

one blade is inserted into the opening in the skull, the other blade grasping the head over the face or ear; the handles are brought together by means of a nut and screw and the head is delivered by traction; as the skull is empty the head undergoes compression and is moulded in obedience to the pressure of the parturient canal. The cephalotribe is applied like the ordinary forceps, and when the handles are screwed together the base of the skull is crushed. Tarnier's cephalotribe has a perforator combined with it, but the crushing usually is unnecessary. Before the performance of craniotomy the cervix must either be dilated or dilatable. Apart from the danger of sepsis, the soft parts of the mother may be severely injured in cases of extreme contraction of the pelvic canal.

**Decapitation.**—The indications for this operation are impacted shoulder presentations with thinned lower uterine segment, interlocked twins, and monstrosities. The usual instrument employed for decapitation is Braun's hook, but scissors, fine wire, or even cord can be employed in an emergency. The patient is anesthetized and prepared as usual; while an assistant pulls down upon an arm, if prolapsed, the hook, guided by the internal finger, is passed over the neck of the fœtus and the tissues are cut through by a series of twisting motions. The trunk is delivered by traction upon an arm or leg; the head being extracted by hooking one finger into the opening at the base of the skull aided by pressure from above. In difficult cases the head is seized in the forceps or cephalotribe.

**Visceration.**—This operation consists in removing the contents of the thoracic and abdominal cavities and is indicated in some neglected cases of transverse presentation and in monstrosities. The puncture is made with the scissors and the viscera are dragged out with the hand or blunt hook; delivery is by podalic version. In difficult cases the child's spinal column is cut and the body doubled up before extracting.

**OCCUPATION, HYGIENE OF.**—By "occupation" we mean the regular use of our physical functions and mental faculties in business and employment for remuneration, comfort, and luxuries. The functional activity of our organs in a normal way is a physiological condition of health; the disuse, more or less prolonged, of any organ being, as a rule, followed by atrophical changes. While the normal pursuit of occupation is therefore a condition of health, as well as a corollary of economic life, there have always existed, in occupations, certain factors which are productive of pathological changes. The medicine of antiquity and of the Mediæval Ages ignored the problem of the injurious influence of certain trades on health, partly because these trades were pursued by the lower classes and the slaves, whose health was of no special consideration to the ruling classes, partly because the most injurious effects of occupation on health are but a product of the modern system of industry.

Apart from the few hints in the works of Hippocrates, Celsus, and others, and the mention by Pliny of the "diseases of the slave," we find nothing on the subject of the relations of occupation to health until we come to the seventeenth century, in the latter half of which we first come across a notice of occupational disease in the Transactions of the Royal Society of England, in which we find many pertinent observations on the effects of lead and coal mining, manufacturing of mirrors, etc., on the health of the operatives. To Italy, however, is due the great credit of the first attempt at a detailed description of the evils of certain occupations, the treatise of Bernardo Ramazzini, "De Morbis Artificum Diatriba," published in Modena in 1700, and soon after translated into many languages, being the first work accurately and vividly to describe the special effects of each occupation on health.

Ramazzini laid the foundation for all further investigations on the subject, and it is no detraction from his deserved reputation that his book partly suffers from the superstitions and ignorance of his age; indeed we must feel respect and admiration for the many excellent and true observations, and the systematic exposition of the injurious effects of occupations which are found, for the first time in medical literature, in his work.

More than two centuries have passed since Ramazzini's epoch-making work was published—centuries not only full of remarkable revolutionary changes in trades and industries, but also characterized by a no less wonderful, progressive development of the sciences, among which the study of the hygiene of occupation has kept equal pace with the other branches of medical research.

The list of monographs, articles, and books on industrial hygiene fills many pages of the "Index Catalogue of the Surgeon-General's Library," and I can make mention here of only the more important landmarks on the subject in medical literature:—

Tissot's work on "Diseases Incident to Literary and Sedentary Persons," published in 1768 in French, was the next important book; it was followed nearly a half-century later by that of Patisier, who, however, gave but a republication of Ramazzini's work with additional notes and commentaries. After these follow, in succession, the treatises of C. Turner Thacrah ("The Effects of the Arts, Trades, and Professions on Health and Longevity," published in 1831), and of A. C. Halford ("Die Krankheiten der Kuenstler und Gewerbetreibenden," published in 1845). These were followed by the works of Lévy, Tardieu, and Layet, and then finally, in the year 1871, by that of the great epoch-making work of Hirz—"Die Krankheiten der Arbeiter"—which first placed industrial hygiene on a true scientific basis. In England, Farr, Chadwick, Simon, Ogle, and others worked on in the same line, giving special attention to the statistical part of the subject of occupational mortality and morbidity. Of the later works on the subject, we can mention only the more systematic treatises of Popper, Eulenburg, Merkel, Albrecht, Arlidge, the volume on "Gewerbelygiene" in Veyl's "Handbuch der Hygiene," the work by Thomas Oliver ("Dangerous Trades," published in London, 1902), and the latest work just published in Germany, O. Dammer's "Handbuch der Arbeiter Wohlfahrt."

The immense bibliography and the vast extent of the subject matter of industrial hygiene render any attempt to review or even to summarize our knowledge of this branch of medical science within the limits of a short article, a very ungrateful task, it being utterly impossible to do justice to it under such restrictions. I have decided to abandon the alphabetical order of treatment by "trades," handed down by Ramazzini, and adopted by the writer on this subject in the former edition of this HANDBOOK, and I shall treat the subject matter under the following heads: Occupational Mortality Statistics; The Diseases of Occupation; The Worker; The Workplace; The Conditions of Work; The Processes of Work; Prophylaxis; and, last, "Offensive Trades."

OCCUPATIONAL MORTALITY STATISTICS.

Occupation is a potent factor in the determination of human longevity. If we deduct from man's life the time of infancy and childhood, and the hours devoted to sleep, the greatest part of it is spent within the periods of industrial activity, and is necessarily largely influenced by occupation. The relative number of those who die while in pursuit of their occupations bears an important relation to the healthfulness of the occupations. Moreover, if the figures revealed by the relative mortality statistics corroborate the scientific *a priori* de-

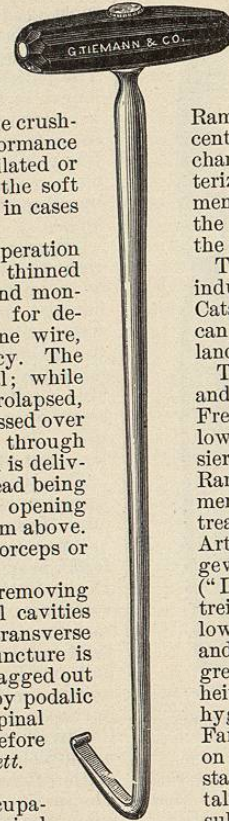


Fig. 3614.—Blunt Hook.

ductions from the study of the processes of occupations and their pathological influences, we then have quite a valuable criterion of the influence of the different trades on the lives of the operatives. Herein lies the importance of mortality statistics, as determined by occupations. In order, however, that these statistics shall have any scientific value, they must cover large periods, embrace great numbers, include various races and countries, and be properly prepared and tested. For it is evident that there are a number of difficulties greatly invalidating the conclusions drawn from occupational mortality statistics. These are as follows:

First, occupation, while playing an important rôle in human life, is, nevertheless, only one of the many factors influencing it, there being a great number of others, such as race, country, climate, heredity, geographical, economic, political, and other conditions, each of which undoubtedly affects the lives of operatives; and it is exceedingly difficult to differentiate the causative influences of occupation on longevity from those of all other factors.

Second, there are under the modern system of subdivision of labor several thousands of special branches of trades and industries, only a very few of which, however, and these the most general, being, as a rule, mentioned or tabulated in the mortality statistics. Thus there are about half a hundred occupations in Ogle's tables, not many more in Bertillon's; and in the last (twelfth) census of the United States there are 140 groups, 70 of which are further subdivided, making the whole number in the last census 303. It is obvious that each of the general groups of occupations may embrace a large number of minor trades, each of which will have a different bearing on health and life, thus greatly invalidating the deductions from the general tables.

Third, in our modern industrial production, there are very few trades which are hereditary, as the feudal guilds were, and in which the operatives remained during their whole lives. The greatest number of industries constantly change their *personnel*, most individuals pursuing several trades successively; and the occupation in which they happen to die gives little indication of the one in which they may have spent the greatest part of their lives, and where they perchance had received the injuries to health to which they subsequently succumbed.

Fourth, certain trades can be pursued only by very strong and healthy individuals; while others, being comparatively light, can be carried on by the physically weak and feeble. It is, therefore, manifestly incorrect to base deductions on occupational mortality statistics, seeing that the primary factors (*i.e.*, the workers) are not on an equal basis as to health. All the above considerations make it incumbent upon us to regard occupational mortality and morbidity statistics with a certain suspicion, and to apportion them only such value as is warranted by the scientific deductions of the general and special characteristics of each trade, and its effect on health.

Ogle's statistics deserve the great credit attributed to them by hygienists, by reason of their careful elaboration and intelligent preparation. They have been quoted widely and are regarded as standards. I shall give Ogle's table, followed by more recent data from the last United States census, and from J. Tatham's recent morbidity figures in Oliver's book.

COMPARATIVE MORTALITY OF MEN, TWENTY-FIVE TO SIXTY-FIVE YEARS OF AGE, IN DIFFERENT OCCUPATIONS, FOR THE YEARS 1881-83, BY W. OGLE, AS REPORTED IN A PAPER READ BEFORE THE SEVENTH INTERNATIONAL CONGRESS FOR HYGIENE, IN 1891.

Occupations.	Com- parative mortality.	Occupations.	Com- parative mortality.
Clergymen* .....	100	Grocers .....	139
Gardeners .....	108	Fishermen .....	143
Farmers .....	114	Carpenters, joiners .....	148
Agricultural laborers .....	126	Lawyers .....	152
Paper-makers .....	129	Silk manufacturers .....	152

\* The mortality rate of clergymen, being the lowest, is taken at 100.

OGLE'S COMPARATIVE MORTALITY TABLE.—Continued.

Occupations.	Com- parative mortality.	Occupations.	Com- parative mortality.
Drapers .....	159	Medical men .....	302
Coal miners .....	160	Stone & slate quarriers .....	302
Shoemakers .....	166	Bookbinders .....	310
Commercial travellers .....	171	Butchers .....	311
Corn millers .....	172	Glass workers .....	314
Bakers .....	172	Lead workers .....	316
Cabinetmakers .....	173	Cutlers .....	329
Masons, bricklayers .....	174	Brewers .....	345
Blacksmiths .....	175	Cab drivers .....	347
Clerks .....	179	Liquor dealers .....	374
Railway laborers .....	185	Filemakers .....	300
Gunsmiths .....	186	Earthenware workers .....	313
Wool workers .....	186	Cornish miners .....	331
Tailors .....	189	Costermongers, ped- dlers .....	338
Hatters .....	191	Inn, hotel service .....	397
Cotton workers .....	196		

OCCUPATIONAL MORTALITY TABLE ACCORDING TO THE (TWELFTH) UNITED STATES CENSUS FOR THE CENSUS YEAR OF 1900 (ONLY IN THE "REGISTRATION AREA"—TEN STATES<sup>2</sup>).

Occupations.	Mortality, per 1,000.	Occupations.	Mortality, per 1,000.
Mercantile and mechan- ics, average .....	12.1	Leather makers .....	12.3
Professional average .....	15.01	Tin workers .....	14.5
Laborers and servants .....	20.2	Marble & stone workers .....	14.9
Engineers, surveyors .....	8.2	Engineers, firemen .....	15.7
School teachers .....	12.2	Painters .....	16.2
Medical men .....	17.2	Butchers .....	16.1
Lawyers .....	19.9	Plasterers .....	17.0
Clergymen .....	22.5	Carpenters, joiners .....	17.2
Textile mill workers .....	8.8	Leather workers .....	17.5
Plumbers and gasfitters .....	9.4	Hat, cap makers .....	17.9
Shoemakers .....	10.5	Cabinetmakers and Upholsterers .....	18.0
Machinists .....	10.7	Blacksmiths .....	18.3
Iron and steel .....	10.8	Cigar, tobacco workers .....	18.7
Glass makers .....	11.8	Brewers, distillers .....	19.7
Tailors .....	12.1	Stone masons .....	19.9
Printers, pressmen .....	12.3	Coopers .....	23.8
Bakers, confectioners .....	12.3	Millers, flour, grist .....	26.6

The United States occupation-mortality statistics being only for ten States and only for one year do not have the value of Ogle's tables, which embraced several years and the whole of England and Wales.

COMPARATIVE MORTALITY FROM SPECIFIED CAUSES IN CERTAIN DUSTY OCCUPATIONS. (JOHN TATHAM.<sup>3</sup>)

Occupations.	Comparative mortality, all causes.	PHTHISIS AND RESPIRATORY DISEASES.		MORTALITY FIGURE.	
		Mortality figure.	Ratio.	Phthisis.	Res- piratory diseases.
Agriculturists .....	602	221	100	106	115
Earthenware .....	1,702	1,001	453	333	668
Cutlers .....	1,516	900	407	382	518
Filemakers .....	1,810	825	373	402	423
Glass workers .....	1,487	740	325	295	445
Copper workers .....	1,281	709	317	294	408
Gunsmiths .....	1,228	649	294	325	325
Iron and steel .....	1,301	645	292	195	450
Zinc workers .....	1,198	587	266	240	347
Stone quarriers .....	1,176	576	261	269	307
Brass workers .....	1,088	552	250	270	273
Chimney-sweeps .....	1,311	551	249	230	291
Lead workers .....	1,733	545	247	148	397
Cotton workers .....	1,141	540	244	202	338
Cooper and wood turners .....	1,088	526	238	250	276
Rope makers .....	925	486	220	219	267
Masons and bricklayers .....	1,001	476	215	225	251
Carpet workers .....	873	471	215	226	245
Wool manufacturers .....	994	451	214	217	234
Tin workers .....	901	447	202	191	256
Locksmiths .....	925	428	194	223	205
Blacksmiths .....	914	392	177	159	233
Bakers and confectioners .....	920	392	177	185	207



"In this table the mortality of the several dust-producing occupations is contrasted with that of agriculturists, who have been shown to suffer the least from the effects of dust. The aggregate death rate from tuberculous phthisis, and diseases of the respiratory system, is shown in this table, as are also the figures relating to each affection separately. Columns 1 and 2 give the combined mortality from these diseases in comparison with that of agriculturists. In the third column the mortality of the latter is taken as one hundred, showing the proportional relation to other workers."<sup>5</sup>

## DISEASES OF OCCUPATION.

Disease has been defined as an abnormal condition of the body, a perturbation in the state of the living organism; while life itself is a struggle of the organism with its environment. In the study of the pathogenesis of disease, we come to a complex phenomenon, which on closer study resolves itself into two main branches: First, the intrinsic constitution of the organism; and second, the external world, *i. e.*, the environment. Among the environmental conditions influencing life and health, one, not the least in importance, is that of occupation. In the mortality statistics we have seen that occupation does affect the longevity of man; at least, there is a strong array of figures, corroborating each other, from various races, countries, and localities, which persistently show that some occupations have a very large comparative mortality, and which therefore warrant the deduction that these occupations possess some elements or conditions capable of causing those disturbances in the organism which terminate life more rapidly than is commonly the case when the conditions in question are absent. If death itself, which is but the culmination of all abnormal conditions of life, can be, more or less directly, brought on by occupation, how much more likely is it that occupation will influence the daily life and cause the morbid states called *disease*?

As a matter of fact, since the time of Ramazzini, we do regard many morbid states as due to the influence of occupation, and we call them "industrial diseases," or "diseases of occupation," by which we mean such diseases as are superinduced directly or indirectly by one or more elements existing in occupation. There are, however, two points which we must note in the study of industrial diseases: individual susceptibility, and the relative importance of occupation in the causation of disease. Those who have made a study of the pathogenesis of disease know the remarkable rôle which is played in health and disease by the inherited constitution, personal vital resistance, and power of immunity of each individual. We frequently observe two individuals working in the same trade, side by side, influenced by identical conditions, subject to the same harmful elements, and breathing the same foul, dusty, and poisonous atmosphere; yet while the one, sooner or later, succumbs to these dangers of his trade, and becomes invalidated by the general or special maladies of his calling, the other continues to enjoy life, with apparent immunity from all injurious influences. It is evident that in industrial, as in other diseases, the personal element, the individual susceptibility must be taken into account. So far as the question of the relative importance of occupation in the causation of disease is concerned, there are those who totally deny that there are *any* diseases of occupation. They claim that we may just as well classify diseases by habitation, soil, sewerage; by races, localities, and countries; by monarchies, republics, and constitutional governments, inasmuch as each of these external factors undoubtedly bears some relation to conditions of health, and may, in some more or less remote way, cause disease. This position is, however, untenable; for occupation certainly exerts a greater comparative influence on health than do many of the other external factors; and there are some industrial diseases which may be directly traced to certain specific industries, while this can hardly be said of the other factors.

Among the industrial diseases there are some which can be shown to be directly due to the toxic elements or substances generated in each trade; others there are in which their connection with some particular industry is more remote; and still other diseases in which occupation plays only a predisposing rôle. It is impossible to give here the detailed description of all industrial diseases, nor is it necessary, as all of these diseases are at the same time common to all mankind, and are more fully treated in other parts of this HANDBOOK. The diseases to be briefly alluded to here are only those which bear a direct etiological relation to occupation.

*Diseases of the Respiratory System.*—The organs of the respiratory system are the greatest sufferers from industrial conditions. The respiratory passages have been very aptly named "the entrance port" of the body where most of the infective agents land on their arrival. All impurities of air, if persistently inhaled for long periods, are liable to produce inflammatory changes in the respiratory passages, and so to weaken them that they readily become a prey to any infective organism. The most pernicious effects on the respiratory organs are produced by the inhalation of dust. In the divers industrial processes, all kinds of materials from animal, vegetable, mineral, and metal substances are undergoing various processes of transformation, with the inevitable result that a great quantity of dust is raised and fills the air of the places of work, and is constantly being inhaled by the operatives. A mere temporary inhalation of dust is followed by increased secretion from the mucous membrane of the respiratory passages, by which these try to get rid of the foreign matter. When, however, the action of the dust is persistent and continuous, the mucous membrane of the passages gets congested, inflamed, and denuded of its protective ciliated epithelia, and, with the weakening of the defensive forces, the entrance of foreign matter or infective materials into the parenchyma of the lungs is no longer prevented. The statistical tables of Hirt, Ogle, Tatham, Bertillon, Kummer, and of the United States census, all agree that the greatest burden of ills due to occupation falls upon the much-abused respiratory organs.

*Bronchitis.*—Of the diseases of the respiratory system, the most directly traceable to industrial influences is bronchitis. Among the principal causes of bronchitis, Hoffman<sup>4</sup> mentions: (1) catarrhal congestion, (2) inhalation of dust, (3) inhalation of gases. All these factors are pre-eminently those which are most frequently due to industrial conditions. Excessive muscular exertion, increased body heat due to hard labor, sudden chilling of body surface, exposure to varied and extreme temperatures, etc., are a few of the causes of catarrhal congestion in the bronchi, leading to subsequent chronic inflammatory changes. Inhalation of dust as a cause of bronchitis is easily understood when we remember the irritation which any foreign matter produces in the mucous membranes, and the special irritating qualities of a great many industrial dusts. Poisonous gases and fumes are direct irritants, and cause intense congestion of the bronchial mucous membrane and inflammatory changes which tend to become chronic if the inhalation of such fumes persists. The statistical data, as to the prevalence of bronchitis among workers, are not reliable, for the reason that the disease in its initial forms is hardly one for which the worker discontinues work or seeks medical aid, and certainly not one which would figure in mortality statistics. Hirt<sup>5</sup> gives the percentage of workers suffering from chronic bronchitis as from 11 to 69 per cent. Some dusts are more irritating than others. Thus Hirt found, in an investigation which covered 12,000 workers in a dusty atmosphere, that of those who experienced harmful effects therefrom in a greater or less degree, 11 per cent. were workers in mineral dust, 13.6 per cent. in animal dust, 14.8 per cent. in metallic dust, 18.4 per cent. in dust of a mixed character, and 19 per cent. in vegetable dust.

*Emphysema.*—Emphysema is a disease of the lungs in which a part of the tissue loses its normal elasticity and

remains in a state of abnormal dilatation. Emphysema is caused by all conditions which interfere with the normal expiratory functions of the lungs. Among the causes of emphysema are: (1) Catarrhal conditions of the passages, leading to accumulation of mucus in the bronchi, to obstruction of the bronchioles and to violent fits of coughing; (2) the lodgment of foreign matter and dust in the bronchioles, and the obstruction of these channels resulting therefrom; (3) constrained attitudes, etc., leading to interference with respiration. Most of these conditions are present in many occupations. We have seen that chronic bronchitis is very prevalent among most workers, and consequently favors the production of emphysema among them. Hirt<sup>5</sup> says that from eight to ten per cent. of all who suffer from bronchitis have emphysema. The filling up of bronchioles with dust is a frequent condition in the lungs of coal miners and others who work in clouds of dust, and such obstruction will cause compensatory hypertrophy and dilatation of other alveoli, also dilatation of the right ventricle of the heart. Work in a constrained attitude, playing on wind instruments, glass blowing, lifting of heavy weights, severe muscular exertion, and alcoholism are among the other predisposing causes of emphysema among workers. According to Kubborn<sup>6</sup> 37 per cent. of miners suffer from emphysema, and according to Seltman<sup>7</sup> 50 per cent. According to Fueller<sup>8</sup> breathing foul air, deficient in oxygen and rich in carbonic acid, predisposes to emphysema; he quotes Seltman's figures to show that, among coal miners, of those who worked in pure air only 7.9 per cent. suffered from this disease, whereas of those who worked constantly in foul air, as many as 62 per cent. were so affected. Hirt<sup>5</sup> gives the following table of the relative frequency of emphysema among workers in dusty occupations: Of 100 cases of sickness there were among metallic workers 3.1 per cent., among those exposed to animal dust 3 per cent., to vegetable dust 4.7 per cent., to mixed dusts 5.1 per cent., and to mineral dusts, 9 per cent.

*Pneumonokoniosis.*—Zenker applied this term to affections of the lungs due to deposits of dust in their parenchyma. Several forms of pneumonokoniosis are distinguished according to the nature of the dust inhaled and deposited in the lungs. Dust particles are carried to the lung tissue by direct inhalation and also by the action of the lymph channels. These latter play an important rôle in the dissemination of the dust particles, as has been shown by the discovery of some dusts—for instance coal—not only within the lung, but also in the liver, spleen, and kidneys. Fueller<sup>8</sup> quotes the report of a French chemist who found in several samples of lung tissue, weighing respectively 1,800 gm., 2,860 gm., and 220 gm., the following quantities of coal: 85 gm., 140 gm., and 114 gm. According to Merkel<sup>7</sup> the following factors are determining in the etiology of pneumonokoniosis: (1) The state of health and individual susceptibility of the worker; (2) the vulnerability of the respiratory organs; (3) the duration and intensity of the exposure to dust inhalation; and (4) the quality and character of the dust. Quimby (see article on *Lungs, Diseases of: Pneumonokoniosis* in Vol. V. of this HANDBOOK) gives the following more common vocations in which laborers are exposed for prolonged periods to a dusty atmosphere: Mining of various minerals, and the handling of coal in transit to its point of consumption; charcoal grinders and carriers, moulders and those who clean castings, metal and glass polishers, stone masons and plasterers, chimney-sweepers, laborers who tear down old buildings, potters and grinders on various forms of stone, bakers and pastry cooks, gilders and gold and tinfoil beaters, workers in mother-of-pearl and lead, jewelers and glass-cutters, file-cutters, millers, tobacco workers, grain shovellers, etc.

We shall refer to various pneumonokonioses when we come to the subject of dusty occupations and their influence on health.

*Tuberculosis.*—Pulmonary tuberculosis is a very frequent disease among all kinds of workers, especially

among those who work in a dusty atmosphere. The etiological relation of occupation to pulmonary tuberculosis is not difficult to understand, although the connection is not always directly traceable. Occupation is more of a predisposing than an exciting cause of tuberculosis. All conditions of occupations, sex, age, foul air, overcrowding, variety in temperature, exposure, constrained attitude, inhalations of dusts, gases, fumes, and poisons, all tend to predispose the organism to fall a prey to the ravages of the tubercle bacilli. The infection may take place outside of the place of work, but generally happens within its precincts; for there is no better place for the cultivation, distribution, and dissemination of the bacteria than the foul, ill-ventilated, close, damp, overheated, dusty shops, where, if only one tuberculous patient expectorates, enough material may be spread to infect hundreds. The prevalence of pulmonary tuberculosis among various workers has been noted in the already cited table of Tatham on mortality due to this affection. The last United States census gives the number of deaths from pulmonary tuberculosis in the census year as 109,750. Dusty occupations, as already noted, predispose to phthisis. All statistical data, from Hirt to Tatham, confirm the statement that tuberculosis is the most frequent disease among all occupations, and the frequency is directly proportionate to the amount of dust that is formed in the occupation.

*Lobar Pneumonia.*—It is difficult directly to connect lobar pneumonia with occupation, although Hirt claims that the largest number of cases of this malady occurs among the laboring class. Congestion and a catarrhal condition of the respiratory passages and exposure to bad weather, etc., are the main predisposing causes. Bronchitis and emphysema, so frequent among workers, predispose to infection with the pneumococcus, by reason of the fact that the normal pulmonary tissue has lost its power to resist infection. Exposure leads to chilling of the surface of the body and congestion of the lungs. The average frequency of pneumonia was found by Hirt<sup>5</sup> to be 7.3 per cent. in some workers, while in millers the percentage was 20.3. According to the figures of the last United States census the laboring class shows the greatest percentage of cases of pneumonia. Merkel<sup>7</sup> denies that dust has any effect on the etiology of pneumonia. In one hundred and forty dead, out of ten hundred and thirty-five cases of pneumonia, he failed to find any trace of dust in the lungs. If dust affects the lungs at all, it may do so by the wounding of the mucous membrane, thus presenting a solution of continuity, favoring bacterial infection. It was claimed that textile workers are prone to this disease, although this is denied by later investigators. According to Hirt's table those who are exposed to vegetable dusts suffer the most from pneumonia.

*Diseases of the Nervous System.*—The nervous system is the most abused part of the organism of the worker. Modern industry, with its complex mechanical development, enormous rate of speed, intensity of action, and the great demands on the nervous and mental forces of men, tends to overstrain the delicate nervous cells, and sacrifice them to the much-vaunted strenuousness of life. Some of the factors, more or less frequently accompanying all occupations, which lead to nervous disturbances are the following: Excessive cardiac action, intense muscular strain, overuse of an organ or group of muscles, prolonged mental labor, overwhelming responsibility, intense anxiety, mental worry, sudden and continuous shocks and jarrings, extremes of heat, cold, dampness, and variations of air pressure, inhalations of certain gases, and the ingestion of certain poisons.

Among the nervous diseases most frequent among workers are cerebral and spinal hyperemia, peripheral neuritis, the fatigue neuroses, progressive muscular atrophy, various toxic paralyses, and insanity. According to the last census report, persons engaged in literary and professional occupations suffer relatively more from nervous diseases than do all the other classes. Thus medical men show the largest number of deaths due to nervous



diseases. The nervous disturbances due to toxic influences will be treated later.

*The Fatigue Neuroses.*—These neuroses, also called "functional impotences," are directly due to various occupations. They manifest themselves in loss of motor, sometimes of sensory, power in some organs or groups of muscles; this loss being due to the continuous, prolonged, and excessive use of the same. Causes which predispose to these neuroses are weakness of the nervous system, alcoholism, excessive use of tobacco, mental anxiety, and trouble. According to Oliver<sup>3</sup> the primary seat of the disorder is situated in the cortex of the brain, and he adds that "altered nutrition of the cerebral centres is in all probability responsible for the defective muscular movements; and that the spasm is only the initial fact in the illness." The most common fatigue neuroses are "writer's cramp" or "scrivener's palsy," telegrapher's spasm, as well as the spasms which occur in typesetters, milkers, hammermen, piano players, violin players, etc.

*Eye Diseases.*—The eyes frequently suffer from effects of occupation. Injury to the eyes may come from a too prolonged close application and straining; from exposure to excessive light or heat; from various dusts; from gases and poisons; from burns and accidents.

Overuse and close application and overstrain produce pain, asthenopia, myopia, presbyopia, and other changes in refraction. Clerks, copyists, engravers, draughtsmen, watchmakers, proof-readers, etc., are those who overstrain their eyes.

Certain occupations which compel very close application with accompanying constrained positions cause *nystagmus*. This disorder of the eyes is chiefly due to the constrained position which some laborers are compelled to assume during their work, and is very frequent in coal miners, five per cent. (according to some authorities, ten per cent.) of whom are afflicted with it; although workers in other trades, such as compositors, metal rollers, etc., are sometimes affected. The comparative frequency of nystagmus among coal miners is due to the unnatural positions assumed by them when undercutting in coal seams, lying on their sides, and straining the eyes in order to follow the pick.

Exposure to excessive light and heat is frequent among certain trades, as those of silver finishers, burnishers, furnace-workers, glass-blowers, electric welders, etc. In some of these occupations, notably in electric welding, the temperature may reach 3,000° F. and over. Conjunctivitis, hyperemia, hyperaesthesia of the retina are common among this class of workers. Glass-blowers were said to be subject to cataract formations. Those who work in dusty trades very often suffer mechanical injuries to their eyes, owing to accidental and frequently unavoidable entrance of gritty, sharp dust particles into the eyes.

The effects of certain gases, fumes, and poisons on the eyes are well known, and cannot be gone into here. All strong irritants will affect the eyes and produce various diseases in them. Certain toxic substances cause various amblyopias.

Burns and accidental injuries are very common in many industries. Of 18,644 accidents to 25,000 workers, nearly 1,000 were injuries to the eye.<sup>3</sup>

*Dermatoses.*—Many affections of the skin are directly due to certain conditions in occupations. Thus, the skin is liable to scalds and burns, to the mechanical action of various dusts, to the action of poisons, of irritating gases. Constant pressure and friction will also cause abrasions or callosities. The dermatoses vary in their extent and severity from a simple erythema, to vesicles, pustules, and ulcerations. Occupational eczema is frequent. Scalds and burns are very frequent in some occupations. Dust, mixed with perspiration, will form crusts, which irritate the epidermis, causing itching and erythema, and leading to subsequent infection and more serious lesions. Flax workers very commonly suffer from severe eczema of the hands and fingers. Lead, arsenic, and other poisons produce severe skin affections. Certain workers who

are obliged to scrape hides with their fingers suffer from a form of disease of the nails, called "furrier's nails."

The constant friction and pressure on circumscribed places of skin produce thickenings, callosities, and bursæ. These vary in location according to the special character of the work and the parts of body exposed to the pressure and friction. The hand and fingers are the most frequent places of callosities, the knees and olecranon the most frequent places for bursæ.

*Cardiac and circulatory diseases* owe their origin among workers to excessive strain and muscular effort, the lifting of heavy weights, the strain at too arduous tasks, excessive variations in temperature, etc. Cardiac hypertrophy and dilatation are frequent among athletes, professional pugilists, gymnasts, etc. Disorders of the circulation also depend on alcoholism.

*Diseases of the digestive tract*, unless caused directly by absorption of certain poisons, like lead, arsenic, etc., are mostly due not to the occupation, but to the poor hygienic conditions under which so many of the workers are compelled to live.

Of the *surgical diseases*, apart from wounds, fractures, and dislocations, occupations may cause hernias, varicose veins, aneurisms, etc.

*Infectious Diseases.*—There are a number of maladies which are frequently observed in certain occupations,—maladies which are due to infection by pathogenic organisms that happen to cling to the materials of work. All forms of microbes can be at times found in various substances and materials handled by workers. Thus, the microbes of scarlet fever or of typhoid fever may cling to the materials handled by the tailor; gardeners, who are obliged to handle earth, are more liable to contract tetanus; the men who care for horses are almost the only ones who become infected with glanders; the tunnel workmen are specially liable to anchylostomiasis, the wool workers to anthrax, etc. The infection by the last two has been regarded as closely connected with the occupation, although they can hardly be regarded as occupation diseases.

*Anthrax.*—This is a disease of cattle, induced by the action of the bacillus anthracis. As it forms the subject of an extended article in Vol. I. of this HANDBOOK, it is not necessary that I should enter into any further details in this place.

*Anchylostomiasis* (maladie des tunnels).—This is an infective disease from which many workers in tunnels of Belgium, Switzerland, Australia, and other places have been found suffering. In one pit in the province of Liège from fifty to sixty-nine per cent. of all workers, and in a Hungarian pit eighty per cent. of all workers, were affected. This malady, of which a pernicious anemia is the most characteristic sequel, is caused by a minute parasite which fixes itself in the upper part of the small intestine by a number of hooklets and sucks the blood. The disease has been found in others beside tunnel workers. The infective parasite is found in the excreta, from which the infection recurs. Defective sanitary arrangement in the places of work and the lack of care and hygienic supervision are the causes of the spread of this disease, which will disappear whenever better hygienic conditions are established in tunnels.

Of the other industrial diseases, it remains to mention caisson disease and several minor affections, such as "shoddy fever," "glass-blower's mouth," "stamp-licker's tongue," etc.

*Caisson Disease.*—This term is applied to a group of symptoms the pathology of which is obscure, and which are met with in workers in compressed-air chambers in sinking mines, in excavating for piers for bridges, and in building foundations in boggy soil for large structures. The danger to the workers seems to be greater on going out of the compressed-air chamber into the decompression room than on entering or working in compressed air. The usual symptoms of the disease are vertigo, buzzing in the ears, vomiting, muscular pain, numbness in the legs, unconsciousness, followed, not rarely, by sudden death. The danger is greater the greater the air

pressure and the quicker the entrance of the worker from the compressed air into the decompression chamber; also when the workers are compelled to climb stairs and undergo cardiac and muscular strain soon after coming out of the compressed-air chamber. Oliver<sup>3</sup> thinks that caisson disease is due to increased solution of gases in the blood and sudden liberation of them. Others regard the symptoms as due to the increase in carbonic acid. Not all workers exposed to compressed air suffer equally, and there are some who entirely escape harm. In the building of the St. Louis bridge, where the pressure was sometimes as high as from four to six times the normal, there were twelve fatal cases. In the building of the Brooklyn Bridge the fatality was less.

"Shoddy fever" is an influenza-like infection which is met with in workers in rags and shoddy garments. It is due probably to infection with some bacterial organism.

"Glass-blower's mouth" is a swelling of the parotid gland extending from the angle of the mouth to below the ears, and is met with in glass-blowers.

"Stamp-lickers' tongue" is a stomatitis sometimes met with in those who lick labels and stamps, and is due to infection.

#### THE FACTORS OF OCCUPATION.

The relative increase in the mortality and the greater frequency of disease in certain occupations are in a great part due to the complex group of phenomena which we call occupation, and which is composed of a number of factors, each of which has its own special bearing upon life and health. The primary factors of occupation are: the worker, the place of work, the conditions of work, and the processes of work. These primary factors are composed of several minor factors, each of which may play an important rôle in the causation of sickness and may influence the duration of life. A more or less detailed analysis of each factor is necessary to the understanding of the *modus operandi* of industrial influence on health.

**THE WORKER.**—The primary state of health, the hereditary "physiological wealth," the physical normal development of all organs of the worker, are fundamental elements in all subsequent influences of occupations on health. Some occupations can be followed only by the very strong and exceptionally robust, while others attract the weakling and the feeble only. The susceptibility of the worker to the injurious elements of his trade and his relative predisposition to succumb to the noxious elements or processes of occupation will greatly depend on his primary condition of health before entering the trade which he has chosen as his life profession. The greater the capital of health the worker takes with himself when starting on his vocation, the greater will be his resistance to the dangerous features of his work; the weaker the worker, the more surely will he be affected by any and all detrimental elements. A perfect eyesight, hearing, and other physical faculties are therefore absolutely paramount conditions of normal occupation. But not less than these are also the habits and the care the worker takes of his life and health while at work. Carelessness in the handling of machinery will result in accidents to limb and life; personal uncleanness in mine, factory, and shop will be followed by the relatively sooner ingress into the system of deleterious dusts, etc. Similarly, the worker will be affected by too great addition to alcohol. The excessive heat or cold, the relatively great dryness or too great humidity of the place of work, the foul and dusty atmosphere, the difficult tasks, the arduous labor, the strain and tension of machine work, the worry and fear of the relentless mechanical powers, and the thousand and one demands on the muscular and nervous functions of workers all tend to the creation of a special need and a craving for some stimulating and bracing drug, which is furnished by the ever-present and readily obtainable alcoholic beverages. The use, however, of alcohol leads very often to its abuse, and the excessive drinking of alcoholic liquors is bound, sooner or later,

to produce pathological changes, and injuriously to influence the health of the worker. The state of the blood-vessels in alcoholics, and their relatively greater susceptibility to pneumonia and other acute diseases, as well as to chronic digestive and liver troubles, are well known. There are several special trades which are known by their tendency to favor alcoholism in the workers. Brewers, bakers, drivers, innkeepers, bartenders, glass-workers, workers in the iron and steel industry are notoriously addicted to alcohol.

*Sex and Age.*—In many industries child and female labor is very largely employed; and the effect of work on them is very detrimental to health. The injurious influences of female labor are due to the following factors: (1) The comparative physical weakness of the female organism; (2) the greater predisposition to harmful and poisonous elements in the trades; (3) the periodical semi-pathological state of health of women; (4) the effect of labor on the reproductive organs; and (5) the effects on the offspring. As the muscular organism of woman is less developed than that of man, it is evident that those industrial occupations which require intense, constant, and prolonged muscular efforts must become highly detrimental to their health. This is shown in the general debility, anemia, chlorosis, and lack of tone in most women who are compelled to work in factories and shops for long periods.

The increased susceptibility of women to industrial poisons and to diseases, has been demonstrated by a great number of observers. The female organism, especially when young, offers very little resistance to the inroads of disease and to the various dangerous elements of certain trades. Hirt<sup>5</sup> says, "it must be conceded that certain trades affect women a great deal more injuriously than men," and he mentions, among others, the effects of lead, mercury, phosphorus, and other poisons. Even where there are no special noxious elements, work may produce, as already mentioned, harmful effects on the health of women; but when to the general effects of industrial occupation are added the dangers of dust, fumes, and gases, we find that the female organism succumbs very readily, as compared with that of the male. Shuler<sup>6</sup> found that the frequency of sickness in females, under eighteen, as compared with that of men of the same age, is as 174 to 100. Miss Mary E. Abrahams<sup>7</sup> found that out of 138 lead-poisoning cases in Newcastle, where the number of men and women workers was about the same, there were 94 cases among the women to 41 among the men. She also found that out of the 23 deaths from plumbism, in the years 1889-1892, 22 were women and only 1 was a man. The women were all between seventeen and thirty years of age. These figures are substantiated by Hirt, Arlidge, C. Paul, Tardieu, and others. The predisposition of women in industrial occupations to disease in general is greater than it is in men, as was proven by Hirt in his statistics of tuberculosis among workers. The effect of work on the physical development of women was found to be very detrimental, especially when they were young. Arlidge<sup>9</sup> says that in those who from their youth work in high temperatures, the bones and joints are imperfectly developed, and that they are liable to female deformities and to narrow pelvis. Herkner<sup>9</sup> found in his studies of Belgian female workers that girls who are engaged in mines suffered from deformed joints, from deformities of the spinal column, and from narrow pelvis.

It has been estimated that out of every one hundred days women are in a semi-pathological state of health for from fourteen to sixteen days. The natural congestion of the pelvic organs during menstruation is augmented and favored by work on sewing-machines and other industrial occupations necessitating the constant use of the lower part of the body. Work during these periods tends to induce chronic congestion of the uterus and appendages, and dysmenorrhea and flexion of the uterus are well-known affections of working girls.

The effect of work on the offspring is known to be injurious in female workers. Abortion is very frequent