trade and was under medical care during the six weeks immediately before his death. He graduated from the public schools, a big, strong boy, weighing 165 pounds, and went to work in a factory making tin cans, pails, etc. The ventilation was poor, and the room was kept very warm in order that the solder might be kept as thin as possible. He worked 6 months with no noticeable ill effects. Then he grew pale and lost weight and showed symptoms of lead poisoning. At the end of the second half year he was

obliged to stop work and lived only 5 months more. Although he had other symptoms of lead poisoning he did not suffer with cramps until shortly before his death.

Case No. 30.—J—— H—— D—— died at the age of 44 on November 29, 1909, of "chronic lead poisoning." He worked both as an outside painter and as an interior decorator up to within a few weeks of his death. He was under special medical care during the last 4 weeks. The history of lead poisoning, however, extends over a period of 3 years. According to his physician the symptoms were multiple neuritis, the blue line on the gums, progressive loss of strength and weight, and general arteriosclerosis, the kidneys sharing in the last-named change. "The occupation," says the physician, "was directly causative, and the loss of earning capacity complete for the whole period. A fellow workman generously cared for him."

Case No. 31.—C—— H—— C—— died at the age of 44 on December 9, 1909, of "cerebral hemorrhage and paralysis from lead poisoning." He was a painter by trade, and was attended by a physician during the last 6 weeks of his life.

Case No. 32.—F—— K—— died at the age of 54 on December 10, 1909, of "uræmia (duration 5 days) and acute exacerbation of chronic nephritis, arteriosclerosis, and chronic lead poisoning (duration 100 days)." He was a house painter by trade, doing mostly outside work. He was well up to 7 years before his death when he had an attack of painter's colic. He drank beer, sometimes to excess, though not often. On October 9, 1909, he reported to the physician that his feet had been swollen during the day for the past 2 weeks, but that he kept at his work. He then had severe cramps in his abdomen. Diagnosis, painter's colic. Toward the end of the month the patient suffered severe pains in his shoulders, knees, and ankles. He lost flesh, became weaker, and on December 5 he developed uræmic symptoms and died 5 days later.

Case No. 33.—L—— A—— S—— died at the age of 39 on December 17, 1909, of "chronic poisoning from lead and tobacco (duration about 8 months) and valvular heart disease (duration 12 years)." She worked 8 years as a brush drawer. "After working about one year and a half," according to her physician, "she began to show symptoms of lead poisoning." In making the brushes, pads were usually painted with a white enamel (white lead) coating and then "drawn" with white bristles.

Case No. 34.—C—— G—— died at the age of 67 on December 22, 1909, of "gastric carcinoma and cardiac asthenia, following chronic plumbism." He was a painter by trade and had always enjoyed good health until about 9 months before his death. He then showed the usual symptoms of chronic lead poisoning, and complained of continual pain in his legs and arms. According to the

physician the principal cause of death was the gastric carcinoma preceded by pernicious anæmia and general breakdown due to lead poisoning.

Case No. 35.—J—— J—— G—— died at the age of 49 on January 21, 1910, of "cerebral hemorrhage, chronic lead poisoning, and albuminuria." For the past 30 years he had been employed as a printer, working as a compositor on one of the New York City papers. Eleven years ago he was compelled to give up his work for a short time on account of lead colic. Three and five years later he had similar attacks and with the last he had a slight paralysis of his left arm. In October, 1901, he lost 3 days from his work as well as 2 weeks in December, and all of the months of January and February, and 3 weeks in March, 1902. He earned, when at work, as shown by the assessment books of the typographical union, \$24 a week.

His father, mother, and brothers were always healthy, and, except for the ordinary diseases of childhood, he had spent a remarkably healthy life until the time when his trade began to show its effects upon his health. He smoked moderately and drank only occasionally. In recent years he became subject, at irregular intervals, to attacks of dizziness and headaches, and was advised by his physician to get other employment.

On January 19, 1910, according to the hospital records, he was suddenly taken with an apoplectic seizure and hurried to the hospital in deep coma. Examination showed paralysis, very high blood pressure, hardened arteries, Bright's disease, and granular degeneration of his red blood corpuscles (a condition typical of lead poisoning). He lived only 2 days.

Case No. 36.—B—— F—— S—— died at the age of 48 on January 29, 1910, of "chronic lead poisoning and paralysis."

Case No. 37.—F—— S—— died at the age of 68 on March 2, 1910, of "chronic lead poisoning, chronic nephritis, and uræmia." He was a house painter by trade, working principally on interior work from the time he was 14 years of age until just before he died. He mixed his own paints. During the last 4 months, according to the statement of his family, he finished bathrooms and closets in white enamel at one of the large apartment houses. He felt dizzy after working in such confined spaces. He suffered with constipation and had trouble also with his ankles. "Like most patients of his class," says the physician, "he did not attribute his trouble to his occupation, but I did. He had also suffered from time to time with severe intestinal pains (lead colic)."

Case No. 38.—J—— F—— died at the age of 36 on March 11, 1910, of "nephritis, complicating a lead colic." He was a painter by trade.

Case No. 39.—T—— S—— died at the age of 45 on March 19, 1910, of "chronic interstitial nephritis, chronic lead poisoning, and congestion of the liver." He was recorded on the death certificate as a laborer. For 12 years he worked in a lead smelting and refining works. From April, 1902, until November 7, 1903, he received an average wage of \$14 a week. Six years before his death he was obliged to give up all work. He had lead poisoning 15 years before his death, according to the hospital records, and suffered partial paralysis of one wrist. The hospital diagnosis was as follows: "Chronic lead poisoning, aortic stenosis, and hypertrophy of liver." He was a moderate drinker and smoker.

Case No. 40.—R—— C—— died at the age of 30 on March 19, 1910, of "painter's colic (1½ days' duration)." He wandered into the village looking for work as a painter only 2 days before his death at the local hospital. As he was partly unconscious no satisfactory history could be secured, but he was suffering with severe symptoms of lead poisoning.

Case No. 41.—F—— C—— died at the age of 44 on March 27, 1910, of "œdema, due to chronic lead poisoning." The coroner's records are no more explicit in this case, but the vice president of the rubber company for which he worked states that C—— when 26 years old began work there at 75 cents a day as a packer of rubber balls. Later he received from \$1.75 to \$2.50 per day of 9 or 10 hours when he worked on a drill which bores holes in the balls, and finally in the heater room where rubber balls and toys are cured. "He never worked on the grinders where the compounds are made, and never in any department where there was danger," declared the company official, who immediately added, "He didn't take good care of himself anyway."

Case No. 42.—J—— W—— died at the age of 45 on April 2, 1910, of "myocarditis, acute endocarditis, and chronic lead poisoning." He had always worked as a painter. He used alcohol and tobacco sparingly and admitted that he was not very careful about cleanliness of finger nails at meals or about care of teeth and mouth. Five years previous to his final illness he had a similar attack, which lasted for 4 months. His last illness began, about 3 months before his death, with pain in his right knee and ankle, which at times compelled him to remain at home. Six weeks later the pain in right knee became so bad that he was obliged to spend a week in bed, and after another month he entered the hospital. Upon examination he was found to be pale and sallow looking, markedly anæmic, and with the blue lead line present along the edge of the gums.

Case No. 43.—J—— B—— died at the age of 59 on April 6, 1910, of "apoplexy and chronic lead poisoning." At times he had painted houses and worked as a paper hanger, but he had worked for

13 years as a painter for a company which manufactures treadmills. "In this painting," says the physician, "he would dip his arms up to the elbows in the paint solution all day long. He used to get dizzy and faint and drop over wherever he was. It took four men to hold him when he got these spells, and he would yell at the top of his voice. At such times he would vomit very hard. He had pronounced wrist-drop. He worked part of the time during the last year, but paralysis affected his right side so that he could not use his right arm and could only drag his right foot along."

Case No. 44.—S—— C—— died at the age of 34 on April 21, 1910, of "chronic lead poisoning and myocarditis." He was a painter by trade and had had several previous attacks of lead colic. Suddenly he was seized with colicky pain in the abdomen while at work and died within 1 day after admission to the hospital.

Case No. 45.—J—— M—— died at the age of 44 on April 26, 1910, of "chronic lead palsy, nephritis, and acute bronchitis." For 15 years he was a painter and careless in his habits. He was a patient in one hospital from December 31, 1909, until April 2, 1910, suffering with lead colic and neuritis, due to lead poisoning. Two months earlier he was in another hospital suffering with lead colic for 10 days. Shortly after his discharge from this institution he developed both "wrist-drop" and "foot-drop." He finally died with all of the symptoms of lead poisoning, including lead palsy, nervous irritability, and the blue line on the gums, according to the physician who treated him during the final 6 months.

Case No. 46.—W—— J—— K—— died at the age of 62 on May 2, 1910, of "lead colic (died in 15 minutes) and anæmia." For 30 years he had been a house painter and paper hanger. During the last 15 years he had been afflicted with chronic lead poisoning to such an extent that he was obliged to give up his work from time to time. According to the physician, "He suffered with anæmia and periodical attacks of colic, dying in such an attack before I could reach his bedside."

Case No. 47.—B—— A—— died at the age of 43 on July 1, 1910, of "chronic lead poisoning, arteriosclerosis, and valvular heart disease." He was a contract house painter by trade, doing both inside and outside work for 28 years. He did not use alcohol and smoked moderately. He was in early life a strong, healthy man. His father is living and well at 85 years. His mother died in childbirth at 44 years of age. He began to complain about 1 year before his death of colicky pains and constipation, and he had severe anæmia and the blue line on the gums. He suffered with intense headaches and pain in the joints and had wrist-drop and arteriosclerosis.

His earnings were from \$20 to \$35 per week. He left a family almost destitute.

Case No. 48.—O—— L—— died at the age of 65 on July 8, 1910, of "chronic diffuse myelitis and chronic plumbism." He was a house painter by trade. Eight years before his death he noticed that he could not hold his paintbrush, but secured treatment and kept up his work after a fashion for 5 years. Pain then appeared in his lower limbs, and when it ceased he became so weak he could not walk. Palsy of the right limb developed, and he complained of bowel trouble. He was naturally a strong, robust man and drank no whisky, but he drank beer in moderation and smoked a pipe.

Case No. 49.—C—— S—— N—— died at the age of 61 on July 11, 1910, of "ulcerative gastroenteritis and paint poisoning." He was a painter and decorator by trade.

Case No. 50.—L—— M—— died at the age of 39 on July 18, 1910, of "paralysis of respiration due to chronic lead poisoning, with cerebral disturbances." He worked in a lead-pipe and shot factory during the 18 years preceding his death. He carried lead in bars and also molten lead from vats to forms and operated a lead-pipe machine. He was exposed during this time to the fumes and dusts of lead, but was never until the last year incapacitated for work except from severe gastric attacks of cramps and vomiting, lasting from 12 to 24 hours. In December, 1909, however, he called in a physician in connection with an attack which lasted 1 week. The physician then warned him and told him to get other work. He resumed his old work, however, and in June, 1910, suffered an attack which continued with great severity during the month before his death. He was a temperate man in both smoking and drinking and was physically strong throughout his life.

Case No. 51.—F—— H—— died at the age of 55 on July 19, 1910, of "acute diffuse nephritis, following plumbism." He was a painter by trade.

Case No. 52.—S—— K—— died at the age of 22 on August 7, 1910, of "chronic plumbism and acute endocarditis." He had been a painter for 8 years. Three weeks before his death he experienced trouble in buttoning his shoes. One week later he entered the hospital with symptoms of lead poisoning and died there after 18 days.

Case No. 53.—J—— S—— died at the age of 55 on September 22, 1910, of "acute uræmia, chronic lead poisoning, and chronic nephritis." He had worked for two small employers for 9 years as a house painter and glazier, and previous to that had been an itinerant glazier. He was careless in the handling of white lead which he mixed with oil, zinc, and putty. Seven weeks before his death, according to the records of the hospital where he died, he developed severe symptoms of lead poisoning and was unable to walk thereafter.

Case No. 54.—T—— L—— died at the age of 38 on September 26, 1910, of "cardiac failure, from lead poisoning." Until the last 4 years of his life he was a clerk. Then he began work as a painter, handling much lead. Until this time he had never been sick, but almost immediately he was seized with abdominal cramps which lasted several days at a time. At each succeeding attack the cramps became more severe. Two weeks before his death he experienced an unusually severe attack, and a few days later, when admitted to the hospital, he carried well-marked evidences of lead poisoning, including wrist-drop and the blue line on the gums.

Case No. 55.—T—— S—— died at the age of 41 on October 5, 1910, of "lead poisoning and chronic nephritis." He was a painter by trade and according to the physician was very careless about eating with paint on his hands. On April 26, 1909, he entered a hospital and received treatment during 1 week. The most marked trouble at the time was loose teeth, an abscess and sloughing gums. He neither drank nor smoked and had no venereal disease, according to the medical history. He returned to work and about May 30, 1910, was attacked with lead colic and pain and weakness in his legs. The blue line on the gums appeared. The symptoms continued with increasing severity until his death.

Case No. 56.—C—— McW—— died at the age of 64 on October 10, 1910, of "cardiac asthma and chronic lead poisoning." For about 30 years he worked as a hand compositor on bookwork for a large printing establishment, according to the records in the corner's office. After the type is set up by hand in the printing office, and before the wax impression is made for the stereotypers' mold, black lead is dusted on the surface of the wax. Some of this black lead adheres to the type as it is distributed in the case. The hand compositor frequently shakes his case in order to bring the remaining type into the middle of the respective compartments, and the dust which arises, containing some lead, is breathed by the worker. The compositor in this instance was obliged to stop work from time to time after the seventh year before his death. In 1906 he drew \$21 in out-of-work relief, but on September 14, 1907, according to the records of the typographical union, he was placed on the local old-age pension list. He drew \$4 a week pension from the local fund from that time until August, 1908, when he was transferred to the International Typographical Union pension roll and then received \$4 a week from the international fund until his death in October, 1910. The regular \$150 death benefit was paid from the same sources.

Case No. 57.—D—— D—— died at the age of 51 on October 22, 1910, of "internal hemorrhage, following lead poisoning." For 25 years he had worked for a white-lead factory, and according to his family received \$2 a day. He suffered for a year preceding his

death, but took medicine which enabled him to continue his work. He lost only 3 days, but suffered intense pain.

The manufacturers of white lead who employed him state that he filled several positions in this factory during the 25 years, including stack hand, fireman, and cooper, and that for a time he ran a pulp mixer. As a cooper he packed the white lead in barrels and "headed up" the barrels. At this factory the lead company uses the Dutch process of corrosion, and as a stack hand he emptied the fermenting tanbark stacks (where the change from metallic lead to the white carbonate takes place) of their accumulations of dusty white lead. He therefore worked at two of the most dangerous tasks in a white-lead factory.

Case No. 58.—W—— A—— H—— died at the age of 26 on November 23, 1910, of "lead poison. Sifted white lead in a factory. Dust of lead poisoned him."

Case No. 59.—W—— G—— died at the age of 42 on November 28, 1910, of "painter's colic, lead poisoning, acute, fibrinous pleurisy, et acute pericarditis." He worked steadily as a painter during the last 6 years and previous to that "off and on" for many years. He had lead colic 2 years before his death, and several later attacks. The last attack was very severe and of 3 weeks' duration. He had the blue line on the gums, but no wrist-drop, according to the hospital records.

Case No. 60.—C—— L—— died at the age of 40 on December 5, 1910, of "cirrhosis of the liver and chronic lead poisoning." He had always worked as a painter and his illness according to the medical history dates back about 15 years, beginning with abdominal pain, soreness of gums, headache, and constipation. These symptoms persisted with periods of improvement under medical treatment and subsequent relapse when he returned to work. The final attack was of 6 weeks' duration.

LAWS ENACTED DURING 1911 REQUIRING THE REPORT OF OCCUPATIONAL DISEASES.

During the legislative sessions of the present year, largely through the efforts of the American Association for Labor Legislation, bills requiring reports by physicians of all cases of occupational diseases occurring in their practice were introduced in the legislatures of eight States: California, Connecticut, Illinois, Michigan, Minnesota, New York, Pennsylvania, and Wisconsin. In six of these States—California, Connecticut, Illinois, Michigan, New York, and Wisconsin—the bills were passed and became laws. In Illinois the requirement in regard to occupational disease reports is part of a general occupational disease bill. The whole of the bill is, however, reproduced in the following pages as being specially germane to the articles on lead poisoning which occupy the early part of this Bulletin.

The text of the laws above referred to concerning reports of occupational diseases is given in the following pages:

CALIFORNIA.

ACTS OF 1911.

CHAPTER 485.—*Reports of occupational diseases.*

SECTION 1. Every medical practitioner attending on or called in to visit a patient whom he believes to be suffering from lead, phosphorus, arsenic or mercury or their compounds, or from anthrax, or from compressed-air illness, contracted as a result of the nature of the patient's employment, shall send to the State board of Health a notice stating the name and full postal address and place of employment of the patient and the disease from which, in the opinion of the medical practitioner, the patient is suffering, and shall be entitled in respect of every bona fide notice sent in pursuance of this section to a fee of fifty cents, to be paid as part of the expense incurred by the State board of health in the execution of this act.

SEC. 2. If any medical practitioner, when required by this act to send a notice, willfully fails forthwith to send the same, as provided by this act, he shall be guilty of a misdemeanor, and upon conviction of the same shall be fined not more than ten dollars.

SEC. 3. It shall be the duty of the State board of health to enforce the provisions of this act, and it may call upon local boards of health and health officers for assistance and it shall be the duty of all boards and officers so called upon for such assistance to render the same. It shall furthermore be the duty of said State board of health to transmit such data to the commissioner of the bureau of labor statistics.

CONNECTICUT.

ACTS OF 1911.

CHAPTER 159.—*Reports of occupational diseases.*

SECTION 1. Every physician shall report, in writing, to the commissioner of the bureau of labor statistics, every case, occurring in his practice, of poisoning from lead, phosphorus, arsenic, or mercury, or their compounds, or of anthrax,

or of compressed air illness, contracted, in the opinion of the physician, as the result of the nature of the patient's employment. Such report shall be made by such physician within one week after his recognition of the disease, and shall state the name, post-office address, and place of employment of the patient, and the disease from which, in the opinion of the physician, the patient is suffering. For each such report the physician making the same shall receive a fee of fifty cents, to be paid by the commissioner of the bureau of labor statistics as a part of the expenses of his office.

SEC. 2. This act shall take effect September 1, 1911.

ILLINOIS.

ACTS OF 1911.

CHAPTER 250.—*Occupational diseases.*

SECTION 1. Every employer of labor in this State, engaged in carrying on any work or process which may produce any illness or disease peculiar to the work or process carried on, or which subjects the employees to the danger of illness or disease incident to such work or process, to which employees are not ordinarily exposed in other lines of employment, shall, for the protection of all employees engaged in such work or process, adopt and provide reasonable and approved devices, means or methods for the prevention of such industrial or occupational diseases as are incident to such work or process.

SEC. 2. Every employer in this State engaged in the carrying on of any process of manufacture or labor in which sugar of lead, white lead, lead chromate, litharge, red lead, arsenate of lead, or paris green are employed, used or handled, or the manufacture of brass or the smelting of lead or zinc, which processes and employments, are hereby declared to be especially dangerous to the health of the employees engaged in any process of manufacture or labor in which poisonous chemicals, minerals or other substances are used or handled by the employees therein in harmful quantities or under harmful conditions, shall provide for and place at the disposal of the employees engaged in any such process or manufacture and shall maintain in good condition and without cost to the employees, proper working clothing to be kept and used exclusively for such employees while at work, and all employees therein shall be required at all times while they are at work to use and wear such clothing; and in all processes of manufacture or labor referred to in this section which are unnecessarily productive of noxious or poisonous dusts, adequate and approved respirators shall be furnished and maintained by the employer in good condition and without cost to the employees, and such employees shall use such respirators at all times while engaged in any work necessarily productive of noxious or poisonous dusts.

SEC. 3. Every employer engaged in carrying on any process or manufacture referred to in section 2 of this act, shall, as often as once every calendar month, cause all employees who come into direct contact with the poisonous agencies or injurious processes referred to in section 2 of this act, to be examined by a competent licensed physician for the purpose of ascertaining if there exists in any employee any industrial or occupational disease or illness, or any disease or illness due or incident to the character of the work in which the employee is engaged.

SEC. 4. It is hereby made the duty of any licensed physician who shall make the physical examination of employees under the provisions of section 3 of this act, to make an immediate report thereof to the State board of health of the State of Illinois upon blanks to be furnished by said board upon request, and if no such disease or illness is found, the physician shall so report, and if any such disease is found, the report shall state the name, address, sex and age of such employee and the name of such employer, and the nature of the disease or illness with which the employee is afflicted, and the probable extent and duration thereof, and the last place of employment: *Provided*, That the failure of any such physician to receive the blanks of the State board of health for the making of such report, shall not excuse such physician from making the report as herein provided.

SEC. 5. The secretary of the State board of health shall, immediately upon receipt of any report from any physician in accordance with the provisions of section 4 of this act, transmit a copy thereof to the Illinois department of factory inspection.

SEC. 6. Every employer engaged in carrying on any process of manufacture referred to in section 2 of this act, shall provide, separate and apart from the workshop in which such employees are engaged, a dressing room and lavatory for the use of such employees who are exposed to poisonous or injurious dusts, fumes and gases, and such lavatory shall be kept and maintained in a clean and wholesome manner and provided with a sufficient number of basins or spigots, with adequate washing facilities, including hot and cold water, clean towels and soap and shower bath, and the dressing rooms shall be furnished with clothes presses or compartments, so that the ordinary street clothes of such employees shall be kept separate and apart from their working clothes.

SEC. 7. No employees shall take or be allowed to take any food or drink of any kind into any room or apartment in which any process or manufacture referred to in section 2 of this act is carried on, or in which poisonous substances or injurious or noxious fumes, dusts or gases are present as the result of such work or process being carried on in such room or apartment, and the employees shall not remain in any such room or apartment during the time allowed for meals, and suitable provision shall be made and maintained by the employer for enabling the employees to take their meals elsewhere in such place of employment, and a sufficient number of sanitary closed receptacles containing wholesome drinking water shall be provided and maintained for the use of the employees within reasonable access and without cost to them.

SEC. 8. All employers engaged in carrying on any process or manufacture referred to in section 2 of this act, shall provide and maintain adequate devices for carrying off all poisonous or injurious fumes from any furnaces which may be employed in any such process or manufacture, and shall also provide and maintain adequate facilities for carrying off all injurious dust, and the floors in any room or apartment where such work or process is carried on shall, so far as practicable, be kept and maintained in a smooth and hard condition, and no sweeping shall be permitted during working hours except where the floors in such workshop are dampened so as to prevent the raising of dust; and all ore, slag, dross and fume shall be kept in some room or apartment separate from the working rooms occupied by the employees, and where practicable, all mixing and weighing of such ore, slag, dross or fume shall be done in such separate room or apartment, and all such material shall, so far as practicable, be dampened before being handled or transported by employees.

SEC. 9. When any flues are used in any such process or manufacture referred to in section 2 of this act, and such flues are being cleaned out or emptied, the employer shall in every case provide and maintain a sufficient and adequate means or device, such as canvas bags or other practical device, or by dampening the dust, or some other sufficient method for catching and collecting the dust and preventing it from unreasonably fouling or polluting the air in which the employees are obliged to work, and, wherever practicable, the dust occasioned in any process or manufacture referred to in section 2 of this act, and any polishing or finishing therein, shall be dampened or wet down, and every reasonable precaution shall be adopted by the employer to prevent the unnecessary creation or raising of dust, and all floors shall be washed or scrubbed at least once every working day; and such parts of the work or process as are especially dangerous to the employees, on account of poisonous fumes, dusts and gases, shall, where practicable, be carried on in separate rooms and under cover of some suitable and sufficient device to remove the danger to the health of such employee, as far as may be reasonably consistent with the manufacturing process, and the fixtures and tools employed in any such process of manufacture, shall be thoroughly washed and cleaned at reasonable intervals.

SEC. 10. All hoppers or chutes or similar devices used in the course of any process or manufacture referred to in section 2 of this act shall, where practicable, be provided with a hood or covering, and an adequate and sufficient apparatus or other proper device for the purpose of drawing away from the employees noxious, poisonous or injurious dusts, and preventing the employees from coming into unnecessary contact therewith; and all conveyances or receptacles used for the transportation about or the storage in any place where any such process or manufacture referred to in section 2 of this act is carried on, shall be properly covered or dampened in such way as to protect the health of the employees, and no refuse of a dangerous character incident to the work or process carried on in any such place shall be allowed to unnecessarily accumulate on the floors thereof.

SEC. 11. It shall be the duty of the State department of factory inspection to enforce the provisions of this act and to prosecute all violations of the same

before any magistrate or any court of competent jurisdiction in this State, and for that purpose such department and its inspectors are empowered to visit and inspect at all reasonable times all places of employment covered by the provisions of this act. In the enforcement of the provisions hereof the department of factory inspection shall give proper notice in regard to any violation of this act to any employer of labor violating it, and directing the installment of any approved device, means or method reasonably necessary, in his judgment, to protect the health of the employees therein, and such notice shall be written or printed and shall be signed officially by the chief State factory inspector or the assistant chief State factory inspector, and said notice may be served by delivering the same to the person upon whom service is to be had, or by leaving at his usual place of abode or business an exact copy thereof, or by sending a copy thereof to such person by registered mail, and upon receipt of such notice calling the attention of the employer to such violation, he shall immediately comply with all the provisions of this act.

SEC. 12. If any occupational or industrial disease or illness or any disease or illness peculiar to the work or process carried on shall be found in any place of employment in this State by the inspectors of the State department of factory inspection, or called to their attention by the State board of health, which disease or illness shall be caused in whole or in part, in the opinion of the inspector, by a disregard by the employer of the provisions of this act, or a failure on the part of the employer to adopt reasonable appliances, devices, means or methods which are known to be reasonably adequate and sufficient to prevent the contraction or continuance of any such disease or illness, it shall be the duty of the department of factory inspection to immediately notify the employer in such place of employment, in the manner provided in section 12 of this act, to install adequate and approved appliances, devices, means or methods to prevent the contracting and continuance of any such disease or illness and to comply with all the provisions of this act.

SEC. 13. For the purpose of disseminating a general knowledge of the provisions of this act and of the dangers to the health of employees in any work or process covered by the provisions of this act, the employer shall post in a conspicuous place in every room or apartment in which any such work or process is carried on, appropriate notices of the known dangers to the health of any such employees arising from such work or process, and simple instructions as to any known means of avoiding, so far as possible, the injurious consequences thereof, and the chief State factory inspector shall, upon request, have prepared a notice covering the salient features of this act, and furnish a reasonable number of copies thereof to employers in this State, covered by the provisions of this act, which notice shall be posted by every such employer in a conspicuous place in every room or apartment in such place of employment. The notices required by this section shall be printed on cardboard of suitable character and the type used shall be such as to make them easily legible, and in addition to English they shall be printed in such other language or languages as may be necessary to make them intelligible to the employees.

SEC. 14. Any person, firm or corporation who shall, personally or through any agent, violate any of the provisions of this act, or who omits or fails to comply with any of its requirements, or who obstructs or interferes with any examination or investigation being made by the State department of factory inspection in accordance with the provisions of this act, or any employee who shall violate any of the provisions of this act shall be deemed guilty of a misdemeanor and on conviction thereof shall be punished for the first offense by a fine of not less than ten dollars (\$10) or more than one hundred dollars (\$100), and upon conviction of the second or subsequent offenses, shall be fined not less than fifty dollars (\$50) or more than two hundred dollars (\$200), and in each case shall stand committed until such fine and costs are paid, unless otherwise discharged by due process of law.

SEC. 15. For any injury to the health of any employee proximately caused by any willful violation of this act or willful failure to comply with any of its provisions, a right of action shall accrue to the party whose health has been so injured, for any direct damages sustained thereby; and in case of the loss of life by reason of such willful violation or willful failure as aforesaid, a right of action shall accrue to the widow of such deceased person, his lineal heirs or adopted children, or to any other person or persons who were, before such loss of life, dependent for support upon such deceased person, for a like recovery of damages for the injury sustained by reason of such loss of life, not to exceed

the sum of ten thousand dollars: *Provided*, That every such action for damages in case of death shall be commenced within one year after the death of such employee.

SEC. 16. The invalidity of any portion of this act shall not affect the validity of any other portion thereof which can be given effect without such invalid part.

Approved May 26, 1911.

MICHIGAN.

ACTS OF 1911.

CHAPTER 119.—*Reports of occupational diseases.*

SECTION 1. Every physician attending or called upon to treat a patient whom he believes to be suffering from poisoning from lead, phosphorus, arsenic or mercury, or their compounds, or from anthrax, or from compressed air illness, contracted as a result of the nature of the patient's employment, shall send to the State board of health, who shall transmit to the commissioner of labor a notice stating the name, post-office address and place of employment of the patient, the length of time of such employment, and the disease from which in the opinion of the physician, the patient is suffering.

SEC. 2. Any physician who shall fail to make any report required by the preceding section, or who shall willfully make any false statement in such report, shall be deemed guilty of a misdemeanor and on conviction thereof shall be punished by a fine of not more than fifty dollars.

SEC. 3. It shall be the duty of the commissioner of labor and of the prosecuting attorney of the county where anyone violating the provisions of this act may reside, to prosecute all violations of the provisions of this act which shall come to the knowledge of them or either of them.

Approved April 25, 1911.

NEW YORK.

ACTS OF 1911.

CHAPTER 258.—*Reports of occupational diseases.*

SECTION 1. Article four of the labor law, entitled "An act relating to labor, constituting chapter thirty-one of the consolidated laws," is amended by the addition of a new section numbered fifty-eight, to read as follows:

Section 58. Industrial poisonings to be reported. 1. Every medical practitioner attending on or called in to visit a patient whom he believes to be suffering from poisoning from lead, phosphorus, arsenic or mercury or their compounds, or from anthrax, or from compressed air illness, contracted as the result of the nature of the patient's employment, shall send to the commissioner of labor a notice stating the name and full postal address and place of employment of the patient and the disease from which, in the opinion of the medical practitioner, the patient is suffering, with such other and further information as may be required by the said commissioner.

2. If any medical practitioner, when required by this section to send a notice, fails forthwith to send the same, he shall be liable to a fine not exceeding ten dollars.

3. It shall be the duty of the commissioner of labor to enforce the provisions of this section, and he may call upon the State and local boards of health for assistance.

SEC. 2. This act shall take effect September first, nineteen hundred and eleven.

Approved June 6, 1911.

WISCONSIN.

ACTS OF 1911.

CHAPTER 252.—*Reports of occupational diseases.*

SECTION 1. There is added to the statutes a new section to read:

Section 1022-53m. 1. Every medical practitioner in this State attending on or called in to visit a patient whom he believes to be suffering from poisoning

from lead, phosphorus, arsenic or mercury or their compounds, or from compressed-air illness, contracted as a result of the nature of the patient's employment, shall send to the secretary of the State board of health and bureau of vital statistics a notice, stating the name and full postal address and place of employment of the patient and the disease from which, in the opinion of the medical practitioner, the patient is suffering.

2. If any medical practitioner fails to comply with the provisions of this section, he shall be liable to a fine not exceeding ten dollars.

3. It shall be the duty of the commissioner of labor and industrial statistics to enforce the provisions of this section, and he may call upon the State and local boards of health for assistance.

SEC. 2. This act shall take effect and be in force from and after its passage and publication.

DECISIONS OF COURTS AFFECTING LABOR.

[Except in cases of special interest, the decisions here presented are restricted to those rendered by the Federal courts and the higher courts of the States and Territories. Only material portions of such decisions are reproduced, introductory and explanatory matter being given in the words of the editor.]

DECISIONS UNDER STATUTE LAW.

ALIEN CONTRACT LABOR—VIOLATION OF STATUTE BY CORPORATION—INTENT—RESPONSIBILITY FOR ACTS OF ITS EMPLOYEES—*Grant Brothers Construction Co. v. United States, Supreme Court of Arizona, 114 Pacific Reporter, page 955.*—This was a proceeding by the United States to recover a penalty for the violation of the alien contract-labor law (34 Stat. 900) by the company named. In the district court for the first district of the Territory judgment had been awarded against the company on 45 counts, with a penalty of \$1,000 on each count, from which the defendant company appealed. The appeal resulted in the judgment of the court below being affirmed. Judge Kent, speaking for the court, said:

It is to be noted that the act is broad and comprehensive in its terms. By section 4 it is made a misdemeanor for any person or corporation in any manner whatsoever to prepay the transportation, or in any way to assist or encourage the importation or migration, of any contract laborer into the United States, unless such laborer be of the class exempt, and that by section 5 provision is made for the bringing of an action to recover a penalty against any person violating the provisions of section 4 by knowingly assisting, encouraging, or soliciting the migration or importation of any such contract laborer into the United States. In order to warrant a recovery in the action, the violation of the act must have been knowingly done by the person sought to be held responsible. Under the act it is not sufficient that the defendant sought to be charged assisted, encouraged, or solicited the importation of a contract laborer into the United States, unless such was done knowingly; but a corporation, as well as an individual, is capable of forming a guilty intent and capable of having the knowledge necessary, provided the officers of the corporation capable of voicing the will of the corporation have such knowledge or intent. This act, a statute of the United States, being penal in its consequences, must be strictly construed, and as knowledge is the principal and indispensable ingredient in the offense, the Government, the plaintiff in the case, must be held to proof of such knowledge or to proof of circumstances from which it might be fairly inferred. Unless the evidence, therefore, affords proof of knowledge by the construction company, or proof of circumstances from which

such knowledge may be fairly inferred, of the acts of Carney and his associates, the construction company can not be held liable for such illegal acts of Carney, for the master or principal is not liable criminally for the unlawful acts of his agent or servant, though such unlawful act be committed in the master's business, unless such unlawful act was directed by him or knowingly assented to or acquiesced in.

Following this there was a discussion of the degree of knowledge necessary to fix liability, and a review of the very extensive testimony offered in the case. It appears that one Cashion, a foreman of the construction company, had entered into an oral agreement with one Carney at Nogales, Ariz., to furnish the construction company laborers for its camps in Arizona, agreeing to pay a dollar each for such laborers and to meet the expense of their meals while traveling from Nogales to the camps. Some 450 workmen were procured under this agreement, a large number of them being Mexicans, about 80 of whom were from Hermosillo, Mexico, where they had been openly employed to work for Grant Bros. Construction Co., through the solicitations of one Ruppelius, with whom Carney had agreed to divide fees if he would assist in procuring workmen. Cashion testified that when he made the contract with Carney he told him that he should, under no circumstances, secure laborers by solicitation or talk on the Mexican side, and "not to go into Mexico for him or do anything in any way that would complicate us in this matter." Various other matters were considered, following which, Judge Kent said:

On this state of this long record, which we have but partially summarized, the defendants claim that, in view of the uncontradicted facts of the instructions by the Cashions to Carney not to violate the law, the evidence on the part of the plaintiff tending to show knowledge of such violation on the part of the construction company is so inadequate and meager that the verdict and judgment based thereon can not be allowed to stand. The contention of the United States, the appellee, is that the contract between the construction company and Carney was entered into by a vice principal of the appellant under such circumstances that the very conversation which resulted in and constituted the contract charged him with notice that violation of the law, as charged in the complaint, would necessarily or very probably be committed by Carney, or agents, acting by virtue of such contract; that the proof is ample to show the acquiescence of the construction company in these unlawful actions, and that it received the benefits of such unlawful actions under such circumstances that the construction company's knowledge thereof could properly be inferred, and that there is in the record such proof of the ratification of these unlawful acts; that the acquiescence in them for such a length of time and under such condition of circumstances, with the reception by the appellant of the benefits of these unlawful acts, constituted a ratification thereof.

We think that, though the fact of the instructions given by Cashion to Carney not to solicit men on the Mexican side is unquestioned,

such instructions are important only if made in good faith and if they be not merely colorable, and that the question of the good faith of such instructions so given was one for the jury, provided the evidence on the part of the United States as to the surrounding circumstances and conditions and the knowledge of such conditions by the two Cashions was such that they either knew of the intended and actual violation of the law, or was such that they willfully and intentionally ignored facts and circumstances known to them, which would have led to such knowledge. The evidence of the plaintiff, standing by itself, without the denials on the part of the officers of the construction company, seems to us sufficient to warrant the trial court in the submission of the case to the jury upon the question whether or not the construction company had such knowledge of the facts and circumstances as to warrant a verdict that they were guilty of encouraging or assisting the migration or importation of contract laborers. Upon the denials of the construction company's officials of any such knowledge or any intention to violate the law, it became a question of fact for the jury to determine both the truth of such denials and also whether or not such instructions were given in good faith.

Various other matters of objection were considered, none of which, however, was found by the court to invalidate the conclusions of the court below, which were therefore affirmed.

ASSIGNMENTS OF WAGES—FUTURE EARNINGS—STATUTORY REGULATION—COMPLIANCE—*Hall v. Boston Plate & Window Glass Co.*, *Supreme Judicial Court of Massachusetts*, 93 *Northeastern Reporter*, page 640.—Harry D. Hall and another sued the company named as employers of one Does, who had given the plaintiffs an assignment of his wages on August 17, 1908, to secure a debt due from him to them. Chapter 390, Acts of 1906 of the Massachusetts Legislature, requires certain formalities to be complied with in the assignment of unearned wages, among which are notice to the employer and a recording of the assignment. The plaintiffs gave no notice to the employer of the assignment by Does until June 25, 1909, and the assignment was not recorded until August 2, 1909. In the meantime Does, who was still employed by the defendant, made another assignment of his wages on January 9, 1909, to one Hills to secure a loan from him. Hills had no notice of the prior assignment and was informed by Does that there was none. The employers also stated that they had no notice of any assignment, and an examination of the records disclosed none on record. Assignee Hills therefore accepted the assignment, gave prompt notice of the same, and caused it to be recorded in the town clerk's office, all in the month of January, 1909. Subsequently the prior assignees, Hall and another, sued the employing company in an attempt to recover a balance due them under the earlier assignment, and from a judgment in favor of the defendant employer carried

their appeal to the supreme court, where the judgment of the lower court was affirmed.

Having stated the facts, Judge Morton said:

Statutes of 1906, chapter 390, is entitled "An act relative to the assignment of wages," and by section 6, "all acts and parts of acts inconsistent herewith are hereby repealed." Section 1 provides that no assignment of future wages shall be valid for a period exceeding two years from the date thereof, nor unless certain specified requirements are complied with. Section 2 provides that no such assignment shall be valid unless a copy is delivered to the assignor by the assignee at the time of the execution of the assignment, and that it shall not be binding on the employer of the assignor until a copy of it and an account conforming to the requirements thereafter stated shall have been delivered to the employer. The plain implication of what is required to be done in order to make the assignment binding on the employer is that if that is done the assignment shall be binding on the employer according to its terms. This is borne out by the provisions in section 5 that "An assignment of wages made in accordance with the provisions of this act shall bind all wages earned by the assignor within the period named in such assignment." The effect of the statute is, therefore, to render invalid as against a subsequent assignment where the requirements of the statute have been observed, a prior assignment where the requirements of the statute have not been observed. The matter being one of statutory regulation, cases like *Thayer v. Daniels*, 113 Mass. 129, on which the plaintiffs rely, which deal with conflicting assignments at common law, do not apply. It follows from the construction which we have given to the statute that the defendant was justified in paying over the wages to Hills after it received notice from the plaintiffs of their assignment. Upon its execution in accordance with the requirements of the statute the assignment to Hills operated to transfer to him the wages earned by Does, while in the employ of the defendant, during the time covered by the instrument. And so long as it continued in force the rights and obligations of the parties could not be affected by an invalid assignment previously made. Nor could validity be given to such invalid assignment as against one subsequently properly made, by attempting to comply later with the requirements of the statute. The rights of the parties were fixed once for all, so far as these proceedings are concerned, by the execution of a valid assignment to Hills. The defendant was not bound to see to the appropriation of the wages paid to Hills by them. The only question is whether they were justified in paying them to Hills, and, as we have already said, we think that they were. Whether the plaintiffs have any remedy by means of a trustee process summoning Hills as trustee or otherwise to compel an accounting as between Hills and Does, it is not necessary now to consider.

Judgment affirmed.

COERCION OF EMPLOYEES—PROTECTION AS TRADERS—CONSTITUTIONALITY OF STATUTE—*State v. Nashville, Chattanooga & St. Louis Railway Co.*, Supreme Court of Tennessee, 135 Southwestern Reporter, page 773.—A statute of Tennessee, Acts of 1887, chapter 208,

prohibited "any joint-stock company, association, or corporation," either domestic or foreign, from discharging or threatening to discharge any of its employees or workmen for trading or dealing or not trading or dealing with any particular merchant, person, or class of persons. The company above named was indicted for the violation of this statute and offered the defense that it was unconstitutional. This view was adopted by the circuit court of Maury County, and the State brought the case to the supreme court, where the judgment of the court below was affirmed. Judge Shields, speaking for the court, said in part:

In the view we have taken of this statute, it is only necessary to consider the contention that the statute is arbitrary and vicious class legislation, and a denial of the equal protection of the laws.

It is obvious from a reading of the statute, chapter 208, Acts 1887, that it only includes and applies to corporations created and organized under the laws of Tennessee and foreign corporations doing business in this State under its laws, and the officers and agents of such corporations. The terms "joint-stock company" and "association" are used as synonymous with the word "corporation," and are surplusage. There are no such corporate bodies as a "joint-stock company" or "association" known to the laws of this State, and it is clear from the whole act that it was the intention of the legislature to include corporations only, whether domestic or foreign. This is shown by the punishment provided for a corporation violating the act and that for an officer or agent violating it. Joint-stock companies, associations, and corporations are only punished by fine, because they can not be imprisoned, while the officer or agent is punished by both fine and imprisonment. If unincorporated bodies were meant by "joint-stock company" and "association," there would not have been this discrimination; but the individuals composing a joint-stock company or association would also have been punished as individuals who are merely officers or agents. Certainly a more severe punishment would not have been denounced against the agent than the principal.

There is no mention in the statute of firms and partnerships, which are composed of individuals associated together for business purposes, or of individuals, and in no view of the statute can it be made to apply to natural persons doing business as partners or individuals. We therefore have a statute which prohibits corporations and their agents from doing certain things under severe penalties which does not apply to firms or individuals doing the same thing.

The general assembly undoubtedly has the power, and is not prohibited by the constitutional provisions referred to, from enacting laws containing reasonable and proper classification of the objects of the legislation, but the classification must not be mere arbitrary selection. It must have some basis which bears a natural and reasonable relation to the object sought to be accomplished, and there must be some good and valid reason why the particular individual or class upon whom the benefit is conferred, or who are subject to the burden imposed, not given to or imposed upon others, should be so preferred or discriminated against.

The statute in question applies to all corporations, regardless of the business which they were incorporated and authorized to conduct, whether they be quasi public, as in case of public-service corporations, or private corporations, such as those created to conduct a mercantile, manufacturing, or other business, located at one point or extending over many counties, with large or small capital, or having in their service thousands or only a few employees.

It does not apply to natural persons, either as individuals or members of a partnership or firm, engaged in conducting the same business, at the same place, in the same manner, and with similar employees. New burdens and restrictions are placed upon corporations, the property of which belongs to individual shareholders, which are not placed upon natural persons engaged in the same business, conducted in the same way, and at the same place. We can see no good reason or natural and reasonable basis for this discrimination. None has been suggested or can be suggested, for they do not exist. The application of the statute is made to depend solely upon whether the employer is a natural or artificial person, between which, within the protection of the constitutional provisions invoked, there is no distinction. The distinction made is in the character of the employer, and not in that of the employment or business conducted.

We are of opinion that for this discrimination this act is arbitrary and vicious class legislation; that it denies all corporations doing business in Tennessee the equal protection of the laws, and is in contravention of the constitution of this State and of that of the United States, and void. We do not hold that there may not be a classification of corporations, or of employers, for that question is not here involved. Where such classification is natural and reasonable, and based upon some distinctive difference in the business of the several classes, a difference peculiar to and inhering in its very nature, it is valid, and will be sustained.

We express no opinion upon the other objections made to the statute, as those we have considered are conclusive of the case.

It results there is no error in the judgment of the trial court, and the same is affirmed.

EIGHT-HOUR LAW—CONSTRUCTION OF FEDERAL STATUTE—WORKMEN ON JETTIES—*Breakwater Co. v. United States*, *United States Circuit Court of Appeals, Third Circuit*, 183 *Federal Reporter*, page 112.—The company named above was convicted of violating a Federal statute, act of August 1, 1892 (27 Stat. 340), prohibiting employment by any contractor for Government work of any laborer or mechanic for more than eight hours in any calendar day except in cases of extraordinary emergency. The judgment was, on appeal to the court of appeals, reversed on the ground that the workmen employed did not come within the terms of the law. The facts appear in the opinion, which was delivered by Judge Buffington, which is as follows:

The Breakwater Co. contracted with the United States Government for the erection of two jetties near Cape May Harbor, in the State

of New Jersey. The jetties were parallel, and extended from shore to a depth of 26 feet at low water, with tops 10 feet above mean low water. All work done on them was offshore, and the men, whose work [for] more than eight hours was the offense for which the Breakwater Co. was convicted, were employed on a barge which, with its cargo of stone, was towed across Delaware Bay to the jetty. The stones were used in the construction of the jetties, and were thrown from the barge into the water to build them up. The men named in the indictment were either engineers, boatmen, or hookers on such barges. The latter, after being towed across the bay, were anchored, and, as needed, were towed by some of these men, using a gasoline launch, to the jetty. Here all aboard helped in discharging cargo. As occasion required the men also warped the barges along the jetty, by warping lines run by the barge engine. The barge had no other crew than these men, who worked in various capacities in discharging cargo, except a watchman, who also attended the fires. The men were selected for their seafaring experience, were hired by the month, and lived ashore. Some of the barges had four engineers, whose sole duty was to run the engines while discharging cargo and warping the vessel. The boatmen handled yawl and gasoline boats and assisted in discharging cargo. The hookmen handled the lines in discharging the cargo and aided in warping. The work done and the time required to do it depended on tide, wind, and weather on an open, exposed seacoast.

It is clear, therefore, that no exact hours could be fixed when the work of these men should and could cease. Under ordinary circumstances the elements of tide, wind, and weather necessitated variable hours of service on the part of those employed on the barge. In view of this, was it the intent of Congress, by the act in question, to describe these men by the terms "laborers and mechanics," and thus make it illegal to employ them more than eight hours, even though in the ordinary performance of their duty an exact eight-hour day was impossible in handling a barge and cargo on an open coast? Is it not much more reasonable to say that these men, who were doing a maritime service, and who by virtue thereof had at law rights, privileges, and obligations peculiar to themselves, were more aptly described as seamen? The barge was a maritime vessel. She was engaged in a maritime duty. The men were entitled to a maritime lien on her for their wages, for their work was of a maritime character. Their labor contributed to the work in which the barge was engaged, and they were clothed with the rights of seamen. We are therefore of opinion that these men were in the eyes of the law seamen, and, being such, the Supreme Court, in *Ellis v. United States*, 206 U. S. 258, 27 Sup. Ct. 600 [Bulletin No. 71, p. 361], held seamen were not laborers or mechanics, within the meaning of the act here in question.

EMPLOYERS' LIABILITY—COMPENSATION OF EMPLOYEES FOR INJURIES—ABROGATION OF DEFENSES—STATE INSURANCE—*In re House Document No. 2154, Supreme Judicial Court of Massachusetts, Senate Document No. 615, 1911.*—The Senate of the State of Massachusetts had before it for consideration a bill from the lower house of the

assembly providing for the enactment of a law abrogating certain defenses in case of suits against employers for damages on account of injuries to their employees, and establishing a voluntary system of insurance to provide compensation for injuries resulting from industrial accidents. The insurance was proposed to be administered through the agency of a corporation to be known as the Massachusetts Employees' Insurance Association, but the senate adopted an amendment permitting any liability insurance company doing business in the State to insure the liability to pay the compensation provided for by the proposed law on condition that both the insured employer and the insurance company shall be subject to the regulations and obligations imposed upon the association.

On account of the novelty of the doctrines involved in the proposed legislation, and because a law enacted by the Legislature of New York to effect a similar purpose had been declared unconstitutional by the court of appeals of that State, the senate by resolution required the opinion of the justices of the supreme judicial court as to the following questions:

First. Is the said bill, House Document No. 2154, in conformity with the provisions of the constitution of the Commonwealth of Massachusetts which requires that property shall not be taken from a citizen without due process of law?

Second. Is the bill in conformity with the fourteenth amendment to the Federal Constitution?

In reply thereto the following opinion was furnished, sustaining without dissent the constitutionality of the proposed law:

We have received the questions, of which a copy with the act referred to therein and the amendment adopted by the senate, is hereto annexed, and after giving to them such consideration as we have been able to give in the time at our disposal, we respectfully answer them as follows:

The questions submitted to us are important, and the proposed act involves a radical departure in the manner of dealing with actions or claims for damages for personal injuries received by employees in the course of their employment from that which has heretofore prevailed in this Commonwealth; but we think that nothing would be gained by an extended discussion and we therefore content ourselves with stating briefly the conclusions to which we have come and our reasons therefor.

The first section of the act (Part I, § 1) provides that "In an action to recover damages for personal injury sustained by an employee in the course of his employment, or for death resulting from personal injury so sustained, it shall not be a defense:

1. That the employee was negligent;
2. That the injury was caused by the negligence of a fellow employee;
3. That the employee had assumed the risk of the injury."

This section deals with actions at common law. We construe clauses 1 and 2 in their reference to negligence as meaning contributory neg-

ligence or negligence on the part of a fellow servant which falls short of the serious and willful misconduct which under Part II, § 2, will deprive an employee of compensation. So construed we think that the section is constitutional. We neither express nor intimate any opinion whether it would be unconstitutional if otherwise construed. The rules of law relating to contributory negligence and assumption of the risk and the effect of negligence by a fellow servant were established by the courts, not by the constitution, and the legislature may change them or do away with them altogether as defenses (as it has to some extent in the employer's act) as in its wisdom in the exercise of powers intrusted to it by the constitution it deems will be best for the "good and welfare of this Commonwealth." (See *Missouri Pacific Railway v. Mackey*, 127 U. S. 205; *Minnesota Iron Co. v. Kline*, 199 U. S. 593.) The act expressly provides that it shall not apply to injuries sustained before it takes effect. If, therefore, a right of action which has accrued under existing laws for personal injuries constitutes a vested right or interest, there is nothing in the section which interferes with such rights or interests. The effect of the section is not to authorize the taking of property without due process of law, as the Court of Appeals of New York held was the case which the statute referred to in the preamble to the questions submitted to us, and which in consequence thereof was declared by that court to be unconstitutional. (*Ives v. South Buffalo Railway*, 201 N. Y. 271, [94 N. E. 431, Bulletin No. 92, p. 251].) Construing the section as we do and as we think that it should be construed, it seems to us that there is nothing in it which violates any rights secured by the State or Federal Constitutions. We see nothing unconstitutional in providing, as is done in Part 1, § 2, that the provisions of § 1 shall not apply to domestic servants and farm laborers; nor in providing, as is done in Part 1, § 5, that the employee shall be deemed to have waived his right of action at common law if he shall not have given notice to his employer as therein provided. The effect of the provisions referred to is to leave it at the employee's option whether he will or will not waive his right of action at common law. (See *Foster v. Morse*, 132 Mass. 354.)

The rest of the act deals mainly with a scheme for providing, through the instrumentality of a corporation established for that purpose entitled the Massachusetts Employees' Insurance Association, and the subscription of employers thereto, for compensation to employees for personal injuries received by them in the course of their employment, and not due to serious and willful misconduct on their part. There is nothing in the act which compels an employer to become a subscriber to the association, or which compels an employee to waive his right of action at common law and accept the compensation provided for in the act. In this respect the act differs wholly so far as the employer is concerned from the New York statute above referred to. By subscribing to the association an employee voluntarily agrees to be bound by the provisions of the act. The same is true of an employee who does not choose to stand upon his common law rights. An employer who does not subscribe to the association will no longer have the right in an action by his employee against him at common law to set up the defense of contributory negligence or assumption of the risk, or to show that the injury was caused by

the negligence of a fellow servant. In the case of an employee who does not accept the compensation provided for by the act and whose employer had become a subscriber to the association, an action no longer can be maintained for death under the employer's liability act. But these considerations do not constitute legal compulsion or a deprivation of fundamental rights. We do not deem it necessary to take up and consider in detail the numerous provisions by which the right to compensation and the amount thereof and the persons entitled thereto and the course of procedure to be followed and matters relating thereto are to be settled and determined. We assume, however, that the meaning of §§ 4 and 7 of Part III of the proposed act is that the approved agreement or decision therein mentioned is to be enforced by proper proceedings in court, and not by process to be issued by the Industrial Accident Board itself. Taking into account the noncompulsory character of the proposed act, we see nothing in any of these provisions which is not "in conformity with" the fourteenth amendment to the Federal Constitution, or which infringes upon any provision of our own constitution in regard to the taking of property "without due process of law." It is within the power of the legislature to provide that no agreement by an employee to waive his rights to compensation under the act shall be valid. (See *Missouri Pacific Railway v. Mackey*, 127 U. S. 205; *Minnesota Iron Co. v. Kline*, 199 U. S. 593.)

In regard to the amendment it is to be observed that no liability insurance company is obliged to insure, and that if it chooses to do so there is nothing unconstitutional in requiring that it and the policy holder shall be governed by the provisions of the act so far as applicable.

It should be noted perhaps in the interest of accuracy that there is no phrase in our constitution which in terms requires that "property shall not be taken from a citizen without due process of law." The quoted words, which we take from the first question submitted to us, are a paraphrase of what is contained in the constitution, but are not the language of the constitution itself.

We have confined ourselves to the questions submitted to us, and we answer both of them in the affirmative.

EMPLOYERS' LIABILITY—EMPLOYMENT OF CHILDREN—OPERATION OF DANGEROUS MACHINERY—AGE LIMIT—CERTIFICATES—*Casperson v. Michaels*, *Court of Appeals of Kentucky*, 134 *Southwestern Reporter*, page 200.—Margaret Michaels was employed by Louis C. Casperson in his laundry to assist in the operation of a mangle. The injury was received while she was warming her hands on the mangle, touching her fingers to the cylinder, when her attention was momentarily diverted so that her hand was caught in the mangle and severely injured, and she brought suit to recover damages therefor. At the time of her injury Margaret Michaels was 14 years and 5 months of age. A law of the State of Kentucky prohibits the employment of any child under the age of 16 years to "operate or

assist in operating laundry machinery." The employment of children in factories under the age of 14 years is prohibited by the same statute, while another section of the law permits children between 14 and 16 years of age to be employed on condition that an age certificate is furnished. A verdict in the amount of \$1,500 was awarded the plaintiff, and from the judgment following the employer appealed. The appeal resulted in the affirmation of the judgment of the lower court. One contention of the appellant was that while the law prohibited employment without a permit, the fact that the child had a certificate of employment would operate as a defense in this case. As to this Judge Clay, who spoke for the court, said:

A careful reading of the section of the statutes, however, convinces us that the certificate of employment referred to in the other subsections of section 331a has no application to cases arising under subsection 11 [prohibiting employment at dangerous machinery, etc.]. It is evident that the legislature regarded the employments referred to in this subsection as being so dangerous that it was best to prohibit entirely children under 16 years of age from being employed at such occupations. To that end it was provided that no child under the age of 16 years should be employed in any capacity enumerated in that subsection. That being true, the court did not err in refusing to permit the certificate of employment to be read to the jury.

The next contention was that the injury was not due to the employment even if in violation of the statute, inasmuch as the child was warming her hands on a part of the mangle at which she was not supposed to work. As to this Judge Clay said:

In this connection it is argued that appellant had the right to employ appellee in the laundry, just so she was not put to work at any of the machinery therein used; that as she was injured at a part of the machinery where she was not employed to work, and at a time when she was not actually engaged in work, the case is just the same as if she had been employed to mark towels, an employment attended by no danger, and had gone into the machinery room and been injured in the same manner; that if that be true, her right to recover does not depend upon the statute, and her case should be considered from a standpoint entirely independent of the statute; and when so considered, her own evidence shows that the danger of placing her hand on or near the drum was so obvious and apparent that even a child of much tenderer years ought to have known and appreciated the danger. While we appreciate fully the force of appellant's contention, we think the difference between the supposed case and that at bar consists in this: In the supposed case there would be no violation of the statute, and, therefore, no right of action could be predicated on the statute; in the case at bar, however, appellee was employed and put to work at the mangle in violation of the statute. She was actually injured by the mangle at which she had been put to work. It is immaterial that she was injured by that part of the mangle at which she was not expected to work, or that she was injured while not being actually engaged in her customary duties. The purpose of

the statute was to protect children not only from the dangers necessarily incident to their employment in and around machinery of certain kinds, but from injuries which might result from their own thoughtlessness and childish acts. In other words, the purpose of the statute was to prevent their being exposed to danger. Here appellee was on hand, waiting to be summoned to work. She was near the mangle at which she was employed to work. Yielding to her childish instincts, she followed the example of a boy who had put his hand near the cylinder for the purpose of warming it, and attempted to do the same thing. It is evident that the statute was designed to protect her under just such circumstances. Knowing that a child under 16 years of age might be injured while actually employed at work on dangerous machinery, or that he might, in a spirit of play or because of heedlessness that is characteristic of children, touch or come in contact with the machinery in some way, the legislature made it unlawful to employ children under 16 years of age to work at such machinery. As appellee was, by virtue of her employment, exposed to the danger which resulted in the injuries complained of, we conclude that the proximate cause of her injuries was her employment at the mangle in violation of the statute. That being true, the court did not err in refusing to instruct the jury as if the case were one where no violation of the statute had taken place.

EMPLOYERS' LIABILITY—RAILROAD COMPANIES—FEDERAL STATUTE—APPLICATION OF LAW—*Pedersen v. Delaware, Lackawanna & Western Railroad, United States Circuit Court, Eastern District of Pennsylvania, 184 Federal Reporter, page 737.*—Martin Pedersen was injured while in the employment of the company named, engaged in work on a bridge in the State of New Jersey. The company was engaged in both interstate and intrastate business, and the bridge on which Pedersen was employed was intended for use both in local business and in commerce between the States. The train which caused the injury was a purely local train running between two points in the State of New Jersey. The action was brought under the Federal employers' liability act of April 22, 1908 (35 Stat. 65), and the question before the court was whether or not the statute was applicable to the case in hand. A negative view of this question was held by Judge McPherson, and judgment was rendered for the defendant company, notwithstanding a verdict for the plaintiff. In the discussion of the construction of the law Judge McPherson referred to the decision of the Supreme Court in declaring the liability act of 1906 unconstitutional (207 U. S. 463, 28 Sup. Ct. 141; Bulletin No. 74, p. 216), after which he spoke in part as follows:

This authoritative interpretation must have been influential in determining the scope of the act of 1908; and, indeed, it is well known that the act was passed for the express purpose of meeting

the foregoing decision. The first section bears evident signs of this purpose:

"That every common carrier by railroad, while engaging in commerce between any of the several States or Territories, etc., * * * shall be liable in damages to any person suffering injury while he is employed by such carrier in such commerce or in case of the death of such employee, etc., * * * for such injury or death resulting in whole or in part from the negligence of any of the officers, agents, or employees of such carrier, or by reason of any defect or insufficiency due to its negligence in its cars, engines, etc. * * *."

Under this section the new remedy—which, being in derogation of the common law, is to be confined to its plain meaning—is only to be available when two facts appear: First, the offending carrier must at the time of the injury be "engaging in commerce between any of the several States, etc."; and, second, the injury must be suffered by the employee "while he is employed by such carrier in such commerce." Both these facts must be present or the act does not apply—the carrier must be actually engaging in interstate commerce, and the employee must also be taking part therein. If, therefore, the business being done by the carrier is purely intrastate, and in the course of such business it injures an employee, the act does not apply. Neither does it apply, although the business being done by the carrier is commerce between the States, if the injured employee is engaged in work that does not properly belong to such commerce. But the act apparently does not require that the carrier and the injured employee should both be engaged in the same act of interstate business. Commerce between the States has many divisions and subdivisions, and if the carrier while engaged in doing one kind of interstate work should injure an employee who is engaged in doing another kind of such work, the remedy provided by the act appears to be available. Difficult questions will no doubt arise in the effort to determine whether the work being done by the employee can properly be regarded as interstate commerce, and also in the effort to determine whether the carrier is also engaged in such commerce; but these questions must be met as they arise and be decided on the circumstances presented from time to time. This much at least seems clear: The tests to be applied in determining whether a given case falls within the statute have been laid down by Congress in language that is not ambiguous, and this language declares that a right of action does not arise unless the employee be actually engaged in interstate commerce at the time of his injury, and unless also the injury be inflicted while the carrier is conducting the same kind of commerce. Applying these tests, I am of opinion that the present action can not be maintained. Without deciding the question whether the plaintiff was engaged in interstate commerce at the time of his injury, it seems to me beyond successful dispute that the defendant did not inflict the injury in the course of such commerce. The train was a purely local train carrying passengers between two points in the State of New Jersey, and the business was wholly intrastate.

In *Colasurdo v. Railway Co.* (C. C.), 180 Fed. 832 [Bulletin No. 92, p. 281], it appeared that the plaintiff was engaged in repairing a switch in the defendant's yards at Jersey City. While thus engaged he was injured by the negligence of other employees on a train that

had come from Somerville, N. J., to Jersey City, and was afterwards being shifted about on the defendant's tracks. The repair of the switch was held to be interstate business, because the switch was used indifferently in both kinds of commerce. Upon the remaining question whether the railway company was engaging in interstate commerce while doing the injurious act, the court held that it was a matter of no consequence whether or not the train that struck the plaintiff was so engaged, giving as a reason:

"It is true that the act is applicable to carriers only 'while engaged' in interstate commerce, but that includes their activity when they are engaging in such commerce by their own employees. In short, if the employee was engaged in such commerce, so was the road, for the road was the master and the servant's act its act. The statute does not say that the injury must arise from an act itself done in interstate commerce, nor can I see any reason for such an implied construction."

With much respect I am unable to agree with this construction. As it seems to me, the statute does say that the injury shall arise from an act itself done in interstate commerce; for in the light of the legislative history I am unable to find a broader meaning in the words "while engaging in commerce between any of the several States, etc." A carrier is not engaging in commerce between the States while it is doing intrastate business, and I think that Congress is not attempting in the act of 1908 to regulate intrastate business by charging such business with important liabilities. For the purposes of the commerce clause, the two kinds of business are as distinct as if they were undertaken by different corporations. One corporation, the interstate carrier, might be regulated by Congress, and therefore its acts might be charged with liability. The other corporation, the intrastate carrier, would not be subject to Federal control, and Congress would have no power to affix legal consequences to its acts.

This would be clear enough, I think, if the two kinds of business were actually separated, and were actually performed by two corporations respectively. The fact that only one corporation actually performs them both makes it more difficult to separate the acts and to assign the proper consequences to each, but in my opinion can not change the rules that must be applied. It is easy to depict certain anomalies and hardships that may arise. Both are probably inevitable under the dual control exercised by the State and the Federal Governments over the complicated business of carriers; but this dual control is a fundamental fact in the division of legislative power between these two Governments, and the distinction must be observed. In the last analysis it appears to be a question of power. Can Congress regulate the intrastate business of a common carrier? If not, I do not see how it can declare that a purely intrastate act shall subject the carrier to liability solely because such act has injured a person who at the time is engaged in commerce between the States. Clearly Congress could not so declare if the injured person had suffered while he was engaged in business intrastate in character, and I can not escape the conclusion that the carrier's liability must be determined by considering what kind of an act did the harm, and not exclusively by the occupation of the injured person. It is the doing, or the omitting to do, some act that gives rise to a cause of

action, and it would certainly be an exceptional exercise of Federal power to attempt to give a right of action for a particular wrong unless Congress was also able to forbid the wrong itself. Therefore—and in this region of controversy I express my own opinion with great deference for what may well be the better opinion of others—since Congress can neither directly forbid nor regulate the purely intrastate acts of a common carrier, believe that it can not reach the same result indirectly by declaring that important and burdensome consequences shall follow such acts.

Without prolonging the discussion, I conclude that the plaintiff is not entitled to recover, because he was injured by an act of the defendant done in the performance of purely intrastate business, and for this reason I direct that judgment be entered in favor of the defendant notwithstanding the verdict.

EMPLOYERS' LIABILITY—RAILROAD COMPANIES—FELLOW-SERVICE LAWS—STATE AND FEDERAL STATUTES—JURISDICTION—*Thompson v. Wabash Railroad Co., United States Circuit Court, Eastern District of Missouri, Northern Division, 184 Federal Reporter, page 554.*—Ethel Thompson, a citizen of Missouri, sued in the circuit court of Randolph County, Mo., to recover damages from the railroad company, named on account of the death of her husband, an employee of that company. The action was brought under a statute of the State of Missouri, and in its answer the company presented the contention that the case was one involving the application and construction of the Federal statute of April 22, 1908, contending that as the accident occurred in the course of interstate commerce that law exclusively controlled, and sought the removal of the case to a Federal court. The county court denied the petition for removal, whereupon the company made a transcript of the case and filed it in the United States court above set forth. Mrs. Thompson then filed a motion to remand the case to the circuit court of Randolph County on the ground that the Federal court had no jurisdiction of the case, and it was on this motion to remand that the present hearing was had. Having stated the facts in the case, Judge Dyer said:

Under the statutes of Missouri the plaintiff has a cause of action against the defendant to recover damages for the death of her husband. The law of Missouri gives this right to the wife, and in the event that she does not exercise it within six months, then the right of action is in the children, if any, of the deceased. This suit was instituted within six months after the death of the husband, and under and in pursuance of the laws of the State of Missouri, where the plaintiff resided, and where defendant resides, and where the husband was killed. The statutes of Missouri also provide that if the husband loses his life through the negligence of a fellow servant the plaintiff may recover. Congress, by an act entitled "An act relating to the liability of common carriers by railroad to their

employees in certain cases," approved April 22, 1908 (act April 22, 1908, c. 149, 35 Stat. 65 [U. S. Comp. St. Supp. 1909, p. 1171]), provides:

"That every common carrier by railroad while engaging in commerce between any of the several States or Territories, or between any of the States and Territories, or between the District of Columbia and any of the States or Territories, or between the District of Columbia and any of the States or Territories and any foreign nation or nations, shall be liable in damages to any person suffering injury while he is employed by such carrier in such commerce, or, in case of the death of such employee, to his or her personal representative, for the benefit of the surviving widow or husband and children of such employee; and if none, then of such employee's parents; and if none, then of the next of kin dependent upon such employee, for such injury or death resulting in whole or in part from the negligence of any of the officers, agents, or employees of such carrier, or by reason of any defect or insufficiency, due to its negligence in its cars, engines, appliances, machinery, track, roadbed, works, boats, wharves, or other equipment."

Under this act it is perfectly apparent that the plaintiff, the widow of the deceased, can not maintain the action. It must be done, if at all, by the personal representatives of the deceased; that is to say, his executors or administrators. The question here is as to whether this act of Congress does away with the State statute authorizing the widow to sue for and recover damages against the railroad company, through the negligence of whose officers or agents her husband lost his life, or is it an act giving employees an additional forum in which under certain circumstances they may go for the redress of wrongs? If the court refuses to remand this case, what then? This plaintiff has no right of action under the Federal statute and the case must necessarily be dismissed.

My opinion is that the circuit court of Randolph County has complete jurisdiction to try and determine the case. The laws of the State give the right to the wife to recover for the death of her husband, and this right is in no wise interfered with by the act of Congress to which reference is made. In this I may be wrong, but if I am some court of higher authority will correct it.

The motion to remand will be sustained.

EMPLOYERS' LIABILITY INSURANCE—LIABILITY OF THIRD PERSONS—BASIS OF RIGHT OF RECOVERY—SUBROGATION OF INSURANCE COMPANY—*Travelers' Insurance Co. v. Great Lakes Engineering Works Co., United States Circuit Court of Appeals, Sixth Circuit, 184 Federal Reporter, page 426.*—The Herancourt Brewing Co. was having installed an engine purchased from the engineering company named, and during such installation and the accompanying test one of its workmen, Leinhart by name, was killed, and another, Wund, injured on account of the negligence of the engineering company. The brewing company carried a policy of employers' liability insurance under which it was to be indemnified against loss by reason

of the liability imposed upon it by law for damages resulting from injuries or death of its employees. The policy provided that the insurance company should be subrogated to any rights of recovery that the employing company might have against persons responsible for the injuries for which it might pay any compensation. The insurance company settled with the administratrix of the estate of the employee whose death was caused by the accident and also made a settlement with the injured workman. It then sued the engineering company to recover the amount of its expenditures in this behalf in the Circuit Court of the United States for the Southern District of Ohio. The petition of the insurance company was demurred to on the ground that it failed to state facts sufficient to constitute a cause of action in reference to the claim in behalf of the deceased employee, and further that if this claim were stricken out the payment on account of the injured workman was too small to permit the case to come to a Federal court. The court below held that the brewing company could have no right of action against the engineering company for damages which the former had to pay on account of the death of the workman for the reason that only his administratrix could have recovered against either the employer or the engineering company; and as the insurance company could recover against the engineering company only on the basis of such rights as the brewing company might have the action could not be sustained. From this ruling of the court the insurance company appealed, the appeal resulting in the reversal of the judgment of the court below. Judge Knappen, having stated the facts in the case and disposed of some preliminary matters, said in part:

We are thus brought to the question whether the insurer, by reason of a contract of indemnity against employers' liability, such as exists here, can maintain an action against a third party whose negligence has caused liability to the insured employer for injuries resulting in the death of its employee.

The rule is well settled, in fire insurance as well as in marine insurance, that the insurer, upon paying to the assured the amount of a loss on the property insured, is subrogated in a corresponding amount to the assured's right of action against any other person responsible for the loss; this right of the insurer against such other person not resting upon any relation of contract or of privity between them, but arising out of the nature of the contract of insurance as a contract of indemnity derived from the assured alone, and enforceable in his right only. [Cases cited.]

But it is insisted by defendant that the brewing company could have no right of action against the engineering company for causing the death of Leinhart, for the reason that there is no common law right of action for causing the death of a human being, the right of action being purely statutory—in Ohio the action being required to be brought in the name of the personal representative of the deceased, and for the exclusive benefit of the wife, husband, children,

parents, or next of kin of the deceased (Rev. St. Ohio 1908, secs. 6134, 6135), and that the injury to the insurance company from the death of Leinhart is thus too indirect and remote to give a right of action to the insurance company.

It is a general rule of law that a principal or employer is civilly responsible for wrongs committed by his agent or servant while acting within the scope of the employment of the agent or servant. (1 Thompson on Negligence, secs. 518, 520, 526.) The rule of law is likewise general that where a principal or employer is not in fault, but has nevertheless been compelled to pay damages to a third person for the negligence of his agent or employee, he may maintain an action over against such servant or employee to recover what he has been compelled to pay. (Story on Agency (9th ed.), sec. 217; 4 Thompson on Negligence, sec. 3870.) The brewing company thus had, by virtue of its alleged relations with the engineering company, a right of action over against the latter for negligence on its part which caused legal damage to the brewing company. The injury to the brewing company resulting from that negligence was direct and immediate.

With respect to injuries not causing death, as in the case of Wund, we apprehend this proposition would not be questioned. With respect to the damage resulting from Leinhart's death, the fact that Leinhart had no right of action is immaterial. There is no attempt to recover here in any right of his. The ground of the recovery sought is that the engineering company failed in its primary and positive duty toward the brewing company, whereby the latter company sustained a loss. It can make no difference, with its right of action over, that the original recovery against it belonged to one person rather than another—to the widow and children rather than to the representative of Leinhart's estate. Under the allegations of the petition the negligence of the engineering company was the direct and sole cause of Leinhart's death, and thus of the damages suffered by the brewing company. The injury to the insurance company was thus not indirect or remote, but was direct and immediate, because it stands in the shoes of the brewing company. We know of no reason, either upon principle or authority, why the doctrine of subrogation, which has been expressly held applicable to indemnity by way of fire and marine insurance, and by at least necessary implication in the case of casualty insurance, should not be held to extend to employers' liability indemnity.

But it is contended that this right of subrogation, if it exists, can in a court of law be enforced only in the name of the insured.

Turning to the statutes of Ohio (Rev. St. 1908, sec. 4993), we find that "an action must be prosecuted in the name of the real party in interest," with certain exceptions not applicable here. In several cases statutes similar to that in Ohio have been expressly held to give the right of action at law in the name of the assured, although the rule would be different when the insurer had paid a part only of the loss, for in such case the principle forbidding the splitting of an action would forbid a suit by the insurer for a part only of the loss claimed.

It is further urged against plaintiff's right of recovery that the petition does not show that judgment was actually taken against the brewing company, the implication being that the liability was settled

without judgment. We see no merit in this contention. Assuming that no recovery could be had in advance of actual payment of the liability, the only effect of a judgment would be by way of evidence establishing liability. If the insurance company saw fit to pay the claimed liability without judgment and without warning in [to] the engineering company, so as to bind it by that judgment, the burden rests upon it of establishing in this suit, by proof, not only that Leinhardt's death occurred through the negligence of the engineering company, but also the extent of the damages recoverable by his relatives on account of that death.

It follows, from the views we have expressed, that the court below erred in sustaining the demurrer.

The judgment is accordingly reversed, with directions to take such further proceedings in the case as are not inconsistent with this opinion.

EMPLOYMENT OF CHILDREN—AGE LIMIT—VIOLATION OF STATUTE—LIABILITY OF EMPLOYER FOR INJURIES—DEFENSES—MISREPRESENTATION OF AGE—*Norman v. Virginia-Pocahontas Coal Co., Supreme Court of Appeals of West Virginia, 69 Southeastern Reporter, page 857.*—This case involved the construction of the West Virginia mining law of 1907, chapter 78, Acts of 1907, in its limitation of the employment of children in coal mines. The question was one of the liability of the employer for injury, and the case turned largely on the effect of the unlawful employment of a child under the prohibited age. The plaintiff had recovered a judgment of damages in the circuit court of McDowell County, which judgment was on appeal affirmed. The essential facts are indicated in the opinion of the court, which was delivered by Judge Robinson, of which the important parts are as follows:

By the statute law of this State it is provided: "No boy under 14 years of age * * * shall be permitted to work in any coal mine, and in all cases of doubt the parents or guardians of such boys shall furnish affidavits of their ages." (Code Supp. 1909, c. 15H, sec. 17.) Following this inhibition, punishment by fine or imprisonment is prescribed to be imposed upon any operator, agent, or mine foreman who shall be convicted of knowingly violating the mandate. This statute is enforceable as a criminal or penal one. Its terms prescribe no other liability for its violation than fine or imprisonment. The case which we are now to consider involves the applicability of this statute to a suit for damages arising from an injury alleged to have been caused by its violation.

Though the statute provides only for a fine or imprisonment, still an action lies for damages caused by its nonobservance. The plaintiff, if his allegations are true, is one of a class for the benefit of which the statute was enacted. Any boy under the age of 14 years who is injured by reason of his unlawful employment in a coal mine may maintain a civil action for damages in the premises against the mine operator, agent, or foreman who has failed to observe the law

and thereby caused the boy's injury. "One who disobeys the law subjects himself to any proceeding, civil or criminal, which the same law has ordained for the particular case. In the absence of which ordaining, or in the presence of it when not interpreted as excluding other methods, he is liable to those steps which the common law has provided for cases of the like class; as, to an indictment, or to a civil action, or to both, according to the nature of the offending. The civil action is maintainable when, and only when, the person complaining is of a class entitled to take advantage of the law, is a sufferer from the disobedience, is not himself a partaker in the wrong of which he complains, or is not otherwise precluded by the principles of the common law from his proper standing in court." (Bishop on Noncontract Law, sec. 141.)

Many and varied are the views that have been expressed as to the consideration of evidence in regard to violation of a statute in cases like the one at hand. It is not our purpose to cite and review the decisions on the subject. The point is one of first instance with us. We adopt the view that seems consonant with reason. Briefly stated it is this: The violation of the statute is actionable negligence whenever that violation is the natural and proximate cause of an injury. The true question to be determined in an action based upon a failure to obey a statute like the one under consideration is: Did the unlawful employment cause the injury? The trial of the case must be guided by this question. If the injury complained of is a natural and probable consequence of a violation of the statute, then that violation is correctly taken as the proximate cause of the injury. If the very injury has happened which was intended to be prevented by the statute law, that injury must be considered as directly caused by the nonobservance of the law. But if the injury is one that happened by causes independent of the violation of the statute, it is not actionable on the basis of that violation. If an intervening event against which the statute evidently did not intend to provide, and the appearance of which was not anticipated by the spirit and purpose of the act, has in fact caused the injury, that event is plainly the proximate cause.

The statute does not provide that an employer shall respond in damages for all injuries sustained by a boy under 14 years through employment in a coal mine. It merely provides that the employer shall be guilty of a misdemeanor and punished therefor. While the boy may have a civil remedy for injury sustained in the unlawful employment and resort to the violation of this statute for evidence of the negligence which caused the injury, still the statute does not say, or even imply, that the employer shall respond in damages other than those given by the common law. The statute does not put an absolute liability on him for civil damages. It puts no liability on him in that regard. But it may be shown that he is liable for damages at the common law for an injury sustained by reason of its violation. So as a matter of law it can not be said that the employer is chargeable in damages with all injuries that result. The evidence must prove that he is chargeable—that the injury indeed proceeded from the unlawful employment.

But the doctrines in relation to assumption of risk and of fellow servancy do not apply, if the evidence establishes that the statute

against employment of boys in mines has been violated. If the employment of a boy in a mine is unlawful, he can not be held to have assumed the risks incident to the employment, among which are those proceeding from the acts of fellow servants. Assumption of risk must stand upon the contract of employment, whether the risks assumed are viewed as proceeding from fellow servancy or other conditions connected with the employment. The employer can not take advantage of the unlawful contract so as to say that the boy assumed the risks arising from the occupation or from fellow servants. As Judge Taft has stated it, the servant can not "contract the master out" of the statute. (*Narramore v. C., C., & St. L. Ry. Co.*, 96 Fed. 298, 37 C. C. A. 499, 48 L. R. A. 68).

The doctrine of contributory negligence, however, is not based upon contract of employment, and is open as a defense in cases like this one. How far that defense may apply in view of the consequences to be anticipated from a violation of the statute and in consideration of the proximate cause of the injury is a question to be particularly discriminated in any trial in which the defense is raised in such case as the one before us. That contributing negligence from incapacity to appreciate danger and from childish inclinations is a natural result of the violation of the statute, and the employer is bound to anticipate it. Therefore if he disobeys the law, he is chargeable with the results, which he should have anticipated, one of which is the boy's own negligence because of his years. He is chargeable with any injury which the immaturity of the boy brings on himself, because he is bound to know that the law requires that he protect the boy against harm from his lack of capacity by not employing him. But if a boy, though under 14 years, is not so immature as is merely presumed from his age, and actually has knowledge and capacity to appreciate the dangers because of careful instruction, unusual experience, or precocious intellect, shall we say that he is entitled to civil damages because of the violation of a statute not made for his benefit? Shall we give one having capacity to avoid danger the benefit of inferences from a law that has been made in the interest of those not having that capacity? There is not a word in the statute itself which says civil liability shall exist because of failure to observe the mere age fixed. The statute indicates that protection from a generally presumed want of capacity in those under the age is the end it seeks. Therefore it is not violated in a sense to bring civil damages unless the employer has actually taken into his service one that he must reasonably know may be injured by reason of his own boyish inclinations. Though a boy may be a few days under 14 years, it may be shown that he has been so well instructed and experienced as to have even more appreciation of danger than one over that age.

The common law allows the defense of contributory negligence if facts are shown whereby it appears that under the law such negligence is attributable to the boy. If he has the sense to avoid dangers, the unlawful employment can not hurt him in this regard, if he uses that sense. So we say that if the contributory negligence is not of that order against which the statute itself provides, is not of that kind which must be anticipated as a probable consequence of a violation of the statute, but comes from one who is shown to have the

capacity to refrain from contributing to his own injury, it is an available defense. The employer is entitled to this defense if he can show that the boy contributing to the injury had extraordinary wisdom and full appreciation of the dangers.

Some of the decisions hold that under no circumstances can contributory negligence avail in a case like the one at hand. But the weight of authority is the other way, and to our minds consistent with legal principles. The statute does not in words abrogate the defense. A civil action does not get its force from that statute. It only looks to the violation of the statute for evidence to support the action. Why shall not common-law principles apply?

Though the boy may have misrepresented his age, still he may recover if he makes a case. He is not precluded from the action because he has been a party to the unlawful employment. The inhibition is upon the employer. Again, we say, if his failure to observe the law causes injury, he may be made to respond in damages. (*Braasch v. Michigan Stove Co.*, 153 Mich. 652, 118 N. W. 366.)

The employer must ascertain the age of the boy. He must not be negligent in this particular. Unless he actually knows the age, so that he may safely rely on the fact before a jury, he must do what the statute directs—he must secure the affidavit of the parent or guardian. The statute requires him to get this affidavit “in all cases of doubt.” If there is not certainty, there must be doubt. If he does not actually know the age, so that he may safely rely on the knowledge he has obtained in that regard, he is only uncertainly informed, and it is a case of doubt. We think the statute virtually says that the employer must clear up all uncertainty that exists by securing the affidavit. Only that affidavit or absolute proof that the boy is over 14 years will protect him. He “knowingly” violates the statute when he does not settle all doubt in advance of the employment. Representations, appearances, and good faith can not take the place of the affidavit or unfailing proof which the statute requires. The purpose of the act and the very spirit which it discloses through its words sanction this construction.

Now, when we view the case in the light of the principles announced, we observe the verdict and judgment to be fully justified. The pleadings and evidence warrant the recovery of damages for an injury caused by the act of the defendant in unlawfully employing plaintiff in a coal mine. That injury was the loss of a leg, for which the jury awarded \$1,500. There is evidence supporting a finding that the plaintiff was under the age of 14 years and that the injury was a natural and probable consequence of his unlawful employment. The happening by which the injury came to plaintiff was one which the employer must have reasonably anticipated would follow the employment of a person so immature. The evidence does not take the boy out of the class for the benefit of which the statute was enacted. It does not raise his capacity over that generally presumed. No affidavit of the boy's age was sought or furnished. It is plainly shown that the defendant's agent even doubted the boy's statement as to his age. Defendant can not, as it undertakes to do, rely on evidence of the boy's misstatements and of what its agent believed from his appearance. There is no error in the giving and refusing of instructions to the jury. Those given presented the case as favorably

for defendant as could properly have been done. Those refused were not warranted in a proper view of the case. The judgment in plaintiff's behalf is founded upon no error. It will be affirmed.

HOURS OF LABOR OF EMPLOYEES ON RAILROADS—TELEGRAPH OPERATORS—FEDERAL STATUTE—PERIODS OF SERVICE AND REST—CONSTRUCTION OF STATUTE—*United States v. Atchison, Topeka & Santa Fe Railway Co.*, *Supreme Court of the United States*, 31 *Supreme Court Reporter*, page 362.—This case was before the Supreme Court on an appeal from the circuit court of appeals in an action to recover penalties for a violation of the act of March 4, 1907 (34 Stat. 1415, 1416). This act provides that no telegraph operator or person in like employment shall be permitted to be on duty for a longer period than 9 hours in any 24-hour period where such offices are operated continuously, nor for longer than 13 hours in offices operated only during daytime. The defendant company employed an operator at Corwith, in the outer limits of the city of Chicago, the office being closed between the hours of 12 and 3 by day and by night, but open the rest of the time. The same operator was employed from half past 6 in the morning until 12 and again from 3 p. m. to half past 6, involving 9 hours of actual work within the 12-hour period. The Government contended that the place was "continuously operated night and day," and that when 9 hours had passed from the moment of beginning work no more labor should be permitted by the same operator until after the recurrence of the same time of beginning on the next day. This contention had been sustained by the district court, but reversed in the court of appeals, and on this hearing in the Supreme Court the judgment of the circuit court of appeals was affirmed. Justice Holmes, who delivered the opinion of the court, spoke in part as follows:

We are of opinion that the Government's argument can not be sustained, even if it be conceded that Corwith was a place continuously operated night and day, as there are strong reasons for admitting. The antithesis is between places continuously operated night and day and places operated only during the daytime. We think that the Government is right in saying that the proviso is meant to deal with all offices, and if so, we should go further than otherwise we might in holding offices not operated only during the daytime as falling under the other head. A trifling interruption would not be considered, and it is possible that even three hours by night and three hours by day would not exclude the office from all operation of the law, and to that extent defeat what we believe was its intent.

But if we concede the Government's first proposition, it is impossible to extract the requirement of 15 hours' continuous leisure from the words of the statute by grammatical construction alone. The proviso does not say 9 "consecutive" hours, as was said in

the earlier part of the section, and if it had said so, or even "for a longer period than a period of 9 consecutive hours," still the defendant's conduct would not have contravened the literal meaning of the words. A man employed for 6 hours and then, after an interval, for 3, in the same 24, is not employed for a longer period than 9 consecutive hours. Indeed, the word "consecutive" was struck out when the bill was under discussion, on the suggestion that otherwise a man might be worked for a second 9 hours after an interval of half an hour. In order to bring about the effect contended for it would have been necessary to add, as the section does add in the earlier part, a provision for the required number of consecutive hours off duty. The presence of such a provision in the one part and its absence in the other is an argument against reading it as implied. The Government suggests that if it is not implied, a man might be set to work for 2 hours on and 2 hours off, alternately. This hardly is a practical suggestion. We see no reason to suppose that Congress meant more than it said. On the contrary, the reason for striking out the word "consecutive" in the proviso given, as we have mentioned, when the bill was under discussion, and the alternative reference in section 2 to "16 consecutive hours" and "16 hours in the aggregate," show that the obvious possibility of two periods of service in the same 24 hours was before the mind of Congress, and that there was no oversight in the choice of words.

LABOR ORGANIZATIONS—INTERFERENCE WITH EMPLOYMENT—INJUNCTION—CONSTRUCTION OF STATUTE—*George Jonas Glass Co. v. Glass Bottle Blowers' Association, Court of Errors and Appeals of New Jersey, 79 Atlantic Reporter, page 262.*—The company above named had procured an injunction against the association following a boycott of its business instituted in the year 1901 and a strike in the following year and thereafter. (See Bulletin No. 72, p. 629.) From the decree awarding this injunction the defendants appealed, the appeal resulting in the decree being affirmed. The injunction awarded restrained the defendants—

(1) From knowingly and intentionally causing or attempting to cause, by threats, offers of money, payments of money, offering to pay expenses, or by inducement of persuasion, any employee of the complainant under contract to render service to it to break such contract by quitting such service.

(2) From personal molestation of persons willing to be employed by complainant with intent to coerce such persons to refrain from entering such employment.

(3) From addressing persons willing to be employed by complainant, against their will, and thereby causing them personal annoyance, with a view to persuade them to refrain from such employment.

(4) From loitering or picketing in the streets or on the highways or public places near the premises of complainant with intent to procure the personal molestation and annoyance of persons em-

ployed or willing to be employed by complainant, and with a view to cause persons so employed to refrain from such employment.

(5) From entering the premises of the complainant against its will with intent to interfere with its business.

(6) From violence, threats of violence, insults, indecent talk, indecent abusive epithets, annoying language, acts, or conduct practiced upon any person without their consent, with intent to coerce them to refrain from entering the employment of complainant or to leave its employment.

(7) From attempting to cause any persons employed by complainant to leave such employment by intimidating or annoying such employees by annoying language, acts, or conduct.

(8) From causing persons willing to be employed by complainant to refrain from so doing by annoying language, acts, or conduct.

(9) From inducing, persuading, or causing, or attempting to induce, persuade, or cause, the employees of complainant to break their contracts of service with complainant or quit their employment.

(10) From threatening to injure the business of any corporation, customer, or person dealing or transacting business and willing to deal and transact business with the complainant by making threats in writing or by words for the purpose of coercing such corporation, customer, or person against his or its will so as not to deal with or transact business with the complainant.

One member of the court of errors and appeals dissented from that part of the opinion which upholds the injunction against "inducing, persuading, or causing, or attempting to induce, persuade, or cause the employees of complainant to break their contracts of service with complainants or quit their employment;" while three other judges dissented in so far as the decree appealed from directs that the defendants be enjoined from the peaceful persuasion of persons who are not under any contract to serve the complainant. The opinion of the majority of the court, as delivered by Judge Pitney, is as follows:

Each portion of the injunctive relief thus granted is directed to some manifestation of the strife that was carried on by the combined defendants against the complainant. And in each respect the injunction is justified by the evidence in the case.

The employees of complainant referred to in the decree are those who either refused to join the strike or who entered complainant's employ after the strike. With respect to these, it will be observed that the defendants are restrained from using coercion, inducements, or persuasion to bring about a termination of the employment, whether the employee be under contract of service or not. With respect to other persons, not as yet employed, but willing to take employment under the complainant, the defendants are restrained from interfering to prevent this by coercion or personal molestation and annoyance; but are not restrained from using mere persuasion in such a case. There is a restraint against picketing designed to molest and annoy persons employed or willing to be employed, and there is a restraint against the continuance of the boycott. It is clear beyond dispute that the complainant has suffered grievously in its property

and business through the acts of the defendants, whose continuance is thus prohibited. That the injury to the complainant is irreparable by action at law is likewise clear. If, therefore, the acts themselves are unlawful and violative of the property rights of the complainant, the injunction is proper. The conduct of defendants in using coercion in some cases and persuasion in others in order to bring about breaches of the contracts of personal service existing between complainant and some of its employees—defendants having, of course, full notice of the existing employment—was unlawful and actionable upon well-settled principles. And the same is true of conduct whose object and purpose were to bring about a termination of the relation of master and servant between the complainant and its employees in cases where there was no binding contract of service, but a mere service at will. In *Frank & Dugan v. Herold* (63 N. J. Eq. 443, 450, 52 Atl. 152), Pitney, V. C., said that to create the relation of master and servant it is not necessary that there should be a contract in writing, or even verbal, between them to work for any particular length of time, that the relation exists when the one person is willing from day to day to work for another, and that other person desires the labor and makes his business arrangements accordingly. Whether an action will lie for interference in the relations existing between employer and employee where there is a mere service at will and where the interference is the result of fair competition in the labor market is a question mooted, but not necessary to be decided in the present case. The defendants were not competitors in the labor market. Their interference had for its immediate object the crippling of the complainant's business. The only semblance of excuse alleged is that defendants desired to bring about "improved labor conditions" in complainant's works; but this object did not warrant the resort to unlawful measures.

Reliance is placed by the defendants upon the "act relative to persons combining and encouraging other persons to combine." (P. L. 1883, p. 36; Gen. Stats. 1895, p. 2344, pl. 23.) The enactment is: "That it shall not be unlawful for any two or more persons to unite, combine, or bind themselves by oath, covenant, agreement, alliance, or otherwise, to persuade, advise, or encourage, by peaceable means, any person or persons to enter into any combination for or against leaving or entering into the employment of any person, persons, or corporation." In *Mayer v. Journeymen Stonecutters' Association*, 47 N. J. Eq. 519, 531, 20 Atl. 492, 496, Vice Chancellor Green apparently treated this act as legalizing private injuries. And in *Cumberland Glass Mfg. Co. v. Glass Bottle Blowers' Ass'n*, 59 N. J. Eq. 49, 53, 46 Atl. 208, Vice Chancellor Reed construed it as permitting the adoption of peaceable measures for inducing workmen to quit or refuse to enter an employment. Whatever may have been the purpose of its framer, there are, as we think, constitutional obstacles in the way of giving the act so extensive a force. The rights of enjoying and defending life and liberty, acquiring, possessing, and protecting property, and pursuing and obtaining safety and happiness are declared by our constitution to be unalienable. (Const. N. J., art. 1, pl. 1.) No act of the legislature is to be construed as infringing upon these rights, unless its language plainly and clearly requires such a construction. If its language so reads, it is to the

extent indicated unconstitutional and void. The act of 1883 is, as we think, properly to be treated as merely rendering the combination no longer indictable; in effect, as repealing the rule laid down by the supreme court of this State in *State v. Donaldson*, 32 N. J. Law, 151, 90 Am. Dec. 649. It does not legitimize an invasion of private rights nor prevent the party injured from having full redress. Its proper scope is indicated in the opinion of Pitney, V. C., in *Frank & Dugan v. Herold*, 63 N. J. Eq. 443, 447, 448, 52 Atl. 152.

So much of the decree as awards an injunction to restrain the defendants from using coercive measures to prevent the flow of labor to complainant's works is likewise proper. In *Jersey City Printing Co. v. Cassidy*, 63 N. J. Eq. 759, 765, 53 Atl. 230, *Stevenson, V. C.*, recognized and enforced the right of an employer to an injunction to prevent undue interference with those who wish to come to him for employment. It is principally upon this ground that injunctions against what is known as picketing have been sustained in this and other jurisdictions.

So much of the decree as is directed against the continuance of the boycott is plainly justified by the evidence, and accords with the law. (*Barr v. Essex Trades Council*, 53 N. J. Eq. 101, 30 Atl. 881; *Martin v. McFall*, 65 N. J. Eq. 91, 55 Atl. 465.)

The decree under review should be affirmed, with costs.

MINE REGULATIONS—EXAMINATION AND CERTIFICATION OF MINERS—
CONSTRUCTION OF STATUTE—CONSTITUTIONALITY—*People v. Evans*,
Supreme Court of Illinois, 93 *Northeastern Reporter*, page 388.—
Harry Evans was convicted of violating a statute of the State of Illinois (Hurd's Rev. Stats., 1909, ch. 93) which provides for the examination of miners by an examining board, and prohibits the employment of such miners as have not received a certificate from such board. The board is to be appointed by the county judges of the State and is to consist of persons who are practical, experienced, and skillful miners of at least five years' continuous experience and who are at the time actually engaged in mining coal in the county for which they are appointed. Miners who were employed at the time the act took effect and who had been employed as miners for at least two years in coal mines were entitled to certificates without examination. Other provisions relate to fees, penalties, times of holding examination, etc.

There was no question as to the fact that Evans had employed a miner who did not have a certificate, and at the trial in the Saline County court Evans was convicted and appealed. His appeal was based on the alleged unconstitutionality of the law in a number of its provisions. On each point, however, with a single exception, the court sustained the law and affirmed the judgment of the court below. The opinion of the court was delivered by Judge Hand, who first took up the contention that the law was unconstitutional since it invested county judges with authority not contemplated in their origi-

nal appointments, the contention being that the members of the examining boards are State officers subject to appointment by the governor only. This view was rejected by the court and the validity of the mode of appointment affirmed. Following this, Judge Hand said:

It is next contended that the statute is unconstitutional by reason of the fact that it discriminates against such miners as were not actually employed in mining in this State on the date said statute became effective, and discriminates in favor of such miners as were actually employed in mining in this State on the date said statute became effective. The statute provides that no person shall receive a certificate permitting him to work in a coal mine in this State unless he shall have had two years' practical experience as a miner or with a miner, and provides that the examination required by the statute shall be taken by a miner unless the miner has been employed two years in practical mining, and was actually employed in mining in this State at the time the statute went into effect.

As we view the provision of the statute which exempts the miner from an examination if he was employed in mining in this State at the time the statute went into effect, as a prerequisite to issuing him a certificate, it does not confer upon such miner any privilege, right, or immunity, and does not discriminate in his favor as against the miner who was not so employed at the time the statute became effective. The most that can be said is that the statute leaves the miner who has had two years' experience in mining coal and was employed in mining coal in this State at the time the statute went into effect, in the precise situation that he was in before the statute was passed; that is, it permits him to continue his employment upon his satisfying the miners' examining board that he had been for two years engaged in mining coal, and was engaged in mining coal in this State at the time the statute went into effect. Neither does it take from the miner who resides in this State or resides out of this State, and who has had two years' experience in mining, any privilege, right, or immunity, but leaves such miner where it found him when the statute was passed; that is, without employment in a coal mine; and if he desires to again engage in mining, then the statute provides that he may do so by passing an examination and otherwise complying with the statute. In the one instance the law is just to the miner who was employed when the law went into effect, as it permits him to continue his employment, while it does not in any way work an injustice to the miner who has for years, or even temporarily, abandoned the mining of coal and again desires to be employed in that calling. We are therefore constrained to hold that the statute does not discriminate in favor of the class of miners who were employed as miners when the act became effective, or discriminate against the class of miners who were not so employed when the act became effective.

Various other points were then considered, all of which were decided in favor of the constitutionality of the statute except the last, as to which Judge Hand said:

It is finally contended that that portion of the statute which provides that money paid into the State treasury by the miners'

examining board shall be paid out again upon warrants issued by the several county judges of the State is invalid. That this provision of the statute is unconstitutional is conceded by the defendant in error, and it is too plain for argument that the portion of the statute which authorizes a county judge to draw warrants against money in the State treasury must be held to be unconstitutional. The other provisions of the statute, however, are not dependent upon this provision, and, eliminating from the statute the portion admittedly unconstitutional, the remaining part of the statute is valid and constitutional.

RAILROADS—FULL CREW LAW—CONSTITUTIONALITY OF STATUTE—REGULATION OF COMMERCE—*Chicago, Rock Island & Pacific Railway Co. v. State of Arkansas, Supreme Court of the United States, 31 Supreme Court Reporter, page 275.*—This case came before the Supreme Court of the United States for a review of a judgment of the Supreme Court of the State of Arkansas penalizing the company named for operating a freight train with less than three brakemen, in violation of act No. 116 of the laws of 1907 of that State. The law was restricted in its application to railroads over 50 miles in length and operating trains consisting of 25 cars or more. The company contended that its trains were equipped with automatic couplers and air brakes, and that two brakemen were sufficient in number to operate the train safely, so that the requirement for a third brakeman was a useless and unnecessary burden. On this ground it maintained that the statute was unconstitutional as depriving it of its property without due process of law. This contention the supreme court denied, upholding the constitutionality of the statute, and affirming the judgment of the court below. Justice Harlan, who delivered the opinion of the court, discussed a number of laws of various States prescribing the methods of operation and of equipment of railroads in the States, which had been sustained as within the power of the State legislatures to provide for the safe operation of the railroads within their boundaries. In conclusion, Justice Harlan said:

Local statutes directed to such an end have their source in the power of the State, never surrendered, of caring for the public safety of all within its jurisdiction; and the validity under the Constitution of the United States of such statutes is not to be questioned in a Federal court unless they are clearly inconsistent with some power granted to the General Government, or with some right secured by that instrument, or unless they are purely arbitrary in their nature. The statute here involved is not in any proper sense a regulation of interstate commerce, nor does it deny the equal protection of the laws. Upon its face, it must be taken as not directed against interstate commerce, but as having been enacted in aid, not in obstruction, of such commerce, and for the protection of those engaged in such commerce. Under the evidence, there is admittedly some room for controversy as to whether the statute is or was necessary; but it can not

be said that it is so unreasonable as to justify the court in adjudging that it is merely an arbitrary exercise of power, and not germane to the objects which evidently the State legislature had in view. It is a means employed by the State to accomplish an object which it is entitled to accomplish, and such means, even if deemed unwise, are not to be condemned or disregarded by the courts, if they have a real relation to that object. And the statute being applicable alike to all belonging to the same class, there is no basis for the contention that there has been a denial of the equal protection of the laws. Undoubtedly, Congress, in its discretion, may take entire charge of the whole subject of the equipment of interstate cars, and establish such regulations as are necessary and proper for the protection of those engaged in interstate commerce. But it has not done so in respect to the number of employees to whom may be committed the actual management of interstate trains of any kind. It has not established any regulations on that subject, and until it does, the statutes of the State, not in their nature arbitrary, and which really relate to the rights and duties of all within the jurisdiction, must control. This principle has been firmly established, and is a most wholesome one under our systems of government, Federal and State.

RAILROADS—SAFETY APPLIANCES—HEADLIGHTS ON LOCOMOTIVES—
CONSTITUTIONALITY OF STATUTE—*Atlantic Coast Line Railroad Co. v. State, Supreme Court of Georgia, 69 Southeastern Reporter, page 725.*—This case was before the supreme court on certified questions from the court of appeals as to the validity of an act of the Legislature of the State of Georgia, page 50, laws of 1908. The questions involved are entirely points of law, and the somewhat lengthy opinion was summarized by the court in a syllabus which presents the points of interest and is mainly as follows:

2. An act provided "that all railroad companies are hereby required to equip and maintain each and every locomotive used by such company to run on its main line after dark with a good and sufficient headlight, which shall consume not less than 300 watts at the arc, with a reflector not less than 23 inches in diameter, and to keep the same in good condition." It also provided that "any railroad company violating this act in any respect" should be liable to indictment and a prescribed punishment, and that "this act shall not apply to tram roads, mill roads, and roads engaged principally in lumber or logging transportation in connection with mills." (Laws, 1908, p. 50.) Held:

(a) The term "railroad company" employed in the act includes natural persons as well as corporations.

(b) The act is not void, as being violative of the "equal-protection" clauses of the State and Federal Constitutions, because it exempts from its operation tram roads, mill roads, and roads engaged principally in lumber or logging transportation in connection with mills.

(c) Even if receivers of railroads are not within the operation of the act, it would not for this reason be violative of the equal-protection clauses referred to in the preceding note.

3. The act does not violate the "due-process" clauses of the State and Federal Constitutions, because its enforcement will require a loss of property to the defendant in doing away with the headlights on locomotives now in use and cause the defendant to incur expense in equipping its locomotives with the headlights required by the act.

(a) The act is not violative of the "due-process" clauses of the State and Federal Constitutions, because it requires an arc electric headlight, which shall consume "not less than 300 watts at the arc and with a reflector not less than 23 inches in diameter," on the ground that it deprives the defendant "of its own right to make contracts and manage its own business."

(b) The act was passed in the legitimate exercise of the police power of the State, and is not void on the ground that its requirements are unreasonable.

(c) Nor does the act violate the "due-process" clauses of the State and Federal Constitutions, on the ground that it contains no emergency clause and absolutely and without exception makes the railroad company guilty of a crime if it operated one of its engines on its main line after dark without the required headlight.

4. The act does not violate the "commerce clause" of the Federal Constitution, on the ground that it would require at the State line a change of headlights on locomotives doing an interstate business, if other States required headlights of a kind different from that prescribed by the act in question, although such change might involve some loss of time and expense on the part of the railroad company.

DECISIONS UNDER COMMON LAW.

BOYCOTT—CONSPIRACY—EXERCISE OF RIGHT—MOTIVE—*Union Labor Hospital Association v. Vance Redwood Lumber Co., Supreme Court of California, 112 Pacific Reporter, page 886.*—The hospital association named brought action against the lumber company and six affiliated companies which had agreed among themselves on a system of hospital relief which involved the deduction of \$1 per month from the wages of their workmen. In partial exchange therefor the workmen received hospital tickets. These tickets admitted the workmen to treatment at any one of four designated hospitals, of which the Union Labor Hospital was not one. A complaint was made that the failure to designate the Union Labor Hospital as one at which treatment might be received under the agreement of the lumber companies formed a malicious and willful conspiracy, combination, and boycott, designed to vex and injure the plaintiff's business, and coerce and intimidate its patrons and customers, and prevent the sale of its bonds by injuring its credit. There was no evidence of any coercion or other action directed toward the hospital, nor of any suggestion to the workmen that they should not patronize it. The companies insisted merely that the workmen should

buy tickets in one of the designated hospitals, leaving them at liberty to also buy tickets in the plaintiff's hospital if they should so desire, though, as was remarked by the court, "in the nature of things an employee having purchased a ticket in another hospital would not be likely to lay out any more money for such a purpose."

Judgment had been given in the plaintiff's favor in the superior court of Humboldt County, which judgment was on appeal reversed and the case remanded. The opinion of the court was delivered by Judge Henshaw, and from it the following extracts are taken as showing the grounds for its reversal:

There being no contractual relations between plaintiff and defendants, the defendants, individually or in combination, were under a duty only to refrain from inflicting a legal wrong upon plaintiff. The finding of the court is that defendants in making their agreements with the Sequoia, St. Francis, Marine View, and Trinity Hospitals were acting solely for the purpose and with the intent to subserve their own interests. But if this were not so, and their purpose were to injure the business of plaintiff, nevertheless, unless they adopted illegal means to that end, their conduct did not render them amenable to the law, for an evil motive which may inspire the doing of an act not unlawful will not of itself make the act unlawful. (*Parkinson v. Building Trades Council*, 154 Cal. 581, 98 Pac. 1027. *Pierce v. Stablemen's Union*, 156 Cal. 70, 103 Pac. 324.) Unquestionably there was nothing illegal in the measures employed to accomplish this result. The suasion or intimidation or coercion was purely moral, and went no further upon the part of the defendants than a refusal to employ or to retain in their employ any one unwilling to comply with their hospital regulation. This was purely a matter between employer and employee, and where no contract between them stands in the way it is the unquestioned right of the employee to leave the employment at his pleasure, and it is equally the right of the employer to discharge at his pleasure, or to impose conditions upon the retention of the employee in his employment.

Appellant contends this is an action in tort, based on the malicious and wanton acts of the respondent, and seems to predicate his right to recovery upon respondent's wrongful motive. Judge Cooley, at page 1505 (832) of volume 2 (third edition) of his work on Torts, says: "Bad motive, by itself, then, is no tort. Malicious motives make a bad act worse, but they can not make that a wrong which in its own essence is lawful. An act which does not amount to a legal injury can not be actionable, because it is done with a bad intent. Where one exercises a legal right only, the motive which actuates him is immaterial. When in legal pleadings the defendant is charged with having wrongfully and unlawfully done the act complained of, the words are only words of vituperation, and amount to nothing unless a cause of action is otherwise alleged." In substance, the act of respondent of which appellant complains is that it has maliciously caused its employees to violate their contract with him; but the acts herein alleged give the appellant no cause of action as against respondent. (*Boyson v. Thorn*, 98 Cal. 578, 33 Pac. 492.)

We are unable to perceive where any element of monopoly enters into this consideration, as respondent contends. Defendants had the undoubted right to deal with any hospital which they might select. In fact they are dealing with four, and they are not even prohibiting their men from engaging the services of plaintiff. We repeat, that since the acts of defendants are within their legal rights, the motive for those acts is not a subject of inquiry. "To entitle a plaintiff to recover, there must be a wrong done. 'No one is a wrongdoer but he who does what the law does not allow.' He who does what the law allows can not be a wrongdoer whatever his motive. So no one is guilty of a fraud because he exerts his rights. The motive which may induce such exertion is immaterial." (*Heywood v. Tillson*, 75 Me. 237, 46 Am. Rep. 373.)

The judgment is reversed and the cause remanded.

BOYCOTT—CONSPIRACY—INJUNCTIONS—RIGHTS SUBJECT TO PROTECTION—DAMAGES—*Baldwin v. Escanaba Liquor Dealers' Association*, *Supreme Court of Michigan*, 130 *Northwestern Reporter*, page 214.—This case involves the boycotting of a newspaper by an unincorporated association of persons resident in the city and county in which the newspaper was published. It is not a case involving the activities of a labor union, but involves identical principles. Francis L. Baldwin, proprietor of the *Escanaba Journal*, had brought suit in the circuit court of Delta County to secure an injunction and damages on account of activities of an association commonly known as the *Escanaba Liquor Dealers' Association*, together with other defendants. Baldwin, as proprietor of the *Journal*, published articles, editorials, and news items commenting on and criticising alleged unlawful methods of conducting business followed by the liquor dealers' association of the city and criticising the laxity of the enforcement of the law with reference thereto. It was in evidence that a committee of the association visited a number of patrons of the journal who had published advertisements therein or had job work done in its office, and that as a result of such interference and threats of injury to business his interests were endangered and his business damaged. Judgment was rendered in Baldwin's favor in the court below in an extended opinion delivered by Judge Stone. On appeal to the supreme court this judgment was affirmed, the court adopting the opinion of Judge Stone as the opinion of the supreme court. This opinion reviewed the facts and reached the conclusion from the evidence that there had been formed a conspiracy or combination at meetings of the association looking to interfering with the legitimate business of the complainant by way of boycott if he did not desist from further publications relating to the liquor and kindred business in the city of Escanaba. The acts of the committee

and the members of the committee and all other persons that came to the meetings were regarded as carrying out the same end of inducing Baldwin's customers to do no further business with him. The following is quoted from the opinion:

In restraining boycotts the authorities proceed on the theory that they are unlawful interferences with property rights. The constitution of our State guarantees liberty to every citizen, and a certain remedy in the laws for all injuries or wrongs which he may receive in his person, property, or character; and the rights so guaranteed are fundamental, and can be taken away only by the law of the land, or interfered with, or the enjoyment thereof modified only by lawful regulations adopted as necessary for the general public welfare.

As remarked by Judge Bradley in the *Slaughterhouse Cases*, 16 Wall. (U. S.) 36-116, 21 L. Ed. 394: "For the preservation, exercise, and enjoyment of these rights the individual citizen, as a necessity, must be left free to adopt such calling, profession, or trade as may seem to him most conducive to that end. This right to choose one's calling is an essential part of the liberty which it is the object of government to protect; and a calling when chosen is a man's property and right. Liberty and property are not protected where these rights are arbitrarily assailed."

A person's occupation or calling by means of which he earns a livelihood and endeavors to better his condition and to provide for and support himself and those dependent upon him, is property within the meaning of the law, and entitled to protection as such. Persons may organize and persuade and induce others to join them, but when they resort to unlawful means to cause injury to others with whom they have no relations, contractual or otherwise, the limit permitted by the law is passed, and they may be restrained. (*Gray v. Building Trades' Council*, 91 Minn. 171, 97 N. W. 663.)

But we need not go outside of our own decisions to find ample support for the doctrine already stated. In *Beck v. Railway Teamsters' Protective Union* (118 Mich. 497, 77 N. W. 13), it was held that injunction would lie to restrain a combination of persons from attempting to ruin complainant's business, by bringing to bear upon his customers and employees intimidating and coercive means, though the acts were unaccompanied by actual violence or threats of violence. Mr. Justice Grant, speaking for the court, said: "The law abhors subterfuges. It lays aside the covering and looks to the actual facts beneath. In the language of Chief Justice Shaw: 'The law is not to be hoodwinked by colorable pretenses; it looks at truth and reality, through whatever disguise it may assume.'" (*Com. v. Hunt*, 4 Metc. (Mass.) 111, 129, 38 Am. Dec. 346.) "Threats in language are not the only threats recognized by the law. Covert and unspoken threats may be just as effective as spoken threats."

There would seem to be no doubt that the defendants constituting the committee, by their language and conduct in their interview with Salinsky and Wilkinson and other parties, as disclosed by the evidence, intended in an emphatic manner to convey to them, as customers of complainant, that they would be boycotted unless they ceased to trade or do business with complainant. "The law sanctions only peaceful means, which leave everyone to the exercise of

his own free will. The boycott condemned by the law is not alone that accompanied by violence and threats of violence, but that where the means used are threatening in their nature, and intended and naturally tend to overcome, by fear of loss of property, the will of others, and compel them to do things which they would not otherwise do." (See also *Ideal Mfg. Co. v. Ludwig*, 149 Mich. 133, 112 N. W. 723.)

Under the evidence there can be no doubt that the defendants, constituting the committee, carried out and acted in accordance with the instructions of the meeting of January, 1908. The conspiracy was formed at the meeting. All of those who were present and acting in concert with the project of the meeting were equally guilty with the committee. The evidence shows that all who were present and acting in concert in the appointing of this committee, and acquiescing therein, were equally guilty.

Upon the subject of damages it seems to be well settled in this State that equity, having once acquired jurisdiction, will retain it, to give such full relief as will finally dispose of the controversy. The complainant was by his bill entitled to an injunction. The court had jurisdiction. It should retain it to give relief by way of damages, and thus avoid a multiplicity of suits. (See cases cited in *Hall v. Nester*, 122 Mich. 146, 80 N. W. 982.)

I am unable to agree with complainant's solicitor as to the amount of damages sustained by the complainant by reason of the conspiracy, as shown by the evidence. The withdrawal of business by a number of the parties is not traceable to the conspiracy or the acts following it. The loss occasioned by the withdrawal of the business of the witness Salinsky is the most tangible and the largest in amount. After a careful reading of the evidence upon this subject, and taking into consideration that these damages which the plaintiff has suffered have been continuing and may continue for an indefinite period, and that the acts of the defendants which are complained of have been willful and oppressive, I am constrained to fix the damages of the complainant at the sum of \$1,000.

BOYCOTT—INJUNCTION—CONTEMPT—PUNISHMENT—*Gompers v. Bucks Stove & Range Co.*, *Supreme Court of the United States*, 31 *Supreme Court Reporter*, page 492.—Samuel Gompers, John Mitchell, and Frank Morrison had been judged guilty of contempt in violating an injunction restraining them from continuing a boycott against the company named, and were sentenced to terms in jail by the Supreme Court of the District of Columbia. (See Bulletin No. 83, p. 169.) This judgment was affirmed by the court of appeals of the District of Columbia. (See Bulletin No. 86, p. 355.) Following this the case was appealed to the Supreme Court of the United States. Earlier proceedings in the same case are presented in Bulletins No. 74, page 246, and No. 80, page 124. There was also an appeal by the company on the ground that the court of appeals had erroneously modified the injunction issued by the Supreme Court of the District.

After stating the facts and discussing the nature of the various questions that had been raised in the lower courts, Justice Lamar delivered the opinion of the Supreme Court as follows:

The defendants, Samuel Gompers, John Mitchell, and Frank Morrison, were found guilty of contempt of court in making certain publications prohibited by an injunction from the Supreme Court of the District of Columbia. They were sentenced to imprisonment for 12, 9, and 6 months, respectively, and this proceeding is prosecuted to reverse that judgment.

The order alleged to have been violated was granted in the equity suit of the Bucks Stove & Range Company *v.* The American Federation of Labor and others, in which the court issued an injunction restraining all the defendants from boycotting the complainant, or from publishing or otherwise making any statement that the Bucks Stove & Range Co. was, or had been, on the "Unfair" or "We don't patronize" lists. Some months later the complainant filed a petition in the cause, alleging that the three defendants above named, parties to the original cause, in contempt of court and in violation of its order, had disobeyed the injunction by publishing statements which either directly or indirectly called attention to the fact that the Bucks Stove & Range Co. was on the "Unfair" list, and that they had thereby continued the boycott which had been enjoined.

The defendants filed separate answers under oath, and each denied (1) that they had been in contempt or disregard of the court's orders; (2) that the statements complained of constituted any violation of the order; and, on the argument, (3) contended that if the publication should be construed to amount to a violation of the injunction they could not be punished therefor, because the court must not only possess jurisdiction of the parties and the subject matter, but must have authority to render the particular judgment. Insisting, therefore, that the court could not abridge the liberty of speech or freedom of the press, the defendants claim that the injunction as a whole was a nullity, and that no contempt proceeding could be maintained for any disobedience of any of its provisions, general or special.

If this last proposition were sound it would be unnecessary to go further into an examination of the case or to determine whether the defendants had in fact disobeyed the prohibitions contained in the injunction. (*Ex parte Rowland*, 104 U. S. 612.) But we will not enter upon a discussion of the constitutional question raised, for the general provisions of the injunction did not, in terms, restrain any form of publication. The defendants' attack on this part of the injunction raises no question as to an abridgment of free speech, but involves the power of a court of equity to enjoin the defendants from continuing a boycott which, by words and signals, printed or spoken, caused or threatened irreparable damage.

Courts differ as to what constitutes a boycott that may be enjoined. All hold that there must be a conspiracy causing irreparable damage to the business or property of the complainant. Some hold that a boycott against the complainant, by a combination of persons not immediately connected with him in business, can be restrained. Others hold that the secondary boycott can be enjoined where the conspiracy extends not only to injuring the complainant, but sec-

ondarily coerces or attempts to coerce his customers to refrain from dealing with him by threats that unless they do they themselves will be boycotted. Others hold that no boycott can be enjoined unless there are acts of physical violence or intimidation caused by threats of physical violence.

But whatever the requirement of the particular jurisdiction as to the conditions on which the injunction against a boycott may issue, when these facts exist, the strong current of authority is that the publication and use of letters, circulars, and printed matter may constitute a means whereby a boycott is unlawfully continued, and their use for such purpose may amount to a violation of the order of injunction. (*Reynolds v. Davis*, 198 Mass. 300; *Sperry v. Perkins*, 147 Mass. 212; *Davis v. Reynolds*, 203 Mass. 150; *Brown v. Jacobs*, 115 Ga. 452, 431; *Gray v. Council*, 91 Minn. 133; *Lohse Co. v. Fuelle*, 215 Mo. 421, 472; *Thomas v. Railroad Co.*, 62 Fed. 803, 821; *Continental Co. v. Board of Underwriters*, 67 Fed. R. 332; *Beck v. Teamsters' Union*, 118 Mich. 527; *Pratt Food Co. v. Bird*, 148 Mich. 632; *Barr v. Essex*, 53 N. J. Eq. 102. See also *Ludwig v. Western Union Telegraph Co.*, 216 U. S. 156; *Bitterman v. L. & N. R. R.*, 207 U. S. 206; *Board of Trade v. Christie*, 198 U. S. 236; *Scully v. Bird*, 209 U. S. 489.)

While the bill in this case alleged that complainant's interstate business was restrained, no relief was asked under the provisions of the Sherman antitrust act. But if the contention be sound that no court under any circumstances can enjoin a boycott if spoken words or printed matter were used as one of the instrumentalities by which it was made effective, then it could not do so, even if interstate commerce was restrained by means of a blacklist, boycott, or printed device to accomplish its purpose. And this, too, notwithstanding section 4 (26 Stat. 209) of that act provides that where such commerce is unlawfully restrained it shall be the duty of the Attorney General to institute proceedings in equity to prevent and enjoin violations of the statute.

In *Loewe v. Lawler* (208 U. S. 206) the statute was held to apply to any unlawful combination resulting in restraint of interstate commerce. In that case the damages sued for were occasioned by acts which, among other things, did include the circulation of advertisements. But the principle announced by the court was general. It covered any illegal means by which interstate commerce is restrained, whether by unlawful combinations of capital or unlawful combinations of labor; and we think also whether the restraint be occasioned by unlawful contracts, trusts, pooling arrangements, black lists, boycotts, coercion, threats, intimidation, and whether these be made effective, in whole or in part, by acts, words, or printed matter.

The court's protective and restraining powers extend to every device whereby property is irreparably damaged or commerce is illegally restrained. To hold that the restraint of trade under the Sherman Antitrust Act, or on general principles of law, could be enjoined but that the means through which the restraint was accomplished could not be enjoined would be to render the law impotent.

Society itself is an organization and does not object to organizations for social, religious, business, and all legal purposes. The law, therefore, recognizes the right of workmen to unite and to invite

others to join their ranks, thereby making available the strength, influence, and power that come from such association. By virtue of this right powerful labor unions have been organized.

But the very fact that it is lawful to form these bodies, with multitudes of members, means that they have thereby acquired a vast power, in the presence of which the individual may be helpless. This power, when unlawfully used against one, can not be met except by his purchasing peace at the cost of submitting to terms which involve the sacrifice of rights protected by the Constitution, or by standing on such rights and appealing to the preventive powers of a court of equity. When such appeal is made it is the duty of Government to protect the one against the many as well as the many against the one.

In the case of an unlawful conspiracy the agreement to act in concert when the signal is published gives the words "Unfair," "We don't patronize," or similar expressions a force not inhering in the words themselves, and therefore exceeding any possible right of speech which a single individual might have. Under such circumstances they become what have been called "verbal acts," and as much subject to injunction as the use of any other force whereby property is unlawfully damaged. When the facts in such cases warrant it a court having jurisdiction of the parties and subject matter has power to grant an injunction.

Passing then to the consideration of the question as to whether the defendants disobeyed the injunction and were therefore guilty of contempt, we are met with the objection that for want of a bill of exceptions we must treat the decree as conclusive as to the fact of disobedience, and can only examine the petition and the finding to determine whether one charges and the other finds acts which constitute a contempt of court. This view was adopted by the majority of the court of appeals, which treated this as a criminal proceeding, refused to examine the testimony, and affirmed the judgment in analogy to the rule that on a general verdict of guilty upon an indictment containing several counts, some of which were bad, the conviction would not be reversed if there was one good count warranting the judgment.

That rule originated in cases where the finding of guilt was by the jury while the sentence was by the judge. In such cases the presumption is that the judge ignored the finding of the jury on the bad counts and sentenced only on those which were sufficient to sustain the conviction.

But there is no room for such presumption here. The trial judge made no general finding that the defendants were guilty. But in one decree he adjudged that each defendant was respectively guilty of the nine independent acts set out in separate paragraphs of the petition. Having found that each was guilty of these separate acts he consolidated the sentence without indicating how much of the punishment was imposed for the disobedience in any particular instance. We can not suppose that he found the defendants guilty of an act charged unless he considered that it amounted to a violation of the injunction. Nor can we suppose that having found them guilty of these nine specific acts he did not impose some punishment for each. Instead, therefore, of affirming the judgment if there is one good count, it should be reversed if it should appear that the defendants

have been sentenced on any count which, in law or in fact, did not constitute a disobedience of the injunction.

But in making such investigation it is again insisted that this is a proceeding at law for criminal contempt, where the findings of fact by the trial judge must be treated as conclusive, and that our investigation must be limited solely to the question whether, as a matter of law, the acts of alleged disobedience set out in the finding constitute contempt of court.

This contention on the part of the Bucks Stove & Range Co. prevents a consideration of the case on its merits and makes it necessary to enter into a discussion of questions more or less technical as to whether this was a proceeding in equity or at law. Where results so controlling depend upon proper classification it becomes necessary carefully to consider whether this was a case at law for criminal contempt, where the evidence could not be examined for want of a bill of exceptions, or a case in equity for civil contempt, where the whole record may be examined on appeal and a proper decree entered.

Contempts are neither wholly civil nor altogether criminal. And "it may not always be easy to classify a particular act as belonging to either one of these two classes. It may partake of the characteristics of both." (*Bessette v. Conkey*, 194 U. S. 329.) But in either event, and whether the proceedings be civil or criminal, there must be an allegation that in contempt of court the defendant has disobeyed the order, and a prayer that he be attached and punished therefor. It is not the fact of punishment but rather its character and purpose that often serve to distinguish between the two classes of cases. If it is for civil contempt the punishment is remedial, and for the benefit of the complainant. But if it is for criminal contempt the sentence is punitive, to vindicate the authority of the court. It is true that punishment by imprisonment may be remedial, as well as punitive, and many civil contempt proceedings have resulted not only in the imposition of a fine, payable to the complainant, but also in committing the defendant to prison. But imprisonment for civil contempt is ordered where the defendant has refused to do an affirmative act required by the provisions of an order which, either in form or substance, was mandatory in its character. Imprisonment in such cases is not inflicted as a punishment, but is intended to be remedial by coercing the defendant to do what he had refused to do. The decree in such cases is that the defendant stand committed unless and until he performs the affirmative act required by the court's order.

For example: If a defendant should refuse to pay alimony, or to surrender property ordered to be turned over to a receiver, or to make a conveyance required by a decree for specific performance, he could be committed until he complied with the order. Unless there were special elements of contumacy, the refusal to pay or to comply with the order is treated as being rather in resistance to the opposite party than in contempt of the court. The order for imprisonment in this class of cases, therefore, is not to vindicate the authority of the law, but is remedial and is intended to coerce the defendant to do the thing required by the order for the benefit of the complainant. If imprisoned, as aptly said in *In re Nevitt*, 117 Fed. 451, "he carries the keys of his prison in his own pocket." He can end the sentence and discharge himself at any moment by doing what he had previously refused to do.

On the other hand, if the defendant does that which he has been commanded not to do, the disobedience is a thing accomplished. Imprisonment can not undo or remedy what has been done nor afford any compensation for the pecuniary injury caused by the disobedience. If the sentence is limited to imprisonment for a definite period, the defendant is furnished no key, and he can not shorten the term by promising not to repeat the offense. Such imprisonment operates, not as a remedy coercive in its nature, but solely as punishment for the completed act of disobedience.

It is true that either form of imprisonment has also an incidental effect. For if the case is civil and the punishment is purely remedial, there is also a vindication of the court's authority. On the other hand, if the proceeding is for criminal contempt and the imprisonment is solely punitive, to vindicate the authority of the law, the complainant may also derive some incidental benefit from the fact that such punishment tends to prevent a repetition of the disobedience. But such indirect consequences will not change imprisonment which is merely coercive and remedial into that which is solely punitive in character, or vice versa.

The fact that the purpose of the punishment could be examined with a view to determining whether it was civil or criminal is recognized in *Doyle v. London Guarantee Co.*, 204 U. S. 605, 607, where it was said that "While it is true that the fine imposed is not made payable to the opposite party, compliance with the order relieves from payment, and in that event there is no final judgment of either fine or imprisonment. * * * The proceeding is against the party, compliance with the order avoids the punishment, and there is nothing in the nature of a criminal suit or judgment imposed for public purposes upon a defendant in a criminal proceeding." (*Bessette v. Conkey*, 194 U. S. 328; *In re Nevitt*, 117 Fed. 448; *Howard v. Durand*, 36 Ga. 359; *Phillips v. Welch*, 11 Nev. 187.)

The distinction between refusing to do an act commanded, remedied by imprisonment until the party performs the required act, and doing an act forbidden, punished by imprisonment for a definite term, is sound in principle, and generally, if not universally, affords a test by which to determine the character of the punishment.

In this case the alleged contempt did not consist in the defendant's refusing to do any affirmative act required, but rather in doing that which had been prohibited. The only possible remedial relief for such disobedience would have been to impose a fine for the use of complainant, measured in some degree by the pecuniary injury caused by the act of disobedience. (*Rapalje on Contempt*, secs. 131-134; *Mills v. Oregon Co.*, 19 Fed. 20; *In re North Bloomfield Co.*, 27 Fed. 795; *Sabin v. Fogarty*, 70 Fed. 483.)

But when the court found that the defendants had done what the injunction prohibited, and thereupon sentenced them to jail for fixed terms of 6, 9, and 12 months, no relief whatever was granted to the complainant, and the Bucks Stove & Range Co. took nothing by that decree.

If then, as the court of appeals correctly held, the sentence was wholly punitive, it could have been properly imposed only in a proceeding instituted and tried as for criminal contempt. The question as to the character of such proceedings has generally been raised, in the appellate court, to determine whether the case could be reviewed

by writ of error or on appeal. (*Bessette v. Conkey*, 194 U. S. 324.) But it may involve much more than mere matters of practice. For, notwithstanding the many elements of similarity in procedure and in punishment, there are some differences between the two classes of proceedings which involve substantial rights and constitutional privileges. Without deciding what may be the rule in civil contempt, it is certain that in proceedings for criminal contempt the defendant is presumed to be innocent, he must be proved to be guilty beyond a reasonable doubt, and can not be compelled to testify against himself. (*Boyd v. United States*, 116 U. S. 616; *United States v. Jose*, 63 Fed. 951; *State v. Davis*, 50 W. Va. 100; *King v. Ohio Ry.*, 7 Biss. 529; *Sabin v. Fogarty*, 70 Fed. 482; *Drakeford v. Adams*, 98 Ga. 724.)

There is another important difference. Proceedings for civil contempt are between the original parties and are instituted and tried as a part of the main cause. But on the other hand, proceedings at law for criminal contempt are between the public and the defendant, and are not a part of the original cause. The court of appeals recognizing this difference held that this was not a part of the equity cause of the *Bucks Stove & Range Company v. The American Federation of Labor et. al.*, and said that: "The order finding the defendants guilty of contempt was not an interlocutory order in the injunction proceedings. It was in a separate action, one personal to the defendants, with the defendants on one side and the court vindicating its authority on the other."

In this view we can not concur. We find nothing in the record indicating that this was a proceeding with the court, or more properly the Government, on one side and the defendants on the other. On the contrary, the contempt proceedings were instituted, entitled, tried, and up to the moment of sentence treated as a part of the original cause in equity. The *Bucks Stove & Range Co.* was not only the nominal, but the actual party on the one side, with the defendants on the other. The *Bucks Stove Co.* acted throughout as complainant in charge of the litigation. As such and through its counsel, acting in its name, it made consents, waivers, and stipulations only proper on the theory that it was proceeding in its own right in an equity cause, and not as a representative of the United States prosecuting a case of criminal contempt. It appears here also as the sole party in opposition to the defendants; and its counsel, in its name, have filed briefs and made arguments in this court in favoring affirmance of the judgment of the court below.

But as the court of appeals distinctly held that this was not a part of the equity cause, it will be proper to set out in some detail the facts on this subject as they appear in the record.

In the first place, the petition was not entitled "*United States v. Samuel Gompers et al.*" or "*In re Samuel Gompers et al.*," as would have been proper, and according to some decisions necessary, if the proceedings had been at law for criminal contempt. This is not a mere matter of form, for manifestly every citizen, however unlearned in the law, by a mere inspection of the papers in contempt proceedings ought to be able to see whether it was instituted for private litigation or for public prosecution, whether it sought to benefit the complainant or vindicate the court's authority. He should not be

left in doubt as to whether relief or punishment was the object in view. He is not only entitled to be informed of the nature of the charge against him, but to know that it is a charge and not a suit. (*United States v. Cruickshank*, 93 U. S. 542, 559.)

Inasmuch, therefore, as proceedings for civil contempt are a part of the original cause, the weight of authority is to the effect that they should be entitled therein. But the practice has hitherto been so unsettled in this respect that we do not now treat it as controlling, but only as a fact to be considered along with others, as was done in *Worden v. Searles* (121 U. S. 25) in determining a similar question. Thus considering it, we find that the petition instituting the contempt proceeding was entitled in the main cause "*Bucks Stove & Range Company, plaintiff, v. The American Federation of Labor et al., defendants*, No. 27305, Equity," and that the answers of the defendants, every report by the examiner in chancery, every deposition, motion, and stipulation, every order—including the final decree and the amended decree, were all uniformly entitled in the equity cause. Not only the pleadings in the original cause, but all the testimony, oral and written, was, by reference in the petition, made a part of the contempt proceedings. The trial judge quoted largely from this oral testimony thus introduced in bulk, and the severity and character of the sentence indicate that he was largely influenced by this evidence which disclosed the great damage done to the complainant's business by the boycott before the injunction issued.

It is argued the defendants' answers concluded with a statement that as questions of criminal and quasi criminal intent were involved, a jury was better qualified to pass on the issues than a judge, and in the event he should be of opinion that the charges had not been sworn away, they moved that issues of fact should be framed and submitted to a jury. Such a motion was not inconsistent with the theory that this was a proceeding for civil contempt in equity, but was in strict accord with the practice under which questions of fact may be referred by the chancellor to a jury for determination.

In proceedings for civil contempt the complainant, if successful, is entitled to costs. (*Rapalje on Contempts*, sec. 132.) And evidently on the theory that this was a civil proceeding and to be governed by the rules applicable to an equity cause, the *Bucks Stove & Range Co.* moved the court to amend the decree so as to award to it "its costs." After argument by solicitors for both parties, the motion was granted, and the court adjudged that the complainant do recover against the defendants its costs in said contempt proceeding. This ruling was no doubt correct, as this was a civil case, but could not have been granted in a proceeding for criminal contempt, where costs are not usually imposed in addition to the imprisonment. Where they are awarded they go to the Government for the use of its officers, as held by Justice Miller on circuit. (*Durant v. Washington County*, 4 Woolw. 297.)

In another most important particular the parties clearly indicated that they regarded this as a civil proceeding. The complainant made each of the defendants a witness for the company, and, as such, each was required to testify against himself—a thing that most likely would not have been done, or suffered, if either party had regarded this as a proceeding at law for criminal contempt—because the pro-

vision of the Constitution that "no person shall be compelled in any criminal case to be a witness against himself" is applicable, not only to crimes, but also to quasi criminal and penal proceedings. (*Boyd v. United States*, 116 U. S. 616.)

Both on account of the distinct ruling to the contrary by the court of appeals, and the importance of the results flowing from a proper classification, we have with some detail discussed the facts appearing in the record, showing that both parties treated this as a proceeding which was a part of the original equity cause. In case of doubt this might, of itself, justify a determination of the question in accordance with the mutual understanding of the parties, and the procedure adopted by them. But there is another and controlling fact, found in the brief but sufficient prayer with which the petition concludes. We have already shown that in both classes of cases there must be allegation and proof that the defendant was guilty of contempt, and a prayer that he be punished. The classification then depends upon the question as to whether the punishment is punitive, in vindication of the court's authority, or whether it is remedial by way of a coercive imprisonment, or a compensatory fine payable to the complainant. Bearing these distinctions in mind, the prayer of the petition is significant and determinative. After setting out in detail the acts of alleged disobedience, the petition closes with the following prayers: (1) "That the defendants show cause why they should not be adjudged in contempt of court and be punished for the same," and (2) "that petitioner may have such other and further relief as the nature of its case may require."

"Its case"—not the Government's case. "That petitioner may have relief"—not that the court's authority may be vindicated. The Bucks Stove & Range Co. was not asserting the rights of the public, but seeking "such other and further relief as the nature of its case may require." If it had asked that the defendants be forced to pay a fine to the Government, or be punished by confinement in jail, there could have been no doubt that punishment pure and simple was sought.

On the other hand, if it had prayed that the court impose a fine payable to the Bucks Stove & Range Co., the language would have left no doubt that remedial punishment was sought. It is not different in principle if, instead of praying specifically for a fine payable to itself, it asks generally for "such relief as the nature of its case may require." In either event such a prayer was appropriate to a civil proceeding, and under it the court could have granted that form of relief to which the petitioner was entitled. But as the act of disobedience consisted not in refusing to do what had been ordered, but in doing what had been prohibited by the injunction, there could be no coercive imprisonment, and therefore the only relief, if any, which "the nature of petitioners case" admitted, was the imposition of a fine payable to the Bucks Stove & Range Co.

There was therefore a departure—a variance between the procedure adopted and the punishment imposed, when, in answer to a prayer for remedial relief, in the equity cause, the court imposed a punitive sentence appropriate only to a proceeding at law for criminal contempt. The result was as fundamentally erroneous as if in an action of "*A. v. B. for assault and battery*," the judgment

entered had been that the defendant be confined in prison for 12 months.

If then this sentence for criminal contempt was erroneously entered in a proceeding which was a part of the equity cause, it would be necessary to set aside the order of imprisonment, examine the testimony, and thereupon make such decree as was proper, according to the practice in equity causes on appeal. And, if upon the examination of the record it should appear that the defendants were in fact and in law guilty of the contempt charged, there could be no more important duty than to render such a decree as would serve to vindicate the jurisdiction and authority of courts to enforce orders and to punish acts of disobedience. For while it is sparingly to be used, yet the power of courts to punish for contempts is a necessary and integral part of the independence of the judiciary, and is absolutely essential to the performance of the duties imposed on them by law. Without it they are mere boards of arbitration whose judgments and decrees would be only advisory.

If a party can make himself a judge of the validity of orders which have been issued, and by his own act of disobedience set them aside, then are the courts impotent, and what the Constitution now fittingly calls the "judicial power of the United States" would be a mere mockery.

This power "has been uniformly held to be necessary to the protection of the court from insults and oppression while in the ordinary exercise of its duty, and to enable it to enforce its judgments and orders necessary to the due administration of law and the protection of the rights of citizens." (*Bessette v. Conkey*, 194 U. S. 333.)

There has been general recognition of the fact that the courts are clothed with this power and must be authorized to exercise it without referring to the issues of fact or law to another tribunal or to a jury in the same tribunal. For if there was no such authority in the first instance there would be no power to enforce its orders if they were disregarded in such independent investigation. Without authority to act promptly and independently the courts could not administer public justice or enforce the rights of private litigants. (*Bessette v. Conkey*, 194 U. S. 337.)

Congress in recognition of the necessity of the case has also declared (Rev. Stat. 725) that the courts of the United States "shall have power to punish by fine or imprisonment contempts of their authority" * * * including "disobedience * * * by any party of any lawful order * * * of the said court." But the very amplitude of the power is a warning to use it with discretion, and a command never to exert it where it is not necessary or proper. For that reason we can proceed no further in this case because it is both unnecessary and improper to make any decree in this contempt proceeding.

For on the hearing of the appeal and cross appeal in the original cause in which the injunction was issued, it appeared from the statement of counsel in open court that there had been a complete settlement of all matters involved in the case of *Bucks Stove & Range Company v. The American Federation of Labor et al.* This court therefore declined to further consider the case, which had become moot, and those two appeals were dismissed. (219 U. S. 581.) When the main case was settled, every proceeding which was dependent on

it, or a part of it, was also necessarily settled—of course without prejudice to the power and right of the court to punish for contempt by proper proceedings. (*Worden v. Searles*, 121 U. S. 27.) If this had been a separate and independent proceeding at law for criminal contempt, to vindicate the authority of the court, with the public on one side and the defendants on the other, it could not, in any way, have been affected by any settlement which the parties to the equity cause made in their private litigation.

But, as we have shown, this was a proceeding in equity for civil contempt where the only remedial relief possible was a fine payable to the complainant. The company prayed "for such relief as the nature of its case may require," and when the main cause was terminated by a settlement of all differences between the parties, the complainant did not require and was not entitled to any compensation or relief of any other character. The present proceeding necessarily ended with the settlement of the main cause of which it is a part. (*Bessette v. Conkey*, 194 U. S. 328, 333; *Worden v. Searles*, 121 U. S. 27; *State v. Nathan*, 49 S. C. 207.) The criminal sentences imposed in the civil case, therefore, should be set aside.

The judgment of the court of appeals is reversed, and the case remanded with directions to reverse the judgment of the Supreme Court of the District of Columbia and remand the case to that court with direction that the contempt proceedings instituted by the Bucks Stove & Range Co. be dismissed, but without prejudice to the power and right of the Supreme Court of the District of Columbia to punish by a proper proceeding, contempt, if any, committed against it.

EMPLOYERS' LIABILITY—VICE PRINCIPALSHIP—NATURE OF ACT AS TEST—*Tendall v. Great Northern Railway Co.*, *Supreme Court of Minnesota*, 130 *Northwestern Reporter*, page 22.—Lars Tendall sued the company named to recover damages for injuries received by him while in its employment as member of a wrecking crew. While working under the orders of the foreman, Landberg, he assumed a position in accordance with the foreman's orders and while in that position was injured as result of the car becoming loose, partly as a result of Landberg's physical efforts applied in assisting the other workmen in the labor. The jury in the trial court brought in a verdict in Tendall's favor, but the judge of the court decided against him, notwithstanding the verdict, whereupon the plaintiff appealed. The judge in the court below had held that when Landberg undertook to assist in the physical labor of releasing the car he became a fellow servant with Tendall, for whose actions the employing company was not responsible. On hearing in the supreme court this view was rejected and the judgment for the company was reversed and the verdict ordered reinstated. From the opinion of the court, which was delivered by Judge Lewis, the following is quoted:

It was conceded at the argument that Landberg was a vice principal up to the time all began to pry up the car, but it was claimed that

they then became engaged in a common enterprise, and the relation of vice principal and laborer ceased. A little reflection will disclose the fallacy of this position. If the plaintiff was subject to the control of the master at the time, and in obedience to orders took a position at the west end of the car for the purpose of applying the bar, at what particular point of time did the relation of master and servant cease? If the relation existed up to the time plaintiff took his position, it continued to exist while engaged in carrying out the orders. And if plaintiff had the right to assume that the master would exercise due care for his protection, then Landberg's action in assisting to lift the car did not convert himself from a master into a fellow servant. The servant was justified in remaining at his post with the assurance that his superior would exercise reasonable care to protect him.

EMPLOYERS' LIABILITY INSURANCE—CONTRACT TO DEFEND ACTION—DENIAL OF LIABILITY—ESTOPPEL—*Fairbanks Canning Co. v. London Guaranty & Accident Co., Court of Appeals of Missouri, 133 Southwestern Reporter, page 664.*—The canning company had taken out a policy of insurance in the accident company named to indemnify it against losses by reason of damages accruing to employees on account of injuries for which the canning company should become legally liable. The liability on account of any single claim was limited to \$5,000, and the policy was drawn not to cover loss from liability for injuries or death to or caused by any child employed by the canning company contrary to law, or to any child under 14 years of age where no statute restricts the age of employment. The accident company was to be notified of the occurrence of any accident and of all claims and actions made or undertaken against the canning company, whereupon it was to defend all suits and actions unless it should elect to settle the same without trial.

The canning company had in its employment one James Stamp, whose age was represented to be 16 years. During the existence of the insurance contract young Stamp was permanently injured and brought suit for damages for personal injuries, as did his father for the loss of services of his son. Notice was duly given to the insurance company of the accident and the suit and it took charge and control of the defense and assumed the expense of the same, among other things having the case transferred to a Federal court. Negotiations were undertaken to secure settlement before trial and an offer was obtained from the attorney for the injured boy of a settlement for \$7,000. This sum was \$2,000 more than the insurance company's maximum liability under the policy, and a conference was had as to the proportion the two companies would pay. Further conference reduced the demand to \$6,000, but the insurance company was unwilling to pay more than \$3,500 on a settlement on the basis of \$5,000 as total payment, leaving the canning company the sum of \$1,500 to pay;

which fell short of the demand of the Stamps' attorney by the sum of \$1,000. About 10 months of time had elapsed from the date of the injury before this agreement had been reached, and the time of trial was approaching, when the insurance company, without notifying the canning company of its intentions, secured evidence to the effect that James Stamp was, in fact, under 14 years of age when employed by the plaintiff, and was therefore not within the original terms of the policy. It therefore denied its liability and withdrew from its control and management of the legal proceedings, and left the canning company to make its settlement with the injured parties.

This case was an action by the canning company to recover from the insurance company on its policy, and it secured a verdict in the circuit court of Buchanan County in its favor. The insurance company then secured an order for a new trial, whereupon the canning company appealed, the result of the appeal being that the order for a new trial was reversed and the case remanded with directions to enter judgment on the original verdict. The principal point involved in the case was that of the right of the insurance company to withdraw from the defense after having conducted negotiations for a period of 10 months and assumed the responsibility for the defense. On this point Judge Ellison, who delivered the opinion of the court, spoke as follows:

It will be noticed that by condition "B," above set out as part of the policy, the defendant expressly disclaimed liability for injury to any child under 14 years of age employed by the plaintiff. Defendant discovered in the manner we have already stated that James Stamp was under that age, and it now insists upon such fact as a complete bar to plaintiff's claim; and it is conceded it would be, but for its conduct, which plaintiff designates as a waiver of such defense, or as an election on its part to regard the policy as binding and as entitling plaintiff to reimbursement if Stamp was hurt in such circumstances as would render it liable to him. Defendant answers this by the argument that there can be no estoppel in pais without knowledge, and that, as it did not know Stamp was under 14 years of age until after the action had been taken which is claimed to constitute the estoppel, none could arise against it. Defendant is not entirely correct in saying it must have had knowledge before its acts could estop it from making use of a fact establishing its nonliability. A party in the position that defendant occupied in this case may carelessly choose to act without knowledge, or it may regard the matter about which it is concerned as of doubtful character, and may choose to act by taking charge of the case. In either instance the assured would have the right to assume that he was acquainted with the situation, and was taking such action as was deemed most prudent for his own interests. Such action is sometimes said to constitute an estoppel in pais (*Mining Co. v. Fidelity Co.*, 126 Mo. App. 104, 103 S. W. 1098; *Glens Falls P. C. v. Insurance Co.*, 162 N. Y. 399, 56 N. E. 897); sometimes it is denominated an election of position which can not afterwards be changed (*Tozer v. Ocean Accident*

Corp., 94 Minn. 478, 103 N. W. 509); sometimes it is said to be a contemporaneous construction of the contract by the party claimed to be bound (*Employers' Liability Co. v. Chicago & Big Muddy Coal Co.*, 141 Fed. 962, 73 C. C. A. 278); and yet again it is called a waiver (*Glens Falls P. C. Co. v. Insurance Co.*, 11 App. Div. 411, 42 N. Y. Supp. 285). But, in whatever way it may be designated, it is such conduct on the part of the insurer as will cut him out of a defense he might have made had he insisted upon it at a time when the other party might have taken care of himself to his complete exculpation, or, at least, a betterment of his condition. If, instead of relying upon his right when the claim was first brought to his attention, he, without due investigation, assumes himself to be liable, sets the assured aside and claims the right of control of the defense, he can not afterwards ignore the right the assured has acquired by reason of such action merely because he has made a belated discovery of fact, or law, which he thinks puts the case outside the terms of the policy.

The facts of this case are beyond question ample to hold defendant to the election it made to assume liability under the policy and make defense to Stamp's action and to prevent it from afterwards changing position. In the first place when plaintiff, in compliance with the policy, gave to defendant the information it possessed as to Stamp's age, it did not say he was more than 14 years old; on the contrary, it stated to defendant that "he said he was 16, about, when hired." That manner of statement was in itself a suggestion to defendant that plaintiff did not, or might not, know what his age was. It suggested further inquiry. But, more than that, the record shows defendant continued in charge of the case for near three months after its own agents and representatives learned that there was grave doubt as to Stamp being over 14 years. The question of defendant's knowledge or information which would have led to knowledge of Stamp's age was submitted to the jury, but the facts were of such indisputable character as would have justified the court in so declaring peremptorily had it been requested.

But it is earnestly urged that before one can benefit by acts relied upon as constituting an estoppel, or acts in the nature of an estoppel, he must show that he has been prejudiced by such acts, and that plaintiff has not shown that it has been in anywise injured by the course taken by the defendant. It would be dangerous and unjust to allow such position to prevail. Who can say what plaintiff might have done in its own behalf had it not been ousted from control and direction of the defense in the Stamp cases? If a man is to bear the burden of the result of a defense to an action, it is his privilege to have his own personality appear in its course. He is entitled to have the results measured up to him, and not to some other. (*Gore v. Brockman*, 138 Mo. App. 231, 119, S. W. 1082). The loss of a right to control and manage one's own case is itself a prejudice. As we said through Judge Johnson in *Mining Co. v. Fidelity & Casualty Co.*, supra, one "must be presumed to have been prejudiced by such conduct, and need not be put to the proof that it could have achieved better results had there been no interference." In referring to a similar situation in *Glen Falls P. C. Co. v. Insurance Co.*, supra, the court said that: "If the insurance company had then notified the

cement company that it denied the validity of the policy, the latter company might possibly have settled with Jasmin (injured party) upon more favorable terms than it afterwards did."

We think a new trial should not have been granted, and the judgment will be reversed and the cause remanded, with directions to reinstate the verdict and render judgment thereon. All concur.

EMPLOYERS' LIABILITY INSURANCE—CONTRACTS—ACCEPTING AND RETAINING POLICIES—BASIS FOR PREMIUMS—RIGHTS OF THE INSURER—GOOD FAITH—*United States Casualty Co. v. Charleston (S. C.) Mining and Manufacturing Co., United States Circuit Court, District of South Carolina, 183 Federal Reporter, page 238.*—In the year 1898 the casualty company named was engaged in various lines of insurance, including the writing of policies known as employers' liability policies. It had an agent in the city of Richmond, Va., who in the line of business secured memoranda for insuring the company named, following which 30 policies were issued covering various plants and for different periods. It was the contention of the defendant company that the memoranda called for insurance covering its liabilities in respect of the working force, excepting executive officers and office men, while in fact all but two of the policies covered all the employees of the company without exception. The payment of premiums was based on the amount of the pay rolls of the company, the insuring company accepting and relying upon the statements made by the manufacturing company as to the amount of such pay rolls. After the termination of business arrangements between the companies it became known to the insurance company that the manufacturing company claimed a much larger pay roll than it had reported in connection with its insurance policies, and proceedings were taken to investigate the facts and to secure the payment of additional amounts of premium in accordance with the newly discovered information. The manufacturing company claimed that their request that executive officers and office men be excepted should control in the construction of the contract, and that in any case the acceptance by the company of the premiums tendered it precluded further claims by them and that they had been guilty of laches in pursuing their rights, if any. Judgment was rendered for the insurance company on grounds that appear in the following quotations from the opinion of the court, which was delivered by Judge Pritchard:

The principle that, in the absence of fraud, a party accepting a contract without objection is bound by all its recitals, covenants, and conditions, is well established. That preliminary negotiations and arrangements, in order to secure the issuance of a policy, should be

taken in subjection to the terms of the policy, as the same may be written, is the universal rule; and the contract, in this instance, must necessarily be determined by an examination of the policies themselves and the provisions thereof, which, from the very nature of things, necessarily control.

The evidence shows that the defendant received these policies and, without reading them and ascertaining the provisions contained therein, put the same in a place of safety. It was the duty of the defendant, under the circumstances, when the policies were received, to examine them, and, if they contained any provisions that were not in accordance with the terms agreed upon, the defendant could, then and there, have returned the policies and relieved itself from any obligation thereunder; but this was not done, while, on the other hand, as I have stated, the policies were accepted, and the complainant was permitted to assume any and all liability attaching thereunder, on account of any accidents that might occur to the laborers employed as well as the executive officers and office men. Under these circumstances, if any of the executive officers or office men had been injured, undoubtedly the complainant would have been liable under the policies for damages resulting from such injury.

That the plaintiff has the right, in order to determine the amount of premiums to which it may be entitled, to an audit of the defendant's books, pay rolls, and like documents, under the clause in the policy to which reference has been made, has been determined in numerous cases.

The next question to be determined is as to whether the claimant, by accepting the annual payments of the premiums, thereby waived its right to recover in this proceeding against the defendant such excess of the actual pay rolls over the amounts included in the annual settlements. It is apparent from the evidence that, when these annual settlements were made, a number of the employees of the defendant were not included within the pay rolls, then used as a basis of settlement, and it is insisted that as a result of an audit made, during the progress of the cause, over \$600,000 of wages to such officers and employees were found not to have been included in the annual settlements. The fact that executive officers and office men were included in the policies and employed by the company was peculiarly within the knowledge of the defendant, and, from the very nature of things, the complainant could not have had knowledge of these facts at the time the settlements were made. It was shown by the evidence that the complainant had no knowledge of any failure on the part of the defendant to include as a part of its pay rolls this class of men.

It is well settled that, to constitute a waiver, the party affected thereby must have knowledge of the facts and be fully informed as to the voluntary surrender of any right arising out of the facts thus within his knowledge.

The complainant, relying upon the good faith and fair dealing of the defendant, entered into the annual settlements which are now sought to be used as ground upon which to base a waiver, and now comes into a court of equity for the purpose of seeking the compensation to which it would have been entitled in the beginning had it been in possession of all the facts and circumstances surrounding the preparation of the pay rolls. In view of the evidence I am impelled

to the conclusion that the complainant has not waived its right to assert claim to any excess that may have existed over the pay rolls upon which these annual settlements were made.

Has the complainant been guilty of laches in the pursuit of its right, or, on the other hand, has it used proper diligence in the assertion of its rights? It is insisted by the defendant in its answer that the complainant has been guilty of laches and is, therefore, not entitled to be heard at this time. Among other things, it is stated in the answer that certain records and information, which would have enabled it to entirely disprove the truth of the complainant's claims, "now for the first time set up" (had such claims been made within a reasonable time after the expiration of the policies), had been lost, and that it had been so prejudiced by the complainant's delay in bringing the action that it can not now properly defend itself.

Being of the opinion that it was the duty of the defendant to furnish complete pay rolls, which would necessarily include executive officers and office men, each year during the period contained in the policies, it was the duty of the defendant to preserve the pay rolls; and, such being the case, if it destroyed its pay rolls and other documentary evidence, or put itself in a position where it could not comply with the terms of the contract which it had undertaken to fulfill, the defendant can not now plead its own neglect as an excuse for not complying with the terms of its contract, or as a reason why the complainant should not be permitted to assert its right.

Following the rule as laid down by the Supreme Court of the United States, as well as other courts, I am of the opinion that the complainant has not been guilty of laches in this instance. It is therefore at liberty to assert any right to which it may be entitled under the provisions of the contract in this respect. It necessarily follows that the complainant is entitled to recover of the defendant premiums on the basis of the amounts paid by the defendant for compensation to its employees, which should include executive officers and office men during the respective policy periods to be ascertained hereafter.

It has been intimated that the parties may agree as to the amounts of the various pay rolls; however, if there should not be an agreement as to the amount involved, an auditor will be appointed in order that there may be an accurate report made as to the amount of pay rolls and as to the number of employees, including executive officers and office men, in accordance with the terms of the policies.

INTERFERENCE WITH EMPLOYMENT—BLACK LIST—LABOR AS PROPERTY—*Jones v. Leslie, Supreme Court of Washington, 112 Pacific Reporter, page 81.*—C. R. Jones sued John C. Leslie and others to recover damages for unwarranted and malicious interference with his right to employment. From a judgment in favor of the defendants Jones appealed and secured a reversal of said judgment, with instructions to the lower court to proceed with the trial of the case. It appeared that Jones was working for the Seattle Cracker & Candy Co. and Steeves Bros., but was laid off during the summer

during the vacation of some relative of the employers, who was at home and wished employment, with the understanding that Jones would be reinstated when an opening should occur. In the meantime Jones secured employment at lower pay with the Leslie Power Co., which he retained until he learned of an opportunity to return to his former position. The manager of the Leslie Power Co., objected to his leaving, and said that he would prevent his securing the position which he had in view. This he actually did by threatening to withhold his patronage, which was considerable, from the persons who proposed to give Jones employment.

The questions involved were discussed at some length by Judge Dunbar, who said in part:

This presents a case here which is purely a question of law. It would be well to remember in the beginning that it is fundamental that a man has a right to be protected in his property. The property of the capitalist is his gold and silver, his bonds, credit, etc., for in these he deals and makes his living. For the same reason the property of the merchant is his goods. And every man's trade or profession is his property, because it is his means of livelihood, because through its agency he maintains himself and family, and is enabled to add his share toward the expenses of maintaining the Government. Can it be said with any degree of sense or justice that the property which a man has in his labor which is the foundation of all property and which is the only capital of so large a majority of the citizens of our country is not property; or, at least, not that character of property which can demand the boon of protection from the Government? We think not. To destroy this property, or to prevent one from contracting it or exchanging it for the necessities of life, is not only an invasion of a private right, but is an injury to the public, for it tends to produce pauperism and crime. This relief has been granted to employers in many forms. Workmen have been enjoined from collecting about the employer's place of business for the purpose of ridiculing his employees with a view of causing them to stop work; and many other demonstrations of the same character and purpose have been enjoined, of course, on the theory that it was an unlawful act. To deny the same relief to the employee under similar circumstances would be a reproach to the law. It is true that in many cases the element of conspiracy existed, but the principle is the same. Nor have the courts refused this protection to employees, but in a vast majority of cases of the kind it has been held that a legal right has been invaded, and the law imposed a liability.

Following this a number of cases were reviewed, including that of *Purington v. Hinchliff* (219 Ill. 159, 76 N. E. 47; Bulletin No. 64, p. 892), in which it was held that any person or combination of persons who unlawfully by direct or indirect means obstruct or interfere with another in the conduct of his lawful business are liable in damages for loss willfully caused by such action; and the case of *London Guarantee & Accident Company v. Horn* (206 Ill. 493, 69 N. E. 526; Bulletin No. 55, p. 1674), in which the insurance company

was held liable in damages for procuring the discharge of an employee who insisted on suing for damages after rejecting the offer of the company of a certain amount of money in settlement of his claim for injuries. Other cases were cited, after which the opinion concluded as follows:

There are hundreds of these cases cited in the cases which we have quoted from which sustain the doctrine that the person[s] causing the loss of employment under such circumstances as were the cause of the loss in this case are liable if damages ensue. It seems to be almost the universal doctrine of the courts of the country. Nor are we able to find any just criticism for such a rule. It is an excellent rule of action to refrain from interference with the affairs of others and especially if the motive actuating such interference is to work injury to others.

The judgment will be reversed, and the cause remanded, with instructions to proceed with the trial of the case.

LABOR ORGANIZATIONS—STRIKES—JUSTIFICATION—EFFORT TO PROCURE CLOSED SHOP—INJUNCTION—*Folsom v. Lewis, Supreme Judicial Court of Massachusetts, 94 Northeastern Reporter, page 316.*—Lucius B. Folsom and others had procured an injunction against George F. Lewis and others, restraining them from proceeding with or causing the continuance of a strike for the purpose of compelling the plaintiffs to enter into an agreement to employ none but union men in their shops, or of compelling them by either direct or indirect methods to run a closed shop. This injunction had been granted by the superior court of Suffolk County after reference of the subject matter to a master in chancery, and from the findings of the latter and the decree by the court an appeal was taken which resulted in the decree being affirmed. The opinion of the court was delivered by Judge Knowlton, and is mainly as follows:

There was a strike by the Boston photo-engravers' labor union against all the nonunion employers of photo-engravers in Boston. The master found "that one of the objects of the strike was to compel the employers to recognize the union as such, to employ none but union men, or nonunion men provided they should join the union within 30 days, and after a certificate of the right to work until the time that they had joined the union, and that the strike was a strike for the closed shop." He therefore found and ruled that the strike was not for a lawful object in these particulars.

The principal contention before us is that this finding is plainly wrong. The evidence upon this part of the case is not before us, except as the master has reported a large number of evidential facts, most, if not all, of which appear to be unquestioned, upon which his conclusion is founded. The only evidence that he was asked to report was that on the claim for damages.

The matters stated in the report amply justify, if they do not require, the finding of this conclusion by the master. The general

course of proceedings of the local union and its officers, and the International Photo-Engravers' Union with which the local union was connected, and the officers of the international union, some of whom were in Boston several months before the strike was called, seemingly engaged in the work of trying to obtain control of the labor in all the shops in Boston and to compel the assent by the employers to an agreement which should establish the closed shop in this business in Boston, all tend to support this finding of the master. While certain concessions were asked for in the interest of the men just before the strike was ordered, most, if not all, of which the employers seem to have been willing to grant, the part of the proposed agreement which the representatives of the union absolutely insisted upon was article 8: "That the employing photo-engravers signing this agreement shall employ none but members of the International Photo-Engravers' Union of North America, or applicants for positions holding a permit from the Boston Photo-Engravers' Union, No. 3, P. E. U." There is nothing in the case to indicate that there was anything in the condition of the business or in the relations of the workmen to their employers that made such a requirement of any importance to these employees, in reference to their profit or comfort, or other direct interest as employees. The master was undoubtedly right in finding that the purpose of the defendants and the real object of the strike was not so much to obtain certain slight advantages referred to in the proposed agreement, as to compel the employers, by inflicting this injury upon them, to submit to an attempt to obtain for the union a complete monopoly of the labor market in this kind of business, by forcing all laborers who wished to work to join the union, and by forcing all employers to agree not to employ laborers, except upon such terms as they could make with the combination that should control all labor in this business. This has been held to go beyond the limit of justifiable competition. Conduct directly affecting an employer to his detriment, by interference with his business, is not justifiable in law, unless it is of a kind and for a purpose that has a direct relation to benefits that the laborers are trying to obtain. Strengthening the forces of a labor union, to put it in a better condition to make its claims in controversies that may afterwards arise with employers, is not enough to justify an attack upon the business of an employer by inducing his employees to strike. (*Berry v. Donovan*, 188 Mass. 353, 74 N. E. 603.)

This most important part of the decision of the master and of the judge is well sustained.

There was also a finding that the defendants interfered with persons who were under contracts with the plaintiffs for future service, by inducing them to break their contracts. This too was a special wrong, which was a proper subject for an injunction.

There was evidence well warranting the finding of the master on the question of damages.

Decree affirmed with costs.

STRIKES—INTERFERENCE WITH EMPLOYMENT—FALSE STATEMENTS—
RELIEF BY INJUNCTION—*M. Steinert & Sons Co. v. Tagen*, Supreme
Judicial Court of Massachusetts, 93 Northeastern Reporter, page

584.—In this case the company named sued for an injunction against certain defendants because of their unjustifiable interference with its business. The company is engaged in the sale and moving of pianos and the defendants were members of an association called "Piano and Furniture Movers' and Helpers' Union, 343," affiliated with the International Brotherhood of Teamsters and the American Federation of Labor. The teamsters employed by the company, 11 in number, had in April, 1910, endeavored to secure an increase in wages and shorter hours of labor, which failing, a strike was declared. The teamsters all left employment, but within a few days their places were filled and remained so up to the time of this hearing. Eight of the strikers soon secured employment and the other three left the State. In October, 1910, the union directed that a horse and wagon with strips of canvas be employed to advertise a strike by union teamsters against the complainant company and another company, and this plan was carried out and the wagon driven through the streets of Boston daily for one week, passing in front of the plaintiff's place of business and otherwise bringing the notice to the attention of the plaintiff's teamsters. No crowds followed the wagon, and there was no attempt to interfere with or intimidate employees of the company otherwise than by the mere driving of the wagon through the streets with the legends upon it. There was no evidence that any employee had left his place or that any person had withheld patronage on account of the display of these signs. An injunction was, however, allowed the plaintiff company on grounds which appear in the opinion of the court as delivered by Judge Sheldon, which, with the omission of the cases cited, is as follows:

The strike of the plaintiff's employees in May was for the purpose of obtaining higher wages and shorter periods of labor. It was a justifiable strike. It does not appear to have been carried on in any respect in an unlawful manner or by the use of any unfair coercion or wrongful means. Nor could we say that the particular act charged in the bill to have been done by the defendants would be in itself an unlawful means of publishing the fact that a strike was going on. There was no picketing, no blocking of the streets, no actual interference with the plaintiff or with the men whom it employed in place of the strikers. We see nothing more than an attempt to inform the public, including probable applicants for work with the plaintiff, of the fact of the pending strike. Even if this were before doubtful, we could not now condemn it, in view of the provisions of Statutes of 1910, chapter 445, which imposed upon the plaintiff while the strike lasted the duty to give this information to any persons whom it solicited to take the place of the strikers.

But in the case at bar the strike was over. Although this fact was not expressly found in the superior court, in our opinion it is necessarily to be inferred from the facts which are found, and must be taken to be a fact. The strike was declared May 2, 1910. The plaintiff within a few days secured men to take the places of the

strikers, has had ever since an adequate force, and is not seeking any new men. Of the 11 men who left the plaintiff's employ, 8 soon secured and still have new employment in the same kind of work as before and 3 have left this Commonwealth. Moreover, a short time after the strike began, the International Brotherhood of Teamsters, the organization with which the defendants' labor union was affiliated, ceased to aid the strikers any further. It is difficult to imagine a case, short of a formal agreement of both parties, in which it could be more manifest that a strike had come to an end.

The defendants' act in driving the wagon through the streets with the placards complained of began on October 14, 1910, long after the end of the strike, and has since been continued. We can see no justification of it. It is a false announcement, not adapted in any way to benefit the defendants or their union, but likely to embarrass the plaintiff whenever it may need to employ additional men. It manifestly was intended merely to injure the plaintiff. This shows that it was done maliciously within the legal meaning of that word.

The case does not come within the doctrine that equity will not enjoin the publication of a libel. There is here a wrongful act maliciously done, continuing and repeated day by day, which, although it is not shown to have caused as yet any damage to the plaintiff, is manifestly intended to produce that result, is liable at any time in the future to do so, and may cause real and substantial damage of which it would be certainly difficult and might be impossible to prove either the existence or the quantum of loss. It is like a boycott declared and maintained without cause. In such a case equity will give relief.

STRIKES—JUSTIFICATION—INTERFERENCE WITH EMPLOYMENT—DAMAGES—*De Minico v. Craig*, *Supreme Judicial Court of Massachusetts*, 94 *Northeastern Reporter*, page 317.—Mariano De Minico and one Ardolino were foremen employed by a company operating a stone quarry, and while employed as such incurred the displeasure of the workmen under them by their efforts to enforce the rules laid down by the common employer somewhat more strictly than had been previously the custom. The dislike of the men resulted in an agreement, at a meeting of the union to which they belonged, to strike against the continued employment of the objectionable foremen, and by reason of this strike the foremen were reduced to the rank of journeymen. For this De Minico sought to procure an injunction against the union forbidding its further interference with his employment and also sued to recover damages. The findings of the master in chancery to whom the case was referred for a discovery of the facts were to the effect that the grievances were trivial and resulted not from oppressive action, but from an effort to carry out the prescribed rules of the employers, and that De Minico was not of unfit conduct or character to continue as foreman and that he would appar-

ently have been retained in that position except for the action of the men. The work as a whole had terminated before the hearing of the case, so that no injunction was allowed on account of the fact that the conditions referred to were at an end. The strike was held to be unjustifiable and damages were awarded in accordance with the facts reported by the master. The opinion of the court was delivered by Judge Loring, and, after statement of facts, is as follows:

Whether the purpose for which a strike is instituted is or is not a legal justification for it is a question of law to be decided by the court. To justify interference with the rights of others the strikers must in good faith strike for a purpose which the court decides to be a legal justification for such interference. To make a strike a legal strike it is necessary that the strikers should have acted in good faith in striking for a purpose which the court holds to have been a legal purpose for a strike, but it is not necessary that they should have been in the right in instituting a strike for such a purpose. On the other hand a strike is not a strike for a legal purpose because the strikers struck in good faith for a purpose which they thought was a sufficient justification for a strike. As we have said already, to make a strike a legal strike the purpose of the strike must be one which the court as matter of law decides is a legal purpose of a strike, and the strikers must have acted in good faith in striking for such a purpose.

The purpose of the strike here in question has been found to have been to get rid of two foremen because some of the workmen had personal objections to and a dislike for them. Or, to use the words of their own counsel, because these foremen were "distasteful to [some of] the employees." We are of opinion that that is not a legal purpose for a strike. The plaintiff had a right to work, and that right of his could not be taken away from him or interfered with by the defendants unless it came into conflict with an equal or superior right of theirs. The defendants' right to better their condition is such an equal right. But to humor their personal objections, their likes and dislikes, or to escape from what "is distasteful" to some of them is not in our opinion a superior or an equal right.

It is doubtless true that in a certain sense the condition of workmen is better if they work under a foreman for whom they do not have a personal dislike; that is to say, one who is not "distasteful" to them. But that is not true in the sense in which those words are used when it is said that a strike to better the condition of the workmen is a strike for a legal purpose. One who betters his condition only by escaping from what he merely dislikes and by securing what he likes does not better his condition within the meaning of those words in the rule that employees can strike to better their condition.

The defense in the case at bar has not failed because a strike to get rid of a foreman never can be a strike for a legal purpose. We can conceive of such a case. If, for example, a foreman was in the habit of using epithets so insulting to the men that they could not maintain their self-respect and work under him, a strike to get rid of him in our opinion would be a legal strike. It is not necessary in the case at bar to define such cases and lay down their limits. It is wiser, in our opinion, in matters such as we are now dealing with,

to go no farther than to decide each case as it arises. What we have just said is said to prevent misapprehension as to what is now decided. What we now decide is that a strike to get rid of a foreman because some of the employees have a dislike for him is not a strike for a legal purpose. For these reasons a majority of the court are of opinion that the strike was not a legal one.

It appears that the work at Wells Bros. ceased on January 10, 1910. There is therefore no occasion for an injunction to issue in the case at bar.

The master found that the difference between the plaintiff's wages as foreman and as a journeyman for the period in which he was employed by Wells Bros. is \$110.62, and then made the following finding: "In addition to this the complainant claims the right to recover damages for his loss of position as foreman, damage to his reputation, and the hindering of his prospects of advancement. I make no ruling on this contention of the complainant or his right to recover for the difference between what he formerly earned and that which he now receives, and without intimating in any way that he is entitled to recover anything, but in order that the court may have all of the facts before it at the hearing on this report, I find that if the court shall rule that the strike was not justifiable and that the complainant is entitled to damages, the sum of \$500 will amply compensate him for whatever damage he has suffered or may suffer, including loss of wages." We could not say that the plaintiff would not be entitled to recover for damage to his reputation if he proved that damage to his reputation was in fact caused by the defendant's illegal action. Under the finding of the master we are of opinion that the plaintiff is entitled to the larger sum, with interest from January 10, 1910, when his work at Wells Bros. ceased, the bill having been filed in the preceding July.

Decree accordingly.