IN THE SUPREME COURT OF THE

PERMANENT. FILE

DECEMBER TERM, A. D., 1909

VN

W. C. RITC COMPANY, ET ALS. APPELLEES, *vs.* JOHN E. W. WAYMAN AND EDGAR T. DAVIES, APPELLANTS.	APPEAL FROM THE CIRCUIT COURT OF COOK COUNTY. HON. RICHARD S. TUTHILL, JUDGE PRESIDING.

BRIEF AND ARGUMENT FOR APPELLANTS

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The Supreme Court of the State of Illinois

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W. C. RITCHIE AND COMPANY ET AL.,
APPELLEES,

vs.

JOHN E. W. WAYMAN AND EDGAR T. DAVIES,
APPELLANTS.

This case presents the question whether the Illinois Act, approved June 15, 1909, Session Laws, page 212, entitled "An Act to regulate and limit the hours of employment of females in any mechanical establishment, factory, or laundry, in order to safeguard the health of such employees," etc., violates the constitution of the state.

The Act provides:

Section 1. . . . "That no female shall be employed in any mechanical establishment or factory or laundry more than ten hours during any one day. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than ten hours during the twenty-four hours of any day."

The Circuit Court of Cook County, Honorable Richard S. Tuthill, Judge Presiding, held that the "ten-hour law is unconstitutional and void and wholly beyond the power of the legislature to enact," and enjoined its enforcement on the ground that it violated Article II, Section 2, of the Constitution of the State of Illinois, which provides that

"No person shall be deprived of life, liberty, or property without due process of law."

ARGUMENT

The legal rules by which the constitutionality of the women's ten-hour law must be determined appear to be well established in Illinois, namely:

First: The "liberty" secured by Article II, Section 2, of the Illinois Constitution, "means not only freedom of the citizen from servitude and restraint, but is deemed to embrace the right of every man to be free in the use of his powers and faculties."

Braceville Coal Co. vs. *People, 147 Ill. 66, 71.*

Second: This right to "liberty" is, however, "subject to the restraints necessary to secure the common welfare"; in other words, is subject to the restrictions enacted in the exercise of the police power.

Braceville Coal Co. vs. *People, 147 Ill. 66, 71.*

Third: "The police power of the State is that power which enables it to promote the health, comfort, safety, and welfare of society. It is very broad and far-reaching, but is not without its limitations. Legislative acts passed in pursuance of it . . . must have some relation to the ends sought to be accomplished; that is to say, to the comfort, welfare, or safety of society. Where the ostensible object of an enactment is to secure the public comfort, welfare, or safety, it must appear to be adapted to that end. It cannot invade the rights of persons and property under the guise of a mere police regulation, when it is not such in fact; and where such an act takes away the property of the citizen or interferes with his personal liberty, it is the province of the courts to determine whether it is really an appropriate measure for the promotion of the comfort, safety, and welfare of society."

Ritchie vs. *People, 155 Ill. 98, 110.*

Fourth: "While the legislature may determine when the exigency exists for the exercise of the police power, it is for the courts to determine what are the subjects for the exercise of this power, and it is necessary that the act should have some reasonable relation to the subjects of such power. The court must be able to see that the act tends in some degree to the . . . preservation of the public health, morals, safety, or welfare. It must be apparent that such end is the one actually intended, and that there is some connection between the provisions of the law and such purpose."

People vs. *Steele, 231 Ill. 340, 345.*

Fifth: The "exercise of legislative discretion is not subject to review by the courts when measures adopted by the legislature are calculated to protect the public health and secure the public comfort, safety, or welfare; but the measures so adopted must have some relation to the ends thus specified."

Bessette vs. *People, 193 Ill. 334, 345.*

Sixth: "The legislature have power to form classes for the purpose of police regulation, if they do not arbitrarily discriminate between persons in substantially the same situation."

Lasher vs. *People, 183 Ill. 226, 231.*

Facts of common knowledge of which the court takes judicial notice establish conclusively:

That the limitation imposed by the Women's Ten-Hour Law is purely a police regulation; that it is intended solely to preserve the health, safety, morals, and welfare of the community; that it does not arbitrarily discriminate between persons in substantially the same position; that there is the strongest ground for holding that to permit women in Illinois to work in a "mechanical establishment, or factory, or laundry" more than ten hours in one day is dangerous to the public health, safety, morals, and welfare; and that the prohibition of women's working in such establishments more than ten hours a day "is an appropriate measure for the promotion of the comfort, welfare, and safety of society."

These facts of common knowledge will be considered under the following heads:

Part I. Legislation, American and foreign, restricting the hours of labor for women.

Part II. The world's experience upon which the legislation limiting the hours of labor for women is based.

PART FIRST

LEGISLATION RESTRICTING THE HOURS OF LABOR FOR WOMEN

I

I. THE AMERICAN LEGISLATION

Twenty-five States of the Union, besides Illinois, including nearly all of those in which women are largely employed in factory or similar work, have found it necessary to take action for the protection of their health and safety, and the public welfare by enacting laws limiting the hours of labor for adult women.

This legislation has not been the result of sudden impulse or passing humor, — it has followed deliberate consideration, and been adopted in the face of much opposition. More than a generation has elapsed between the earliest and the latest of these acts.

In no instance has any such law been repealed. Nearly every amendment in any law has been in the line of strengthening the law or further reducing the working time.

The earliest statute in the United States which undertook to limit the hours of labor for women in mechanical or manufacturing establishments was Wisconsin Statute, 1867, chap. 83, which fixed the hours of labor as eight. The act, however, provided a penalty only in case of compelling a woman to work longer hours.

The earliest act which effectively restricted the hours of labor for women was Massachusetts Statute, 1874, chap. 34, which fixed the limit at ten hours. The passage of the Massachusetts act was preceded by prolonged agitation and repeated official investigations. The first legislative inquiry was made as early as 1865.

After the Massachusetts act had been in force six years, an elaborate investigation of its economic effects was undertaken by the Massachusetts Bureau of Labor Statistics, under the supervision of its chief, Mr. Carroll D. Wright. His report, published in 1881 (Twelfth Annual Report of the Massachusetts Bureau of Statistics of Labor), to the effect that the reduction of the hours of labor had not resulted in increasing the cost or reducing wages, led to the passage, in 1885 and 1887, of the ten-hour law for women in Rhode Island, Maine, New Hampshire, and Connecticut, and largely influenced the legislation in other States.

In the United States, as in foreign countries, there has been a general movement to strengthen and to extend the operation of these laws. In no State has any such law been held unconstitutional, except Illinois and Colorado where eight-hour laws were declared void.

Ritchie vs. *People, 155 Ill. 98.*

Burcher vs. *People, 41 Col. 495.*

In 1908 the Supreme Court of the United States held the Oregon women's ten-hour law constitutional.

Muller vs. *Oregon, 208 U. S. 412.*

That decision has been followed by similar or additional legislation in twelve States and one territory. The main provisions of the Illinois Act of 1909 are identical in terms with the Oregon Act.

The existing American legislation is as follows:

MASSACHUSETTS

First enacted in 1874 (chap. 221), now embodied in Acts of 1909 (chap. 514).

. . . No woman shall be employed in laboring in a manufacturing or mechanical establishment more than ten hours in any one day . . . unless a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week, and in no case shall the hours of labor exceed fifty-eight in a week; and if any child or woman be employed in more than one manufacturing or mechanical establishment, the total number of hours so employed shall not exceed fifty-eight in any one week. From and after the first day of January, in the year 1910, . . . no woman shall be employed in laboring in a manufacturing or mechanical establishment more than ten hours in any one day . . . unless a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week; and in no case shall the hours of labor exceed fifty-six in a week, except that in any such establishment where the employment is by seasons the number of such hours in any week may exceed fifty-six but not fifty-eight, if the total number of such hours in any year shall not exceed an average of fifty-six hours a week for the whole year, excluding Sundays and holidays.

(Held constitutional, Comm. *v.* Hamilton Mfg. Co., 120 Mass. 383.)

Rhode Island

First enacted in 1885 (chap. 519, sec. 1) now embodied in Laws of 1909 (chap. 384).

. . . No woman shall be employed in laboring in any manufacturing or mechanical establishment more than fifty-six hours in any one week; and in no case shall the hours of labor exceed ten hours in any one day, excepting when it is necessary to make repairs to prevent the interruption of the ordinary running of the machinery, or when a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week.

Louisiana

First enacted in 1886 (Act No. 43), and amended by Acts of 1902 (No. 49); again amended by Acts of 1906 (No. 34) and Acts of 1908 (No. 301).

. . . No woman shall be employed in any places or industries enumerated in section 1 of this act (mill, factory, mine, packing-house, manufacturing establishment, workshop, laundry, millinery or dressmaking store or mercantile establishment in which more than five persons are employed, or in any theater, concert hall or in or about any place of amusement where intoxicating liquors are made or sold, or in any bowling-alley, boot-blacking establishment, freight or passenger elevator, or in the transmission or distribution of messages, either telegraph or telephone, or any other messages or merchandise, or any other occupation not herein enumerated which may be deemed unhealthy or dangerous. Agriculture and domestic industries excepted) for a longer period than ten hours per day or sixty hours per week. There shall be one hour allowed each day for dinner, but such dinner time shall not be included as part of the working hours of the day. In case two-thirds of the employees so desire, time for dinner may be reduced at their request to not less than thirty minutes.

(Certain exceptions covering Saturday and Christmas.)

Connecticut

First enacted in 1887 (chap. 62, sec. 1), now embodied in Acts of 1909 (chap. 220).

. . . No woman shall be employed in laboring in any manufacturing or mechanical establishment more than ten hours in any day, except when it is necessary to make repairs to prevent the interruption of the ordinary running of the machinery, or where a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week; . . . but in no case shall the hours of labor exceed fifty-eight in a calendar week; provided, that in case any employer in such establishment shall, on or before the first day of January of any year, give notice to his employees, by notices posted as hereinbefore provided, that the hours of labor of minors under sixteen years of age and of women employed by him, as aforesaid, shall not exceed fifty-five in any week during the months of June, July, and August of the ensuing calendar year, then said employer may employ such minors and women not to exceed sixty hours in any week during said year, except during said months of June, July, and August.

Maine

First enacted in 1887 (chap. 139, sec. 1), re-enacted in Revised Statutes, 1903, chap. 40, sec. 48, amended by Acts of 1909 (chap. 70).

. . . No woman shall be employed in laboring in any manufacturing or mechanical establishment in the State, more than ten hours in any one day, except when it is necessary to make repairs to prevent the interruption of the ordinary running of the machinery, or when a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week; and in no case shall the hours of labor exceed 58 in a week; . . . provided, that any female of 18 years of age or over, may lawfully contract for such labor for any number of hours in excess of ten hours a day, not exceeding six hours a week, or sixty hours in any one year, receiving additional compensation therefor; . . . (In effect Jan. 1, 1910.)

New Hampshire

First enacted in 1887 (chap. 25, sec. 1), now re-enacted by Stat. 1907 (chap. 94).

No woman . . . shall be employed in a manufacturing or mechanical establishment for more than nine hours and forty minutes in one day except in the following cases: 1. To make a shorter day's work for one day in the week. 2. To make up time lost on some day in the same week in consequence of the stopping of machinery upon which such person was dependent for employment. 3. When it is necessary to make repairs to prevent interruption of the ordinary running of the machinery. In no case shall the hours of labor exceed fifty-eight in one week.

Maryland

First enacted in 1887 (chap. 139, sec. 1), now re-enacted in Code of Pub. Gen. Laws, 1903, Art. 100, sec. 1.

No corporation or manufacturing company engaged in manufacturing either cotton or woollen yarns, fabrics or domestics of any kind, incorporated under the laws of this state, and no officer, agent, or servant of such . . . and no person or firm owning or operating such corporation or manufacturing company . . . shall require, permit or suffer its, his or their employees in its, his or their service, or under his, its or their control, to work for more than ten hours during each or any day of twenty-four hours for one full day's work, and shall make no contract for agreement with such employees or any of them providing that they or he shall work for more than ten hours for one day's work during each or any day of twenty-four hours, and said ten hours shall constitute one full day's work.

(Section 2 makes it possible for male employees to work longer either to make repairs, or by express agreement.)

Virginia

First enacted in 1890 (chap. 193, sec. 1), now embodied in Virginia Code (1904), chap. 178a, sec. 3657b.

No female shall work as an operative in any factory or manufacturing establishment in this State more than ten hours in any one day of twenty-four hours. All contracts made or to be made for the employment of any female . . . as an operative in any factory or manufacturing establishment to work more than ten hours in any one day of twenty-four hours shall be void.

PENNSYLVANIA

First enacted in 1897 (No. 26), and re-enacted in Laws of 1905, No. 226.

Section 1. That the term "establishment" where used for the purpose of this act, shall mean any place within this Commonwealth other than where domestic, coal-mining, or farm labor is employed; where men, women, or children are engaged, and paid a salary or wages, by any person, firm or corporation, and where such men, women, or children are employees, in the general acceptance of the term.

Section 3. . . . No female shall be employed in any establishment for a longer period than sixty hours in any one week, nor for a longer period than twelve hours in any one day. . . . and provided further, That retail mercantile establishments shall be exempted from the provisions of this section on Saturday of each week, and during a period of twenty days beginning with the 5th day of December and ending with the 24th day of the same month; and provided, That during the said twenty days preceding the 24th day of December, the working hours shall not exceed ten hours per day of sixty hours per week.

(Held constitutional in Comm. *v.* Beatty, 15 Pa. Superior Ct. 5.)

NEW YORK

First enacted in 1899 (chap. 192, sec. 77), now embodied in Stat. 1907, chap. 507, sec. 77, 78.

77.

3. . . . No woman shall be employed or permitted to work in any factory in this State . . . more than six days or sixty hours in any one week; nor for more than ten hours in any one day except as hereinafter provided.

78.

1. A female sixteen years of age or upwards . . . may be employed in a factory more than ten hours a day: (a) regularly

in not to exceed five days a week, in order to make a short day or a holiday on one of the six working days of the week; (b) irregularly in not to exceed three days a week; provided that no such person shall be required or permitted to work more than twelve hours in any one day or more than sixty hours in any one week. . . .

Nebraska

First enacted in 1899 (chap. 107), now embodied in Compiled Statutes, 1905, sec. 7955a.

No female shall be employed in any manufacturing, mechanical, or mercantile establishment, hotel, or restaurant in this State more than sixty hours during any one week, and ten hours shall constitute a day's labor. The hours of each day may be so arranged as to permit the employment of such female at any time from six o'clock A. M. to ten o'clock P. M.; but in no case shall such employment exceed ten hours in any one day.

(Held constitutional in Wenham *v.* State, 5 Neb. 394.)

Washington

Enacted in 1901, Stat. 1901, chap. 68, sec. 1.

No female shall be employed in any mechanical or mercantile establishment, laundry, hotel, or restaurant in this State more than ten hours during any day.

The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than ten hours during the twenty-four.

(Held constitutional in State *v.* Buchanan, 29 Wash. 603.)

New Jersey

Enacted in 1905 (chap. 102).

No employee shall be required, permitted or suffered to work in any bakery more than 60 hours in any one week, or more than 10 hours in any one day, unless for the purpose of making a shorter work day on the last day of the week, nor more hours in any one week than will make an average of ten hours per day for the whole number of days in which such employee shall so work during such week, but it shall be lawful, in cases of emergency, for an employer to permit any employee to work on time not exceeding two hours per day, such extra work to be remunerated at the rate of weekly wages paid to such employee for his week of sixty hours.

Oregon

First enacted in 1907 (chap. 200), amended in 1909 (chap. 138).

No female shall be employed in any manufacturing, mechanical or mercantile establishment, laundry, hotel or restaurant, or telegraph or telephone establishment or office or by any express or transportation company . . . more than ten hours during any one day or more than sixty hours in one week. The hours of work may be so arranged as to permit the employment of females at any time so that they shall not work more than ten hours during the twenty-four hours of one day or sixty hours during any one week.

Held constitutional, Muller *v.* Oregon, 208 U. S. 412.

Tennessee

Enacted in 1907 (chap. 308).

It shall be unlawful for any person, firm, or corporation to employ in any manufacturing establishment any female . . . more than sixty-two hours in any week.

Commencing Jan. 1, 1909, it shall be unlawful for any person, firm, or corporation to employ in any manufacturing establishment . . . any female . . . more than sixty-one hours in any one week.

Commencing Jan. 1, 1910, it shall be unlawful for any person, firm, or corporation to employ in any manufacturing establishment . . . any female . . . more than sixty hours in any one week.

Arizona

Enacted in 1909 (chap. 100, sec. 1).

The period of employment of working women and other persons who shall be employed in working in the laundry department in any laundry establishment shall be eight hours in any one day, except when it is necessary to make repairs to prevent the interruption of the ordinary running of the machinery or when a different apportionment of the hours of labor is made for the sole purpose of making a shorter day's work for one day of the week, and in no case shall the hours of labor exceed forty-eight hours in a week.

Michigan

Enacted in 1909 (Act No. 285, sec. 9).

. . . No female shall be employed in any factory, mill, warehouse, workshop, clothing, dressmaking, or millinery establishment, or any place where the manufacture of any kind of goods is carried on, or where any goods are prepared for manufacturing, or in any laundry, store, shop, or any other mercantile establishment, for a period longer than an average of nine hours in a day or fifty-four hours in any week, nor more than ten hours in any one day: Provided, however, that the provisions of this section in relation to the hours of employment shall not apply to nor affect any person engaged in preserving perishable goods in fruit and vegetable canning establishments. . . .

Minnesota

Enacted in 1909 (chap. 499).

No female shall be employed in laboring in a manufacturing or mechanical establishment more than ten hours in any one day, except as hereinafter provided in this section, unless a different apportionment of hours of labor is made for the sole purpose of making a shorter day's work for one day of the week; and in no case shall the hours of labor exceed fifty-eight in a week.

Missouri

Enacted in 1909 (p. 616).

No female shall be employed or permitted to work in any manufacturing or mercantile establishments, laundry, or restaurant in any cities . . . of over 5,000 inhabitants before 5 A. M. or after 10 P. M. of any day, nor for more than fifty-four hours in any one week. Provided, that this act shall not apply to any mercantile establishment where three or less such females are employed; provided, that women may be employed after 10 P. M. in restaurants but shall not be employed therein more than nine hours in any one day.

Montana

Enacted in 1909 (chap. 75).

On all lines of public telephones, operated in whole or in part within this state, it shall hereafter be unlawful for any owner, lessee, company, or corporation to hire or employ any operator or operators, other person or persons, to run or operate a telephone switch-board or boards for more than nine hours in twenty-four hours in cities or towns having a population of 3,000 or over. Provided, however, that the provisions of this act shall not apply to any person or persons, operator or operators, operating any telephone board or boards more than nine hours in each twenty-four for the purpose of relieving another employee in case of sickness or other unforeseen cause or causes.

Legislation somewhat different in character exists in the following States:

Wisconsin

First enacted in 1867 (chap. 83, sec. 1), now embodied in Statutes of 1898, sec. 1728.

In all manufactories, workshops, or other places used for mechanical or manufacturing purposes the time of labor . . . of women employed therein shall not exceed eight hours in one day; and any employer, stockholder, director, officer, overseer, clerk, or foreman who shall compel any woman . . . to labor exceeding eight hours in any one day, . . . shall be punished by fine not less than five nor more than fifty dollars for each such offense.

North Dakota

First enacted in 1877 (Penal Code, sec. 739), now embodied in Revised Code, 1905, sec. 9440.

Every owner, stockholder, overseer, employer, clerk or foreman of any manufactory, workshop, or other place used for mechanical or manufacturing purposes, who, having control, shall compel any woman . . . to labor in any day exceeding ten hours, shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by a fine not exceeding one hundred and not less than ten dollars.

South Dakota

First enacted in 1877 (Penal Code, sec. 739), now embodied in Revised Code, 1903 (Penal Code, sec. 764).

Every owner, stockholder, overseer, employer, clerk, or foreman of any manufactory, workshop or other place used for mechanical or manufacturing purposes, who, having control, shall compel any woman . . . to labor in any day exceeding ten hours, shall be deemed guilty of a misdemeanor, and upon conviction, shall be punished by a fine not exceeding one hundred and not less than ten dollars.

Georgia

First enacted in 1889, p. 163, sec. 2240 (Code of State of Georgia, Vol. II. p. 292, sec. 2615).

The hours of labor required of all persons employed in all cotton or woolen manufacturing establishments in this state, except engineers, firemen, watchmen, mechanics, teamsters, yard-employees, clerical force, and all help that may be needed to clean up and make necessary repairs or changes in or of machinery, shall not exceed eleven hours per day, or the same may be regulated by employers, so that the number of hours shall not in the aggregate exceed sixty-six hours per week; provided, that nothing herein contained shall be construed to prevent any of the aforesaid employees from working such time as may be necessary to make up lost time, not to exceed ten days, caused by accidents or other unavoidable circumstances.

Oklahoma

First enacted in 1890 (Stat. 1890, chap. 25, article 58, sec. 10), now embodied in Revised Statutes, 1903, chap. 25, article 58, sec. 729.

Every owner, stockholder, overseer, employer, clerk, or foreman of any manufactory, workshop, or other place used for mechanical or manufacturing purposes, who, having control, shall compel any woman . . . to labor in any day exceeding ten hours, shall be deemed guilty of a misdemeanor, and upon conviction shall be punished by fine not exceeding one hundred and not less than ten dollars.

New Jersey [1]

First enacted in 1892 (chap. 92), now embodied in General Statutes, page 2350, secs. 66 and 67.

Section 66. . . . Fifty-five hours shall constitute a week's work in any factory, workshop, or establishment where the manufacture of any goods whatever is carried on; and the periods of employment shall be from seven o'clock in the forenoon until twelve o'clock noon, and from one o'clock in the afternoon until six o'clock in the evening of every working day except Saturday, upon which

[1] It has been suggested that this provision has been repealed by a general repealing act of 1904, chap. 83

last named day the period of employment shall be from seven o'clock in the forenoon until twelve o'clock noon.

Section 67. . . . No woman shall be employed in any factory, workshop, or manufacturing establishment except during the periods of employment hereinbefore mentioned: Provided, That the provisions in this act in relation to the hours of employment shall not apply to or affect any person engaged in preserving perishable goods in fruit-canning establishments or in any factory engaged in the manufacture of glass.

South Carolina

First enacted in 1907 (No. 223), amended in 1909 (chap. 121).

. . . Ten hours a day or sixty hours a week, provided, however, that the hours of a single day shall not exceed eleven hours, except for the purpose of making up lost time as hereinafter provided, shall constitute the hours of working for all operators and employees in cotton and woolen manufacturing establishments engaged in the manufacture of yarns, cloth, hosiery, and other products for merchandise, except mechanics, engineers, firemen, watchmen, teamsters, yard employees, and clerical force. All contracts for longer hours of work other than herein provided in said manufacturing establishment shall be and the same are hereby declared null and void; . . . Provided, That nothing herein contained shall be construed as forbidding or preventing any such manufacturing company from making up lost time to the extent of sixty hours per annum when such lost time has been caused by accident or other unavoidable cause.

II. THE FOREIGN LEGISLATION

The leading countries of Europe in which women are largely employed in factory or similar work have found it necessary to take action for the protection of their health and safety and the public welfare, and have enacted laws limiting the hours of labor for adult women.

About two generations have elapsed since the enactment of the first law. In no country in which the legal limitation upon the hours of labor of adult women was introduced has the law been repealed. Practically without exception every amendment of the law has been in the line of strengthening the law or further reducing the working time.

(a) Great Britain

First law enacted in 1844. The British law of 1844 was the first statute in any country limiting the hours of labor for adult women. It simply extended to women the provisions of the Act of 1833, which had restricted the work of children in textile mills to twelve hours per day. In 1847 the legal working time for women as well as children in textile mills was reduced to ten hours per day. By further legislation in 1867, 1878, 1891, 1901, and 1907 further restrictions were introduced. The law, subject to certain exceptions allowing overtime, is in substance as follows (Law of 1901, 1 Edw. VII. ch. 22):

Hours.
Textile Factories. (Sec. 24.)

The period of employment, except on Saturday, shall either begin at 6 A. M. and end at 6 P. M., or begin at 7 A. M. and end at 7 P. M.

There shall be allowed for meals during said period of employment on every day except Saturday not less than two hours, of which one hour at the least shall be before 3 P. M.

Special regulations for a shorter day on Saturdays.

Non-textile Factories and Workshops. (Sec. 26.)

The period of employment, except on Saturdays, shall either begin at 6 A. M. and end at 6 P. M., or begin at 7 A. M. and end at 7 P. M., or begin at 8 A. M. and end at 8 P. M.

There shall be allowed for meals during the said period of employment on every day except Saturday not less than one and one-half hours, of which one hour at the least shall be before 3 P. M.

Special regulations for a shorter work-day on Saturdays.

In a Workshop which does not employ Children or Young People. (Sec. 29.)

The period of employment shall, except on Saturdays, be a specified period of twelve hours taken between 6 A. M. and 10 P. M.

There shall be allowed to a woman for meals and absence from work during the period of employment not less than one and one-half hours.

Overtime granted for special trades, press of work, etc.

For special regulations for laundries see Stat. 1907, p. 192, chap. 39.

(*b*) FRANCE

The law of 1848, as amended by Act of November 2, 1892, and March 30, 1900, which became operative in 1904, provides in substance:

Hours of Labor (in industrial establishments).

The maximum length of the working day shall be ten hours (Art. 3, sec. 2), broken by at least one hour of rest. (Art. 3, sec. 1.)

Overtime may be granted by departmental decrees for two hours in one day, during not more than sixty days in the year, for certain trades, chiefly season trades. (Art. 4, sec. 4.) By departmental decrees employment of women may be prohibited or regulated in trades considered dangerous to health or morals. (Arts. 12 and 13.)

(*c*) SWITZERLAND

The Canton of Glarus enacted in 1848 a law limiting the hours of labor to thirteen in one day. In 1864 this limit was reduced to twelve hours, and in 1872 it was further reduced to eleven hours. The Town of Basel enacted in 1869 a law limiting the hours of labor to twelve in one day.

The Canton of Ticino enacted in 1873 a law limiting the hours of labor to twelve in one day.

The Federal Swiss Constitution of 1874 provided:

Article 34: The Confederation has the right to make uniform prescription . . . concerning the duration of labor which may be required of adults.

The Federal law enacted in 1877 provides:

Hours of Labor (in industrial establishments).

The daily hours of work shall not exceed eleven hours in one day, and shall not exceed ten hours on the days before Sundays or holidays.

These working hours must be broken by a rest of at least one hour at noon; one and one-half hours for women who have to attend to household. (Art. 2, sec. 1.)

Overtime may be granted by the separate cantons for fixed times and fixed hours.

All the cantons have the same restriction of hours as is fixed by the Federal law except

Zurich (Law of 1894).

Hours of Labor (in industrial establishments).

The daily hours of labor shall not exceed ten hours in one day, and shall not exceed nine hours on the days before Sundays and holidays.

Overtime allowed for two hours in the day during seventy-five days in the year for various causes, such as season trades, press of work, etc. (Art. 9–16.)

(*d*) Austria

First law enacted in 1885; as amended by Acts of 1897, provides, in substance:

Hours of Labor (in factories and workshops).

Women shall not be employed more than eleven hours in one day. (Art. 96 a, secs. 1–3.)

These working hours must be broken by rests amounting to one and one-half hours, one hour of which is allowed at noon. (Art. 74 a.)

Overtime for one hour in the day may be granted by the Ministers of Commerce and of the Interior for certain trades, the list of which must be revised every three years. (Art. 96 a, secs. 1–3.)

The Ministers may prohibit or regulate employment of women in trades held dangerous to health.

(*e*) Holland

First law enacted in 1889 provides as follows:

Hours of Labor (in factories and workshops).

The daily hours of labor shall not exceed eleven hours in one day. (Art. 5, sec. 1.)

Between 11 A. M. and 3 P. M. a rest of at least one hour must be allowed. (Art. 6.)

Overtime may be granted by the provincial governors, allowing a thirteen-hour day for at most six consecutive days, or on alternative days during two weeks. (Art. 5, sec. 3.)

By royal decree employment of women may be prohibited or regulated in trades held dangerous to health.

(*f*) Italy

The law of June 19, 1902, provides in substance:

Hours of Labor.

Women shall not be employed more than twelve hours in one day. (Art. 7.)

The day's work shall be broken by one or more rests amounting to one and one-half hours in a day of from eight to eleven hours, and amounting to two hours in a day of more than eleven hours. (Art. 8.)

(*g*) Germany

The law of 1891 as amended December, 1908, provides in substance:

Hours of Labor (in workshops in which as a rule at least ten workmen are employed).

Working women may not be employed between eight o'clock in the evening to six o'clock in the morning, and on Saturdays and the eve of holidays not after five o'clock in the afternoon. (Sec. 137 a.)

The employment of working women may not exceed the duration of ten hours daily, and of eight hours on the eve of Sundays and holidays.

Between working hours at least one hour of noon rest must be allowed to working women.

After the end of the daily working time a continuous rest of at least eleven hours must be allowed to working women.

Working women who have to attend to a household must, at their request, be dismissed half an hour before the noonday rest, unless this lasts at least one hour and a half.

Overtime may be granted by the lower administrative authority for not more than twelve hours of labor in one day, during two weeks, not more than forty days in the year, but there must be an unbroken interval of ten hours between one day's work and the next.

For a period exceeding two weeks the same permission may be granted only by the higher administrative authority, but not to exceed fifty days in the year. (138 a.)

The Federal Council may grant overtime for special trades, not more than forty days in the year, and for not more than twelve hours of labor in one day, but there must be an unbroken interval of ten hours between one day's work and the next. (139 a.)

(*h*) Nova Scotia

The Factories Act of 1901, as amended by the laws of 1909 (ch. 36), provides in substance:

Hours of Labor (in factories).

No . . . woman shall be employed more than nine hours in one day.

(*i*) South Australia

Factories Act of 1907, Part VII, Div. I, sec. 65, provides:

Women may not be employed

a, more than forty-eight hours in any one week;

b, more than ten hours in any one day.

Overtime may be granted (in emergency) up to fifty-five hours in one week — not over one hundred hours overtime in one year.

PART SECOND

THE WORLD'S EXPERIENCE UPON WHICH THE LEGISLATION LIMITING THE HOURS OF LABOR FOR WOMEN IS BASED

I. THE DANGERS OF LONG HOURS

A. *Causes*

(1) Physical Differences between Men and Women

The dangers of long hours for women arise from their special physical organization taken in connection with the strain incident to factory and similar work.

In structure and function women are differentiated from men. Besides anatomical and physiological differences, physicians are agreed that women are fundamentally weaker than men in all that makes for endurance; in muscular strength, in nervous energy. Overwork, therefore, which strains endurance to the utmost, is more disastrous to the health of women than of men, and entails upon them more lasting injury.

British Sessional Papers. Vol. XV. 1831–2. Report from the Select Committee on the "Bill to regulate the Labour of Children in the Mills and Factories of the United Kingdom." GREAT BRITAIN

Samuel Smith, Esq., member of College of Surgeons and practising surgeon in Leeds:

10385. Are not the females still less capable of sustaining this long labour than males would be of a similar age? — No doubt whatever of it; because in the female neither the bony nor the muscular system is so strongly developed as it is in the male; in fact, the whole body is more delicately formed.

10386. Is the peculiar structure of the female form so well adapted

GREAT BRITAIN

to long continued labour, and especially which is endured standing, as is that of a male? — No, it is not. (Page 503.)

10453. You stated that females were not as competent to sustain the labour of the factories as males of the same age: is it not considered that females attain to full maturity and full strength much earlier than males? — They do.

10454. And would they not be so able to do the labour proportioned to their strength as the males of the same age? — No, I think not; the female is altogether a more delicate being than the male. (Page 510.)

Thomas Young, Esq., M.D., physician at Bolton:

10600. Will you state whether the female can bear labour as well as the male? — I think females cannot endure labour as well as males. (Page 522.)

John Malyn, Esq.:

10678. Do you conceive that the evils that result from the factory system are such as would fall with still greater severity upon the female sex, as compared with the male? — I think they would, from the greater degree of delicacy of the female frame, and from their having less resiliency than man when acted upon by disease. I have already in an early part of my evidence stated the probable effect of too early employment on the pelvis of that sex. (Page 532.)

10698. You have already said that its effect would be more pernicious to the females, and consequently that they need at least an equal protection, and that, coupled with the circumstances of the majority of those employed in mills and factories being females, strengthens you in your conclusion as to the necessity of a legislative measure on behalf of those individuals? — Yes, for three reasons: first, they are naturally of a weaker constitution than the male; secondly, injuries during growth might be of serious moment at the time of parturition; and, thirdly, their propensities are developed earlier than in the male, — which might be counteracted, if time or means were afforded for mental cultivation. (Page 533.)

James Blundell, Esq., M.D., lecturer on physiology and midwifery in the school of Guy's Hospital:

10874. . . . Will you state whether the female sex is as well fitted to sustain long exertion, especially in a standing position, as the male, either in respect of the peculiar structure of certain parts of the skeleton or of muscular power? — Decidedly females are not so well fitted to bear those exertions as the males; and the standing position long continued is, from the peculiarities of the womanly make, more especially injurious to them. (Page 544.) GREAT BRITAIN

Sir Anthony Carlisle, F.R.S., surgeon in the Westminster Hospital:

11067. A considerable majority of those employed in mills and factories are females; do you conceive that the female sex is as well fitted to endure labour of the description alluded to as males? — Oh, no, certainly not; they are by nature less muscular, and I would say there is less sensorial power about them, and less animal vigour. (Page 561.)

Peter Mark Roget, Esq., M.D., F.R.S., practising physician in London, consulting physician to the Northern Dispensary, consulting physician to Queen Charlotte's Lying-in Hospital:

11167. It is known that a considerable majority of persons employed are females; do you think the female constitution is as well adapted to labour of the description alluded to as that of the male? — I think it is not as well adapted, certainly. (Page 570.)

Sir William Blizard, F.R.S., surgeon to the London Hospital and lecturer on surgery, anatomy, and physiology:

11220. It is a known fact, and often referred to as a sort of an apology for this system, that it affords employment to females principally; would you conceive, arguing on physiological principles, that the female is as well calculated to endure long and active labour as the male? — Certainly not; and universal observation would confirm that opinion. (Page 574.)

Sir George Leman Tuthill, F.R.S., physician to the Westminster Hospital and Bethlem Hospital.

11334. . . . Do you conceive that the constitution of the female is as well calculated to sustain long and fatiguing labour as the male? — I do not. (Page 582.)

Joseph Henry Green, Esq., F.R.S., surgeon of St. Thomas's Hospital and professor of surgery at King's College:

11380. . . . Do you conceive that the female frame and constitution is as well adapted to long-continued and strenuous exertion as that of the male? — I do not.

11381. So the protection becomes the more necessary, when we refer to the fact of females being the principal operatives in such works? — Yes. (Pages 587–588.)

Charles Aston Key, Esq., surgeon at Guy's Hospital:

11441. . . . Do you consider that the female sex is, generally speaking, as well calculated to endure labour and fatigue as the male sex? — Much less able to endure labour than the male sex. (Page 593.)

James Guthrie, Esq., F.R.S., vice-president of Royal College of Surgeons, surgeon to Westminster Hospital and to Westminster Eye Hospital.

11488. . . . Will you state whether the female sex is as well fitted to sustain long exertion, especially in a standing position, as the male, either in respect of the peculiar structure of certain parts of the skeleton or of muscular power? — It is not. (Page 596.)

Benjamin Travers, Esq., F.R.S., senior surgeon to St. Thomas's Hospital in Southwark:

11603. It is alleged that a great majority of the young persons employed are of the female sex; do you think females as competent to sustain labour as males? — I should think not, in general. (Page 606.)

British Sessional Papers. Vol. XXVIII. 1844. Reports of Inspectors of Factories for Half-year ending 31st Dec. 1843.

Twelve hours' daily work is more than enough for any one; but however desirable it might be that excessive working should be prevented, there are great difficulties in the way of legislative interference with the labour of adult men. The case, however, is very different as respects women, for not only are they much less free agents, but they are physically incapable of bearing a continuance of work for the same length of time as men, and a deterioration of their health is attended with far more injurious consequences to society. (Page 4.)

British Sessional Papers. Vol. XVII. 1892. Select Committee on Shop Hours Bill.

Witness, Mr. Thomas Sutherst, barrister, and author of "Death and Disease behind the Counter":

1358. You have taken the evidence of 173 male shop assistants? — Yes.

1360. If all these men, with hardly an exception, complain of the conditions of shop life, must it not be harder upon the women than upon the men? — Very much harder. (Page 60.)

Ibid. Report of Lancet Sanitary Commission on Sanitation in the Shop.

Without entering upon the vexed question of women's rights, we may nevertheless urge it as an indisputable physiological fact that, when compelled to stand for long hours, women, especially young women, are exposed to greater injury and greater suffering than men. (Page 248.)

British Sessional Papers. Vol. XII. 1895. Report of Select Committee on Shops (Early Closing) Bill.

Witness, Dr. Percy Kidd, M.D., University of Oxford, Fellow of the College of Physicians and Member of the College of Surgeons; attached to the London Hospital and the Brompton Hospital.

5282. Are those symptoms (debility of the nervous system, indigestion, constipation) more marked in women than in men?—I think they are much more marked in women. I should say one sees a great many more women of this class than men; but I have seen precisely the same symptoms in men, I should not say in the same proportion, because one has not been able to make anything like a statistical inquiry. There are other symptoms, but I mention those as being the most common. Another symptom especially among women is anæmia, bloodlessness or pallor, that I have no doubt is connected with long hours indoors. (Page 215.)

British Sessional Papers. Vol. VI. 1901. Report from the Select Committee of the House of Lords on Early Closing of Shops.

Witness, Sir W. MacCormac, President of the Royal College of Surgeons:

2470. Would you draw a distinction between the evil resulting to women and the evil resulting to men?—You see men have undoubtedly a greater degree of physical capacity than women have. Men are capable of greater effort in various ways than women. If a like amount of physical toil and effort be imposed upon women, they suffer to a larger degree. (Page 120.)

British Sessional Papers. Vol. X. 1904. Report of the Chief Inspector of Factories and Workshops. Report on the Thirteenth International Congress of Hygiene and Demography.

Dr. Trèves cited the case of a machine capable of giving 33,000 blows per diem, at which the men employed utilize on an average

GREAT BRITAIN 18,000 to 20,000, while the women, less inured to fatigue and less capable of attention, utilize but 13,000. (Page 298.)

History of Factory Legislation. B. L. HUTCHINS *and* AMY HARRISON. *Westminster, King, 1903.*

Women are "not only much less free agents than men, but they are physically incapable of bearing a continuance of work for the same length of time as men, and a deterioration of their health is attended with far more injurious consequences to society. (Page 84.)

Man and Woman. A Study of Human Secondary Sexual Characters. HAVELOCK ELLIS. *London, Scott, 1904.*

In strength as well as in rapidity and precision of movement women are inferior to men. This is not a conclusion that has ever been contested. It is in harmony with all the practical experience of life. It is perhaps also in harmony with the results of those investigators (Bibra, Pagliani, etc. Arch. per l'Antrop., Vol. VI, p. 173) who have found that, as in the blood of women, so also in their muscles, there is more water than in those of men. To a very great extent it is a certainty, a matter of difference in exercise and environment. It is probably, also, partly a matter of organic constitution. (Page 155.)

The motor superiority of men, and to some extent of males generally, is, it can scarcely be doubted, a deep-lying fact. It is related to what is most fundamental in men and in women, and to their whole psychic organization. (Page 156.)

CANADA *Toronto University Studies in Political Science. First Series, No. 3. The Conditions of Female Labour in Ontario.* JEAN THOMPSON SCOTT. *Toronto, 1892.*

In the struggle for existence women must recognize that whatever they are or may become intellectually, physically they are not men; . . . A girl who had lost her health, and finally was obliged to give up her situation, on account of continuous application to work, which after some years' experience proved beyond her strength, said to me, "We do not know at the time and do not believe that we are over-exerting ourselves." Isolated cases of women having shown themselves able to stand a severe physical strain cannot refute the fact that a vast majority of women are of a weaker mould than men.

and that overwork has in many cases been the cause of a life of semi-invalidism. It is nothing short of criminal to permit, let alone to exact, an undue exertion of physical strength from women; and it is the duty of the government to prevent it. That women are willing, nay, even anxious sometimes, to attempt hard physical labour, is no reason for their being permitted to do so. (Pages 29.) **CANADA**

Verhandlungen des Deutschen Reichstags. 103 Sitzung, April 18, 1891. [Proceedings of the German Reichstag. 103d Session, April 18, 1891.] **GERMANY**

Representative Bebel:

Workers, both men and women, who realize the true relations of life and labor are everywhere united in endeavoring to shorten the hours of labor as much as is possible. . . . Even those who refuse to listen to this request from working men are inclined to take a different attitude in regard to working women. (Pages 2418–2419.)

Amtliche Mittheilungen aus den Jahres Berichten der Gewerbe Aufsichtsbeamten. XXII. 1897. [Official Information from the Reports of the (German) Factory Inspectors, 1897.] Berlin, Bruer, 1898.

The inspector from Baden writes:

The present 11-hour day, requiring constant standing, in weaving and spinning rooms, is far more destructive to the organism of women than it is to men. The undermining effects of the long hours mentioned upon health are clearly noticeable in the appearance of the middle-aged women. (Pages 241–242.)

Hygiene of Nerves and Mind in Health and Disease. August Forel, M.D. *Trans. from the German by* Austin Aikens, Ph.D. *London, Murray, 1907.*

The nervous hygiene of women demands special consideration because certain periods of their life require extraordinary precautions in view of the special predisposition to nervous troubles caused by menstruation, pregnancy, confinement, and the climactiric. (Page 320.)

It is of special importance to accentuate the injuriousness of certain kinds of fine hand-work which overstrain the attention and irritate the brain, especially long-continued sewing and similar sedentary occupations that strain the mind. The one-sided over-doing of

GERMANY such work makes many women nervous and psychopathic or exaggerates bad tendencies which are already present. (Page 321.)

UNITED STATES *Report of the Massachusetts Bureau of Statistics of Labor, 1875.*

Mr. D——, the publisher of a well-known periodical, says:

I have had hundreds of lady compositors in my employ, and they all exhibited, in a marked manner, both in the way they performed their work and in its results, the difference in physical ability between themselves and men. They cannot endure the prolonged close attention and confinement which is a great part of type-setting. I have few girls with me more than two or three years at a time; they must have vacations, and they break down in health rapidly. I know no reason why a girl could not set as much type as a man, if she were as strong to endure the demand on mind and body. (Page 91.)

Report of the New York Bureau of Labor Statistics, 1884. Hygiene of Occupation, by Dr. ROGER S. TRACY, *Sanitary Inspector of the Board of Health, New York.*

Since the dangers due to various occupations have been brought to public notice, it has become a grave question how far the employment of women and children in factories should be allowed. Women are certainly more delicately organized than men, less capable of sustained muscular exertion, and more susceptible to many of the poisons used in the arts and manufactures. As the physical condition of women has such an important bearing on the welfare of the race, and on the health of future generations, it becomes fairly a question of government control. (Page 199.)

Report of the Maine Bureau of Industrial and Labor Statistics, 1888.

Let me quote from Dr. Ely Van der Warker (1875):

Woman is badly constructed for the purposes of standing eight or ten hours upon her feet. I do not intend to bring into evidence the peculiar position and nature of the organs contained in the pelvis, but to call attention to the peculiar construction of the knee and the shallowness of the pelvis, and the delicate nature of the foot as part of a sustaining column. The knee-joint of woman is a sexual characteristic. Viewed in front and extended, the joint in but a slight degree interrupts the gradual taper of the thigh into the leg. Viewed in a semi-flexed position, the joint forms a smooth ovate spheroid. The reason of this lies in the smallness of the patella in front, and the narrowness of the articular surfaces of the tibia and femur, and which in man form the lateral prominences, and thus is much more perfect as a sustaining column than that of a woman. The muscles which keep the body fixed upon the thighs in the erect position labor under the disadvantage of shortness of purchase, owing to the short distance, compared to that of man, between the crest of the ilium and the great trochanter of the femur, thus giving to man a much larger purchase in the leverage existing between the trunk and the extremities. Comparatively the foot is less able to sustain weight than that of man, owing to its shortness and the more delicate formation of the tarsus and metatarsus. (Pages 142–143.) **UNITED STATES**

Report of the Nebraska Bureau of Labor and Industrial Statistics, 1901–1902.

They (women) are unable, by reason of their physical limitations, to endure the same hours of exhaustive labor as may be endured by adult males. Certain kinds of work which may be performed by men without injury to their health would wreck the constitution and destroy the health of women, and render them incapable of bearing their share of the burdens of the family and the home. The State must be accorded the right to guard and protect women as a class against such a condition, and the law in question to that extent conserves the public health and welfare. (Page 52.)

Report of the New York Department of Labor: Report of the Commissioner of Labor, 1908. C. T. GRAHAM-ROGERS, M.D., *Medical Inspector of Factories.*

The average healthy woman is very much inferior in physical strength and endurance to the average man. Her physical conformation is different, and the physiological and social parts that she plays in life differ from those played by man, therefore we find her more susceptible to the effects of hard labor and prolonged or sedentary occupation, which susceptibility is increased during the child-bearing period. (I. 73.)

Reference Handbook of the Medical Sciences. Hygiene of Occupation. Vol. VI. 1903. GEORGE M. PRICE, M.D., *Medical Sanitary Inspector, Health Department of the City of New York.*

In many industries . . . female labor is very largely employed; and the effect of work on them is very detrimental to health. The

UNITED STATES

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, anæmia, chlorosis, and lack of tone in most women who are compelled to work in factories and in 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 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. Schuler found the frequency of sickness in females under eighteen, as compared with that of men of the same age, as 174 to 100. Miss Mary E. Abrams (Oliver: "Dangerous Trades") found that out of 138 lead-poisoning cases in Newcastle, where the number of men and women workers was about the same, there were ninety-four cases among the women and forty-one among the men. She also found that out of the twenty-three deaths from plumbism in the years 1889–1892, twenty-two were women and only one 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 very young. Arlidge 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 pelves. Herkner 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 pelves. UNITED STATES

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 dysmenorrhœa and flexion of the uterus are well-known affections of working girls. (Page 321.)

(2) The Greater Morbidity among Women

(a) General Morbidity

The need of protecting the health of working women by limiting their working hours is emphasized by statistics of the relative morbidity of men and women. In all countries where such statistics have been kept by sickness insurance societies, the morbidity of women has been found to be higher than that of men.

Sixth International Congress of Hygiene and Demography. Vienna, 1887. Part XIV. Vol. I. Fabrikhygiene und Gesetzgebung. [*Factory Hygiene and Legislation.*] Dr. Fridolin Schuler, *Swiss Factory Inspector. Vienna, 1887.* SWITZERLAND

At time of menstruation, during pregnancy and after childbirth the woman is especially liable to infectious and other diseases. This has been proved by the statistics of morbidity in Switzerland in those industrial establishments where men and women are at work together. ' In one year's time in the same trade the proportion of cases of illness was as follows: Women, 127; men, 100. The number of days lost compared thus: Women, 150; men, 100. These proportions become more divergent when the workers are under 18 years of age. Thus, for such workers we find: proportion of cases

SWITZERLAND

of sickness, girls, 174; boys, 100. Taking the statistics of cotton mills only, we find the proportion of cases of sickness, for women, 156; for men, 100. These figures alone, to go no further, show the necessity of special protection for those who, without this legal protection, are liable to be frightfully exploited. (Page 29.)

Untersuchungen über die Gesundheitsverhältnisse der Fabrikbevölkerung der Schweiz. [Investigations into the Conditions of Health of the Swiss Factory Workers.] Dr. FRIDOLIN SCHULER, *Swiss Factory Inspector, and* Dr. A. E. BURCKHARDT, *Prof. of Hygiene, Basle. Aarau, Säuerländer, 1889.*

There are great varieties in the morbidity of the two sexes. In general men showed a greater frequency of sickness than women. In 1000 general cases there were among men 291 cases of illness; among women, 257. This result is partly induced by the large number of workers in mechanical shops who fall ill. If, however, the figures are taken solely from workers in the same occupation the results are often reversed. So, for example, in cotton mills (spinning processes), where women show a morbidity of 128 : 100 as compared to men, and in cotton factories (weaving processes) of 139 : 100. In the silk mills the proportion of illness among the women is even more extreme, while in machine embroidery it is nearer to a balance — 111 : 100. (Page 33.)

An das Schweiz. Industriedepartement, Bern. Die Eidgenössischen Fabrikinspectoren. [Report of the Swiss Factory Inspectors to the Swiss Department of Labor on the Revision of the Factory Laws.] Schaffhausen, 1904.

The 10-hour day is now almost the rule for men. . . . Those industries where the 11- or 12-hour shift is retained are almost entirely those which employ chiefly, or in large proportions, women and children. In other words, those as yet unprotected classes of workers who are obliged to toil for the longest number of hours in a day are almost entirely women and children. And yet women should be better protected than men, not only because their physical strength is less, but because they are the bearers of the race, whose vigor is materially modified by the health of the mothers. The State has the deepest interest in maintaining vigorous and able defenders, and therefore its foremost duty is to protect women and children from being overburdened. This necessity is most glaring in the case of cotton mills, as the researches of Schuler and Burckhardt, which have never been contested, prove a morbidity of women in this industry notably greater than that of men in the same. (Pages 26–27.) SWITZERLAND

Verhandlungen des Deutschen Reichstags, 103 Sitzung, April 18, 1891. [Proceedings of the German Reichstag, 103d Session, April 18, 1891.] GERMANY

Representative Dr. Schædler:

At the Sixth International Congress of Hygiene in Vienna, 1887, Dr. Schuler, the expert factory inspector, pointed out the greater liability of women to disease produced by unfavorable factory conditions. He stated that the morbidity of women in factory work in Switzerland had been approximately 27 per cent higher than that of men in the same industries. (Page 2406.)

Das Verbot der Nachtarbeit. Bericht erstattet an den internationalen Kongress für gesetzlichen Arbeiterschutz in Paris, 1900. (Schmoller's Jahrbuch, 25³⁻⁴.) [Prohibition of Night Work. Report presented to the International Congress for Labor Legislation at Paris, 1900. (Schmoller's Yearbook, 25³⁻⁴.)] Dr. MAX HIRSCH, *Germany. Leipzig, 1901.*

Adult women have also an inferior power of resistance to the evils of night work as well as to the other harmful tendencies of industry. . . . On this point the sick benefit funds give striking testimony. (Page 265.)

Schriften der Gesellschaft für Soziale Reform, Heft 7–8. [Publications of the Social Reform Society, Nos. 7 and 8.] Die Herabsetzung der Arbeitszeit für Frauen und die Erhöhung des Schutzalters für jugendliche Arbeiter in Fabriken. [The Reduction of Women's Working Hours and the Raising of the Legal Working Age for Young Factory Employees.] Dr. AUGUST PIEPER *and* HÉLÈNE SIMON. *Jena, Fischer, 1903.*

The daily toil in factory or shop, the harm that — aside from the evitable mental and physical exertion — arises from harmful bodily postures, such as continuous sitting or standing, and from the dust or steam that fill workrooms, have been becoming more extensive

GERMANY with the lapse of years, and the longer the hours of work, the more serious are the bad results of these conditions. The statistics of the Sickness Insurance Societies, both as to the total number of cases of illness and as to the relatively longer duration of attacks of illness among working women, show an astonishing amount of sickness under the present working hours. The reports of the factory inspectors for 1899 upon the employment of married women in factories show that they especially suffer an alarming extent of ill-health, and that this is, in many cases, directly traceable to beginnings long before marriage. (Page 4-5.)

In contrast to the usual "occupation diseases" (as lead colic, etc.) are the characteristic diseases of weakness among women wage-earners, viz., anæmia and chlorosis; as in the printing trades of Berlin, where among the 4734 women there were 296 such cases, but only 72 among all the 11,801 men insured in these trades.

When the dangers to both sexes are alike, the figures of the sick fund are always higher for women, unless the totals are complicated by accidents.

It is so in textiles, glove and shoe trades, in the post-office and cigar manufacture. The Local Insurance Society for Berlin in 1899 showed 29.7 per cent ill, and 41.0 per cent women in cigar-making. According to Wirminghaus the percentage of illness in all Germany in 1888 in cigar-making was 0.20 for men and 0.25 for women, while the percentage for the whole country in spinning and weaving was 0.61 for men and 0.72 for women. (Page 93.)

Die Neue Zeit, 23², 1905. Ehret die Frauen. [*Honor to Women.*] EMANUEL WURM. *Stuttgart, 1905.*

In 1903 there were 1,000,000 and more women working beside the 4,000,000 men in German mills and factories. . . . The factory laws have some protective regulations, but not nearly enough to equalize the woman's far inferior physical power of resistance with that of men. The indisputable proof of this lies in the far higher percentage of illness among the women operatives as shown by the sick funds. Many such funds, as, for instance, those of the textile industry, with its membership of 420,000 women and 380,000 men in 1903, are, by this disproportionately high morbidity of women, in the most embarrassing financial situation. (Page 157.)

Le Travail de Nuit des Femmes dans l'Industrie. Rapports sur son importance et sa règlementation légale. Préface par Prof. Etienne Bauer. [*Nightwork of Women in Industry. Reports on its importance and legal regulation. Preface by* Prof. Etienne Bauer.] *Le Travail de Nuit des Femmes dans l'industrie en Autriche.* [Nightwork of Women in Industry in Austria.] Ilse von Arlt. *Jena, Fischer, 1903.* AUSTRIA

According to the testimony of the Sickness Insurance Societies, women, when subjected to the same work as men, have a larger percentage of illness, this predominance being attributed to the influences of industrial labor, since the loss of time incident to childbirth is classified separately. It is much to be regretted that there are no data available which might enable us to judge how women would stand as to health, compared with men, provided that they were only employed during periods when their working capacity was unimpaired. Such data would not simply have purely theoretical interest, but would enable us to determine with precision the dangers to which women are exposed in the different industrial lines, and to elaborate protective measures for them upon an exact basis. (Page 100.)

Tenth International Congress of Hygiene and Demography, Paris, 1900. In one volume. Législation et règlementation du travail au point de vue de l'hygiene. [Labor Legislation and Regulation from the Standpoint of Hygiene.] M. Édouard Vaillant. *M.R.C.S., England. Paris, Masson & Co., 1900.* FRANCE

. . . All reduction of daily and weekly working hours must be regarded as important hygienic progress.

If we study the statistics of morbidity and mortality in the different trades, and seek to isolate, as far as possible, the effects of dangerous trades and of working hours, we shall see very plainly in the reports of factory inspectors, and especially in the insurance records of Germany and Austria, that the reduction of working hours has succeeded, in a few years' time, in bringing down the totals of morbidity and mortality even below the total of trades that are considered relatively more healthy, but where the length of hours had not been decreased. (Pages 515 and 516.)

UNITED STATES

Report of the New York Bureau of Labor Statistics, 1890.

Dr. Schuler, factory inspector of Switzerland, states in a recent report: ". . . According to the experiments made in Switzerland, the morbidness of female factory operatives is 27 per cent higher than that of males; and the average number of days during which the former are incapacitated to work is one and a half times as great as in the case of male workers." (Page 81.)

Bulletin of the United States Bureau of Labor, No. 75, March, 1908. Industrial Hygiene. GEO. M. KOBER, M.D., LL.D.

The statistics of the morbidity and mortality of various occupations, while far from satisfactory, and subject to more or less erroneous conclusions, nevertheless indicate that persons habitually engaged in hard work are more frequently subject to disease, and pressent a higher mortality than persons more favorably situated; and this is especially true of factory employees, because their work is generally more monotonous, fatiguing, performed under less favorable surroundings, and they are too often also badly nourished and badly housed. (Page 473.)

(b) DURATION OF ILLNESS GREATER AMONG WOMEN

The morbidity of women, measured by the number of days lost through illness, is greater than that of men. That is, women suffer from illnesses of longer average duration than men do, — and consequently are more disastrously affected by exhaustion from overlong working hours.

SWITZERLAND

Untersuchungen über die Gesundheitsverhältnisse der Fabrikbevölkerung der Schweiz. [Investigations into the Conditions of Health of the Swiss Factory Workers.] DR. FRIDOLIN SCHULER, *Swiss Factory Inspector, and* DR. A. E. BURCKHARDT, *Prof. of Hygiene in Basle. Aarau, Säuerländer, 1889.*

If, however, not only the frequency but the average duration of single cases of sickness is observed in the two sexes, it will be found that the duration of illness averages, among men, only 85 per cent of that among women. And this prolonged duration of illness is not only found in single branches of industry, but throughout all — probably from various causes. For the woman not only belongs to the "weaker sex," but she is also the one who makes most effort to employ herself usefully in the house, even when she is not well enough to work in industry — contrary to the man whose work is entirely outside of the house. . . . More favorable figures for women are only found among youthful workers. (Pages 33–34.)

SWITZERLAND

Le Travail de Nuit des Femmes dans l'Industrie. Rapports sur son importance et sa règlementation légale. Préface par ETIENNE BAUER. [*Night Work of Women in Industry. Its importance and legal regulation. Preface by* ETIENNE BAUER.] *Jena, Fischer, 1903.*

From the hygienic point of view it is evident that the protection of wage-earning women can have only good effects, when we remember that the susceptibility of women with regard to disease germs is greater than that of men. According to the data of the statistics of diseases of the German Empire there have been for each case of sickness among the men 16 days, and for each case among the women 18 days of assistance or treatment at the hospital during the years 1888–1899. In Switzerland, judging from the researches made by F. Schuler and A. E. Burkhardt (1889) on the health conditions of factory workers, the average duration of sickness has been 21 days for men and 25 days for women. (Page xxxvii.)

Die Gegenseitige Hilfsgesellschaften in der Schweiz im Jahre 1903. [*Mutual Aid Societies in Switzerland in 1903.*] *Berne, 1907.*

Of 100 men insured, an average of 26.76 received sick relief, but of 100 women only 24.26.

The men who received sick relief averaged 23.55 days of illness: the women averaged 32.46.

The women, therefore, gave a lower percentage of relief, but a longer average of sick time, and, as a result of these two circumstances together, the average morbidity of the women is higher than that of the men, — 7.87 as against 6.30. (Page 42.)

FRANCE : *Encyclopédie d'Hygiene et de Médecine Publique, T. 6.* [*Encyclopedia of Hygiene and Public Medicine, Vol. 6.*] *Edited by* Dr. Jules Rochard. *Le Travail des Enfants et des Femmes dans l'Industrie.* [*Industrial Labor of Women and Children.*] Dr. Alexander Layet. *Paris, Delahaye, 1894.*

The few statistics that we possess on these lines show that the morbidity of women is greater than that of men in the same trades.

The Mutual Aid Society of silk workers at Lyon (with 4117 members of all ages and both sexes) in 1889 found that the days of sick time for the men in its membership amounted to 1522, and for the women, during the same time, 3978. Between the ages of 20 and 40, the days lost by sickness averaged 3.56 apiece for men, and 7.28 for the women. (Page 721.)

Italian Workman's Aid Societies with mixed membership showed the same results. Thus, while between 20 and 40 years each man in the membership lost 5.4 days' average by sickness, the women's average was 8.1. (Page 722.)

GERMANY *Handbuch der Hygiene, Bd. 8^{I}.* [*Handbook of Hygiene, Vol. 8^{I}.*] *Edited by* Dr. Theodore Weyl. *Allgemeine Gewerbehygiene und Fabrikgesetzgebung.* [*General Industrial Hygiene and Factory Legislation.*] Dr. Emil Roth. *Jena, 1894.*

The investigations of Schuler and Burckhardt, embracing 18,000 members of Swiss insurance against sickness (about 25 per cent of the Swiss factory workers and fifteen industries), show that factory work, even in a short period, produces very unfavorable effects upon the development of the body of young men. It is even more conspicuous in the case of women. Thus, of 1000 men in the manufacture of embroidery, 302 were sick to 332 women. In bleaching and dyeing, 279 men, 316 women; also in cotton spinning and weaving, the morbidity of women was much greater than of men.

Similarly, the number of working days lost through illness was more among women than among men, being 6.47 among women to 6.25 among men.

With increasing years, both frequency and duration of illness increase. (Page 7.)

A second form of physical inferiority of women is their lessened refractoriness to external injurious conditions. All statistics dealing with the relative morbidity of men and women employed in factories justify the deduction that the greater number of days lost from work by women indicate that disease makes greater inroads upon them, and that in general industrial labor is more injurious to women than to men. (Page 86.) GERMANY

Jahresberichte der Gewerbe-Aufsichtsbeamten und Bergbehörden für das Jahr, 1903. Bd. I, Preussen. [Annual Reports of the Factory and Mine Inspectors for 1903. Vol. I, Prussia.] Berlin, Decker, 1904.

The following figures are taken from the statistics of the local sickness insurance societies for men and women in tailoring and allied trades (chiefly dressmaking establishments of Berlin) and also, for the first time, for those employed in home industries (needle trades), for the year 1901. Corresponding figures for all the German Sickness Insurance Societies throughout the Empire, with over nine and a half million members, are given from the imperial statistical year-book for 1900 and 1901:

	Tailoring trades.	General German Statistics.	
	1902.	1900.	1901.
Cases of illness per member	0.36	0.39	0.38
Days of illness per member	9.21	6.82	6.91
Average duration of an illness	25.6	1.74	18.1

The figures showing cases of illness to each member are seen to be lower in the tailoring trades, but those showing the average days of illness and the average duration of illness are both considerably higher. This difference is largely due to the women members, who constitute ninety-two per cent of the workers. The figures relating to the men tailors approach more nearly to those of the General Imperial Statistics. (Page 71.)

GERMANY *Handbuch der Medizinischen Statistik.* [*Handbook of Medical Statistics.*] Dr. Friedrich Prinzing, *Ulm.* *Fischer, Jena, 1906.*

The days of illness per person averaged, to every 100 persons, as follows:

Age.	Frankfort.		Austria.		Bockenheim.	Mutual Leipzig, 1856–80.		Ital. Working-men's Society, 1866–75.
	Men.	Women.	Men.	Women.	Men.	Men.	Women.	Men.
Under 15	14.7	18.4	12.6	14.5	10.3	. . .	. . . .	17.9
15–20	16.4	19.3	13.7	16.1	12.5	19.3	21.6	23.4
20–30	19.3	24.6	14.3	18.0	12.3	19.9	30.3	24.9
30–40	22.7	31.4	15.9	20.2	13.9	24.0	33.4	25.4
40–50	27.1	31.6	18.6	21.6	17.9	30.7	37.9	28.2
50–60	32.9	45.4	21.4	23.9	19.4	38.9	44.4	30.3
60–over	38.9	58.1	29.8	31.3	26.0	44.1	55.1	36.8
Average	21.6	24.4	16.5	18.8	14.3	27.4	35.0	27.3

(Page 110.)

The appearance of anæmia and chlorosis among women is unusually frequent, especially when the cases of those who continued at work are included. In Frankfort, about one-fifth of all the insured women members have medical treatment for these troubles. (Page 116.)

Geschäfts Bericht der Ortskrankenkasse für Leipzig und Umgegend, über das Jahr, 1907. [*Official Report of the Local Sickness Society of Leipzig and Environs for 1907.*] *Bär and Hermann, Leipzig, 1907.*

Most of the published statistics speak only of "members" without distinguishing between men and women. How different the curve actually is for men and women is shown in the following table:

Age.	Days of sickness for	
Years.	One hundred Men.	One hundred Women.
Under 15	595.0	533.5
15–19	617.4	753.6
20–24	657.1	955.0
25–29	707.5	1,205.4
30–34	813.6	1,395.1
35–39	940.9	1,465.3
40–44	1,088.0	1,453.3
45–49	1,243.4	1,495.9
50–54	1,456.2	1,489.8
55–59	1,704.7	1,485.0
60–64	2,068.9	1,631.7
65–69	2,760.3	2,376.0
70–74	3,456.3	2,530.5
75 and over	4,042.9	2,512.1

(Page 74.)

The curve of women shows how injuriously the double task of being woman and wage-earner affects them. It is evident their number of days lost through sickness during the years of development and child-bearing capacity is greatly in excess of those lost by men. The younger women, those under 15, have a more favorable curve of morbidity than boys of the same age. From 15 to 54 years women are more subject to loss of time from illness than men. Only when the active period of sex life has passed does the woman 's curve again show her superior resistance to morbidity as well as to mortality. (Page 75.)

Statistik des Deutschen Reichs. Bd. 186. [Statistics of the German Empire. Vol. CLXXXVI.] Die Krankenversicherung im Jahre 1906. Bearbeitet im Kaiserlichen Statistischen Amt. [Sickness Insurance for 1906. Compiled in the Imperial Office of Statistics.] Berlin, 1908.

According to Heym, among 100 cases of illness, the length of time lost by men as compared with women was as follows:

	Men.	Women.
14–25 weeks	3.5%	5.7%
26 weeks and over	2.3%	2,8%

Prinzing adds to this: "Sickness of short duration is almost twice as frequent among men as women: but with sickness of a longer duration (more than 3 weeks), the case is exactly reversed." (Page 12.)

(c) CONTINUANCE AT WORK DURING ILLNESS

Women suffering from minor illnesses continue at work more commonly than men. That is, women have fewer illnesses involving complete loss of earning capacity, more illnesses during which they continue to remain at some form of work. Hence excessive hours of labor are doubly injurious to them, because often performed when health is already impaired.

Handbuch der Medizinischen Statistik. [*Handbook of Medical Statistics.*] DR. FRIEDRICH PRINZING, *Ulm. Fischer, Jena, 1906.*

The records next below show only those cases of illness that entailed incapacity for work. The numbers, as before, show the percentage, exclusive of confinements.

Age.	General Relief Fund. Some voluntary members.		Vienna 1896 Trade Societies' Funds (Genossenschaftkasse).		Mutual (Gegenseitigkeit). Leipzig. 1856–80.		Italian Workman's Society. 1866–75
	Men.	Women.	Men.	Women.	Men.	Women.	Men.
Under 15	43.4	30.9	38.2	26.9	....	....	28.0
15–20	56.9	46.9	40.2	36.5	29.5	20.3	29.6
20–30	51.6	48.0	29.4	26.9	25.6	20.8	25.0
30–40	53.3	46.8	27.9	26.3	24.5	19.6	24.4
40–50	55.4	52.9	35.3	28.2	26.1	18.8	24.8
50–60	57.0	49.9	41.8	30.6	28.1	18.4	26.3
over 60	68.0	59.2	56.2	41.4	31.7	21.5	31.2

The differences in frequency of illness in the above tables could only be explained by a thoroughgoing consideration of the details of the management of the sick funds. . . . (Page 107.) **GERMANY**

The difference in morbidity between the two sexes is obvious. In general, women have fewer illnesses involving complete inability to work, than men. . . . On the other hand, illness without loss of earning capacity is much more frequent among the women. (Page 108.)

The total list of all the Berlin sickness insurance offices for 1898 show that to every hundred men insured, 39.46 had illness attended with loss of earning capacity, and of every hundred women, 37.64 had illness attended with loss of earning capacity. (Page 115.)

Inquiries have all shown that the number of sick cases with loss of earning capacity do not in themselves alone give a correct idea of the morbidity of an occupation. (Page 125.)

To estimate the morbidity of an occupation those cases of illness which do not necessitate loss of earning power must be considered. It is then found that many occupations which appear favorable when loss of earning power alone is considered, have actually a much worse standing. So, for instance, Frankfort a. M. in the year 1896, has the following tables:

MEN.	Cases of Illness.				To every 100 Members (including both sick and well.)			
	20–30 Years.		30–40 Years.		40–50 Years.		50–60 Years.	
	Able to earn.	Not able.	Able to earn.	Not able.	Able to earn.	Not able.	Able to earn.	Not able.
Factory workers and day laborers	33	34	34	41	30	45	31	56
Porters, Packers	40	24	46	30	51	31	52	33
Traffic men and drivers	32	31	28	30	26	41	34	55
Waiters, Cooks	44	21	43	25	50	30	42	68
Salespersons . .	55	21	41	20	45	34	60	26
Printers-lithographers	43	29	49	31	41	37	44	31
Tailors	44	21	52	28	37	32	53	37
Carpenters . .	40	33	50	37	27	30	43	54
Painters, Varnishers . . .	28	29	33	35	40	53	46	58
Smiths (lock and other)	49	36	42	34	43	55	41	48
All occupations	41	29	38	35	37	40	40	48

(Page 126)

GERMANY Among women the cases of illness without loss of earning capacity predominate in every occupation.

In Frankfort a. M.

Women.	Cases of Illness.				To every 100 Members.			
	20–30 Years.		30–40 Years.		40–50 Years.		50–60 Years.	
	Able to earn.	Not able.	Able to earn.	Not able.	Able to earn.	Not able.	Able to earn.	Not able.
Factory and day workers . . .	45	37	52	40	47	32	51	40
Servants . . .	43	24	43	30	30	26	42	38
Waitresses, Cooks	46	21	35	18	53	34	25	41
Salesgirls . . .	63	30	64	37	33	20	47	37
Sewing women	53	31	62	40	49	40	29	54
All occupations	51	31	51	36	42	33	41	40

(Page 127.)

(*d*) Mortality

Statistics show that the mortality of working women is higher than that of working men, and also higher than that of other women not at work.

FRANCE *Royal Statistical Society, Vol. LV. London, 1892. Morbidity and Mortality according to Occupation.* Dr. Jacques Bertillon, *Chief of the Municipal Statistical Department of Paris,* [*Trans. from the Journal de la Société de Statistique de Paris, October–November, 1892.*]

[*Statistics from the Lyons Silk Workers' Mutual Aid Society — (Société de Secours mutuels des Ouvriers en Soie de Lyon), — the Statistical Office of Italy, and M. Henri Rauchberg's Study of Workmen's Sick Funds in Vienna — (Die Erkrankungs und Sterblichkeits Verhältnisse bei der allgemeinen Arbeiter, Kranken, und Invaliden Casse in Wien — Statistische Monatschrift, Vienna, 1886.*)]

Women between 20 and 45 show a considerably greater morbidity than men of the same age; above 45 their rate approaches that of the men. At least it is so in the Lyons Silk-Workers' Society, in the Italian societies, and (as far as can be judged from a table in which there is no distinction of age) in the Vienna Arbeiter-Casse. At the same time it should be noted that among the Lyons silk-workers not only the morbidity but also the mortality of females is considerably above that of the males, whereas the opposite holds good with the population as a whole. It is thus at least permissible to enquire whether there be not some peculiarity in this employment which is hurtful to the health of the women engaged in it. The Italian table, which includes a great number of occupations, also brings out a higher rate of morbidity for women than for men, and their mortality at each age (calculated, however, from too small a number of cases) is greater than that of the men. FRANCE

Table II. Comparative Morbidity of the Two Sexes.

Age of the members.	Lyons Silk-Workers (1872–1889)					Italian Societies (1881–1885). (Corrected figures.)				
	Annual average number of members.		Morbidity. Days of sickness per annum per member.		Mortality. Deaths per annum per 1000 members.		Morbidity. Days of sickness per annum per member.		Mortality. Deaths per annum per 1000 members.	
Years.	Mas.	Fem.	Mas.	Fem.	Mas.	Fem.	Mas.	Fem.	Mas.	Fem.
18 and 19	96	479	1.76	2.18	...	...	...	...	...	...
20–24	607	3897	3.06	6.37	13.0	10.2	5.0	7.8	6.3	...
25–29	1481	6100	3.40	7.49	5.4	9.3	5.4	8.0	5.9	9.1
30–34	2507	7377	3.37	7.64	6.4	9.2	5.1	8.9	6.2	10.7
35–39	3259	8209	4.32	7.62	6.4	8.9	6.0	7.7	7.8	8.1
40–44	3442	8161	5.29	7.64	10.2	6.2	6.2	9.3	9.2	10.0
45–49	3569	7720	5.89	8.12	11.8	13.5	6.8	8.2	11.6	8.9
50–54	3214	6429	8.04	9.58	20.2	14.3	7.9	9.3	14.9	14.1
55–59	2964	5021	8.38	11.01	19.5	21.9	9.2	9.7	22.2	15.9
60–64	2623	3795	11.15	14.52	40.7	41.9	11.2	10.0	32.5	...
65–69	1956	2617	16.73	18.57	67.0	55.0	13.4	8.2	50.4	...
70–74	999	1146	19.76	24.48	88.0	85.4	14.7	...	73.6	...
Above 75	378	366	26.90	30.87	148.0	161.0	13.4	...	...	...
Average	27098	61317	7.81	9.39	23.4	17.6	6.6	8.5	11.7	10.7

FRANCE The tables of the Vienna Arbeiter-Casse point also to the fact that the morbidity of women (526 cases and 9,255 days of sickness per annum per 1,000 women) is above that of men (427 cases and 8,366 days.) (Pages 564–565.)

NOTE (6). The general mortality of the women (without distinction of age) is, on the other hand, less than that of men, while the mortality at each age is greater. To explain this apparent anomaly, it is sufficient to consider the first two columns in Table II: it will be seen that nearly half the women (42 per cent) are under 40 years of age, whilst only a quarter (26 per cent) of the men are under 40. The female members being younger, it is not surprising that their general mortality is lower than that of the men, although their mortality at any particular age is greater.

GERMANY *Handbuch der Medizinischen Statistik.* [*Handbook of Medical Statistics.*] DR. FRIEDRICH PRINZING, *Ulm. Jena, Fischer, 1906.*

As to the danger to life to women in industry the statistics are scanty: those of the Austrian sick insurance offices for 1891–95 are almost the only figures that offer considerable material as to women in industry on this point (mortality). According to them, the women engaged in industrial labor not only have a far higher mortality than working men, but also their mortality between the ages of 15–50 years is higher than that of the remaining female population. Compared with men, the mortality of working women between 15–60 years is as 100 (men) to 109 (women). (Page 492.)

Le Travail de Nuit des Femmes dans l'Industrie. Rapports sur son importance et sa règlementation légale. Préface par ETIENNE BAUER. [*Night Work of Women in Industry: Its importance and legal regulation, with preface by* ETIENNE BAUER.] *Jena, Fischer, 1903.*

Moreover and above all we observe, in all countries where woman is protected, a lessening of female and also of infant mortality. For England the convincing argument drawn from this fact has often been cited. There, since the rigorous enforcement of the protective legislation concerning them, the total mortality of women has fallen much below that of men. The ratio of the mortality of men to that of women, 1841 to 1850, was 23.11 per cent for men to 21.58 per cent for women; from 1881 to 1890, as 20.22 per cent to 18.01 per cent. The diminution of these figures shown by comparing the earlier with the later period should be attributed to the great hygienic progress realized during the interval; and the relatively greater reduction of female mortality should be attributed to the protective legislation for the workers, and doubtless also to the activities resulting from sick benefits, By way of reaction, this fortunate condition was shown in the figures of infant mortality. (Pages xxxvii–xxxviii.) GERMANY

The following figures for the German Empire, giving the proportional figures for men and women in the Sickness Insurance Department, show that after 1891, when women were legally protected, their mortality diminished more than that of men.

ONE TO ONE HUNDRED.

Years.	Men.	Women.
1890	1.05	0.75
1891	0.99	0.74
1897	0.91	0.63
1898	0.87	0.61
1899	0.93	0.66

(Page xxxviii.)

(3) THE NEW STRAIN IN MANUFACTURE

(a) SPEED.

Such being their physical endowment, women are affected to a far greater degree than men by the growing strain of modern industry. Machinery is increasingly speeded up, the number of machines tended by individual workers grows larger, processes become more and more complex as more operations are performed simultaneously. All these changes involve correspondingly greater physical strain upon the worker.

British Sessional Papers. Vol. XXI. 1833. Second Report of the . . . Commissioners for Inquiring into the Employment of Children in Factories . . . and Reports by the Medical Commissioners. Medical Reports by Sir DAVID BARRY. GREAT BRITAIN

The first and most influential of all disadvantages of factory work is the indispensable, undeviating necessity of forcing both their mental

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and bodily exertions to keep exact pace with the motions of machinery propelled by unceasing, unvarying power. (Page 72.)

British Sessional Papers. Vol. XVI. 1875. Reports of Inspectors of Factories for the Half-year ending 30 April, 1875.

. . . The speed of machinery has already been pushed to the farthest extent, and lowered from a point which had been attempted but found unprofitable, and injurious to the work. The real evil has long been, not too long hours, but too great tension of the nervous system by aiming at a larger earning, and consequently, the charge of more machinery than is consistent with the health or good work of either.

Hence also an increase of irritating conflict between master and man as to the excellence of workmanship. . . . Far better 60 hours a week and less of this sad unnatural strain; for over-tension may kill in 50 hours a week, and reasonable work not injure in 60. (Page 32.)

British Sessional Papers. Vols. XXIX and XXX. 1876. Factories and Workshops Acts Commission. Vol. XXX. Minutes of Evidence. A. Redgrave.

205. . . . Unhealthiness combined with necessity for close application to rapidly moving machinery. I take those two to be the principal and main causes for the limitation of the hours of young persons and women. (Page 14.)

Effects of the Factory System. Allen Clarke. *London, 1899.*

Greater speed of improved machinery, whereby the work is increased sixfold, resulting in physical deterioration and mental worry. (Page 41.)

The toil is ceaseless; the machinery demands constant watching. . . . Their feet are never still; their hands are full of tasks; their eyes are always on the watch; they toil in an unending strain that is cruel on the nerves. (Page 49.)

And all these hours — ten hours a day — spinner and weaver are on their feet; no sitting down; no resting; one must keep up to the machinery though agonized with headache or troubled by any other complaint. While the engine runs the workers must stand. (Page 51.)

Women's Work. Amy A. Bulley *and* Margaret Whitley. *London, Methuen, 1894.* **GREAT BRITAIN**

. . . machinery has been speeded up to a point which is immensely in excess of that which prevailed when the hours were longer. At the present time, therefore, the strain upon the attention and the wear and tear of the nervous system are greatly in excess of former times, and the worker must be "on the stretch" the whole time to attend properly to the work. (Page 152.)

Dangerous Trades. Thomas Oliver, M.A., M.D., F.R.C.P., *Medical Expert on the White Lead, Dangerous Trades, Pottery, and Lucifer Match Committees of the Home Office. London, Murray, 1902.*

The introduction of steam has revolutionized industry. . . . Machinery acts with unerring uniformity. At times so simple is its mechanism that a child can almost guide it, yet how exacting are its demands. While machinery has in some senses lightened the burden of human toil, it has not diminished fatigue in man. All through the hours of work in a factory the hum of the wheels never ceases. . . . While the machinery pursues its relentless course and is insensitive to fatigue, human beings are conscious, especially towards the end of the day, that the competition is unequal, for their muscles are becoming tired and their brains jaded. . . . Present-day factory labor is too much a competition of sensitive human nerve and muscle against insensitive iron, and yet, apart from an appropriate shortening of the hours of labor, it is difficult to see how this can be remedied. The greater the number of hours machinery runs per day the larger is the output for the manufacturer, but the feebler are the human limbs that guide it. To the machine time is nothing; to the human being each hour that passes beyond a well-defined limit means increasing fatigue and exhaustion. (Page 117.)

Women Workers. Conference in Manchester, 1907. Arranged by the National Union of Women Workers of Great Britain and Ireland in conjunction with the Committee of the Manchester Branch of N. U. W. W. London, King and Son.

Factory legislation has done much to improve general conditions and to shorten hours in the textile factories, but the intensity of labour

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has increased. Owing to the overdriving and the speeding up of machinery the nervous strain and pressure upon the worker is probably greater than in any other industry. (Page 28.)

The Economic Journal. Vol. XVIII. 1908. Gaps in our Factory Legislation. B. L. HUTCHINS. *London.*

Now it is important to remember that these (ten) hours mean more work and more fatigue than they did when the normal day was first introduced fifty-odd years ago. The speeding up of machinery has increased the strain, and even as long ago as 1872 shorter hours were agitated for by the trade unions. . . . One of H. M.'s inspectors tells me that "both in cotton and woolen the strain of the full hours with speeding up is almost intolerable to the less robust women and girls." (Pages 223–224.)

Diseases of Occupation from the Legislative, Social, and Medical Points of View. THOMAS OLIVER, M.A., M.D., F.R.C.P., *Medical Expert on the White Lead, Dangerous Trades, Pottery, and Lucifer Match Committees of the British Home Office. New York,* Dutton, 1908.

In trades that are dangerous to health the hours should not be long; and in textile industries, as the speed of machinery is quickened and the nervous tension upon the worker becomes greater, the hours of labour should be proportionally reduced. (Page xi.)

It is an interesting problem to consider the probable effects upon the health of the workpeople in the future of the increased speed at which machinery is being run in the factories and the speeding-up of the work in ship yards. That there is greater strain upon the nervous system, more exhaustion and consequently need for greater leisure, few will deny, and that in many instances the hard work induces premature old age goes without saying. Will this speeding-up tend to make female mill-workers better mothers and help them to give birth to healthy and robust children, or to infants who are puny, ill-nourished, and of a highly strung nervous system? In some American factories in which stitched muslin underwear is made, so great has been the improvement in the machinery of late that the sewing machines are carrying two to ten needles instead of one as formerly, and as a consequence many of the girls are no longer capable of the sustained effort necessary to follow the improved speed, and have been obliged to relinquish their occupation. The strain of the eyes in watching for broken threads in order to stop the machinery is almost intolerable; it requires an amount of nervous energy and a constancy of attention which the operators cannot supply. There is a limit beyond which the speeding of machinery cannot be run without detriment to the health of the operators unless their hours of work are materially shortened. GREAT BRITAIN

Clearly, therefore, there are occupations, especially the textile trades, that tend through sheer strain to wear out the body of the worker and induce premature old age. These industries may be said to show their baneful effects upon the nervous system. (Pages 3–4.)

Although the introduction of machinery has cheapened products and placed more of them within the reach of the poorer working classes, it has not always lightened labour. The rate at which machinery is run demands greater attention from the workpeople and imposes upon them a severe strain. To the artisan classes the Saturday half-holiday and the shortened working day have proven a boon from a purely physical point of view. Great as the rush and pressure are in this country, they are even greater in America. (Page 5.)

The lightening of the burden of the textile worker by improved machinery has not altogether made mill-work easier, for by raising the speed and increasing the output a larger amount of machinery has to be tended, and this constant vigilance imposes a considerable strain upon the worker. If this is true of simple muscular movements necessitating only mechanical supervision, how much greater must be the strain and exhaustion upon persons who in their employment are obliged to execute a series of educated and rapid muscular movements in which volition is sustained throughout. (Page 358.)

Report of the Inspectors of Factories for the Province of Ontario, Canada, 1894. CANADA

With the increased speed and complications of machinery in textile industries, especially in cotton looms, the attendant has more mental worry in watching the machines, and no doubt is more exhausted physically after a day's work. (Page 13.)

Report of the Inspectors of Factories for Ontario, Canada, 1895.

A very small fraction of the work requires muscular strength, but it is the constant and steady application of the mind, the eager use of the eyes, which exhaust and wear out the human body. The entire nervous system is so intently directed to the detail of the work, while

CANADA the machinery is running to its utmost capacity, that by night the workers are not only tired and weary, but well-nigh worn out. (Page 25.)

Report of the Inspectors of Factories for the Province of Ontario, Canada, 1896. Toronto, 1897.

Though there is little work which requires great muscular strength or exertion in our factories, yet the alertness and exactness of attention and constant application required exhaust the nervous vitality very rapidly. Most of the operators are necessarily on their feet nearly all the time, and this fact has an unfavorable effect upon the health of women and girls. (Page 22.)

Canada Labour Gazette, August, 1903. [Report of British Columbia Royal Labour Commission.] Dawson. Ottawa.

The report concludes with a recommendation as to the shortening of the hours of labour. "In these days," says the Commissioners, "when the human energies are strained to their utmost amid whirling dust and machinery, long hours are a crime against nature. The machine should be the servant of man, and not man the slave of the machine. One of the most legitimate modes in which a legislature can aid in improving the condition of the workmen is by the shortening of hours. (Page 136.)

Report of the Royal Commission on a Dispute Respecting Hours of Employment. The Bell Telephone Company of Canada, Ltd. and Operators at Toronto, Ontario. The Department of Labour, Canada, Ottawa, 1907. Conclusions and Recommendations.

We agree entirely with the view expressed by the local manager that it is the pace that kills, and the working of women at high pressure at work of this kind should be made a crime at law as it is a crime against Nature herself. (Page 98.)

AUSTRALIA *New South Wales. Legislative Assembly. Report of the Working of the Factories' and Shops' Act. 1904.*

Miss Duncan, Inspector:

The effect of factory work on the individual appears to be to produce a skillful specialized worker moving within narrow limits and ill-fitted to rise above them.

On the physical side, the want of exercise among those who sit all day at their work, the long standing of others in those processes which cannot be conveniently carried on when sitting, in either case the over-exercise of certain muscles and the non-exercise of others, must bring about a very one-sided development. . . . Again the constant vibration and noise, the unflagging attention demanded by work on power machines, and the high rate of speed, must tend to operate disadvantageously on the nervous system. (Page 13.) **AUSTRALIA**

Fatigue. A. Mosso, *Professor of Physiology, University of Turin, 1896. Translated by* Margaret Drummond, M.A., *and* W. B. Drummond, M.B., *Extra Physician, Royal Hospital for Sick Children, Edinburgh. New York, Putnam, 1904.* **ITALY**

By constant increase in the rate of movement, by instruments ever better adapted to their ends, modern society endeavours to multiply and render more productive the work both of muscle and of mind. The prodigious extension of the arts and the increasing velocity of machinery combine to hurry us onward; our haste will grow from more to more, till it reaches an extreme point at which the law of exhaustion sets an insuperable barrier to the greed of gain. . . . (Page 168.)

The machinery in our factories is ever becoming more ponderous; it is increasing in size, velocity of motion, and productivity, and this increase still continues despite the fact that we have already surpassed the furthest limit set at first by our imagination. (Page 169.)

One very quietly perceives, however, that those machines are not made to lessen human fatigue, as poets were wont to dream. The velocity of the flying wheels, the whirling of the hammers, and the furious speed at which everything moves, these things tell us that time is an important factor in the progress of industry, and that here in the factory the activity of the workers must conquer the forces of nature. The hiss of the steam, the rattling of the pulleys, the shaking of the joints, the snorting of these gigantic automata, all warn us that they are inexorable in their motion, that man is condemned to follow them without a moment's rest, because every minute wasted consumes time that is worth money, seeing that it renders useless the coal and the movement of these colossi. (Page 171.)

Marx, in his celebrated work (*Le Capital*, Karl Marx, p. 161), devotes a chapter to machinery, and arrives at the following conclu-

ITALY sions: that all our inventions have not diminished human fatigue, but simply the price of commodities; that machinery has rendered worse the condition of the worker, because by rendering strength of no avail it has entailed the employment of women and children, instead of shortening the working-day it has prolonged it, instead of reducing fatigue it has rendered it more dangerous and injurious; that to the accumulation of riches corresponds an increase of poverty; that owing to machinery society is receding further and further from its ideal; that the reality has not corresponded to our hopes.

. . . The powerful automaton of mechanics wants nothing but intelligence and a nervous system; this want a child or a woman can supply and guide the blind giants by the hand. It is a grave accusation to launch against science, that in making herself mistress of the forces of nature she tends to establish a monopoly for machinery, to make labour the slave of capital. There are, moreover, those who fear that human fatigue will come to be less and less regarded, and that the workers will be gradually eliminated and dismissed without means of subsistence, that the intelligence of the people is deteriorating, because the greater the perfection of the machine, the less the skill and ability required from the worker. (Pages 172–174.)

GERMANY *Amtliche Mittheilungen aus den Jahres Berichten der Gewerbe Aufsichtsbeamten. XXII. 1897. [Official Information from the Reports of the (German) Factory Inspectors.] Berlin, Bruer, 1898.*

The demand for shorter hours of work is justified by the hardships in which modern industry has plunged the whole working class. In a comparatively short time, for instance, machinery of much greater speed has been installed in a number of branches of industry. Even the young, industrious workman must stretch every nerve to keep up with the speeding process necessitated by machinery. (Page 156.)

Machine work allows no time for rest and variety, the workman's nerves suffer, and when, as sometimes happens, his Sunday's rest is taken from him, he breaks down. Older workmen cannot accommodate themselves to this pace, and the rapidity of development has been such that a gradual adaptation to the altered conditions is for them absolutely out of the question. The result is that older people are excluded more and more from factory work. (Page 157.) No unsatisfactory results appear to have followed in any instance where hours have been shortened. (Page 158.)

Jahresberichte der Gewerbeaufsichtsbeamten im Königreich Württemberg für das Jahr 1902. [Reports of the Factory Inspectors in the Kingdom of Württemberg for 1902.] Stuttgart, Lindemann, 1903. GERMANY

In general the reduction of women's hours takes place with the utmost slowness, sometimes under pressure of organization . . . sometimes where employers have come to an agreement among themselves. . . .

But this reduction of hours does not keep pace with advances in technique . . . where there is an obvious tendency to make use of human power to the fullest possible extent. This is especially true in the textile mills, where certain older processes are modified by new countrivances. . . . The result now is, that, while the wages of skilled spinners (women) have risen about 12 or 13 per cent, the number of spindles, on which they must concentrate attention for 11 hours, has been raised from 500 to 750 — an increase of 50 per cent. This is not quite the same as saying that the strain upon the spinners is 50 per cent greater, since a certain number of helpers are provided, nevertheless the attention and skill demanded are much greater than was formerly the case. . . . Such examples make it plain that, with this increasing intensity of strain in work, the hours of work must be correspondingly shortened if the people are to be protected from ruin of health. (Pages 74–75.)

Jahresberichte der Gewerbeaufsichtsbeamten im Königreich Württemberg für das Jahr 1903. [Reports of the Factory Inspectors in the Kingdom of Württemberg for 1903.] Stuttgart, Lindemann, 1904.

To-day the technical development of industry leads to ever and ever greater demands upon the intensity and attention of the worker. When the speed of the machine is greatest, then the workman has more given to him to attend to. This uncontested fact of rising claims upon the physical and mental capacity of the workman, which is more or less strikingly evident in every department of labor, has in recent years brought the question of shorter hours to the front. The necessity of compensation through shorter hours is not only recognized by the inspectors, but by many employers as well. (Page 96.)

GERMANY *Jahresberichte der Gewerbeaufsichtsbeamten und Bergbehörden für das Jahr 1904. [Reports of the Factory and Mine Inspectors for 1904.] Vol. II. Württemberg. Berlin, Decker, 1905.*

The claim for a ten-hour day for women is an old and much-contested one: factory inspectors are continually reminded of the great need for its fulfilment, as they see how technical improvements in machinery increase the productivity of the machine and consequently intensify the demands made upon the working strength and capacity of the wage-earners. And this is especially true of the industries which employ women in large numbers. (Pages 4, 102.)

Die Arbeitszeit der Fabrikarbeiterinnen. Nach Berichten der Gewerbeaufsichtsbeamten bearbeitet im Reichsamt des Innern. [The Working Hours of Women in Factories. From the Reports of the (German) Factory Inspectors compiled in the Imperial Home Office.] Berlin, Decker, 1905.

From Frankfurt am Oder it is reported that the insurance records for two textile mills show steady deterioration in the health of the women employed eleven hours a day. One reason for this is believed to be the speeding up of the machinery. Vigorous weavers stated repeatedly that the old, slow looms exhausted them less in twelve and thirteen hours than the swift new looms in eleven hours. The more intensive work requires better nourishment; but there is no adequate increase in wages to afford this improved food, and the eleven-hour day of more rapid work is presumably responsible for the deteriorated health. (Page 119.)

Archiv für Unfallheilkunde Gewerbehygiene und Gewerbekrankheiten. Bd. I. Über den Gesundheitsschutz der Gewerblichen Arbeiter. [Protection of the Workingman's Health.] Dr. SCHAEFER. *Stuttgart, Enke, 1896.*

The more technic is perfected, the more complicated the machine and the more rapid its speed, the greater are the demands made upon the workman and the more important it becomes to shorten his hours of work. (Page 204.)

Handwörterbuch der Staatswissenschaften. Bd. I. [Compendium of Political Science. Vol. I. Edited by Drs. J. Conrad, *Professor of Political Science in Halle;* L. Elster, *Ober Reg. Rath in Berlin;* W. Lexis, *Professor of Political Science in Göttingen; and* Edg. Loening, *Professor of Law in Halle. Arbeitszeit: Hours of Work.]* Dr. H. Herkner, *Berlin. Jena, Fischer, 1909.* GERMANY

The workman sees in reduction of working hours the surest remedy for all the dangers that arise from his work, and that menace him with premature exhaustion of his working power, his only capital. The more piece work and speeding stimulate the intensity of production, the more quickly a dangerous degree of fatigue is likely to appear, resulting from the one-sided exertion of certain nerves or muscles (a feature of the subdivision of labor). (Page 1204.)

Intensiveness of work means progress for the worker, so long as the tempo keeps within customary bounds; that is, while speed can be maintained without requiring continuous new impulses of will-power. If, in spite of shorter hours intensiveness of work leads to chronic overfatigue, then it is just as necessary to overcome that evil as the overfatigue resulting from overlong hours of less intensity. (Page 1217.)

Untersuchungen über die Gesundheitsverhältnisse der Fabrikbevölkerung der Schweiz. [Investigations into the Conditions of Health of the Swiss Factory Workers.] Dr. Fridolin Schuler, *Swiss Factory Inspector* and Dr. A. E. Burckhardt, *Prof. of Hygiene at Basle. Aarau, Säuerländer, 1889.* SWITZERLAND

Instead of becoming wearied by personal labor, as in earlier stages of industry, it is to-day the unremitting, tense concentration in watching the machine, the necessary rapidity of motion, that fatigues the worker. (Page 62.)

An das Schweiz. Industriedepartement, Bern. Die Eidgenössischen Fabrikinspectoren. [Report of the Swiss Factory Inspectors to the Swiss Department of Labor on the Revision of the Factory Laws.] Schaffhausen, 1904.

As technique becomes more developed, machinery more complicated, and the pace swifter, so much more insistent become the

SWITZERLAND demands of the wórkers and the claims of hygienists for a shorter work day as a physiological necessity. (Page 26.)

When we consider the great material advantages of modern industry in being enabled to economize material by the use of water power day and night, by keeping its furnaces forever burning, and so on, it seems as if it might well be in place to economize also the strength of the people by shortening their shifts of work. (Pages 34–35.)

AUSTRIA *Eighth International Congress of Hygiene and Demography at Budapest, 1894. Vol. VII, Sec. V. Über das Verhältniss der Dauer des Arbeitstages zur Gesundheit des Arbeiters und dessen Einfluss auf die Öffentliche Gesundheit. [The Length of the Working Day in its Relation to the Workman's Health and its Influence upon Public Health.]* Dr. E. R. J. Krejcsi, *Vice-Secretary of the Chamber of Commerce in Budapest. Budapest, 1896.*

In branches of industry where machinery is used, the normal working day of which the worker is fully capable is shorter in proportion as machinery is more complicated and the demands made upon the intelligence, attention, and memory of the worker are more incessant.

Such workers expend both their mental and physical strength in strenuous exertion, and thus their normal energy is sooner exhausted and the injurious results of overstrain become evident earlier than in simpler forms of labor. (Page 326.)

UNITED STATES *Report of the Maine Bureau of Industrial Labor Statistics, 1892.*

The constant nervous tension from continued exertion in a modern factory or workshop, for a period of ten hours, is a severe strain upon the physical system. Work is not done in the old, slow way, and, in nearly all industries, by the present methods, from two to four times the quantity of product is turned out in the ten hours. How much faster is the operative compelled to work, and how much greater is the strain, to accomplish this amount of work, in comparison with the old twelve-hour method. (Page 11.)

Seventh Annual Convention of the International Association of Factory Inspectors of North America. Chicago, Sept. 19–22, 1893. **UNITED STATES**

Inspector Dyson, of Massachusetts:

Let it be remembered that the gradual reduction in the hours of labor has been met by the manufacturers with improved machinery....

In a textile mill there is a very small fraction of the work that requires muscular strength. But it is the constant and steady application of the mind, the eager use of the eyes, which exhaust and wear out the human body.

The entire nervous system is so intently directed to the detail of the work while the machinery is running to its utmost capacity, that by night the worker is not only tired and weary, but wellnigh worn out. (Pages 118–119.)

Report of the United States Industrial Commission on the Relations and Conditions of Capital and Labor employed in Manufactures and General Business, 1900.

Mrs. Robertson tells me that when she was a girl, to run one or two looms was as much as any woman would have tried. Now, in some instances, there are women running nine looms, and the looms have more than doubled or trebled their speed. This means more work and harder work. (Page 63.)

United States Congress, House Report No. 1793. (4405). Hours of Laborers on Public Works of the United States. Report from the Committee on Labor. 57th Congress, 1st Session. 1901–1902.

While there is still a variance of opinion on the question whether modern machinery and methods so lighten the physical drudgery of most occupations as to have an equivalent effect to the shortening of hours in the conservation of energy, or whether such machinery and methods operate to so tax the nervous powers as to be equivalent in exhaustive effects to the lengthening of hours, your committee are of the opinion, after what has been said on both sides, that the higher tension of modern employment is at least a full offset to the saving accomplished in muscular force.

This effect of modern machinery on the powers of the worker has been a question more immediately affecting the American workman than those of any other nations. The foreign workman has very

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generally held to the surface theory of some older varieties that machinery is a competitor of labor and the one most threatening to his employment, hence labor has strenuously and to a considerable extent successfully resisted the introduction of modern machinery. (Pages 9–10.)

Report of the United States Industrial Commission, Vol. XIX, 1901.

It is brought out that in nearly all occupations an increasing strain and intensity of labor is required by modern methods of production. . . . The introduction of machinery and the division of labor have made it possible to increase greatly the speed of the individual workman. . . . The testimony of a representative of the Cotton Weavers' Association shows this increasing strain of work. He says:

"Anybody who works in the mills now knows it is not like what it was twenty-five or thirty years ago, because the speed of the machinery has been increased to such an extent, and they have to keep up with it." (Page 763.)

Even these cases where machinery has not increased the intensity of exertion, a long workday with the machine, especially where work is greatly specialized, in many cases reduces the grade of intelligence. The old handwork shops were schools of debate and discussion, and they are so at the present time where they survive in country districts; but the factory imposes silence and discipline for all except the highest. Long workdays under such conditions tend to inertia and dissipation when the day's work is done. (Page 772.)

Report of the Maine Bureau of Labor and Industrial Statistics. 1908.

For the first time, women were interviewed who were running twelve and sixteen Draper looms. These machines are practically a recent addition, and are so arranged that the filling in the shuttle is changed automatically, thus enabling them to go at a greater rate of speed and with less interruption. The women are not expected to clean, oil, or sweep. This matter was quite fully discussed and the complaint made that the work was too hard, but that they tried to do it, as they were dependent upon their positions and they knew there were plenty of foreign men waiting for their places. Where a woman has been accustomed to tend a six loom set, with the Drapers she is given from twelve to sixteen which extend over quite an area. There is no time for sitting during the day, as when employed on the other looms. One woman said she could not sleep at night after running these fast machines, and many have had to give up their places and find other work. UNITED STATES

This marks another evolution in the machinery world. Years ago, a woman tended two slowly running looms. Later, as the hours of work grew less, the number of looms was increased to four and six, and now with the Drapers, an operative is expected to look out for twelve or sixteen. (Pages 42–43.)

National Civic Federation, New York, 1903. Industrial Conference. Prof. George Gunton, *Institute of Social Economics.*

The factory system makes this (shortening of the working day) more and more necessary in proportion as it is perfected in its mechanism. It becomes all the time more and more exacting. The greater the perfection of the machinery or the method, the more attention is required. (Pages 172–173.)

American Academy of Political and Social Science. Vol. XXVII, No. 3, 1906. The Manhood Tribute to the Modern Machine: Influences Determining the Length of the Trade Life among Machinists.

James O'Connell, President International Association of Machinists:

The purpose of this paper is to prove that with the introduction of modern high-speed machinery the life of the operator of such machinery has been shortened. . . .

Great changes have been made in the last quarter of a century, and every industry has been affected with the advent of the machine, but in no other sphere of human activity has such a change been affected as has occurred in the machine shop. (Pages 491–492.)

First of all, old men have disappeared.

. . . Time was when age was honored in the machine shop; . . . The speeding up of the machine has changed all this, . . . his added years prevent him from keeping pace with the machine, its gait is too rapid, so he is forced aside to make room for a younger man. . . .

The youth fresh from school . . . enters the machine shop. . . . The great strain, both mental and physical, soon proves too much

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for him. . . . If his period of service in the machine shop is broken by intervals of rest and recreation, nervous breakdown is averted.

. . . Great care and watchfulness to guard against the effects of the nervous strain are necessary when the youth begins his career in the machine shop, for skill, exact skill, cannot be acquired without it. And when proficiency has been reached, although the young machinist does not notice it, he is still bearing the strain upon his nerves. It is this over-exertion kept up at high tension, day in and day out, year after year, that is shortening the life of the machine-shop worker, and robbing him of longevity. (Pages 462–494.)

Lessen the number of hours the worker is forced to work at high speed, concert pitch, and his nerves will remain normal, and he will live to the full — his promised threescore years and ten. (Page 495.)

Ibid. Length of the Trade Life in the Glass Bottle Industry.

Denis A. Hayes, President of the Glass Bottle Blowers' Association of America:

Each year the production of the individual workman becomes greater. The highest day's work of this season becomes the standard for the next.

A man working according to present-day methods can make three times as many bottles in a day of eight and a half hours as he did twenty years ago in a day of ten hours, but the expenditure of strength and energy is now much greater than it was then.

. . . The hours of labor should be still further reduced, so that men would, after leaving their work, retain sufficient mental and physical vigor for recreation, study, and social intercourse. (Page 498.)

Charities and the Commons, January 2, 1909. Vol. XXI. No. 14. New York. The Working Women of Pittsburgh. Elizabeth Beardsley Butler, *Former Secretary New Jersey State Consumers' League.*

In canneries and cracker factories we find Polish girls who are lighter-handed, fairer, more delicately built than those of the metal trades and the glass houses. These girls have rapid work to do. They have the nervous energy to pack or to fill cans at high speed. They stand beside the travelling conveyor which carries cans of

beans, and slip a bit of pork into each can as it passes. Without turning their heads or changing their position, working with high concentration and intensity, they can keep pace with the chains. (Page 577.) UNITED STATES

Charities and the Commons, January 2, 1909. Vol. XXI. No. 14. New York. The Civic Responsibilities of Democracy in an Industrial District. PAUL U. KELLOGG.

We have the statements of old employees that not more than 25 girls of the 300 in the coil-winding room in one of the Pittsburgh electrical industries have been in the plant as long as three or four years. The speeding-up tends to make the girls nervous, weak, and easily overcome by illness.

Apart from dangers of accident, of speeding, and of injurious processes, the health of a working force bears a direct relation to the length of the working day. (Page 637.)

Charities and the Commons, March 6, 1909. Vol. XXI. No. 23. New York. The Industrial Environment of Pittsburgh's Working Women. ELIZABETH BEARDSLEY BUTLER, *Former Secretary New Jersey State Consumers' League.*

A third factor affecting health (beside essential trade disease, and careless building construction) enters into the industrial environment. This is the system of pace-setting. Four stogy factories, for example, stimulate the speed of their girl rollers by the following sliding scale:

300 stogies from a pound 10 cents a 100.
325 stogies from a pound 11 cents a 100.
350 stogies from a pound 12 cents a 100.
375 stogies from a pound 13 cents a 100.
400 stogies from a pound 13½–14 cents a 100.

In order to earn the market rate in the district (12 cents a hundred), girls must cut close, and at the same time work at an almost impossible rate of speed. In another factory rollers receive only 9 cents a hundred if they make less than 6000 stogies a week, and 11 cents a hundred (the market rate in the district) if they make 6000 or over. The foreman of a printing establishment paid his girls seven dollars a week for an average output (in register folding) of 300 an hour. A system of piece payments was introduced, and in

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two days the rate went up to 500 an hour; week work was then resumed, and the girls were required to keep the same pace. A lamp factory pays 14 cents an hour for punching 600 pieces, and a cent for every extra hundred pieces finished within the same time.

Besides the driving force of these premiums for extra work, the pace of the workers is kept high by the speed of machinery. A travelling chain carries cans of beans past a row of cannery operatives. They must slip a bit of pork into each can as it passes, and the chain is set at a pace which keeps each girl rigid in her place, with every nerve at a tension, fixed on the one motion required of her. In a cracker factory girls lift hot crackers from a travelling conveyor, packing them in oblong boxes with one quick motion, as the conveyor passes; each girl is responsible for all the crackers on a certain section of the conveyor, which is set at a pace requiring her utmost physical and nervous effort. The speed of machinery, when pay is by the week; or a piece payment system, impels the worker to increase the quantity of her output, although rate-cutting keeps weekly earnings down to a customary level. The nervous strain inevitable under these conditions has no inconsiderable share in causing the ill-health or positive breakdown which so frequently follows a girl into her home after she has left the factory. It is the final exaction that the trade makes of her. (Page 1139.)

(b) Monotony

Besides the physical strain due to speed and complexity of machinery, health is injured by the extreme monotony of many branches of industry. Specialization has been carried so far that change and variety of work is reduced to a minimum. Minute division of labor results in the constant repetition of similar motions and processes by the same worker, favoring the onset of fatigue and requiring for relief the establishment of a shorter workday.

GREAT BRITAIN

British Sessional Papers. Vols. XXIX-XXX. 1876. Factory and Workshops Acts Commission. Vol. XXIX. Report.

We have already referred more than once to the unremitting and monotonous character of all labor at a machine driven by steam.

If the day's work of a housemaid or even of a charwoman be closely looked at and compared with that of an ordinary mill hand in a card room, or spinning room, it will be seen that the former, though occasionally making greater muscular efforts than are ever exacted from the latter, is yet continually changing both her occupation and her posture, and has very frequent intervals of rest. Work at a machine has inevitably a treadmill character about it; each step may be easy, but it must be performed at the exact moment under pain of consequences. In hand work and house work there is a certain freedom of doing or of leaving undone. Mill (*i. e.* machine) work must be done as if by clockwork. . . . The people are tied as it were, to machinery moving at a great speed in certain operations; again it has been alleged that the state of the atmosphere is very unhealthy, and the temperature at a great height, and from the employment of machinery the speed has been so much increased that the wear and tear, not merely of the body but of the mind also, of the operatives were too great for them to bear. (Pages xxix–xxx.)

The Hygiene, Diseases, and Mortality of Occupation. J. T. ARLIDGE, M.D., A.B., F.R.C.P. *London, Percival, 1892.*

The majority of indoor industries have the disadvantage of presenting little variety in the methods of working, especially in manufactories, where there is great monotony in whatever branch of employment is pursued, and the workman counts for little else than an appendage to a machine. Day by day the worker is called upon to do the same mechanical act, without feeling a personal interest in the result of his labour; for this is no product of his thinking or inventive faculty, but predetermined by mechanical contrivances; and day by day he continues at his task, wearisome to the spirit, earning a fixed rate of payment, sufficient, usually, to supply his animal requirements, but holding out small prospect of escape from toil, and whilst he can perform it, or a coming period of competency and enjoyment. (Page 18.) And, generally speaking, it may be asserted of machinery that it calls for little or no brain exertion on the part of those connected with its operations, it arouses no interest, and is wearisome by monotony. Machinery, consequently, has nothing in it to quicken or brighten the intelligence, though it may sharpen the sense of sight, and stimulate muscular activity in some one limited direction.

GREAT BRITAIN

. . . That some effect must follow upon the rapid whirling of machines and the noise produced, is a reasonable inference. The special senses so exposed are necessarily subjected to a species of strain or overuse. Those unaccustomed to machinery are dazed by its operations, and willingly escape from its presence; and those regularly occupied with it, in conducting and regulating its action, and in intently watching its output, can only do so at the expense of more or less wear and tear of nerve function, and, indeed, of the whole nervous system. Their fatigue is the fatigue of watching, not of working. Pages 25–26.)

Condition of the Working Class in England in 1844. FREDERICK ENGELS. *London, Sonnenschein, 1892.*

The supervision of machinery, the joining of broken threads, is no activity which claims the operative's thinking powers, yet it is of a sort which prevents him from occupying his mind with other things. We have seen, too, that this work affords the muscles no opportunity for physical activity. Thus it is, properly speaking, not work but tedium, the most deadening, wearing process conceivable. The operative is condemned to let his physical and mental powers decay in this utter monotony. . . . Moreover, he must not take a moment's rest; the engine moves unceasingly. . . . This condemnation to be buried alive in the mill, to give constant attention to the tireless machine, is felt as the keenest torture by the operatives, and its action upon mind and body is in the long run stunting in the highest degree. (Page 177.)

The Effects of the Factory System. ALLEN CLARKE. *London, Grant Richards, 1899.*

And all these hours — 10 hours a day, spinner and weaver are on their feet, no sitting down, no resting; one must keep up to the machinery though agonized with headache, or troubled by any other complaint. While the engine runs the workers must stand. . . . It will thus be seen that this employment is a severe and ceaseless mental strain that makes a tribe of toilers alert at their tasks, but weakens the physique, as does all narrow and monotonous mental strain if continuous. (Pages 51–52.)

No doubt the factory system, by the increased work and worry, contributes a good share of the imbeciles to the asylums. It is well known that monotony is a cause of insanity, and there is nothing more drearily monotonous than factory work. (Page 66.) GREAT BRITAIN

Women's Work and Wages. Edward Cadbury, M. Cecile Matheson, *and* George Shann. *London, T. Fisher Unwin, 1906.*

The incessant noise of the machinery, the excessive monotony of the work (presswork), and, above all, the long hours, which are too often spent in an ill-lighted and ill-ventilated atmosphere, all tend to produce a depressing and deadening effect which cannot fail to destroy alertness of attention and to create a craving for excitement which will catch at the least opening for distraction. . . . (Pages 53-54.)

Women Workers. Conference in Manchester, 1907. Arranged by the National Union of Women Workers of Great Britain and Ireland in Conjunction with the Committee of the Manchester Branch of the N. U. W. W. London, King and Son, 1907.

Monotony, noise, and dirt are inseparable from many occupations and have a depressing effect on vitality that we are apt to forget. In many cases only the movements of a machine are required in tending a machine, and this monotony is largely responsible for the ungovernable excitement shown by many boys and girls when released from work. As one girl said, "When you have been a few days at a press you want to scream." Imagine passing ten hours a day, with never a week's holiday, unless one is ill or out of work, amid the noise of looms, the dirt and dust of polishing lathes, in the heat of a lacquering shop, or in the odour of rubber manufacture or of French polishing. (Page 106.) Monotony of work, movement, or position may be responsible for mental sluggishness, but its effects are more apparent in the low standard of physical development reached by many of the working classes, while the whole trend of industrial development is to increase and not decrease this monotony. (Page 108.)

The Economic Journal. Vol. XVIII, 1908. Gaps in our Factory Legislation. B. L. Hutchins. *London, Macmillan.*

The extreme monotony of factory work is in itself a cause of strain. (Page 224.)

GERMANY *Gesammelte Abhandlungen, Bd. III. [Complete Works, Vol. III.] Die Volkswirthschaftliche Bedeutung der Verkürzung des Industriellen Arbeitstages. [The Economic Significance of a Shorter Working Day. Paper read before the Political Society.* ERNST ABBÉ. *Jena, 1901.] Jena, Fischer,* 1906.

Our whole industrial labor nowadays is characterized by what we call "Effects of the Division of Labor." . . .

This division and subdivision has become a necessary condition of progress, and, much as we may deplore its effects in certain details, it is impossible to abandon it. It stamps all work with uniformity. . . . With this sameness and continually recurring monotony we also get the continuous fatigue of the same organ, — of the same group of muscles, — of the same nerve centres, — of the same part of the brain, — because all that is to be done, whether muscular or brain work, must be constantly repeated in the same manner from morning to night, day by day, and week by week. (Page 225.)

Fourteenth International Congress of Hygiene and Demography. Berlin, September, 1907. Vol. II, Sec. IV. Ermüdung durch Berufsarbeit. [Fatigue Resulting from Occupation.] Dr. EMIL ROTH, *Regierungsrat, Potsdam. Berlin, Hirschwald, 1908.*

. . . With the progressive division of labor, work has become more and more mechanical. . . . A definite share of overfatigue and its sequels, especially neurasthenia, must be ascribed to this monotony, — to the absence of spontaneity or joy in work. (Page 613.)

ITALY *Proceedings of the First International Convention on Industrial Diseases. Milan, 1906. Frenastenia e delinquenza in rapporto a taluni ordinamenti del lavoro. [Imbecility and Criminality in Relation to Certain Forms of Labor.]* Prof. CRISAFULLI.

To understand how cerebral fatigue can cause the arrest of mental development in youths and criminal actions in adults, we must bear in mind that the special functions of the brain have separate centres, the foundation of the psychic and motor-psychic life of individuals. Thus, there is a centre for hearing, another for sight, another for speaking, etc. When only one centre works it becomes overfatigued much more easily than if the functions were alternately performed by the various centres.

Here, then, is another factor in overfatigue due to the *monotony* of work, interrupted only at long intervals. ITALY

This monotony is the determining cause of local disturbances and endangers the entire organism. (Page 150.)

The National Civic Federation Review. Vol. II, No. 8. Jan.-Feb., 1906. The First Annual Meeting of the New England Civic Federation. Boston, Jan. 11, 1906. UNITED STATES

Marcus M. Marks, President of the National Association of Clothing Manufacturers:

. . . Labor asks for shorter hours . . . because the conditions of employment have been changed so much in recent years that workers feel justly entitled to a shortening of the day. They contend that the introduction of machinery has in a large degree replaced the exercise of the muscles, by the use of the eye and mind. This causes more strain on the system. They contend further that specialization of labor has taken away the restful variety and change of occupation which formerly diversified the day's employment, and has substituted a regular monotony of daily labor which is much more tiring. For, whilst a workman might contribute his maximum efficiency in working to twelve hours per day when strictly variegated effort was required, the greater strain of the present so-called "improved" condition of labor may now bring about the necessity for a reduction of hours in order to preserve the same degree of efficiency. (Page 8.)

Charities and the Commons. March 6, 1909. Vol. XXI, No. 23. New York. The Industrial Environment of Pittsburgh's Working Women. Elizabeth Beardsley Butler, *former Secretary, New Jersey State Consumers' League.*

Monotony of occupation, of movement of foot or hand, monotony of thought which directs the foot or hand, has been illustrated repeatedly in the descriptions of different trades. One woman is putting fifty hinges a minute through a machine. Each second a hinge is lifted out and slipped into place, the hand drawn back as the machine moves, another hinge lifted and slipped into place, for ten hours each working day. Other women spread out the tobacco leaves on the suction plates, put the half-made bunch in the leaf, press the treadle

UNITED STATES

and push the rolled stogy aside; spread out another leaf, cut, put the bunch in place, press the treadle and push aside. Others pack crackers, candy, glass, lamps, with quick machine-taught, unvarying motions, lifting, wrapping, putting in place, lifting, wrapping, putting in place, for ten hours each day. Still others steady the paper in a box-covering machine, guide it according to the gauge, replace it when the strip runs out, guide it according to the gauge.

Each of the women-employing trades illustrates the same fact. This work is not creative, — slipping a hinge into place, rolling a stogy at a suction table, running a box-covering machine, packing crackers. It is not merely subsidiary, it is stupefying. Work which demands nothing of the intelligence, costs the intelligence more than work which demands too much. Machine-like precision and speed tend inevitably toward machine-like absence of thought, and the operative, herself reduced to an adjunct, needs for her single task neither training, intelligence, strength, nor skill. (Page 1140.)

(c) Piece Work

All the evils of speed and monotony in industrial establishments are intensified by the system of piece work. When each worker aims to work faster for the sake of a slight increase in wages, a premium is put upon feverish activity, regardless of the physical cost to the worker.

SWITZERLAND

Untersuchungen über die Gesundheitsverhältnisse der Fabrikbevölkerung der Schweiz. [*Investigations into the Conditions of Health of the Swiss Factory Workers.*] Dr. Fridolin Schuler, *Swiss Factory Inspector, and* Dr. A. E. Burckhardt, *Prof. of Hygiene at Basle. Aarau, Säuerländer, 1899.*

. . . The larger proportion of women in factories is certainly to be thought of in estimating the effects of the violent motion of the machinery on health. . . . But even more important is the overexertion . . . this is exhausting, especially when the practice of piece work spurs the women to greater exertion, and much more so when an overseer, warning and reprimanding the workers, urges them to the utmost degree of exertion. (Page 82.)

Deutsche Medizinische Wochenschrift, Nr. 21, Mai 25. Die Neurasthenie in Arbeiterkreisen. [*Neurasthenia in the Working Classes.*] Dr. P. Leubuscher *and* Dr. W. Bibrowicz, *formerly of the Beelitz Sanitarium of the State Old Age and Invalidity Department of Berlin. Berlin, 1905.* GERMANY

. . . Work has become very different! Piece work has indeed obtained larger wages, but has developed an impetus and speed and intensity of effort that used to be unknown, and this invariably crushes the weaker workers, those for whom all work is a heavier burden than for the strong. Continuous anxiety is felt by these lest they fall behind. Then sometimes voluntarily, sometimes compulsorily, overtime is undertaken, and so it turns out that the working hours, instead of being comparatively shorter than the usual day, are really much longer, and, by reason of the irregularity, far more exhausting. (Page 821.)

Fourteenth International Congress of Hygiene and Demography. Berlin, September, 1907. Vol. II, Sec. IV. Ermüdung durch Berufsarbeit. [*Fatigue resulting from Occupation.*] Dr. Emil Roth, *Regierungsrat, Potsdam. Berlin, Hirschwald, 1908.*

Of greater importance is the excessive overstrain of piece work, which indeed pays better, but at the cost of a speed and intensity of work which was formerly unknown. That these injurious effects first assail the weaker part of the working population is self-evident. (Page 614 and 615.)

Il Ramazzini. Giornale Italiano Di Medicina Sociale. Anno I, 10–11. [*Italian Journal of Social Medicine.*] *October–November, 1907. Le Stagioni, i giorni, le ore degli infortuni del lavoro.* [*Days, Seasons, and Hours when Industrial Accidents occur.*] Prof. G. Pieraccini *and* Dr. R. Maffei, *Head Physicians in the Royal Main Hospital of S. M. Nuova, Florence, Italy.* ITALY

Piece work, necessitating higher speed, tends both in itself and together with the fatigue that ensues to favor the occurrence of labor accidents. . . .

We should see to it . . . that, above all, piece work should be condemned, preference being given to time work, the honesty of the worker and the consciousness of his own labor capacity regulating the speed of work. (Pages 593–594.)

CANADA *Report of the Inspectors of Factories for the Province of Ontario, Canada, 1898. Toronto, 1899.*

In almost every industry the working day is ten hours. The system of piece work is becoming more generally adopted. The small pay given by the hundred or thousand, according to the different industries, stimulates the eagerness of the workers to the highest possible pitch. I have seen girls working so rapidly that I have asked myself the question, how long their nervous systems could resist the strain of the excessive fatigue resulting therefrom. A shorter working day for this class of operatives seems an imperative necessity. (Page 31.)

UNITED STATES *Report of the Minnesota Bureau of Labor, Industries and Commerce, 1907-1908.*

. . . The work that is done by women in so many departments of industry is "piece" work, where the nervous strain is at its highest tension.

When, by reason of skill or deftness, or a longer sustained energy, a girl is able to do a maximum amount of work, she is said to "set the pace," and she becomes a "pace maker" for the others. Those less skilled or less deft, or who for any reason are unable to keep up with the leader, are striving with every nerve to earn as much as is possible, and this great demand upon nervous energy entails a rapid decay of nervous force. (Pages 243-244.)

Report of the Wisconsin Bureau of Labor and Industrial Statistics, 1907-1908. Part VII. Women Workers in Milwaukee Tanneries. IRENE OSGOOD, *Special Agent.*

Organized workmen usually object to the piece-work system. It so frequently leads to "speeding up." And the rate per piece is often cut down until only the fastest workmen are able to secure anything like a living wage. Those less skilled and less dexterous are thus made to suffer from the ambition or greed of a few involuntary pacemakers who work themselves out in a short time for the sake of temporarily earning higher wages. (Page 1053.)

The girls have complained, too, of being cut when they began to earn high wages. This was substantiated by a superintendent, who remarked: "Oh, if they get to earning too much they know what they will get," contending that a general level of wages must be maintained. This would mean, then, that the average worker practically determined the amount one could earn, and any exertion beyond this only reacted upon all in a general cut of the piece rate. Employers quite generally admit this situation. Men meet it by organization and by attempting to regulate their employment by agreements with the employer. UNITED STATES

But, paradoxical as it may seem, stimulation to greater speed is frequently furnished in the opposite way. Another superintendent insisted that cutting the rate was the surest way to get more work done. He argued that when workers find their wages decreasing from a customary sum they naturally try to get back to the old standard by extra work. Thus they are caught between the upper and the nether millstones. The possibility of a cut is ever-present. If they work unusually hard and earn higher wages, they face a cut in rates. If they do not turn out enough work to satisfy the superintendent, a cut is made anyhow to spur them on to higher exertions. They are annoyed and bewildered and uncommonly helpless. (Page 1054.)

B. *The Nature and Effects of Fatigue*

(1) General Medical Views of Fatigue

The fundamental need of limiting excessive working hours for women is based on their physiological organization. For medical science has demonstrated that while fatigue is a normal phenomenon — the natural result of bodily and mental exertion — excessive fatigue or exhaustion is abnormal, — the result of over-exertion or work pursued beyond the capacities of the organism.

Two processes are continually carried on in the living body: assimilation or building up; dissassimilation or throwing off waste products. These wastes are poisonous impurities arising from the chemical processes of cellular life. They circulate in the blood, poisoning brain and nervous system, muscles, glands, and other organs until normally removed by the oxygen of the blood, by the liver or kidneys.

When these waste products accumulate in the blood, fatigue ensues. When they exceed their physiological or normal amount, exhaustion results and health is impaired. In extreme instances of over-exertion death results, not from sheer physical exhaustion of the heart or other organs, but from chemical poisoning due to the unexpelled products of fatigue.

GREAT BRITAIN • *Diseases of Occupation from the Legislative, Social, and Medical Points of View.* THOMAS OLIVER, M.A., M.D., F.R.C.P., *Medical expert on the White Lead, Dangerous Trades, Pottery, and Lucifer Match Committees of the British Home Office. New York, Dutton Co., 1908.*

Fatigue or tiredness is a sensation, the outcome of a particular state of the nervous system, the result of work carried beyond the capabilities of the organism. In ordinary physiological activity exhaustion is never attained, for fatigue is the warning signal. In each of us there is a certain amount of reserve force which allows our muscles and nerves to be overtaxed at times without injurious consequences. The increased functional activity is met by a corresponding improved nutrition, whereby recovery is secured. Life involves change of structure. The waste products added to the blood act upon the nerve endings in muscle and upon the gray matter of the brain, and create a sense of fatigue. Although the sensation of tiredness is referred by us to the overworked muscles, the location of the cause is less in the peripheral than in the central nervous system. On the one hand waste products act upon the muscles, diminish their contractibility and render them less responsive to nerve stimuli; and on the other hand they poison the large nerve cells in the gray matter of the brian, render them less receptive of sensory stimuli, and in this way reduce their power of emitting volitional impulses. There is, therefore, in fatigue an element that is mental as well as physical.

After rest and sleep the sensation of fatigue wears off, we rise invigorated and strengthened for work. During repose structure is being rebuilt and waste products are eliminated.

The proof that the circulation of waste products in the blood is a cause of fatigue is demonstrated by taking some of the blood of a fatigued animal and injecting it into a healthy one, when in the latter the physical signs of fatigue gradually appear. (Pages 6–7.)

Thirteenth International Congress of Hygiene and Demography in Brussels, 1903. Vol. V, Sect. IV. Dans quelle mesure peut-on par des méthodes physiologiques, étudier la fatigue, ses modalités et ses degrés dans les diverses professions? Quels sont les arguments que les sciences physiologiques et médicales peuvent ou pourraient faire valoir en faveur de tel ou tel mode d'organisation du travail. [To what extent may fatigue, its forms and degrees in different occupations be studied by physiological methods? What arguments may physiological or medical sciences bring to bear in favor of various modes of industrial organization?] DR. ZUNTZ, *University of Berlin. Brussels, 1903.* GERMANY

Fatigue, resulting from various occupations, which marks the limits of the workingman's capacity or, if disregarded, endangers his health, is very variable in its aspects, according to the organs especially affected.

We may first of all differentiate between fatigue of the motor apparatus and fatigue of the nervous apparatus.

The first group may be again subdivided into two divisions: first, the general muscular weariness resulting from heavy work; second, the fatigue of certain local groups of muscles which have been ovrestrained.

In fatigue of the nervous apparatus we distinguish between fatigue of the special organs of sense, and fatigue of the central nervous system. (Page 1.)

Handwörterbuch der Staatswissenschaften. Bd. I. [Compendium of Political Science. Vol. I.] Edited by DRS. J. CONRAD, *Professor of Political Science in Halle;* L. ELSTER, *Ober Reg. Rath in Berlin;* W. LEXIS, *Professor of Political Science in Göttingen; and* EDG. LOENING, *Professor of Law in Halle. Arbeitszeit: Hours of Work.* DR. H. HERKNER, *Berlin. Jena, Fischer, 1909.*

Conclusions from the physiological and psychological investigations into fatigue.

Physiologically considered, human labor represents a transformation of the potential energy of oxygen and food materials. When assimilated, they are transformed into mental and physical energy, and, in so far as this is utilized for industrial purposes, we have work in the ordinary sense. Every piece of work, then, means expenditure of energy. . . .

GERMANY Products of tissue change are created (after fatigue), especially carbonic acid and other acids which have a poisonous and paralyzing action. Fatigue consists essentially in this — that waste products are created in the muscles more rapidly than they can be eliminated by the blood current and excretory organs. (Page 1214.)

Fourteenth International Congress of Hygiene and Demography, in Berlin, 1907. Vol. II, Sec. IV. Ermüdung durch Berufsarbeit. [Fatigue Resulting from Occupation]. Dr. E. Roth. *Berlin, Hirschwald, 1908.*

Every muscular contraction increases the consumption of oxygen. This greater demand for oxygen is largely met by the correspondingly increased rapidity of the circulation. The increased drain made by the tissues upon the supply of oxygen may be fully compensated for by the more rapid circulation, though the kind of work being done may modify or interfere with this balance. . . .

Accordingly, as a greater amount of oxygen is consumed, a correspondingly greater amount of carbonic acid gas is produced, so that the relative proportion remains the same during work as during rest. . . . Only when work becomes overwork, or when the needed oxygen is not supplied to the tissues, is the excretion of carbonic acid gas greater than the intake of oxygen; in this case the respiratory coefficient fluctuates. (Page 595.)

The well-known experiments of Ranke and Mosso have proved that the products of fatigue circulate in the blood. . . . From the experiments of Ranke we know that, among these fatigue products, acids play a prominent part, whilst those of Kronecker show that blood containing a high percentage of oxygen is of far superior restorative power for muscular fibre than an ordinary supply. The experiments of Fletcher likewise suggest that the beneficial effect of oxygen on fatigued muscle arises from the rapid oxidation of readily combustible fatigue products in the tissues. . . . (Pages 595–596.)

It has been shown by Mosso that the blood of fatigued animals is poisonous, and Kraus has stated that the lack of energy in the motions of fatigued animals is due primarily to the toxic products of disassimilation (waste materials) and that fatigue is thus a form of autointoxication. (Page 597.)

The more gradually the metabolic processes go on, the more slowly does fatigue develop, for the fatigue products are then excreted as rapidly as the assimilation of nutritive material takes place, if not more rapidly. On the other hand, fatigue appears more quickly when waste products are created in the tissues more rapidly than they are excreted, no matter whether this is the result of delayed excretion or of accelerated production of waste material. The latter condition may be demonstrated, as an example, by the action of extreme heat, with the resultant sweating followed by languor; the former in the absence of sufficient oxygen. (Page 605.) GERMANY

Fatigue. A. MOSSO, *Professor of Physiology, University of Turin. 1896. Translated by* MARGARET DRUMMOND, M.A., *and* W. B. DRUMMOND, M.B., *Extra Physician, Royal Hospital for Sick Children, Edinburgh. New York, Putnam, 1904.* ITALY

Fatigue is a chemical process. At the end of the eighteenth century Lavoisier, in a memorable series of chemical analyses made jointly with Sequin, succeeded in demonstrating a fact of fundamental importance, namely, that muscular exertion increases the quantity of oxygen absorbed and of carbonic acid eliminated by man.

The most demonstrative experiments in the analysis of fatigue are usually made upon cold-blooded animals, commonly on frogs. When the sciatic nerve is stimulated, we notice a contraction of the leg. The contraction, upon being repeated a great number of times, becomes more and more feeble. This diminution of energy is not to be attributed to the dissipation of some explosive substance, so to speak, in the muscle, that is to say, of the substance capable of giving rise to contractions. In fact the muscle will still continue to contract for a long time, but no stimulus will produce a contraction so strong as the first ones. The lack of energy in the movements of a weary man depends, as in the case of the frog, upon the fact that the muscles, during work, produce noxious substances, which little by little interfere with contraction.

The proof that we are not here dealing with a phenomenon of deficit is found in the fact that after the frog's leg has been fatigued by long exertion, we can restore its contracticity and render it capable of a new series of contractions, simply by washing it. Of course we do not wash the outer surface, but having found the artery which carries blood to the muscle, we pass through it water in place of blood. . . . Upon the passage of a current of this liquid through the muscle, the fatigue disappears, and the contractions return as vigorously as at the beginning. (Page 106.)

The experiment upon frogs' muscles washed in saline solution shows that, in order to maintain muscular contracticity, there is no need of continual contract between the muscle fibre and the oxygen of the air through the medium of the blood's. It is only necessary to eliminate the carbonic acid. (Page 112.)

Two important facts . . . mark the beginning of our knowledge of the chemistry of muscle.

In 1845 Helmholtz discovered that a muscle in repose contains only a small quantity of matter soluble in alcohol. Let 1 represent the quantity found. Upon taking an equal amount of muscle from a fatigued animal, he found there was a greater quantity of such matter, the amount being 1.3. This is an experiment made, as the saying is, *en bloc*, by which one gets a glimpse of the changes which are produced in the muscles as the result of exercise.

Another discovery of no less importance is that of Du Bois-Raymond, who found that the fatigued muscle is acid, while the muscle in repose is alkaline. (Page 116.)

To demonstrate that muscles accumulate products which interfere with contraction, Ranke made an aqueous solution of muscle which has been exercised, and having injected this into a fresh muscle, found its power of exertion was diminished. After it had been washed, however, its energy returned. (Page 116.)

It was a French chemist, Gautier, who isolated some of these substances which are derived from the albuminoids of living cells. He gave them the name of leucomaines to indicate that they are chemical compounds arising from the decomposition of albumen. Here we have some very recent observations which open a new horizon in the study of the causes which produce disease. (Page 117.)

I have now given a rapid glance at the toxic substances which are produced in the organism. They are not so much poisons as dross and impurities arising from the chemical processes of cellular life, and are normally burned up by the oxygen of the blood, destroyed in the liver, or excreted by the kidneys. If these waste products accumulate in the blood, we feel fatigued; when their amount passes the physiological limit, we become ill.

Thus is our conception of fatigue widened. It is a process which, as we examine it, seems even to become more complicated. Meantime, we know that fatigue is not produced merely by the lack of certain substances which are consumed during exertion, but that it depends also in fact upon the presence of new substances due to decomposition within the organism. (Page 119.)

Observing that after a whole day's walk even the muscles of the arms are tired, I was struck by the thought that fatigue might alter the composition in the blood; and so long ago as 1887 I found that the blood of a fatigued animal is toxic, for if injected into another animal, it produces the phenomena characteristic of fatigue. (Page 119.)

Thirteenth International Congress of Hygiene and Demography, at Brussels, 1903. Vol. V. Section IV. Dans quelle mesure peut-on par des méthodes physiologiques, étudier la fatigue, ses modalités et ses degrés dans les diverses professions? Quels sont les arguments que les sciences physiologiques et médicales peuvent ou pourraient faire valoir en faveur de tel ou tel mode d'organisation du travail? [To what extent may fatigue resulting from occupation be estimated by physiological methods, and what arguments can medical and physiological science present in favor of special methods of industrial organization?] Dr. Zaccaria Treves, *University of Turin. Brussels, 1903.*

The internal process which causes the phenomenon of fatigue is, according to the doctrine of Hering, and applied by Biedermann to muscular tissue, a defective balance between the processes of assimilation and those of disassimilation. These two categories of phenomena are displayed, in permanent fashion, side by side, in the living tissues, and this fact constitutes the very basis of all life.

As long as these opposing processes balance one another there is no fatigue; but, as soon as this equilibrium, under the influence of any excitation whatever, is disturbed in favor of the processes of disassimilation, fatigue appears; the capacity of the tissues to function is weakened little by little; that is to say, under stimulation which does not vary in intensity, the degree of irritability of muscle diminishes. This conception of fatigue, which a thousand different biological phenomena confirm experimentally, is so simple and so rigorously logical that it is impossible to pick a flaw in it. If we now consider that this degradation of tissue is not only quantitative but that it may, at a given moment, become qualitative and be accelerated by an accumulation of the products of disassimilation, we shall have included in the definition of fatigue, beside the two first factors, *i. e.*, 1. *Repetition of stimulus*, and (2) *excess of the processes of disassimilation over those of assimilation* — the third factor, which is to-day

ITALY for every physiologist indissolubly bound to the idea of fatigue — namely, *auto-intoxication of tissue*. (Page 2.)

Professor Kraus . . . calls "measure of the constitution" that relation existing between the maximum quantity of energy that the organism is capable of developing at a given moment and that part of this energy that is utilized in the form of external muscular work. . . .

The respiratory changes are measured by the method of Zuntz and Geppert, and the results serve to establish the relation between the work and the energy employed.

As a general rule, the higher degrees of fatigue are clearly shown in the chemics of respiration.

The consumption of oxygen, corresponding to a given quantity of work, is so much the greater as the muscles are nearer to exhaustion. When the cardiac activity begins to be insufficient and the blood does not convey enough oxygen to the muscles, an abnormal augmentation in the value of the respiratory quotient becomes noticeable: that is to say, the organism has eliminated CO_2 in excess, as compared with the amount of oxygen consumed. The number of calories developed by the organism during the execution of a given amount of external work may be deduced from the quantity of oxygen (in c.cm.) respired. (Page 29.)

FRANCE *De la Fatigue et de son Influence Pathogénique. [Fatigue and its Pathogenic Influence.]* Dr. M. Carrieu, *University of Montpellier. Paris, Baillière et Fils, 1878.*

General fatigue, when carried to an extreme degree, takes the name of exhaustion; all the reserves of strength, accumulated in the organism by nutrition, are expended; all functions flag or cease, the organism, incapable of manifesting activity, is overwhelmed with depression: the organs necessary to life alone continue with difficulty to perform their functions. A state of fatigue incompatible with life is seen in animals that have been overdriven or pursued: thus a stag after a long and desperate chase has been known to drop dead, though unwounded. The body becomes rigid immediately and putrefaction comes on rapidly. (Pages 6–7.)

There are indeed individuals who are always under the influence of fatigue. This subnormal condition is usually linked with anæmia, and is caused by some one of the many pathogenic conditions of this malady (anæmia). (Page 8.)

Etude sur l'Influence de la Durée du Travail Quotidien sur la Santé Générale de l'Adulte. [*Study of the Effect of the Length of Working Hours upon the General Health of Adults.*] ILIA SACHNINE. *Lyon, 1900.* FRANCE

Gautier has shown that, among the products of muscular exertion in the tissues, alkaloidal leucomaines are formed whose toxicity is not inferior to those poisons produced in putrefied meat which are well known as ptomaines. (Page 31.)

According to Herzen, fatigue is produced first in the motor centres, less so or not as evidently in the terminal filaments of the motor nerves, and to a certain still inferior degree throughout the body. Then there occur in the muscular fibre those nutritive changes due to the combustion which accompany contractions. These chemical changes profoundly alter the structure of the tissues at whose expense they have taken place, and from this alteration the products of combustion, of disassimilation, appear in the muscles. (Pages 32-33.)

Acute overstrain is then a poisoning by products appearing in the course of chemical transformation of muscular tissues. (Page 34.)

The toxicity of urine is considerably augmented after muscular effort pushed to the degree of fatigue, even if the diet is exclusively of milk.

According to Tissié, urine, after excessive muscular exertion, has a toxic power greater than the co-efficient of that of acute infectious fevers. (Page 37.)

M. Arloing has demonstrated that the toxicity of sweat is almost nil when it is produced by a hot bath, etc., but that it is very considerable during violent muscular exertion. (Page 37.) Sub-acute overstrain, says Lagrange, is due to the impregnation of the organism with the waste materials of activity. It is found among persons whose bodies have been subjected to sustained labor or to repeated fatigue without having had sufficient periods of rest. (Page 43.)

La Protection Légale des Travailleurs. [*Legal Protection for Working People.*] *Discussions of the French Section of the International Association for Labor Legislation in 1905 and 1906. Paris, Alcan, 1907.*

Mme. Moll-Weiss:

. . . It has been shown absolutely beyond question that, when work of a certain duration of time is under consideration, — say, for

FRANCE

example, eight or ten hours, — the effectiveness of any worker is less at the end of five hours than previous to that time, because there is an accumulation of waste products in the organism, the remains of incomplete combustion, resultant upon work. It has been commonly agreed upon to call this fatigue. (Page 181.)

UNITED STATES

The Mental Symptoms of Fatigue. (Reprinted from the Transactions of the New York State Medical Association). EDWARD COWLES, M.D., *Medical Superintendent of the McLean Hospital, Somerville, Mass. New York, Fless and Ridge, 1893.*

The bodily conditions of fatigue should first be considered as far as we can know them, and may be studied in their two forms or degrees: (1) *normal fatigue*, or the condition of wholesome tire from daily physiological use; and (2) *pathological fatigue*, or the condition of persistent "impoverishment of nervous tissue in excess of repair," according to Beard, which constitutes nervous exhaustion or neurasthenia. The mental symptoms are to be studied in their close and direct correspondence with these conditions of fatigue.

The effects of fatigue are produced by sufficiently continued exercise in the physiological use of any functions, muscular or nervous. The sense of fatigue is complex, and may have a central or peripheral source, or both together. In muscular tissue, the condition of fatigue depends upon the physiological fact that muscular contraction is in some way or other the result of a chemical change whereby the latent energy is set free and expended in the mechanical work, with also the setting free of heat. The resultant chemical products are toxic, and obstructive of muscular function unless they are duly washed away in the blood current; and time must be given in rest and sleep for this process, as well as for nutrition and repair. These toxic products being variously irritant or benumbing, doubtless thus affect the sensory apparatus through which fatigue is felt. It is evident from this that the condition of muscular fatigue has always a dual character — there is direct expenditure of energy, requiring repair, and a toxic element that may be obstructive of function, both that of discharging energy and of taking up nutrition.

In nervous substance, the nature of nerve force being unknown, the effects of the passage of a nervous impulse along nerve-fibres are not demonstrable as attended by chemical changes, or loss of normal irritability as a manifestation of fatigue. But in the central nervous organs it is found that their function is dependent on an adequate supply of oxygen, and this implies that "in nervous, as in muscular substance, a metabolism, mainly of an oxidative character, is the real cause of the development of energy." In fact we do not doubt that toxic waste products attend upon central nervous activity, and this accords with the biological theory that all function is due to chemical changes taking place within the organism, and that the functional activity of a specialized tissue depends upon the changes in its individual cells. The dual character of all conditions of primary fatigue is evident, as is also the importance of recognizing the effects of the self-produced poisonous substances that regularly result from the chemical changes in tissue metabolism within the body, as we are taught by the brilliant revelations of modern chemical physiology and pathology. (Page 7.) UNITED STATES

Sixty-fifth Annual Meeting of the American Institute of Instruction. The Relation of Fatigue to Social and Educational Progress. HENRY S. BAKER, Ph.D. *Boston, 1895.*

It is a fact not questioned, that every movement of a muscle and every mental act, whether it be thinking, feeling, remembering, or the passive reception of impressions through the senses, is accompanied by some chemical change in the muscular or nervous tissue or both. This change may be called a "wearing out," an oxidation or metabolism, and the worn out material or ashes, as it were, is thrown into the blood, from which it is removed by the various organs of depuration as the kidneys and liver. It is important to note that this débris of nerve and muscle is decidedly toxic to the various organs and especially so to the brain. (Page 33.)

Any movement of the mind or body, because it introduces some of the above materials (leucine, creatine, leukomaines, and lactic or saro-lactic acid, tyrosin, and a substance with effects like ptomaines) into the blood, and because it removes by oxidation a portion of the brain always, and, when a muscle is moved, of the muscular tissue, also produces fatigue. Three conditions always exist: 1. Deleterious material in the blood. 2. A changed, abnormal condition of the brain cells. . . . 3. There is general fatigue of the entire body, caused by toxic materials in the blood. . . . 4. There sometimes exists also a local accumulation of waste products in the tissue which produced them, as a muscle, and this is the case when the labor is rapid or vio-

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lent. Since the brain is the motive power, all fatigue is brain fatigue; that is, there can be no fatigue in which the brain does not share, locally in some centre. In all cases, then, there is local fatigue of brain or muscle, or both. When these conditions exist to a small extent the fatigue is normal, healthful, and the recovery takes place quickly. When they are carried to a great extent the system, as a whole, is weakened and permanently injured in one or more organs or tissues. (Pages 34–35.)

The waste products in the blood not only poison tissues and glands by their presence, but prevent the oxygen of the blood from performing its functions. When a man or animal falls dead from overexertion, it is because he is poisoned to death by his own waste products, which were formed faster than they could be eliminated. Fire horses last but a few years, because at every run the above conditions exist to a great extent. (Page 35.)

Report of the New York Bureau of Labor Statistics, 1900.

A French physician . . . concludes that the abnormal sickness and mortality among working people is due not simply to poisonous or noxious substances in the materials of work, but also to fatigue, which affects the nerves. He describes as follows the effects of long hours of work: (1) Fatigue resulting from prolonged *physical* effort is a phenomenon of self-poisoning produced by the substances destroyed within the body. (2) It is altogether probable that in mental effort the phenomena of fatigue likewise proceed from the products of decomposition which have been thrown into the circulation. (3) In physical fatigue, resulting from excessively prolonged manual labor, there appear not only the phenomena of peripheral fatigue localized in the muscles and ends of nerves, but also the same phenomena in the nerve centres. Hence, mental effort after physical labor, or vice versa, bodily exercise after long mental effort cannot serve as rest; the human organism then demands a certain period of absolute rest. (4) Bodily exercises set the circulation strongly in motion, raise the blood pressure and sensibly increase the number of heart beats. If muscular efforts are excessive or continued long they may in due time produce functional and organic alterations both in the heart and in the blood vessels. Hypertrophy and enlargement of the heart are the most usual consequences. (5) It is very probable that excessive and prolonged physical labor retards the circulation of the kidneys, and in some degree causes anæmia of the kidneys. . . . (7) The bodily development of the factory operative remains inferior to that found in other social classes. (Pages 65–66.) UNITED STATES

The Harvey Lectures. Fatigue. FREDERIC S. LEE, Ph.D. *Philadelphia, Lippincott, 1906.*

It is customary to seek the causes of the physical phenomena of fatigue in the chemical changes undergone by the active living substance. . . . In all tissues during activity substances of value to the organism are broken down and substances of little or no value are formed. . . . It is now customary to recognize three distinct metabolic products as fatiguing, namely, sarcolactic acid, mono-potassium phosphate, and carbon dioxid, all of which are acid in reaction. . . . The organism produces normally in the course of its activity a number of acid substances which tend to inhibit further activity. Fatigue is due in great measure to the depressant action of these toxic products of metabolism on the body tissues, particularly on the muscular system, and the sensation of fatigue is in large part the psychic manifestation of the recognition of this depressant action. (Page 180.) The action of fatigue substances is not confined to the tissues in which they arise. The excessive activity of one tissue is capable of causing fatigue to appear in others. . . . Thus localized activity is capable of producing general fatigue, a fact which is often overlooked in our daily life. The explanation of this is afforded by Mosso's well-known experiment: A dog was fatigued by long-continued running; his blood was then transfused into the vessels of a second dog, from which an equivalent amount of blood had been withdrawn, with the result that the second dog exhibited the usual phenomena of fatigue. The blood had evidently become charged with the fatigue substances produced in the muscles, and thus they were able to reach all parts of the body. (Pages 188–189.)

(2) THE TOXIN OF FATIGUE

The need of limiting excessive working hours for women is further emphasized by the most recent medical research of the last five years, which has discovered that fatigue is due not only to actual poisoning, but to a specific poison or toxin of fatigue, entirely analogous in chemical and physical nature to other bacterial toxins such as the diphtheria toxin. It has been shown that when artificially injected into animals in large amounts the fatigue toxin causes death.

The fatigue toxin in normal quantities is said to be counteracted by an antidote or anti-toxin, also generated in the body. But as soon as fatigue becomes abnormal, the anti-toxin is not produced fast enough to counteract the poison of the toxin.

GREAT BRITAIN *Diseases of Occupation from the Legislative, Social, and Medical Points of View.* THOMAS OLIVER, *M.A., M.D., F.R.C.P., Medical Expert on the White Lead, Dangerous Trades, Pottery, and Lucifer Match Committees of the British Home Office. New York, Dutton Co., 1908.*

Weichardt, in 1904, advanced the theory that the cause of fatigue is a toxin generated in the overtaxed organism, and that the ravages of the toxin, like the poison of diphtheria, can be met by the introduction of an anti-toxin into the body. Wolff-Eisner (Centralb. f. Bakteriol. bd. XI, 1906, page 634) is of the opinion that during athletic training there is produced an immunity to the toxin of fatigue, whereby the trained athlete becomes capable of accomplishing more than the untrained man, and without experiencing the sensation of fatigue. It is common knowledge that men who are doing hard, physical toil regularly have not the sense of tiredness felt by men who are new to the work, and we explain this by saying that the latter are not trained. Wolff-Eisner throws new light upon the subject, having obtained a fatigue toxin from overworked animals; he injected small doses of the poison into other animals and produced in them symptoms of fatigue, drowsiness, and a lessening of activity. Large doses caused death, but if very minute doses were injected for a lengthened period there was established in the animals a genuine immunity to fatigue. The toxin is not found in the blood but in the muscles, whereas the anti-toxin is only present in the blood. (Pages 6–7.)

GERMANY *Centralblatt für Bakteriologie, Bd. XL, Abt. I; Heft 5; 1906. Über Ermüdungs und Reduktionstoxine.* [*The Toxin of Fatigue.*] Dr. ALFRED WOLFF-EISNER, *Charlottenburg. Berlin, 1906.*

In the early part of 1904 Weichardt propounded his theory that fatigue was produced by a toxin the composition of which was fully analogous to such previously well-known toxins as ricin, abrin, diphtheria and tetanus toxins, the leading characteristic of which was also to be found in it, in that injections of the fatigue toxin produced an anti-toxin which neutralized the effects of the toxin *in vivo and in vitro*. This theory was at first striking through its novelty, as the view had been quite generally held, among physiologists, that fatigue was produced by chemically analyzable products of metabolism, especially lactic and other acids. And yet there were numerous well-known facts which might have given rise to fresh inquiries into the nature of fatigue products. GERMANY

It was well known that suitable "training" had an astonishing effect, and every one knew, also, that expert — that is, trained — professional bicyclists, gymnasts, etc., could easily accomplish achievements which would have resulted in death after a comparatively short time, for raw recruits or untrained men. It seemed impossible to explain these undoubted facts simply on the ground that the blood supply and its circulation were better in trained muscles. . . . There was much to support the thesis that the trained man benefited by an anti-toxin, which neutralized the fatigue poison at the moment when it was produced. From this point of view it also became clear why for an efficient training it is essential not only to develop the muscles but also to observe a special daily regimen.

It was to be expected that this teaching of the actions of poisons in fatigue would meet great opposition in many circles of physiological specialists, the more so as the whole doctrine of toxins and immunity, well founded though it was, was still regarded in these circles as a dubious acquisition. It was consequently necessary to prove that fatigue, when pushed beyond normal circumstances, produced an accumulation of poison which was capable of causing death.

An experimental demonstration to prove that fatigue had such capacity naturally encountered extraordinary difficulties. In instances where men might be subjected to extraordinary physical exertion, circumstances would make scientific observation impossible. Physiology had already an apparatus for testing dogs while running; but running is not a sufficiently exhausting exertion for large dogs to make it possible to demonstrate the anti-toxin. Weichardt therefore invented a modification of this apparatus by which, while standing on a rough surface, large dogs were continuously pulled backward. Their resistance to this and their efforts to go forward resulted in exertions sufficient to produce an accumulation of fatigue products.

GERMANY (This being obtained and injected into small and rapidly moving animals, such as mice, the influence of the fatigue-producing toxin was fully demonstrated.)

After Weichardt had succeeded in demonstrating the clinical "symptomo-complex" of forced fatigue, his next task was to demonstrate the fatigue material itself. This material, he proved, is not found in the blood current, as the first supposition might be. The blood functions solely as a carrier of the anti-toxin, and in the blood of highly overfatigued dogs no fatigue poison was present. The poison was demonstrated in the muscles, — a discovery that helps to explain the lifelong activity of the cardiac muscle, for the heart, of all muscles, has the richest blood supply, and the blood continually frees the cardiac muscle from its fatigue material. (Pages 634–635.)

The effects of the toxin on animals are as follows: in small doses it produces weariness and craving for sleep, whose demonstration is made evident by the length of time in which the animals will remain in unusual positions, as, for instance, a mouse placed upon its back will remain so for some time. (Page 638.)

In large doses it causes the death of animals, after a persistent fall of temperature, that is, with all the symptoms analogous to those of extreme fatigue.

The injection of the toxin produces in the large animals experimented on a true anti-toxic immunity. (Page 638.)

From all these researches into the nature of albuminous material, poisons, etc., it is evident that fresh emphasis must be laid upon the importance to the animal and human organism of adequate aeration with oxygen, such as is accomplished by the functioning of healthy lungs. Here we must remember the clinical experiences with human beings, — that in all of those whose supply of oxygen is interfered with, whether it be by disease of the lungs or by a deficiency of hemoglobin arising from anæmia, — the body is extremely susceptible to fatigue, and it will be seen that it is far more important to bring the natural supply of oxygen for the body to its normal adequacy, than it is to administer an artificial anti-toxin to fatigue. In this connection it may be recalled how often it is possible by deep inhalations of fresh air to dispel the symptoms of accumulating fatigue toxin. The effect of bad air, as leading to fatigue, is also explained by the insufficient oxidation. (Page 643.)

I would define "training" as follows:

As practice of muscle groups in harmonious associated activity

(Synergesis) without detriment to strength; as modification of respiration in the sense of increased aeration with oxygen for the repair of the blood and tissues and for the oxidation of fatigue products created by work; finally, as heightened production of the anti-toxin of fatigue, by which a surplus of unoxidized fatigue toxin in the blood may be neutralized and so a working capacity made possible which would, for the untrained, result in steadily lowered temperature and death. (Page 644.) GERMANY

Fourteenth International Congress of Hygiene and Demography. Vol II, Sec. IV. Berlin, Sept., 1907. Ermüdung durch Berufsarbeit. [Fatigue resulting from Occupation.] Dr. Emil Roth. *Berlin, Hirschwald, 1908.*

Weichardt succeeded in obtaining a toxin from the extract of the muscles of fatigued guinea pigs, which he injected into the peritoneal cavity of a mouse, with the result that it was thrown into the same condition of extreme fatigue that follows from forced exertion. With repeated intravenous injections of large animals with the fatigue poison, a specific anti-toxin was produced, with which he conducted active and passive immunization experiments, proving successfully that under its influence the muscles of the animals experimented on displayed a lesser degree of fatigue than under ordinary conditions. The fatigue toxin does not pass through dead membranes by dialysis, but is taken up by the living cells of the stomach.

As has been demonstrated by experiments with animals, the toxin exhibits a composite character, as do other well-known poisons (tuberculin; Snakepoison).

Weichardt subsequently succeeded in preparing the toxin artificially, and in augmenting the endurance capacity of animals under experiment by administering small doses to them; he also demonstrated the presence of the fatigue poison in the excretions of animals and human beings.

Weichardt is of the opinion that this proteid-like product of fatigue characterized by poisonous qualities is extremely widely distributed both in the vegetable and animal kingdoms. (Page 597.)

The experiments of Zuntz and Schumberg as well as others show that the expenditure of strength, or, in other words, the cost in energy, for a given work-unit, diminishes with increased practice. The skilled worker economizes his strength more than the unskilled. Ac-

GERMANY cording to Weichardt, the value of "training" so-called consists not only in bringing about an actual increase in tissue elements, but also in producing a bio-chemical substance of marked characteristics, the anti-toxin of fatigue, which is produced by the immunizing action during "training" of the small amounts of toxic material developed in the course of repeated exertions. (Page 608.)

Vierteljahresschrift für Öffentliche Gesundheitspflege, XXXIX, 1907. Ermüdungs und Übererműdungs Massmethoden. [*Methods of estimating Fatigue and Overfatigue.*] Dr. Wolfgang Weichardt, *Erlangen. Braunschweig, Vieveg, 1907.*

I first sought for the toxin in the bodies of animals, and in those which had been excessively overfatigued I found it, not in the blood, but in the juices extracted from their muscular tissues. When this (by various processes described) was freed from indifferent albumins and then injected into animals, it produced symptoms of excessive fatigue and, in large doses, killed them. When repeated injections of this purified extract were administered to horses, the specific, neutralizing agent — the antidote for the fatigue poison — appeared in the blood serum of the horses. Both also, the toxin and its antidote, may be produced, as I was later able to state, by the separation of the albumin molecules by means of physical and chemical processes.

I have demonstrated isolating both substances and have used them in an extensive series of experiments. All the typical signs of fatigue, up to death from extreme fatigue, may be produced by the artificially produced fatigue poison. On the other hand, the effect of the poison has been invariably successfully neutralized by the artificially produced anti-toxin.

That fatigue toxin is of ordinary routine occurrence in the excreta and urine of human beings, shows that the production of poison takes place with ordinary, physiological fatigue; and that it does not follow that there must be a state of severe, pathological fatigue for the development of fatigue poison in the body.

In every healthy body the process of supplying an increased amount of the specific anti-toxin takes place as soon as moderate amounts of the fatigue poison appear. This is easily demonstrated by mice, with which, by means of a special apparatus, the Kymograph, one can obtain a curve illustrating this process. (Page 330.)

The results of experimentation allow us to formulate the two following principles, taking into consideration the practical as well as the theoretical domain of the researches into fatigue and overfatigue. Small amounts of fatigue toxin bring about active immunization, which is later, after a certain time, expressed in heightened efficiency. **GERMANY**

Overdoses of toxin, on the other hand, bring on a decrease of efficiency and may even produce death.

If overdoses of toxin are met by corresponding amounts of antitoxin a decrease of efficiency does not take place, but, instead, after a certain time, a notable increase in capacity is evident. (Pages 332–333.)

The Harvey Lectures. Fatigue. Frederic S. Lee, Ph.D. *Philadelphia, Lippincott, 1906.* **UNITED STATES**

Mention should here be made of the claim of Weichardt, working in Zuntz's laboratory in Berlin, to have isolated from fatigued muscles a true toxin, of a chemical and physical nature like bacterial toxins, which when introduced in minute quantity into the body is capable of giving rise to the phenomena of fatigue. Weichardt further claims to have obtained by the usual methods of bacteriologists an antitoxin endowed with the power of neutralizing the fatiguing properties of the toxin. (Page 187.)

(3) Nervous Fatigue

The most serious injury to the health of working women from excessive hours of labor is due to the fact that overexertion uses up their store of nervous energy. For all industrial work, whether it involves muscular effort or not, requires the expenditure of nervous energy. Overlong working hours may therefore wholly exhaust the sources of nervous endurance.

Nerve cells are the producers of energy; nerve fibres its carriers to the muscles. Medical observation and science have shown that the poisonous waste products of fatigue have a paralyzing action upon the nerve cells, and that after excessive exertion demonstrable changes are found in the cells of the brain and spinal cord.

Since the central nervous system controls all the vital functions, unrepaired nervous fatigue is more fatal to the organism than the exhaustion of any other organ or function.

BELGIUM *Royaume de Belgique. Conseil Supérieur du Travail, 6ᵉ Session, 1901–1902. T. I. Fasc. II. Repos Hebdomadaire.* [*Weekly Rest Day.*] [*Discussions on 21st Jan. 1902,* M. DENIS, *Member of Council.*] *Brussels, 1902.*

In order to justify the intervention of the legislator the testimony of psychology must be added to that of the physiology of fatigue. We then learn that the consciousness of fatigue does not appear coincidently with the physiological phenomena of fatigue and the accumulation of the waste of combustion in our tissues. It comes on more slowly. "The workman who works," says M. Nitti, "does not perceive the oncoming of fatigue until it has reached a certain degree of intensity. This is the chief reason why society, desirous of preventing a wasteful expenditure of energy, must of necessity resort to a legal limitation of labor." And we understand the import of these words when we read in Mosso:

"Fatigue, which we may regard as a sort of poisoning, can alter the composition of the blood and the conditions of life without our experiencing any other feelings than a vague sensation of weakness." (Page 174.)

The labor contract made by one individual with another may thus be vitiated by a sort of permanent error or illusion of the worker, and the principle of social intervention is based on the psycho-physiological constitution of his being.

The collective consciousness of injury must supplement the individual consciousness. (Page 175.)

Les Projets de Limitation de la Durée du Travail des Adultes en Belgique. [*Proposals regarding Limitation of Hours of Work for Adults in Belgium.*] HECTOR DENIS, [*No. X. of the publications of the Belgian Section of the International Association for Labor Legislation.*] *Liège, Benard, 1908.*

Researches into the psychology of work prove that the consciousness of fatigue is only attained when a really grave state of overfatigue has been reached. This alone would justify the intervention of the law. . . . The classic idea was that unrestricted individual liberty best secured individual interests . . . but now it is shown that, in what is a most imperative interest of the working man, namely, conservation of his strength, he is only enlightened imperfectly and tardily by consciousness; what, then, must be the result of all that complicated train of motives which, as Treves has pointed out, may impel the working man to risk overwork and overstrain? (Pages 10–11.) BELGIUM

Thirteenth International Congress of Hygiene and Demography at Brussels, 1903. Vol. 5. Section IV. Dans quelle mésure peut-on par des méthodes physiologiques, étudier la fatigue, ses modalités et ses degrés dans les diverses professions? Quels sont les arguments que les sciences physiologiques et médicales peuvent ou pourraient faire valoir en faveur de tel ou tel mode d'organisation du travail? [To what extent may fatigue resulting from occupation be estimated by physiological methods, and what arguments can medical and physiological science present that will influence favorably certain methods of industrial organization?] Dr. ZACCARIA TREVES, *University of Turin. Brussels, 1903.* ITALY

The solution of the problem (of nerve fatigue in muscular work) has a very practical importance, because the working man, especially when he works with machinery, is most frequently subjected to a mechanical rhythm and uniform intensity, and his labor continues regularly for hours. In reality, *man is provided, by his neuro-muscular apparatus and the systems of levers dependent on it, with a mechanism capable of making a lengthy resistance either to the direct exhaustion of muscle, or to the action of ponogetic substance* (waste materials derived from the brain or nerve tissues)*; so that he is capable of doing intense work, under a permanent routine, and yet of being unaware of the gradual appearance of fatigue, which, however, reveals itself by other symptoms.* (Page 5.)

By the effect of training, which, as we know, enables the minimum maximal weight (technical ergographic term, meaning minimum of effort with maximum result of work accomplished) to be doubled, in experiments, the individual will be able to endure more intensive work as a regular thing; but it will be necessary for him to expend, with every contraction, a greater amount of nervous energy, ITALY so that his total store of disposable nervous energy will be reduced to a minimum.

Now, according to my experiments, *it has not been found that training has as favorable an effect upon nervous energy as upon muscular strength.* The only evident advantage that training shows in the nervous function of voluntary motion is a more ready co-ordination of muscles and an accomplishment of the purpose with a smaller number of muscles.

This qualitative perfecting of motion has also, no doubt, the effect of conserving a certain amount of nervous energy.

The well-trained athlete, then, can by practice lift heavy weights with increasing ease; but, when his muscles have attained their greatest strength, the nervous energy at his command will not have augmented proportionately with the work that his muscles are able to perform. The result is that in order to perform this work his nervous energy will be proportionately more expended. (Page 6.)

This fact explains why muscular training cannot go beyond certain limits and why athletes are often broken down by the consequences of overexertion.

And this fact also teaches us the practical necessity of preventing women, children, and even adult men from being subjected to toil, which, indeed, a gradual muscular training may make possible, but at the price of an excessive loss of nervous energy which betrays itself by no evident and immediate symptom, neither objective nor subjective.

While the individual works, the reserves of disposable nervous energy in the neurones, which preside over muscles, diminish much more rapidly than the production of work, which may, indeed, proceed according to a regular pace. In spite of this diminution, if circumstances continually demand intense and constant work, the stimulus will continue to be sent to the muscle with the intensity necessary to accomplish the purpose. (Page 6.)

Here we have an arrangement of things which is of inestimable value to man in the production of work: but this beneficent provision becomes injurious to the dynamic equilibrium of the organism as soon as it is irrationally employed. It is this that needs to be avoided in the practical organization of industry. (Page 7.)

The dynamometer might serve for this purpose (examination of approximate nervous energy of the individual) by calculating the product of medium strength exerted upon the dynamometer by the duration of the tetanic contraction. A dynamometric comparative test of different hours of work in different occupations, made upon a large number of individuals over a long period of time, might perhaps give us some satisfactory results and discover for us symptoms of fatigue that a superficial observation can neither perceive in the subjective condition of the individual nor by the quality or quantity of work executed. (Page 7.) ITALY

Intelligence and will-power driving us on in intensive labor in order to attain the maximum useful result in a minimum of time, and our practically inexhaustible muscles aiding in this, a state of things is established which involves formidable overstrain of those parts of the nervous system which act as the immediate regulators of our energies. . . . I must conclude from my experiments that the average energy of contraction does not increase in an appreciable extent as the result of practice: *It would appear that a true training of the nervous motor function does not exist.* (Page 28.)

Industry has developed in an almost dizzy fashion, and the worker's tasks have been almost completely transformed, labor having become more intense and more monotonous. It is only by following the methods indicated previously that we shall be able to know exactly whether this state of things may, or may not, be a natural cause of physical and psychical overstrain of working people.

Such overstrain would constitute a danger with which our hygienic reviews have concerned themselves too little, and which is no less grave and menacing than overwork in the school, which in the past few years has become the favorite theme of sociologists and pedagogues as well as physiologists.

And yet, when we consider the knowledge and the methods in the possession of physiology to-day for examining into the resistance of the human organism, the study of the fatigue of working men seems to offer the hygienist a better chance of arriving at a practical solution than that of the fatigue of the schoolboy. (Page 30.)

The above (ergograph, modified ergograph, electric stimuli, sphygmograph, physical and laboratorical examination, psychic tests, ergostat, chemical experiments) are the most exact methods at the disposal of the physiologist for measuring the energetic value of the human organism, and these methods only can prove to the hygienist how a state of what we may call chronic fatigue may be a permanent cause of enfeeblement of the working man. (Page 30.)

. . . The efficiency of the human organism depends rigidly on the stage of evolution and of the resistance of all higher faculties, both moral and intellectual. The workman's productivity depends on his ability to use his head as well as his hands. (Page 32.)

Archiv für Anatomie und Physiologie, 1890. Physiologische Abtheilung. Über die Gesetze der Ermüdung. [*The Laws of Fatigue.*] Dr. Arnaldo Maggiora, *University of Turin. Leipzig, 1890.*

I found, by experiments morning and evening, that the chief importance of sleep is for its effect on the nerve centres. With moderate exertion, such as the ordinary occupations of a day demand, the store of muscular energy is not exhausted, and the night's rest is therefore of minor effect upon the muscles, but the influence of sleep upon the nerve centres is far more definite. (Page 225.)

Fatigue. A. Mosso, *Professor of Physiology, University of Turin, 1896. Translated by* Margaret Drummond, M.A., *and* W.B. Drummond, M.B., *Extra Physician, Royal Hospital for Sick Children, Edinburgh. New York, Putnam, 1904.*

The nervous system is the sole source of energy; and although we must admit a certain amount of localization, this is not of such a nature as to prevent the neighboring organs feeling any loss through the great activity of any one organ. The exhaustion of energy is general; and all the magazines of energy can be drained by the exaggeration of any activity whatever of the organism. The conclusion to which we are led by my experiments is that there exists only one kind of fatigue, namely, nervous fatigue; this is the preponderating phenomenon, and muscular fatigue also is at bottom an exhaustion of the nervous system. (Page 243.)

Cerebral fatigue diminishes the force of the muscles, and with the ergograph we measure this phenomenon with exactitude. The need of rest after intense brain work arises then from the fact that the nervous centres are exhausted and the muscles weakened. The feeling of discomfort and the prostration which characterize intellectual fatigue are due to the fact that the brain, which is already exhausted, has to send stronger stimuli to the muscles in order to make them contract. The exhaustion is twofold: central and peripheral. This explains why after brain fatigue one feels one's energy exhausted by the slightest movement, and why every obstacle which we have to overcome seems to have grown more serious. (Page 280.) ITALY

Berliner Klinische Wochenschrift, Nr 5. Feb. 4, 1901. Ermüdung und Erholung. [*Fatigue and Repair.*] Prof. MAX VERWORN, *Jena. Berlin, Hirschwald, 1901.* GERMANY

There is an organ whose state of fatigue arouses our physiological and pathological interest to a far greater extent than does muscular fatigue, and this is the central nervous system. The central nervous system, as the dominating system of our bodies, which communicates to all other however important organs the impulses which promote or check their activities, must always share in the fatigue of single organs, such as the muscles, by reasons of this co-ordinating function and relation. But it results, too, from the centralization of the control of all our vital functions there, that fatigue of the central nervous system has a far more decisive importance for the collective bodily activities than has the fatigue of a single group of organs such as the muscles. This is made most plainly evident by all the symptoms of pathological fatigue. (Page 127.)

Grenzfragen des Nerven und Seelenlebens. [*Borderland Problems of Nervous and Psychic Life.*] *Edited by* LOEWENFELD *and* KURELLA. *Vol. 6. Über die Geistige Arbeitskraft und ihre Hygiene.* [*On Mental Working Power and its Hygiene.*] Dr. L. LOEWENFELD. *Wiesbaden, Bergmann, 1906.*

The nerve elements of the brain, like other nerve structures, are by no means capable of activity for unlimited time periods. After a certain duration of activity the nerve elements lose their responsiveness to stimulation, and fatigue results, or, under forced stimulation, complete exhaustion follows, even though the store of energy accumulated in the chemical combinations of the nerve cells has not been used up. If we ask why nerve elements become incapable of exertion after long-continued work, though their disposable energy is not consumed, we find that we have here to do with the effect of a poisonous product, the toxic waste product of fatigue. The accumulation of this poison paralyzes the nerve substance. This is one of nature's protective measures. Through the paralyzing action of the poison the elasticity of the tissues is protected from overstrain, and a destruction of tissue substance, which cannot be compensated by

GERMANY rest and food, is prevented. (Page 13.) The hygiene of the mental working capacity in adults demands before all else an economic use of the same, that is, the avoidance of overexertion. The individual's capital of available nerve force, whether that capital is large or small, must not be permanently decreased by the work executed. A disproportionate mental exertion may impair the nerve-capital in two ways:

1. By necessitating a consumption of nerve elements which cannot be fully compensated for by the available nutrition and sleep, thus leading to a progressive diminution of strength.

2. By accumulating poisonous waste products in the tissues, in excess of excretion. These wastes, as we have seen, by virtue of their poisonous properties, and their paralyzing action on nerve elements, lower the mental efficiency even more seriously than is the case when the chemical constituents of the tissues are impoverished by insufficient nourishment.

According to all evidences, mental overexertion does not always exhibit these two phenomena in equal proportion, but one or the other predominates according to the circumstances of the nutrition of the individual. It is clear that those persons whose cerebral circulation is poorer will sooner suffer a loss of mental capital if they are forced beyond their normal mental working power, just because the overconsumption of elasticity that is made necessary by the overexertion does not find adequate reimbursement in the nutritive properties of the blood; and it is also clear that those whose cerebral circulation is especially abundant are enabled to retain their mental capital longer even if subjected to severe nervous strain of work. The disturbances noted in course of time in such an individual are more likely to be those of auto-intoxication from retained waste products. (Pages 43–44.)

Handwörterbuch der Staatswissenschaften. Bd. I. [*Compendium of Political Science. Vol. I.*] *Edited by* Drs. J. Conrad, *Professor of Political Science in Halle;* L. Elster, *Ober Reg. Rath in Berlin;* W. Lexis, *Professor of Political Science in Göttingen; and* Edg. Loening, *Professor of Law in Halle. Arbeitszeit: Hours of Work.* Dr. H. Herkner, *Berlin. Jena, Fischer, 1909.*

In modern industry the activity of the worker is usually confined to certain muscular groups alone. The burden therefore rests upon a few overworked organs. The same muscles, the same nervous tissues, and the same parts of the brain are continually at work. In this way fatigue comes on much more rapidly than where an alternation allows temporary use of various organs, thus giving them time for rest. As, in monotonous muscular work, muscular fatigue comes on quickly, so with monotonous, one-sided mental work (for instance, long-continued addition) fatigue comes on very quickly. In general, fatigue of the nerves approaches more slowly than muscular fatigue; but, on the other hand, nervous repair takes a much longer time. (Page 1215.) GERMANY

Man realizes fatigue not only by the less satisfactory results of work but also by sensations of pain and aversion. These are warning signals and protective devices of nature, by whose help injury may be averted. But it is possible that in the zeal of work these signals may be ignored. The injurious effects will therefore, however, not be avoided. Again, the signal may be noticed but cannot be heeded through the compulsion of circumstances. The day's work must be finished, and work must be kept up longer for the sake of the day's wages. Then, with the utmost strain of the will power, further activity must be wrung from the wearied organism. But this effort of will also means an expenditure of energy, probably a more excessive drain upon albumen. (Pages 1215–1216.)

La Fatigue et l'Entraînement Physique. [*Fatigue and Physical Training.*] Dr. Phil. Tissié. *Paris, Alcan, 1897.* FRANCE

Every muscular act stimulates a nervous activity; every nervous act stimulates a muscular activity. There is an intimate relation between the brain, spinal cord, and muscles. Violent or prolonged activity wearies the brain. (Page 102.)

Etude sur l'Influence de la Durée du Travail Quotidien sur la Santé Générale de l'Adulte. [*Study of the Effect of the Length of Working Hours upon the General Health of Adults.*] Ilia Sachnine. *Lyon, 1900.*

According to the same author (Lagrange) there are two other types of overwork which are not due to auto-intoxication: first, organic exhaustion; an individual compelled to work with expenditure of physical strength must, if his nutrition is insufficient or im-

FRANCE perfectly assimilated, draw upon his reserve tissues for material for combustion, and, when this reserve is exhausted, the organs essential to life are next drawn upon to supply the necessary energy. The organism then deprives itself of the organic elements indispensable to the equilibrium of health. This is auto-phagia, or exhaustion. According to Lagrange, overwork, insufficient sleep and nourishment, and, above all, excessive *hours* of work, give rise to organic exhaustion. The second type of overwork mentioned is dynamic exhaustion; here there is a sort of exhaustion of the motor nerve centres. This form of fatigue shows no appreciable anatomical changes, but only a loss of energy. It results from an over-expenditure of nerve force. (Pages 45-46.)

GREAT BRITAIN *Diseases of Occupation from the Legislative, Social, and Medical Points of View.* THOMAS OLIVER, M.A., M.D., F.R.C.P., *Medical Expert on the White Lead, Dangerous Trades, Pottery, and Lucifer Match Committees of the British Home Office. New York, Dutton Co., 1908.*

As the result of overwork Hodge, an American physiologist, found structural changes in the nerve cells which rest removed. F. H. Scott (Journ. Physiology, Vol. XXXIV, Nos. 1 and 2, p. 145) states that in nerve cells there is formed from the nucleus and Nissl bodies of the cell a substance which passes into the nerve fibres. These fibres are capable of carrying impulses without becoming fatigued, but they cannot maintain the end-organs of the nerve in a condition of activity beyond a limited period. It would appear, therefore, as if some substance were given out from the nerve cells, hence as a consequence the readier fatigue of the central nervous system compared with the peripheral. Scott tried to locate the seat of fatigue. Muscle fibre may become fatigued, also the nerve cells in the spinal cord, owing to the hypothetical substance already alluded to being used up and time not given for fresh secretion to have been formed.

UNITED STATES *Brain Work and Overwork.* Dr. H. C. WOOD. *Philadelphia, Blakiston, 1880.*

Voluntary motion of a hand and arm is the result of a complicated series of acts. Successive discharges of nerve force occur, commencing in the upper brain and passing downward along the spinal cord and outward along the nerves until the muscles are reached and are called by the nervous impulse or force into action. It is a lesson not to be forgotten, that in exercise, not merely the muscle, but almost the whole nervous system labors; and that muscular movements are just as truly a putting forth of nervous power or energy as are mental efforts. (Page 92.) **UNITED STATES**

There is certainly in the adult some antagonism between hard physical and mental labor. Muscular work rests upon a putting forth of nervous energy, and the man who has exhausted his stock of nervous energy in violent exercise cannot be expected to perform a prodigy of brain labor. (Page 98.)

Alienist and Neurologist. Vol. XXI. Influence of Age in the Production of Nervous Diseases. WILLIAM A. KRAUSS. *St. Louis, Hughes, 1900.*

The study of the influence of exhaustion upon the central nervous system has received renewed vigor and enthusiasm since the classic experiments of the American investigator, C. F. Hodge, and later verified by those of Vas, Lambert, Lugaro, Mann, and others. In a series of brilliant experimental researches, Hodge has established the existence of definite morphological alterations in the cell bodies of neurons accompanying the excessive exercise of their physiological function. His experiments on cats, sparrows, pigeons, and honey bees, showing that after prolonged exercise or activity demonstrable changes take place in the protoplasm and nucleus of the cells of the brain and cord, are familiar to you all. (Page 647.)

The Harvey Lectures. Fatigue. FREDERIC S. LEE, Ph.D. *Philadelphia, Lippincott, 1906.*

The term, muscular fatigue, requires a word of explanation, for it has been shown by various investigators, including Waller, Abelous, Santesson, and Joteyko, that when the muscle in fatigue ceases to respond to stimuli sent to it through its nerve, it is still capable of contracting on direct stimulation. Their inference from this fact is that the motor nerve endings within the muscle are the first part of the mechanism to succumb. This nerve ending is probably more susceptible to fatigue than the protoplasm of the muscle cells, and hence the muscle protoplasm itself within the organism probably never reaches the stage of profound exhaustion. . . . It has long gone without dispute that on prolonged activity the brain and spinal cord

UNITED STATES

succumb first, and thus the exhaustion of the peripheral tissues is prevented. The nerve centre has been compared to the fuse of an electric circuit, the burning out of which protects the muscle from grievous injury. By most upholders of the neuron theory central fatigue has been referred to the bodies of the nerve cells, in which Hodge, Vas, Mann, Lugaro, Eve, and others have demonstrated histologic changes after activity. According to most of these observers, moderate activity is accompanied by an increase in the bulk of both cytoplasm and nucleus, excessive activity by a decrease in bulk and the appearances of vacuoles in both, and a loss of the substance of the Nissl bodies . . . these histologic changes after excessive activity have generally been interpreted as significant of fatigue. (Page 173.)

(4) Muscular Fatigue

The dangers of excessive working hours for women are increased by the fact that the onset of fatigue is often unperceived by the worker. Not until the damage is done and health is impaired by the strain of overlong hours is the injury manifest.

Yet though fatigue may thus accumulate unperceived, the laws of fatigue and its progressive growth have been exactly studied by scientific instruments of measurement. The most important such instrument — the ergograph — was devised to measure the fatigue of finger muscles. It records the curves traced upon a revolving cylinder by momentary contractions of the finger muscles lifting a known weight at regular intervals. Such a record shows a steady diminution of the lifting power of the muscle, the rate and regularity of the diminution varying with individuals.

After a certain degree of fatigue has set in, the muscle becomes incapable of performing further work unless a lighter weight is attached, or its contractility is restored either by artificially irrigating the muscle or by allowing an interval of adequate rest to intervene before renewed exertion. If fatigue has not proceeded too far, this suffices to remove the toxic fatigue products which have been produced in the muscle. After exhaustion has set in, a much longer period of rest is required to restore the muscle to use, or it may become wholly incapacitated.

To prevent injurious accumulation of unperceived fatigue, therefore, over-exertion through excessive working hours must be prevented.

Special Reports on Educational Subjects. Vol. IX. On the Measurement of Mental Fatigue in Germany. C. C. Th. Parez, *German Master at Merchiston School. Edinburgh, London, Wyman, 1902.* GERMANY

The application of the first of the above-mentioned methods (physical or muscular test) is due to Mosso, professor of Physiology in Turin, who perfected a method of measuring the work done by a certain group of muscles in raising a definite weight again and again at egular intervals until complete exhaustion ensued.

For this purpose Mosso hit upon the idea of employing an adapted form of the myograph, an instrument devised by H. von Helmholtz for recording muscular contractions, the principle of which may be gathered from the following well-known experiments:

The leg of a frog is separated from the rest of the body, and to its extremity a pencil is attached, which is so arranged that its point comes in contact with a cylinder covered with sooty paper, which revolves round a vertical axis; as long as the leg remains at rest, the pencil traces out an even line on the revolving cylinder, but if the nerves connected with the muscles are excited by electricity, the muscles contract, and the pencil traces a curve on the cylinder, first upward and then downward, whose form corresponds to the muscular contraction of the leg, and gives a measure of the energy developed in the leg by the nervous irritation produced by electricity. After continued application of electricity, the muscle becomes tired and the curves traced on the cylinder show a corresponding modification in size and form.

Acting on the principle here exemplified, Mosso constructed the ergograph, an instrument designed to record the work done by a particular muscle or group of muscles of the human body. The chief point aimed at in the construction of the instrument was to isolate the working muscles completely, so that no other muscle could be in a position to aid them when tired. The apparatus is accordingly

GERMANY arranged so that one part of it holds the arm, hand, and all the fingers fast, except the middle finger, which alone is capable of extension and contraction; that is, the flexor muscles alone can be brought into play; the other part of the apparatus is similar to Helmholtz's instrument, except that to the writing apparatus, which records the curves on the cylinder, a weight of two, three, or more kilograms is attached.

When using the instrument, the person who is to be subjected to the test contracts his middle finger at regular intervals of time, generally every two seconds; the height to which the weight attached to it is raised, is recorded on the cylinder, and decreases gradually until at length, in consequence of fatigue, the flexor muscles have no longer the power to raise the weight at all, so that the mark on the cylinder appears simply a straight line. If a grown man uses a weight of three to four kilograms, and repeats the contractions every two seconds, he is usually able to raise the weight forty to eighty times, each lift being, as a rule, slightly less than the previous one. . . .

If the highest points of all the separate contractions as recorded on the cylinder be joined, the result is a line of characteristic form known as the Curve of Fatigue.

This curve displays a characteristic and constant form for each individual, supposing him to be in fresh condition and the weight raised and the intervals of time to be the same at each trial, from which it may be inferred that every person has special characteristics as regards capacity for work, and liability to fatigue. This inference is confirmed by the following experiment: The nerves of the muscles employed in lifting the weight, attached to the weight were subjected to the action of an electric current, so that all mental influence was eliminated. In this case the curve obtained from the record of the work done by the excited muscles showed again the characteristic form peculiar to the individual, although deficient in length and height. At the same time, however, variations in the mental and physical state of the individual have of course a direct influence in the form and size of the curve; the curve is in fact, as Mosso tells us, "the resultant of a complexity of causes which influence the muscles, nerve centres, and circulation, and depend upon the composition of the blood, and the general condition of the system."

Increase and decrease of bodily vigour, practice, mode of life, duration of sleep, rest, mental excitement, physical as well as mental exertion, all tend to cause modification of the curve. . . .

Practice, of course, strengthens the muscles and enables them to perform more work in course of time, but the results of practice can easily be distinguished and do not effect the characteristic form of the curve. (Pages 531–533.) **GERMANY**

A comparison of curves obtained from different individuals affords an interesting insight into their respective working powers.

Seldom are the curves alike; the number of lifts varies, as also the height of each single effort.

With some persons the contractions attain the same height for a considerable period and drop suddenly towards the end, with others they drop more quickly at first, while in the case of others again, the height decreases regularly for a considerable period and suddenly sinks to a minimum after some time. (Page 533.)

In fact, the record of the ergograph bears out the results of ordinary observation, that some persons feel tired and begin to play almost immediately while others work at comparatively high pressure for some time and give way suddenly as complete exhaustion ensues, some are capable of longer, others of shorter periods of work. (Page 533.[1])

Handwörterbuch der Staatswissenschaften. Bd. I. [Compendium of Political Science. Vol. I.] Edited by Drs. J. Conrad, *Professor of Political Science in Halle;* L. Elster, *Ober Reg. Rath in Berlin;* W. Lexis, *Professor of Political Science in Gottingen; and* Edg. Loening, *Professor of Law in Halle. Arbeitszeit: Hours of Work.* Dr. H. Herkner, *Berlin. Jena, Fischer, 1909.*

Precise estimates of phenomena of fatigue are more easily made in the case of muscle than of nerve. Energetic muscular work makes extra work for the heart, lungs, and digestion, that is easily estimated. If, for instance, the pulse rate exceeds 50–60 per cent of its rate when at rest — if it is over 140, and if after 10 minutes' rest it has not yet fallen to normal, we have before us an injurious degree of fatigue.

Respiration should not exceed the rate existing in a state of rest by more than 75 per cent, and after a fifteen minutes' pause for rest it should not remain higher than 30 per cent above normal. Elevation of the body temperature to 39° or 40° centigrade (Fahrenheit 103°–104°) is unquestionably very harmful.

[1] For another full description of the ergograph see the Text Book of Physiology by William H. Howells, M.D. Philadelphia, W. B. Saunders Co., 1907.

GERMANY The most exact estimate we can make of the consumption of energy is that obtained by the test of the oxygen consumption of the body. This procedure it is true, requires the use of complicated apparatus in physiological laboratories. (Page 1215.)

GREAT BRITAIN *Diseases of Occupation from the Legislative, Social, and Medical Points of View.* THOMAS OLIVER, M.A., M.D., F.R.C.P., *Medical Expert on the White Lead, Dangerous Trades, Pottery, and Lucifer Match Committees of the British Home Office. New York, Dutton Co., 1908.*

During inactivity living muscle is absorbing oxygen from the blood and is throwing off small quantities of carbonic acid — it is storing up glycogen and fat; but during activity the nutrition of the muscle is quite altered. A larger quantity of oxygen is absorbed, the carbonic acid evolved is considerable, glycogen disappears, for it is used up, and the temperature rises. The contractile substance of the muscular fibre becomes acid in reaction, owing to the presence of lactic acid and other derivatives. Whenever muscular activity is carried to the point of exhaustion, glycogen, which is the source of the muscular energy, disappears. It is used up, being transformed into carbon dioxide and water with lactic acid. Although deprived of glycogen, muscle can still contract owing to the nitrogenous substances it contains. Muscular activity requires nervous activity as well. Nerve cells as producers of force, nerve fibres as carriers, and muscles as the agents of contraction are all involved in manual labour. Each of these plays its own part in fatigue. (Page 9.)

ITALY *Thirteenth International Congress of Hygiene and Demography in Brussels, 1903. Vol. V, Section IV. Dans quelle mésure peut on par des méthodes physiologiques, étudier la fatigue, ses modalités et ses degrès dans les diverses professions? Quels sont les arguments que les sciences physiologiques et médicales peuvent ou pourraient faire valoir en faveur de tel ou tel mode d'organisation du travail.* [*To what extent may fatigue resulting from occupation be estimated by physiological methods, and what arguments can medical and physiological science present in favor of special methods of industrial organization?*] DR. ZACCARIA TREVES, *University of Turin. Brussels, 1903.*

The curves of work production and of contractile energy in voluntary muscular work, both under a given rhythm and under a spontaneous rhythm, have shown us that the unfavorable conditions of work may be unperceived by the workman who is subjected to a task beyond his strength. This possibility is greater than is realized, for the observations of Zuntz and Schumberg have proved that, though muscular work provokes ordinarily a greater expenditure of albumin, a fatiguing piece of work performed by an organism in a state of slight inanition results in an accumulation of albumin, an augmentation of the muscular mass, from whence there is an augmentation of the absolute strength of the muscles; so that even in a condition of slight inanition the individual may still exact greater and greater efforts from his muscles.

All circumstances which hamper work in any way, such as ill health or local pain, have the effect of augmenting the expense of energy in proportion to the external work. . . . We can then affirm, as a general law, that *fatigue finds its expression in an abnormal augmentation of the expenditure of tissue materials as compared with work done.* (Page 28.)

When, after fatiguing work, ordinary reagents show traces of albuminuria, it must be concluded that the muscular effort, even if it has not been too prolonged, has surpassed the physiological limits of the individual. The resistance of the human body to work depends on the integrity of its organs; all work results in a destruction of organic substance which should be replaced by food. Alimentary substances constitute not only an aid to matter, but to energy also. The sum of energy which they represent is estimated by the calories developed during the combustion of aliments, while a definite amount of mechanical work estimated by kilogrammeters corresponds to these calories. Now, man can transform into motor force the energy brought to him by his food, and this is a more or less economical way according to circumstances. If conditions are favorable, the useful result may correspond to a third of the energy contained in the substances consumed; but this proportion between energy employed and useful result may fall to one-sixth, and then there will be waste.

This latter working system is injurious to the organism and must be scrupulously avoided, since, if waste augments and continues, the nutritive alterations of the muscle, which at first were only quantitative, become qualitative as well; that is to say, the afflux of blood having become insufficient, the muscular substance undergoes a remarkable and lasting alteration and becomes functionally damaged. (Pages 27–28.)

ITALY *Archiv für Anatomie und Physiologie, 1890. Physiologische Abtheilung. Über die Gesetze der Ermüdung. [The Laws of Fatigue.]* Dr. Arnaldo Maggiora, *University of Turin. Leipzig, 1890.*

My experiments proved that after one whole night's wakefulness the muscles weary much more quickly, so that at 8 A. M. of the following morning the amount of mechanical work obtainable from them is reduced to the half of what it would be under normal circumstances.

In the daytime, after a night without sleep the finger contractions give one contraction of normal or nearly normal size, but the next ones fall off with unusual rapidity. As in anæmia, the reserve strength may be observed to diminish even though spasmodic or single contractions may be performed.

Mosso has shown that, under such circumstances (nightwork without sleep), not only the irritability but the productive capacity is lessened. The diminution of mechanical work is often more extreme than that caused by anæmia. (Page 226.)

Loss of sleep promotes muscular fatigue for the reason that it brings about a general exhaustion of the organism. The muscles can, it is true, continue to perform some work, but they more quickly give out and the amount of mechanical work they produce is small.

This exhausting effect of loss of sleep is not altered by taking food, but disappears only after a compensating degree of sleep. (Page 227.)

FRANCE *La Fatigue et l'Entraînement Physique. [Fatigue and Physical Training.]* Dr. Phil. Tissié. *Paris, Alcan, 1897.*

The need of repair is unconsciously made manifest by the muscles (by means of curves) before this need is recognized by the psychic centres. The first degree of fatigue is then, evidently, of peripheral origin. It indicates that fatigue and nutrition are two related states, since speed is slackened with the need of nutriment and augments when this need has been satisfied. (Page 24.)

Travail et Plaisir. [Work and Enjoyment.] Charles Féré, *Doctor of Medicine. Paris, Alcan, 1904.*

The maximum useful work of a muscle is obtained (in experimentation) with a medium weight. Increase of this weight can only be balanced by a much greater increase in the intervals of rest allowed between muscular contractions. The more frequent the contractions the smaller is the quantity of work and the greater the fatigue. The longer the rest pauses, the less fatigued does the muscle become. The strength of a muscle under intermittent work may attain almost double that which it displays under continuous work. Rapid contractions exhaust the oxygen of the blood, place the muscle in an anaerobic state which is fatal to it, while intermittent contractions permit the blood to renew its oxygen, which destroys the noxious and toxic products of muscular activity. . . . In voluntary ergographic work a rhythm is spontaneously established which represents the maximum frequence compatible with constant work. (Page 20.) FRANCE

Institute Solvay: Travaux du Laboratoire de Physiologie, Tome VI, Fasc. 4. Les Lois de l'Ergographie: Etude Physiologique et Mathématique. [*The Laws of the Ergograph — a Physiological and Mathematical Study.*] Mlle. J. Ioteyko. *Brussels, Misch and Thron, 1904.* BELGIUM

All physiologists agree in attributing a double origin to muscular fatigue. There is, from the view-point of chemistry, a predominance of the process of disassimilation over that of assimilation. On one hand there is progressive consumption of elements necessary to activity which cannot rebuild themselves rapidly enough to suffice for the exigencies of the moment, and on the other hand there is an accumulation of waste products which cannot be eliminated or neutralized with sufficient rapidity. (Pages 393-394.)

Consumption of stored elements is never absolute: a muscle ceases to contract before complete exhaustion of its reserves. . . . It is, then, not so much the consumption of all reserves as the impossibility of drawing further upon them that characterizes fatigue. . . . It is generally admitted that, in its initial contractions, a muscle does not consume the same materials as it consumes in its final contractions. (Page 39.)

Mosso has devised an apparatus which records the curve of nervous effort which functions during fatigue. He has demonstrated by experiments with the ponometer that the nervous stimulus necessary to produce contraction in muscle is much greater if it is fatigued than if it is rested. "Effort increases with fatigue" (Mosso). Thus ergographic fatigue has, for effect produced, increasing resistance in the muscles (proof of the peripheral seat of fatigue), and it is to over-

BELGIUM come this resistance that the nerve centres are compelled to send to the periphery orders of increasing intensity. The ponometric curve, says Mosso, follows, therefore, a course which is the inverse of the ergographic curve. (Page 398.)

UNITED STATES *The Harvey Lectures. Fatigue.* FREDERIC S. LEE, Ph.D. *Philadelphia, Lippincott, 1906.*

Owing to the unequalled opportunity of applying to the study of muscular activity the exact methods of the physicist and the chemist, the phenomena of muscular fatigue are known more exactly than those of other tissues. . . . Let . . . a muscle be stimulated by a series of artificial stimuli of equal intensity, regularly repeated and applied either directly to the muscle itself or indirectly through the mediation of the nerve, and let the muscle perform mechanical work, such as the lifting of a certain load. We may then observe the following phenomena: the degree of shortening of the muscle during each contraction increases for a considerable time, hence the height to which the load is lifted or the amount of work that is performed is gradually increased. Later the reverse occurs — the shortening decreases, reaches its original amount, falls below it, and disappears slowly and very gradually, the muscle becoming incapable of performing further work unless a stronger stimulus or a lighter load be employed, or a period of rest be allowed to intervene, or the chemical composition of the muscle be artificially altered in a suitable manner. The irritability of the muscle at first increases and later decreases; its total capacity for performing work begins to decrease at the beginning of the experiment. (Page 170.)

More than twenty years ago the Italian physiologist, Mosso, devised the important apparatus called the ergograph, and by its means began the long series of studies of voluntary contractions in man, which has made the Turin school famous, and has immeasurably extended our knowledge of fatigue in living human beings. An ergographic record usually consists of a series of curves of momentary contractions, at regular intervals, of certain finger muscles, either one or more, a known weight being lifted or a spring of known tension being stretched. Such a record exhibits in fatigue a gradual diminution of the lifting power of the muscle, the rate and regularity of the diminution varying with individuals. . . . In the course of the experiments I have quoted, it may justly be said that fatigue begins with the first contraction — the muscle is less capable of work by reason of this contraction. It is convenient to set aside the late stages as the period of exhaustion, although the beginning of such a period is not marked by distinctly physical phenomena. If at any time the muscle be irrigated by a stream of fresh blood, by Ringer's solution, or even by an indifferent isotonic solution of sodium chloride, or, what is less efficient, although in some degree effective, if it be allowed simply to rest, the physiologic pendulum tends to swing back, the irritability and the total capacity for work increase, and physiologically the organ is pushed back to an earlier stage of the fatigue process; in other words, the muscle is in some degree restored. UNITED STATES

In recent years we have learned much regarding the nervous relations of muscle, and the existence of the well-developed muscle sense has been established. Sensory end-organs have become recognized in muscles and tendons, and afferent fibres in muscle nerves; the muscles undoubtedly keep the brain informed of their general condition and of the intensity of their contractions. Along with this advance of our knowledge, it has become generally recognized with Wundt, James, Münsterberg, and Baldwin that the feeling of the amount of effort required to make muscles contract is dependent on impulses reaching the psychic centres from the muscles, tendons, and joints. The feeling of effort is of peripheral origin. The same is probably true of the feeling of fatigue. We are distinctly conscious of the fatigue of our muscles; their tone is diminished; their unusual tension gives us a feeling that they are heavy; it seems more difficult to make them respond to our will, and their response is often painful. Moreover, we are aware that our limbs are swollen, the blood vessels are dilated, and that lymph has accumulated in the intercellular spaces. These are but a few of the sensations. Other tissues add their share of stimuli, many of them obscure and difficult of analysis and location. The result of this flood of impulses pouring into the brain is a large complex of sensations, which we call the feeling of fatigue. (Pages 178–179.)

(5) The Greater Drain on Fatigued Muscles

The need of limiting the length of working hours for women is due to the fact that the greatest strain is attendant upon "overtime," or work continued after and in addition to the regular working day.

When the hours of labor are so long that work must be continued after fatigue has set in, the dangers to health are correspondingly increased. Greater injury results from work done by fatigued muscles than from severer labor accomplished before the worker is tired. This is because strain, or the continued exertion of will power to keep up, is more exhausting than work in itself.

Scientific investigation confirms this fact and demonstrates by the ergograph that the final small contractions of the finger muscles expend more energy and exhaust more than the first large ones, made before fatigue has set in.

LY *Archiv für Anatomie und Physiologie. 1890. Physiologische Abtheilung. Über die Gesetze der Ermüdung.* [*The Laws of Fatigue.*] DR. ARNALDO MAGGIORA, *University of Turin. Leipzig, 1890.*

At the outset of my experiments I found that muscles which had been wearied rapidly regained their former energy after the night's rest, but that, by subjecting them to continuous work through the day without sufficient time for rest, they gave a regularly diminishing amount of mechanical work as the day went on. (Page 205.)

It was shown by my experiments that for the first three observations an hour's rest period was sufficient for each hand, to restore energy completely, but not after the three first trials. Following muscular fatigue which is not completely banished we get a mechanical result which diminishes in a regular ratio. (Page 206.)

Having found a one-hour pause insufficient, I repeated the experiments with a pause of an hour and a half for rest. It was proved that this also did not suffice to keep the muscles up to their full capacity, as the amount of mechanical work gradually diminished. Then in another series of experiments I lengthened the pause to two hours, and found this period was sufficient to keep the muscles up to their full capacity and to prevent the development of fatigue, so that from morning to evening the muscles were able to produce that normal amount of mechanical work that they exhibited after full and complete rest. (Page 207.)

It is important to give the muscles a rest in the beginning, so that fatigue does not accumulate, if it is desired to obtain recurring mechanical work from them at regular periods throughout the day. (Page 207.)

Fatigue is complicated here (in certain experiments which have been described) because the utmost possible exertion of the will was continually made. This altered the results, because, as Mosso has shown, and as I have also demonstrated, strain is more exhausting than work. (Pages 210-211.)

The work performed by a muscle that is already wearied is much more harmful in its wear and tear than severer work would be under normal circumstances. (Page 211.)

It is a well-established fact that muscles weary much more quickly under direct stimulus than when they are indirectly stimulated by the nerves, and that a more powerful nerve stimulus is required to make a wearied muscle contract than one which is rested. (Page 211.)

It was shown plainly by a series of experiments that, when the strength of the muscle was not completely exhausted, but the task was remitted before the final stage of weariness came on, the muscle remained much more capable and wearied less easily, being able to produce an amount of mechanical work which was double that produced when it was worked up to full exhaustion, even though the most favorable conditions of periodical rest were then allowed. (Page 213.)

These observations teach that the last smaller contractions of a work tracing exhaust more than the first large ones, and this is most important, as it proves that strain is more fatiguing than work. This result is also stated by Mosso and Kronecker. (Page 213.)

Anæmia produces the same results as fatigue. (Page 217.)

The fatigue of the working muscles reproduces itself in those that are not working directly. (Page 218.)

Mayer, in his work "Die organische Bewegung in ihrem Zuzammenhänge mit dem Stoffwechsel," stated that weariness, when it did not simply result from a momentary excess of work, was diffused over the whole muscular system; for instance, the temporary work of one arm does not fatigue the other arm, but after a fatiguing walk the arms as well as legs are indisposed to further exertion. This I have demonstrated experimentally with the ergograph. (Page 218.)

After a fatiguing day's march, certain soldiers' hand tracings showed a notable diminution of energy even after the night's rest, being very low at 7 A. M., less so at 9 and 11, but only rising to normal energy by 3 P. M. (Page 224.)

ITALY *Fatigue.* A. Mosso, *Professor of Physiology, University of Turin. 1896. Translated by* Margaret Drummond, M.A., *and* W. B. Drummond, M.B., *Extra Physician, Royal Hospital for Sick Children, Edinburgh. New York, Putnam, 1904.*

The consumption of our body does not increase in proportion to the work done. If I do a unit of work, I cannot say that I shall have a unit of fatigue, nor that, if I do twice or thrice the amount of work, I shall have twice or thrice the amount of fatigue.

Dr. Maggiora, in a series of researches carried on in my laboratory, has shown that *work done by a muscle already fatigued acts on that muscle in a more harmful manner than a heavier task performed under normal conditions.*

This method was as follows: By a preliminary series of experiments, he proved that two hours' rest is required before every trace of fatigue disappears from the flexor muscles of the fingers after they have been exhausted by a series of contractions in the ergograph. This was the period of repose which Dr. Maggiora, for example, had to allow his muscles in order to annul entirely all the effects of the exhaustion. If he diminished this period, if, for example, he allowed only one hour instead of two to elapse between one series of contractions and another, it was only natural that the muscle should do less work because it was insufficiently rested.

Now, it might be thought that if the work were reduced by one half, the period of repose might also be reduced in the same proportion. But by experiment it was found that the period of repose might actually be reduced not to a half, but to a quarter; that is to say, if thirty contractions are required to exhaust a muscle completely, the period of repose necessary after fifteen contractions is only half an hour. These observations show that the expenditure of energy in the first fifteen contractions is much less than in those following; and that the fatigue does not increase in proportion to the work done. . . . We find that the work done during the first fifteen contractions is much greater than that done during the second. . . . If the energy of the muscle is not completely exhausted, that is to say, if the final contractions are not made, the fatigue is much less, and the muscle is able to perform more than double the amount of mechanical work which it would do if it worked to the point of exhaustion with the most favorable conditions for repose.

Every one who has made the ascent of a mountain is familiar with the fact that the last part of the climb, when the summit is almost attained, demands a much greater effort than that necessitated by greater difficulties when one was less fatigued. Our body is not constructed like a locomotive which consumes the same quantity of carbon for every kilogrammetre of work. When the body is fatigued even a small amount of work produced disastrous effects. (Pages 151–152.) **ITALY**

I have stated that our organism is more injured by work when it is already fatigued. One of the causes of this is that the muscle having consumed in normal labour all the energy at its disposal finds itself compelled by additional work to trench upon other provisions of energy which it has held in reserve; and thus it happens that the nervous system lends its aid with a greater intensity of nervous action. But though the nervous energy comes more into play the contractions of the fatigued muscle are weak. (Page 152.)

The workman that persists in his task when he is already fatigued not only produces less effective work, but receives greater injury to his organism.

The intervals between one effort and another should be longer when one is tired, because one's energies are restored less rapidly, the excitability of nerve and muscle having been diminished by fatigue. (Page 157.)

Etude sur l'Influence du Travail Quotidien sur la Santé Générale de l'Adulte. [*Study of the Effect of the Length of Working Hours upon the General Health of Adults.*] ILIA SACHNINE. *Lyon, 1900.* **FRANCE**

Maggiora, after numerous experiments, proved that, in order to obtain a series of tracings of normal fatigue in one and the same day and from one hand only, it was necessary to allow two hours to intervene between the tracings, while, if the experiment was made with a hand previously fatigued, it was necessary that a much longer time of rest be allowed in order that the strength of the hand be completely restored. Two hours did not suffice to restore the normal energy.

By the aid of the ponometer, Mosso showed that a much stronger stimulus is necessary to produce muscular contraction when the muscle is fatigued than when it is rested. While the output of work produced in a fatigued state is diminished, the nervous effort is progressively greater; the wearied muscle needs a more intense nervous action to make it contract. This physiological law is shown in all

FRANCE the acts of our daily life. . . . Every one knows what a fund of nerve energy must be expended to enable him to sustain with outstretched arms a weight which at first was hardly felt. (Pages 49–51.)

GERMANY *Handwörterbuch der Staatswissenschaften. Bd. I.* [*Compendium of Political Science. Vol. I. Edited by* Drs. J. CONRAD, *Professor of Political Science in Halle;* L. ELSTER, *Ober Reg. Rath in Berlin;* W. LEXIS, *Professor of Law in Halle. Arbeitszeit.* [*Hours of Work.*] Dr. H. HERKNER, *Berlin. Jena, Fischer, 1909.*

A workman, in the morning hours, between 9 and 10, with an expenditure of energy (a), produces an output (x). In the last hour of the day, on account of fatigue which was plainly felt and required special exertions of will power, he produced an output of $\frac{x}{2}$, but not with the expenditure of energy a, but with a $a + \frac{a}{2}$. It would therefore be a great mistake to think that, as x has cost one hour of work, $\frac{x}{2}$ has cost only half the work. It would actually correspond to an expenditure of energy, not of $\frac{a}{2}$, but $3\frac{a}{2}$.

Precisely because a general relation between time spent, work, and output may be assumed, one can easily fall into the error of regarding all prolongation of working hours as economic advantage and all reduction as disadvantage. (Page 1219.)

If this error still persists it is because practical and easily utilizable methods of exact measurement are still new and of recent development. (Page 1220.)

(6) The Physiological Function of Rest

(a) Rest Needed to Repair Expenditure of Energy

During rest, fatigue disappears. Rest is thus a physiological necessity. With the intensity of modern industry, the individual worker can keep up efficient labor only on condition that the fatigue engendered on one day is completely repaired before the next day. If fatigue is not balanced by adequate rest, a deficit remains which may be little noticed at first, but which inevitably accumulates, and after a shorter or longer period results in physical breakdown.

When an individual has worked to exhaustion through excessive hours of labor, normal rest does not suffice for repair. He has literally "used himself up."

Die Menschliche Arbeitskraft. [*Human Energy.*] Dr. Gustav Yäger, *Professor of Zoölogy, Physiology, and Anthropology, Stuttgart. Munich, 1878.* **GERMANY**

The incidents of the transformations of albumins in the tissues make it clear that repair after overfatigue is a very slow process, . . . and explain the more remote fact that overfatigue often results in a permanent ruin of the constitution by interfering with the regulatory apparatus. (Page 280.)

Gesammelte Abhandlungen. Bd. III. [*Complete Works. Vol. III.*] *Die Volkswirthschaftliche Bedeutung der Verkürzung des Industriellen Arbeitstages.* [*The Economic Significance of a Shorter Working Day.*] Ernst Abbé. [*Papers read before the Political Society, Jena, 1901.*] *Jena, Fischer, 1906.*

Now, when an activity is repeated daily in the same grooves, in the same form, the individual concerned can keep up this activity day by day only on condition that the fatigue engendered on one day has been completely banished by sufficient rest and proper nutriment before the next day's work is undertaken.

If even the smallest deficit remains after the equalization of fatigue and rest, — a deficit that would not be noticeable on any one single day, but which is added to daily and accumulates little by little, then the inevitable consequence is that, after a more or less prolonged period of time, the individual goes to pieces physically. It is the same as when he spends daily ever so little more than his income. If he keeps this up, there comes a time when he inevitably becomes bankrupt. (Page 226.)

I can therefore say: every workman whose work is done under these labor conditions must be afforded daily recuperation for his expended energies, and the daily compensation of rest and food must wholly equal his average total of exertion. The daily average of fatigue and expended strength must be absolutely balanced by fresh strength and recuperation, because the least deficit will accumulate gradually and will finally have ruinous effects. (Page 226.)

GERMANY *Concordia: Zeitschrift der Zentralstelle für Volkswohlfahrt, Nov. 1, 1907. Arbeit, Ermüdung, und Erholung. [Work, Fatigue, and Recuperation.]* DR. F. RITZMANN, *Factory Inspector, Carlsruhe. Berlin, 1907.*

In a modern allegory of life the three fates, weaving the destiny of man, would bear the names Work, Fatigue, and Recuperation, for our whole being is so exclusively under the domination of these three entities that a life free from them is hardly conceivable. It is the more remarkable, then, to see how superficial a knowledge most men have of the actual significance of these three things. And yet an understanding of the relations between work, weariness, and reparative rest is no less important for mankind and for social betterment than the comprehension of other, definitely hygienic, questions of a general nature. The question of the relation between work, fatigue, and recuperation is pre-eminently a hygienic one.

The problem is: How must we arrange our work in order to remain, in the widest sense, healthy in mind, body, and spirit? What is Work?

The science of psychology is concerned, roughly stated, with the study of every kind of mental process. Among these processes, again roughly stated, are to be reckoned every manifestation of life not arising exclusively from muscular movements; namely, the sensibilities, desires, variations of disposition, thought, judgment, and all such manifestations.

. . . Every alteration in the condition of the brain sets free a mental wave: every mental process brings about an alteration of the state of the brain, even as every physical process is inseparably bound up with an alteration of the muscular structure.

Physiological investigations have taught us that chemical transformations occur during these changes of nerve and muscular cells, and with the knowledge thus gained we are able to give a new definition of the term "Work."

By "Work" we mean every process which tends to destruction of tissue cells and the production of poisonous waste matter, and in contrast to this we define the term Reparation, or Recuperation, to signify all those processes which tend to a rebuilding of the tissue cells and the removal of poisonous wastes. Full and intimate knowledge of the nature of those chemical processes which I have defined as destruction of cells and production of poisonous substances has not yet been attained. We know, though, familiarly, that accompaniment of work which we call Fatigue. GERMANY

This conception of the idea of work which we attain through physiology is the amplest that we can imagine. It includes all fatigue-producing activity, even when, as with Sport and Play, this activity is not classed in popular terms with work. It includes also, however, as well, — and this is essential for its usefulness, — every activity which, according to popular terms, whether in the physical or in the politico-economical sense of words, can be regarded as work.

Physiology gives us not only a useful definition of the term Work, but also of the terms "Fatigue" and "Recuperation," and this brings us measurably nearer to a solution of our problem — the hygienic regulation of work.

Fatigue is at once the inseparable companion and the bitterest enemy of work. The most important task of the Hygiene of Work is, therefore, to combat fatigue. (Page 360.)

Fourteenth International Congress of Hygiene and Demography in Berlin, Sept., 1907. Vol. II, Sec. IV. Ermüdung durch Berufsarbeit. [Fatigue resulting from Occupation.] Dr. Emil Roth. *Berlin, Hirschwald, 1908.*

The increasing use of machinery as a substitute for handwork, and the rapid tendency toward subdivision of labor, are bringing about conditions that are more and more favorable for the employer, but for the worker, on the contrary, harder and less favorable, and especially more monotonous. Therefore, from the point of view of health preservation, it must be considered proper to regulate working hours in accordance with the principles enunciated by Abbé: viz.: The daily supply of energy required for daily labor must be gained by sufficiently long periods of rest and economical use of strength, and must not exceed the expenditure of energy required by the accelerated pace of industry. (Pages 593–594.)

A consideration of all the factors concerned in the study of overwork resulting in over-fatigue, shows that these factors are many. One of the most important of all, from the standpoint of prevention, and in the interest of the workers' health, is this: The intensiveness of the labor, or the relation of the energy expended in fulfilling the work's requirements to the length of time during which energy is so

GERMANY expended, must not overstep a certain fixed limit. That industrial establishments fail notoriously in meeting this first and fundamental requirement of labor protection, admits of no debate. (Page 604.)

Handwörterbuch der Staatswissenschaften. Bd. I. [*Compendium of Political Science. Vol. I.*] *Edited by* Drs. J. CONRAD, *Professor of Political Science in Halle;* L. ELSTER, *Ober Reg. Rath in Berlin;* W. LEXIS, *Professor of Political Science in Göttingen, and* EDG. LOENING, *Professor of Law in Halle. Arbeitszeit.* [*Hours of Work.*] DR. H. HERKNER, *Berlin. Jena, Fischer, 1909.*

Quotation from Pope Leo XIII. Encyclical on the Labor Problem:

"Justice and Humanity protest against demands upon laboring men, so excessive that the body gives way and the spirit is dulled. As in man all things have their limitations, even so is it with the capacity for labor, and no one can exceed the limits of his powers.

"Working strength is enhanced, it may be true, by practice and habit, but yet it attains its due efficiency only when, at proper times, rest is provided.

"In respect to hours of work the principle should be recognized that they should not be longer than is proportioned to the workmen's strength." (Page 1205.)

"In general it should be a fixed rule that as much rest should be granted the worker as is needed to restore his strength; for the release from work has the restoration of strength as its purpose." (Page 1205.)

These declarations are in so far noteworthy that they state with great clearness the fundamental principle that the time for rest after the day's work must allow complete restoration of the expended strength. . . . On the other hand the laborer's right to a compensation that exceeds mere recuperation, his right to pleasure, enjoyment of family life, etc., is not recognized. (Page 1205.)

It is a cause for thankfulness that some employers have with great pains voluntarily undertaken a methodical and unprejudiced presentation of material (relating to the problem of overwork), and, also, that the symptoms of fatigue are at present receiving a thoroughgoing investigation at the hands of factory hygienists and physiologists. In this way alone will it be possible to understand the causal relations of fatigue, and discriminate between typical and adventitious features described in individual observations. Then, too, for the first time it will become possible, with exact estimates of fatigue symptoms (by instruments of precision) to agree upon the proper times for pauses for rest, and upon that duration and intensity of work which will yield the maximum of product, while at the same time the working power of the laborer is fully conserved. (Page 1212.) GERMANY

The numerous instances of favorable results from reduced hours can no longer be ignored, even though all are not of equal value. Taken in connection with the most recent psychological and physiological researches, they strengthen the presumption that, where working hours exceed ten, . . . either the employer suffers from slack work or the worker from overfatigue. A reduction to ten hours would therefore, as a rule, not only work no injury to economic interests, but would further them in many cases. As to how far a progressive reduction to 9 or 8 hours could go without injury to commerce, this must also be learned by special investigations which should cover every detail and accessory circumstance in the case. Above all it must be shown, by perfected statistics and scientific methods of precision both physiological and psychological, whether, or why, with a 10-hour day a sober workman of normal physical and mental equipment should suffer fatigue which cannot be compensated for by the daily resting times.

(Length of work, heat, dust, nutrition, etc., must be estimated.) If it appears that the direct or indirect origin of this fatigue is to be found in the length of working hours, then, in such cases, in the interests of the general health, a reduction of hours must be sought, even if, economically, some risk is run. If this reduction cannot be assured by the contracting parties, then the state must take it in hand. Should there be no necessity on hygienic grounds, nevertheless from the standpoint of commercial progress it may appear desirable to approach the 9 or 8 hour limit. (Page 1216.)

Revue Internationale de Sociologie, Nov., 1895. Le Travail Humain et ses Lois. [The Laws of Human Work.] FRANCESCO S. NITTI, *Professor, University of Naples. Paris, Giard and Brière, 1895.* ITALY

In every case it is certain that the workman disposes of a certain amount of potential energy, which, within certain limits, is capable of augmentation and of diminution.

ITALY

A workman, even one sufficiently nourished, cannot produce, beyond a certain limit, without injury. Beyond this limit, if he continues his work, he exposes himself absolutely to fatigue and exhaustion and his productivity is gained at the expense of his own organism. (Page 1026.)

There is a cruel antithesis between the interests of the capitalist and of society. . . . If for the benefit of the former the workman must consume his own tissues and is not able to protect himself, then production proceeds along with the degeneracy of the worker. (Page 1026.)

The consequent loss of energy is a social loss. . . . Society sees the average strength of the workman diminishing, morbidity and mortality extending, the physical development of the masses retrograding. . . . It is therefore natural that society should awake to the need of interference. (Page 1027.)

It is certain that there is a work-limit which the average workman cannot exceed without danger, as beyond it he risks fatigue and degeneracy. (Page 1027.)

The physiological law that work done by a tired muscle injures it more than work done under normal conditions can be verified by every one from his own experience. (Page 1027.)

Thirteenth International Congress of Hygiene and Demography in Brussels, 1903. Vol. V, Sect. IV. Dans quelle mésure peut on par des methodes physiologiques étudier la fatigue, ses modalités et ses degrès dans les diverses professions? Quels sont les arguments que les sciences physiologiques et médicales peuvent ou pourraient faire valoir en faveur de tel ou tel mode d'organisation du travail? To what extent may fatigue resulting from occupation be estimated by physiological methods, and what argument can medical and physiological science present in favor of special methods of industrial organization?] Dr. Zaccaria Treves, *University of Turin. Brussels, 1903.*

In answer to a political economist, who has said "the physiological limits of the duration of work have not yet been found and cannot easily be found," the physiologist replies that *the physiological limit of the duration and the intensity of work is that limit beyond which the organism is reduced to the necessity of working wastefully.* (Page 33.)

Royaume de Belgique. Conseil Supérieur du Travail, 6e Session. 1901–1902. T. I, Fasc. II. [Higher Council of Labor, 6th Session. 1901–1902. Vol. I, Part II.] Le Repos Hebdomadaire. [The Weekly Rest Day.] Brussels, 1902. BELGIUM

M. Adolphe Prins (Member of Conseil):

To-day under present conditions of competition and production it is more than ever necessary to protect working men from overstrain. Rest is more and more indispensable as work becomes more intense. In every line of activity, only the regular alternation of work and rest is able to conserve energy, and those individuals and nations whose lives are so regulated will surpass others in economic rivalry. (Pages 81–82.)

M. Beco:

The man who works must have rest. Rest must alternate with work; this is a physiological necessity. The workman becomes incapable of any physical or mental work whatever if after a certain number of hours he is not able to rest. The desire for sleep, after a certain time, overcomes him. . . . Then in addition to rest during the day, the worker needs periodic rests. (Page 124.)

Every health regulation must have a scientific, exact, and acknowledged basis. . . . Thus the demands of hygiene justify the legal protection of workers against special dangers, poisons, and physical overstrain from excessive labor unreasonably prolonged. No one contests the legality of such legislation; . . . on such lines the police power is extensive and effectual, and its right to be so is not disputed.

Discussion on 21 January, 1902. M. Denis (Member of Conseil):

. . . Man has a new right, the right to leisure and rest, as well as work. . . . The history of labor legislation can be given in two words: the right to rest is inherent in man's physiological structure. It involves an inflexible social necessity to do away with the exhaustion resulting from overwork, and to conserve working power, the most precious possession of a nation.

On this the most learned physiologist of Italy has said: "The prodigious development of industry and of machinery is resulting in extreme intensity of labor and the law of exhaustion must of necessity put a limit to greed for gain."

Science traces out a path for the modern lawmaker: his difficult but glorious mission is to accomplish the normal synthesis of these two inalienable rights springing from the very laws of life — the right

BELGIUM to employ one's working powers and the right to conserve them. (Page 169.)

When we compare the actual working day (in Belgium) with the most moderate requirements for rest endorsed by scientists, we find that there is an absolute necessity for a periodic rest day.

At the International Conference on Sunday Rest in 1889, Dr. Haegler's report justified the weekly rest day from the point of view of hygiene, as he said, "The labor of each day leaves an organic deficit, and the weekly rest day is essential for the purpose of restoring this loss." (Page 172.)

Maggiora has demonstrated that in order to obtain the same quantity of muscular work evenly throughout the day, the muscles must, from the outset, have their proper periods of rest, so that they can act each time with fresh energy and so that fatigue will not accumulate. This accumulation of fatigue is the most important phenomenon to consider now; it arises in the course of the day, from every breach of equilibrium between work accomplished and rest given to the muscles. As soon as work is in excess, or rest is insufficient, there is an accumulation of fatigue, and this, as Maggiora has shown, is displayed by a diminution of effectiveness. What is true of the different hours of the day is true from one day to another. Waste products of fatigue are carried over from one day to another with cumulative effect. Maggiora's writings contain a remarkable chart showing the effects of a sleepless night, — that is, a night without repair. From this chart we may gain an idea of the rapid cumulation of waste substances, and the gradual extension of the organic deficit. (Page 174.)

School children have been submitted to valuable tests. Intellectual fatigue is measured by tactile sensibility as recorded by the esthesiometer. This sensibility diminishes gradually as fatigue increases, and there is a veritable accumulation from one day to another. To return to the normal condition of tactile sensibility, a weekly rest day must be obtained. (Page 174.)

Thus, the accumulation of fatigue which is favored by the modern industrial system and the intensive character of machine work takes place from day to day, and the weekly rest is a liquidation period — a necessary re-establishment of the physiological equilibrium. (Page 174.)

Fourteenth International Congress of Hygiene and Demography, in Berlin, 1907. Die Ermüdung durch Berufsarbeit. Vol. II, Sec. IV. [Overwork as a Result of Occupation.] Prof. IMBERT, *Montpellier. Berlin, Hirschwald, 1908.* **FRANCE**

An industrial machine works, but is not fatigued.

A muscle, on the contrary, works, and becomes fatigued.

Fatigue, essentially and exclusively a physiological phenomenon, characterizes the human organism when the latter is regarded as a working machine. Consequently, even from the economic point of view, the discussion of every question involving the factor of labor in industry is incomplete if the influence and the possible consequences of fatigue are not contemplated. Fatigue, on the other hand, disappears during rest, both as to its causes and effects, if the rest is as much prolonged as the labor has been exacting.

Rest is thus, quite aside from any social or humanitarian consideration, a physiological necessity. . . .

It is physiologically and, one may add, economically essential that the night's rest and the weekly rest should suffice to permit the human organism, which has been subjected to a period of labor, to return to its normal state. If this does not happen, the human machine deteriorates, as complained of by the worker, and the output suffers, which affects the employer, to say nothing of the charges upon Society which may result from such deterioration.

Overstrain is present if, after the daily or weekly rest, at the moment of resuming labor, traces of fatigue still remain and the primal and normal productive capacity has not been restored. (Pages 634–635.)

Eighth International Congress of Hygiene and Demography at Budapest in 1894. Vol. III, Sec. IV. De l'Influence de la Durée du Travail sur l'État de Santé des Travailleurs. [The Influence of Working Hours on the Conditions of Health of Working People.] Dr. JULES FÉLIX, *Hungary. Budapest, 1895.* **AUSTRIA**

Every being must obey the law of work, which is nothing else than the regular and harmonious functioning of the body . . . but there is also another law, that of the necessity of rest, the need of repair . . . for organisms, as well as for separate organs, all prolonged activ-

AUSTRIA ity leads to exhaustion, and to effect repair, periods of rest from functioning are imperative. . . . The time needed for rest, and the materials required for repair must be proportioned to the organic expenditure, to the intensity and duration of work; or, in other words, the duration of rest and the reparative material of every organism must be proportioned to the length and intensity of its activity. (Page 2.) For civilized man sleep alone is not enough for rest. It is also necessary — even indispensable, if man is to preserve the plenitude of his physiological, intellectual, and moral faculties, and not degenerate — that he shall vary his work as well as his recreation. (Page 3.)

GREAT BRITAIN

History of the Factory Movement from the Year 1802, to the Enactment of the Ten Hours' Bill in 1847. "Alfred." London, Simpkin, Marshall, 1857.

Rest of body is the first requisite for one who is habitually overworked; no evil can flow from this requirement being reduced to practice. Experience has proved that factory regulation has been beneficial in body, mind, and morals to those for whose good it was intended. Its promoters have not been deluded theorists, they have been practical statesmen. (Vol. I, page 268.)

Transactions of the National Association for the Promotion of Social Science. Vol. II, 1869. On Public Recreation. WM. HARDWICK, M.D. *London, Longmans, 1870.*

The necessity for lessening the hours of severe labour begins to show itself in many ways.

In former times when labour was not so ardent, holidays were many; now that civilization advances and labour begins to be more intense, the exhaustion is consequently greater, and the period of rest must be more frequent or more prolonged. (Page 476.)

The Lancet. Vol. I. March 4, 1905. "Overwork." (Editorial). London.

Ingenious attempts have been made by Maschek and other writers to classify work under the three headings of effort, velocity, and duration, and to arrive at formulae which should show the proper relations of these three elements to each other. Such attempts have not been conspicuously successful, but they at least serve to call attention to the distinctness of the elements in question and to the necessity of taking each of them into consideration when endeavoring to estimate the output of an individual. They remind us that the spurt of a tired man may be more injurious to him, may, in common parlance, "take more out of him," than sustained efforts more deliberately accomplished. . . .

Maschek succeeded in establishing at least one formula which appears to show that the time occupied in strenuous endeavor should not greatly exceed one-third of the twenty-four hours.

. . . Of the three elements . . . that of duration is usually most under our command, and those who would retain health and attain longevity should see to it both that their efforts are not too prolonged and that they are followed by corresponding periods of rest. . . . If we turn to the elements of velocity in work we shall find abundant reasons for the belief that its predominance implies an amount of strain greatly in excess of the actual accomplishment and calls for a corresponding equivalent of repose. The wise man who must spend his life in living will be all the more solicitous so to manage his expenditure that it may not be wasteful and he will be careful to guide his activities to this end. . . . He will realize that exceptional duration and exceptional speed of work should be avoided whenever possible, and that when they cannot be avoided, they should be followed by correspondingly exceptional periods of repose. (Page 580.)

(b) Rest Needed to Repair the Deficit of Oxygen

The injuries from excessive working hours are confirmed by medical observation and science, which has demonstrated that during overexertion the expenditure of oxygen of any individual exceeds the amount respired, and must be met by the reserves of the organism, by the oxygen of the blood and tissues.

GERMANY *Handwörterbuch der Staatswissenschaften, Bd. I. [Compendium of Political Science, Vol. I. Edited by* Drs. J. Conrad, *Professor of Political Science in Halle:* L. Elster, *Ober Reg. Rath in Berlin:* W. Lexis, *Professor of Political Science in Göttingen, and* Edg. Loening, *Professor of Law in Halle. Arbeitszeit. [Hours of Work.]* Dr. H. Herkner, *Berlin. Jena, Fischer, 1909.*

We distinguish Exhaustion from Fatigue.

In exhaustion there is a deficiency of reparative material for the restoration of the vital tissues. This is especially a deficiency of oxygen. During work more oxygen is taken from the red blood corpuscles than can be normally replaced by them from respiration and food. (Verworn.) While fatigue can be banished by rest, exhaustion can only be overcome by fresh supplies of oxygen and organic tissue building material in food. Recuperation takes place in fullest extent only in sleep, as during sleep the consumption of oxygen is diminished.

Now it is to be remembered that consumption of energy takes place not only in work, but also in the vital processes themselves. We are continually losing heat (energy) to our environment. There is, however, a great difference. The organism at rest requires, in 24 hours, about 2770, the actively working organism 4550, calories.

The consumption of energy during work results from the mechanical and mental activities required by the occupation processes. To this is added further consumption by standing; certain postures of the body; strain of special senses; jarring of the body, by machinery, etc.

In this wise, fatigue of the muscular and of the nervous apparatus is brought about. In laborious work, involving the whole body, fatigue of the entire muscular apparatus appears. (Page 1214.)

FRANCE *Tenth International Congress of Hygiene and Demography at Paris, in 1900, in one vol. Législation et Reglementation du Travail au Point de Vue de l'Hygiene. [Labor Legislation and Regulation from the Standpoint of Hygiene.]* M. Édouard Vaillant, M.R.C.S. *England. Paris, Masson and Co., 1900.*

Physiological researches have proved that if work has been pushed to exhaustion, normal aliment and normal rest no longer suffice for repair; that any work acts more injuriously upon a wearied muscle than even heavy work under normal conditions, that when the normal muscular energy has been expended, the nervous system is under excessive strain and becomes exhausted; that this nerve exhaustion, combined with physical work, increases with a rapidity proportionate to the expense of nervous force and attention demanded by the work; that all muscular work, however light, aggravates a condition of intellectual fatigue and nervous tension, and that rest must be sufficient to ward off fatigue. FRANCE

It is most important to determine the physiological limits of work which the workman should not overpass. . . .

This limit contracts or expands with the physical and intellectual strength, the age, sex, general and technical education, training, the nature and surroundings of the work, and a number of other temporary or permanent conditions. (Page 509.)

The principle of organic protection is this: an individual, in no matter what category, should never exceed the physiological boundary of labor where, through duration, or intensity of effort, overwork and fatigue begin.

This limitation could be easily determined by simple hygienic and medical oversight of that kind now established in an elementary way by the German wage-earners insurance, if carried to completion and established generally throughout industry. (Page 510.)

But even now this physiological limit can be determined. . . .

Combustion, the principal source of energy, can be measured. The transformation of gases, the pulmonary respiration, being the sum of all partial respiratory processes and the amount of oxygen absorbed and of carbonic acid eliminated increasing directly with work, there is a disturbance of equilibrium and an organic deficit, whenever the expenditure of oxygen in the formation of carbonic acid has exceeded the amount respired, and has been met by the reserves of the organism, by the oxygen of the blood and the tissues. Intoxication then begins with stasis of carbonic acid.

The robust workman, turning the wheel of Pettenkofer and Voit, demonstrated how much he had surpassed this limit even in his nine-hour day, and despite his rest. (Page 511.)

The respiratory quotient . . . varies precisely with work, its factors increasing with work and diminishing with rest, for the relation of the carbonic acid produced to the oxygen consumed expresses exactly the expenditure of potential glycogen during work and its renewal during rest. (Page 511.)

FRANCE

The value of the preservative individual warnings of fatigue is evident.

This signal of alarm, from an organism that has, by overwork, or defect of training and education, arrived at the physiological limit of work, is not an uncertain psychic incident. It is a warning: in default of rest, physical effects will follow: morbid effects, menacing intoxication, organic alteration caused by overwork (surtravail) and fatigue. (Page 513.)

As the work of each day causes an organic deficit, the weekly rest, as shown by Dr. Haegler, is a necessity to make up this deficit: the effort is to add one half day of Saturday.

But even with this addition, the reparative rest is not sufficient, its effect is only apparent. The rest of the Sunday and Saturday half holiday should be entered upon without a deficit, without fatigue, and it should be a period of recuperation of strength and of the organic equilibrium, bringing it to a higher level, giving more moral and physical strength to man, — the active energy necessary to carry him without encumbrance of fatigue through his next period of work. (Page 514.)

For all these reasons overtime should be forbidden by law, as infracting the limitation of hours, causing overwork, and contributing to non-employment. (Page 517.)

Etude sur l'Influence de la Durée du Travail Quotidien sur la Santé Générale de l'Adulte. [*Study of the Effect of the Length of Working Hours upon the General Health of Adults.*] ILIA SACHNINE. *Lyon, 1900.*

During the night, and above all during sleep, man absorbs more oxygen than he exhales. According to Voit and Pettenkofer, this surplus oxygen is stored up to be used later in the exertions of the day. (Page 173.)

Dr. Haegler demonstrated, on the basis of Pettenkofer's experiments, that, as each day's work added a slight deficit of oxygen to the deficit of the day before, a weekly rest of 24 hours was necessary to replenish the normal sum of oxygen used in labor or continuous exertion throughout the week. (Page 175.)

De la Fatigue et de son Influence Pathogénique. [*Fatigue and its Pathogenic Influence.*] Dr. M. CARRIEU, *University of Montpellier. Paris, Baillière and Son, 1878.* FRANCE

It had been well established (by Lavoisier and others) that the organism consumed more oxygen during activity than in a state of rest, but the experiments of Voit and Pettenkofer (Zeitschr. f. Biol., 1866) necessitate some modifications of the results of their experiments.

Their researches put into evidence interesting differences in the same individual, accordingly as he was at work or at rest, awake or asleep. The subject of the experiment was a vigorous workman of 28 years of age. He had the same quantity of food whether working or resting except that when working he drank an additional 600 grams of water. The results are thus shown:

JULY 31, 1868. DAY OF REST

	Absorbed.	Eliminated.			O of CO_2
	Oxygen.	CO_2	HO.	Urea.	
From 6 A. M. to 6 P. M.	234.6	532.9	344.4	21.7	175
From 6 P. M. to 6 A. M.	474.3	378.6	483.6	15.5	58
Total for 24 hours	708.9	911.5	828.0	37.2	233

AUGUST 3, 1868. WORK

	Absorbed.	Eliminated.			O of CO_2
	Oxygen.	CO_2	HO	Urea.	
From 6 A. M. to 6 P. M.	294.8	884.8	1094.8	20.1	218
From 6 P. M. to 6 A. M.	659.7	309.4	947.3	16.7	44
Total for 24 hours	954.5	1284.2	2042.1	37.8	262

FRANCE These numbers show that the excretion of carbonic acid is more considerable by day than by night, and that per contra the absorption of oxygen is more active by night than by day. (Page 14.)

Further the amounts of water and of carbonic acid excreted are much greater during work than during rest, whilst the oxygen absorbed does not vary to the same extent. Finally, a larger proportion of oxygen is inspired during the night following the day of work, whilst the amount of carbonic acid excreted was nearly the same in both cases.

The authors conclude from these experiments that oxygen inspired at night is stored up to be drawn upon next day to oxidize food materials. If one works, he exhales a greater amount of CO_2 and then oxygen must be inspired in greater amount during rest. (Page 15.)

ITALY *Revue Internationale de Sociologie, Nov. 1895. Le Travail Humain et ses Lois.* [*The Laws of Human Work.*] FRANCESCO S. NITTI, *Professor University of Naples. Paris, Giard and Brière, 1895.*

The workman, busy with his work, does not perceive the oncoming of fatigue, or, to speak more accurately, he only perceives it when it has attained a certain intensity. This is the principal reason why he does not and cannot protect himself: it is the principal reason why every society, which desires to prevent a wasteful loss of energy, must necessarily resort to regulation to protect him. (Page 1041.)

Variations between individuals, it is true, are very great, but . . . there is an average limit which may be found and applied in legislation. What shall this limit be? . . . In the experiments of Voit and Pettenkofer it was found that the workman at the end of nine hours' labor had expended, in the form of carbonic acid, 192 grammes of oxygen *more* than he had been able to inhale during this time. He had therefore had to give up 20 per cent of the supply of oxygen stored up in his tissues. We may ask, therefore, if the average limit of eight hours would seem altogether arbitrary. (Page 1041.)

UNITED STATES *Text Book of Physiology.* WM. H. HOWELLS, M.D., *Professor of Physiology in the Johns Hopkins University, Baltimore. Philadelphia, W. B. Saunders Co., 1907.*

Chemical Changes in the Muscle during Contraction and Rigor.— Perhaps the most significant change in the muscle during contraction is the production of carbon dioxid. After increased muscular activity it may be shown that an animal gives off a larger amount of carbon dioxid in its expired air. In such cases the carbon dioxid produced in the muscles is given off to the blood, carried to the lungs, and then exhaled in the expired air. Pettenkofer and Voit, for instance, found that during a day in which much muscular work was done a man expired nearly twice as much CO_2 as during a resting day. The same fact can be shown directly upon an isolated muscle of a frog made to contract by electrical stimulation. The carbon dioxid in this case diffuses out of the muscle in part to the surrounding air, and in part remains in solution, or in chemical combination as carbonates, in the liquids of the tissue. It has been shown by Hermann and others that a muscle that has been tetanized gives off more carbon dioxid than a resting muscle when their contained gases are extracted by a gas pump. This CO_2 arises from the oxidation of the carbon of some of the constituents of the muscle, and its existence is an indication that in their final products the changes in the muscle are equivalent in those of ordinary combustion at high temperatures, the burning of wood or fats, for instance. Moreover, the formation of the CO_2 in the muscle is accompanied by the production of heat, as in combustion; and for the same amount of CO_2 produced in the two cases the same amount of heat is liberated. It has been shown, however, in the frog's muscle freshly removed from the body, that the CO_2 is produced whether or not any oxygen is supplied to the muscle, — that is, when the muscle is made to contract in an atmosphere containing no oxygen, or in a vacuum. In this respect the parallel between physiological oxidation and ordinary combustion fails. Wood, oil, and other combustible material cannot be burnt at high temperatures in the absence of oxygen. We must believe, therefore, that in the muscle there is a supply of stored oxygen, and that the muscle will give off CO_2 as long as this supply lasts. The oxidation, instead of being direct, as in the case of combustions, is indirect. . . .

UNITED STATES

The oxygen is absolutely necessary to the normal activity of the muscular tissue, but the tissue, by storing the oxygen, can function for some time when the supply is suspended. As Pflüger has expressed it, in a most interesting paper, the oxygen is like the spring to a clock — once wound up, the clock will go for a certain time without further winding. It must be borne in mind, however, that different tissues show considerable variation in the time during which they will function normally after suspension of their oxygen supply. The cortex of the brain, for instance, loses its activity, — that is, unconsciousness ensues almost immediately upon cessation or serious diminution in the supply of blood, and the same may be said of the functional activity of the kidney. In the cold-blooded animals, with their slower chemical changes, the supply of stored oxygen maintains irritability for a longer time than in the warm-blooded animals. (Pages 62–63.)

BELGIUM *Du Repos Hebdomadaire.* [*On the Weekly Rest Day.*] ESTÈVE DE BOSCH. *Antwerp, 1907.*

De Bosch says of the (following) tracing:

Dr. Haegler has represented in an ingenious fashion the variations which occur in the entirety of our vital forces, in the form of a line, "*b*," which, instead of remaining on the same level at all times, rises or falls according to the alternating work and rest of which life is composed. (Page 49.)

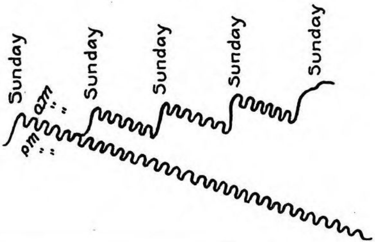
The night's sleep repairs a part of the losses which we suffer by day, but it is not sufficient to make up entirely for the deficit produced by the hours of work. The result is that the line is not found to be on the same level in the morning that it was 24 hours before, and the level of our energy is lowered slightly from day to day.

But there is a way of bringing it up again to its normal place, and that is, to take, every week, 36 consecutive hours of rest; the curve of the line "*a*," which represents the variations of vital energy in a man resting from Saturday evening to Monday morning, proves this fully. The upper line (*a*) represents the variation of strength in a life where work is suspended from Saturday evening to Monday morning.

The lower line (*b*) represents the gradual loss of strength that follows in a life when work is not suspended except by the night's rest. (Page 50.)

This chart was shown by Haegler at the Swiss International Exposition in 1896 in Geneva.

Another chart, also by Dr. Haegler, and shown at the same exhibition, shows that the length of life is longer with those who observe the custom of a weekly day of rest. (Page 51.)

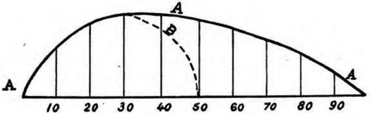


Haegler's Chart

Fatigue curves showing morning rise and afternoon depression. The upper line shows the effect of the weekly day of rest.

The lower line shows the gradual depression of strength with daily work and no time of rest.

(Page 50, in "Du Repos Hebdomadaire.")



Haegler's Chart, Geneva, 1896

Line A shows the normal average of life with proper time of rest.

Line B shows the average life line under overwork and insufficient rest.

(Page 51, in "Du Repos Hebdomadaire.")

(c) Adequacy of Resting Time Allowed between Working Hours

1. *In Ordinary Work*

The adequacy of rest depends on the length of time allowed between working hours. Hence the shorter working day benefits the worker, not alone by requiring less expenditure of energy, but by allowing a more adequate period of rest before the next working day begins.

On the other hand, it is precisely after excessive working hours that the need of repair is greatest and the time allowed away from work is least.

GERMANY *Handbuch der Hygiene. Bd. 8[1]. [Handbook of Hygiene. Vol. 8[1].] Edited by* Dr. Theodore Weyl. *Allgemeine Gewerbehygiene und Fabrikgesetzgebung. [General Industrial Hygiene and Factory Legislation.]* Dr. Emil Roth. *Jena, 1894.*

. . . We may point out that the social condition of the worker, his home, nutrition, and conduct of life are highly important factors in the rate of sickness, and that, the longer the working hours, the less opportunity is left to him of utilizing these health-preserving forces. (Pages 27-28.)

Handbuch der Arbeiterwohlfahrt. [Handbook of the General Welfare of the Working Classes. Edited by Dr. Otto Dammer. *Vol. II.] Arbeiterschutz. [Protection of Working Men.]* Dr. Ascher *Stuttgart, Enke, 1902.*

The injurious consequences of bad conditions upon health cannot, unfortunately, all be as clearly demonstrated as that of dust in the experiments of Moritz and Röpke; we know, however, that for the elimination of dangerous substances from the body a certain time — dependent upon the nature of the material and the constitution of the individual — is essential, and that therefore a shortened exposure to the unfavorable conditions has a double advantage — first, in that the probability of elimination of unhealthful material is increased and its unhygienic consequences more fully avoided. In this connection we must consider also the severer forms of fatigue or exertion of organs beyond the physiological limits of their endurance and the impossibility of repairing their waste and restoring them to normal conditions without ample resting time. (Page 78.) GERMANY

Gesammelte Abhandlungen. Bd. III. [*Complete Works. Vol. III.*] *Die Volkswirthschaftliche Bedeutung der Verkürzung des Industriellen Arbeitstages.* [*The Economic Significance of a Shorter Working Day.*] ERNST ABBÉ. [*Paper read before the Political Society, Jena, 1901.*] *Jena, Fischer, 1906.*

I have briefly referred to the balance between expenditure and renewal of strength. Renewal of strength by nutriment and rest — upon what does it depend? For any one specific individual it is beyond a doubt that the length of resting time allowed is the paramount condition for recuperation of strength. There cannot be the smallest doubt that one who has 16 hours rest between his working hours can repair a greater amount of previous fatigue than he who has only 10. Every one can prove this for himself. (Page 231.)

Therefore, aside from the personal factors which one may call the intensity of metabolism or of the vital functions in different individuals, the important thing is the length of time permitted for rest. The day has only 24 hours; so the time for rest must be the difference between the working day and 24 hours. If the former is 8 hours, there are 16; if 10 hours, only 14 for rest. (Page 231.)

Tenth International Congress of Hygiene and Demography at Paris, in 1900. In one vol. Législation et Règlementation du travail au point de vue de l'Hygiene. [*Labor Legislation and Regulation from the standpoint of Hygiene.*] M. EDOUARD VAILLANT, M.R.C.S., *England. Paris, 1900.* FRANCE

Professor Setschenoff has dealt cleverly with the physiological problem of the necessary relative length of rest and work so that the weariness of one day shall not be felt on the morrow. The normal heart with its regular rhythm of contraction and relaxation, gains sufficient rest during every second to work for a lifetime, its total rest being to its total work as 10 hours to 6 in 16 hours. Now, giving the industrial worker 8 hours of sleep, he has 16 left for work and rest.

It then seems that during the 16 hours of waking time remaining for the worker, his relative rest should not be less in duration than

FRANCE that of the heart, especially as the skeletonic muscles are less richly supplied with blood than those of the heart and as physical rest is not complete in the waking state. (Page 512.)

GREAT BRITAIN *British Sessional Papers. Vol. XV. 1831–32. Report from the Select Committee on the "Bill to regulate the Labour of Children in the Mills and Factories of the United Kingdom."*

Thos. Hodgkin, Esq., M.D., physician to the London Dispensary, Lecturer at Guy's Hospital:

10941. Is not the body in your opinion, in a very unfit state to renew its exertion when it has been insufficiently recreated by sleep, and when therefore labour has to be commenced at the beginning of the day with the feelings and signs of weariness still remaining? — Certainly, it is. . . .

10942. That accumulated fatigue you conceive to be peculiarly injurious to the constitution? — Yes; without the interposition of intervals sufficient to repair the demand which has been made on the system. (Page 549.)

John Morgan, Esq., surgeon to Guy's Hospital:

10998. Do you not think that the body is in a very unfit state to renew its daily labour when the preceding evening's sleep has been insufficient to remove a sense of weariness and fatigue? — Certainly, in a very unfit state. (Page 553.)

Joseph Henry Green, Esq., F.R.S., a surgeon of St. Thomas's Hospital and Professor of Surgery at King's College:

11386. Do you not think that labour is peculiarly pernicious and prejudicial when it has to be commenced in the morning; the body not being sufficiently refreshed and recruited by the insufficient sleep of the preceding evening? — Certainly.

11387. And that fatigue perpetuated is peculiarly wearisome, of course, to the body, and pernicious to all the functions of life? — Yes, I do. (Page 588.)

Benjamin Travers, Esq., F.R.S., senior surgeon to St. Thomas's Hospital in Southwark:

11605. Is it not a strong indication that labour is pernicious when it has to be resumed in the morning with a great sense of remaining weariness and fatigue, which has not been dissipated by the rest of the preceding night? — Certainly.

11606. That, long continued, will be, in your opinion, pernicious to the constitution? — Certainly, especially so. (Page 606.)

2. In Work involving Absorption of Injurious Substances

Adequate resting time between working hours is particularly important in trades where injurious substances, such as dust, fluff, or industrial poisons may be absorbed by the worker. As all trades share these dangers in greater or less degree, the longer the period away from work, the greater the possibility that injurious substances may be eliminated from the body before another workday.

Handbuch der Arbeiterwohlfahrt. [Handbook of the General Welfare of the Working Classes. Edited by Dr. Otto Dammer. *Vol. II.] Arbeiterschutz. [Protection of Working Men.]* Dr. Ascher. *Stuttgart, Enke, 1902.* **GERMANY**

When we arrange the medical testimony given in regard to the longer or shorter working time the following conclusion appears: in any or every trade when a substance injurious to health (poison) may possibly be taken into the body tissues of the worker, the danger is lessened by just so much as the time during which the worker is so exposed, is shortened. The longer the period of rest away from work, the greater the possibility of the injurious material being eliminated from the body. The same is true of mechanically irritant dust. Moritz and Röpke found that, when workmen were exposed continuously to breathe in the dust from polishing during a considerable period of time, the sensitiveness of the mucous membranes, larynx, and bronchi was so diminished that the in-breathed dust could not be coughed up and, instead, found lodging place on the delicate vocal cords. A short time of rest outside of the dusty air sufficed to restore to the tissues their normal irritability, so that the harmful dust acted as an irritant and could be expelled by coughing. On this ground they argued for longer rest periods and shorter working time. Similar reasons hold for shorter hours in all occupation where individual organs — eyes, muscles, bony structure, nerves, heart, lungs — are liable to overexertion. Naturally, then, the free time must be given to healthful exercise and recreation. . . . Through all these reports a gradual tendency to shorten the hours of labor may be accepted as a modern movement. (Pages 61-62.)

GERMANY *Handwörterbuch der Staatswissenschaft. Bd. I. Compendium of Political Science. Edited by* Drs. J. Conrad, *Professor of Political Science in Halle:* L. Elster, *Ober Reg. Rath in Berlin:* W. Lexis, *Professor of Political Science in Göttingen, and* Edg. Loening, *Professor of Law in Halle. Arbeitszeit. [Hours of Work.] Vol. I.* Dr. H. Herkner, *Berlin. Jena, Fischer, 1909.*

. . . The more injurious any process of work is by reason of great heat, poison, dust, noise, etc., the more important does it become to provide some counterbalance to these harmful influences by shortening the time given to labor under these conditions. (Page 1204.)

SWITZERLAND *An das Schweiz. Industriedepartement — Bern — Die Eidgenössischen Fabrikinspectoren. [Report of the Swiss Factory Inspectors to the Swiss Department of Labor on the Revision of the Factory Laws.] Schaffhausen, 1904.*

Finally we must mention those arguments in favor of a shorter day which have been presented by medical men. A prominent hygienist, Dr. Ascher, declares: "In all those industries where more or less injurious foreign material is taken into the body of the workman, the danger is lessened in proportion to the brevity of the time during which he is exposed. The longer the periods of rest outside and away from his work place, the greater the possibility of the tissues of the body casting off the injurious substances. It has been found that, with long or continuous inspiration of dust, the irritability of the mucous membranes, larynx and bronchi is so much lessened that the inspired dust is no longer coughed up, and remains to find lodging place on the delicately sensitive vocal cords. For this reason longer periods of rest and shorter working hours are essential. Analogous reasons are in force for every occupation in which overexertion of special organs — eyes, muscles, bones, nerves, heart, or lungs — is necessitated by the work." (Page 26.)

AUSTRIA *Eighth International Congress of Hygiene and Demography. Budapest, 1894. Vol. VII, Sec. V. Über das Verhältniss der Dauer des Arbeitstages zur Gesundheit des Arbeiters und dessen Einfluss auf die Öffentliche Gesundheit. [The Length of the Working Day in its Relation to the Workman's Health and its Influence upon Public Health.]* Dr. E. R. J. Krejcsi, *Vice-Secretary of the Chamber of Commerce in Budapest. Budapest, 1896.*

The longer the hours of work, the longer the organism is exposed to injurious influences; — the sooner bodily resistance is overcome, and consequently occupation diseases are early established which might have been avoided or at least postponed to a much later period if the hours of labor had been short. (Page 327.) AUSTRIA

C. *Bad Effect of Long Hours on Health.*

(1) General Injuries to Health.

The fatigue which follows excessive working hours becomes chronic and results in general deterioration of health. While it may not result in immediate disease, it undermines the whole system by weakness and anæmia. Continuous overexertion has proved even more disastrous to health than a certain amount of privation; and lack of work in industrial crises has entailed less injury to health than long-continued overwork. The excessive length of working hours, therefore, constitutes in itself a menace to health.

British Sessional Papers. Vol. XV. 1831–1832. Report from the Select Committee on the "Bill to regulate the Labour of Children in the Mills and Factories of the United Kingdom." GREAT BRITAIN

William Sharp, Esq., . . . surgeon to the Dispensary, Bradford, Yorkshire:

7097. Do you consider that excessive labour, or labour too long continued, has a direct tendency to produce disease and debility, and to shorten life? — Yes, I do.

7080. Do you not think the worst effects are produced by the terminating hours of a long day's labour? — Yes. (Page 302.)

Samuel Smith, Esq., . . . member of College of Surgeons and practising surgeon in Leeds:

10341. Do you consider the very uniformity of the exertion would, in all probability, occasion fatigue, and abate the energies of those who have to endure it? — Even supposing no labour whatever were required under such circumstances, the merely having to sustain the erect position of the body for so long a period is harassing in the extreme and no one can have an adequate idea of it unless he has himself been subjected to it. (Page 497.)

10492. Should you attribute part of the pernicious effects upon the constitution of those employed, to their being deprived of fresh air? — Certainly; the long-continued labour and the want of fresh air are the two principal causes of the general effects to which I have alluded. (Page 514.)

Sir Anthony Carlisle, F.R.S., . . . surgeon in the Westminster Hospital:

11035. Is it not an equally received opinion with medical authorities, that exercise or labour, so long continued as to produce great fatigue of mind and body, without affording due intermissions for meals, recreation, and sleep, is inconsistent, generally speaking, with the maintenance of health? — I think every one of the points of that question may be answered in the affirmative. I can, from my own experience and knowledge, affirm that it is so.

11036. Your affirmation in the respect is founded upon the principles of your profession as well as upon your personal experience? — Certainly. (Page 559.)

British Sessional Papers. Vol. XXI. 1833. Second Report of the . . . Commissioners for inquiring into the Employment of Children in Factories . . . and Reports by the Medical Commissioners.

Sir David Barry's report (Scotland):

Although both the young and the adult mill-workers may command more abundant food and better clothing than their unemployed neighbors, there are causes to whose operation they are exposed, which, in a sanitary point of view, counterbalance the advantage alluded to.

1. The first and most influential of all is the indispensable, undeviating necessity of forcing both their mental and bodily exertions to keep exact pace with the motions of machinery propelled by an unceasing, unwearying power.

2. The continuance of an erect posture for periods unnaturally prolonged and too quickly repeated.

3. The privation of sleep. (Page 72.)

Hansards' Parliamentary Debates. Vol. LXXII. 1844.

Mr. Hindley:

Even though the Government only went the length of relieving from the pressure of excessive labour the female portion of the population, a great object would be attained. The inspectors told them that woman ought not to work for more than 10 hours. The surgeons told them that to work for 12 hours was highly injurious. . . . It was universally felt that human labour was quite overdone, and that the state of the law affecting it required immediate and material revision. (Pages 284–285.)

Hansards' Parliamentary Debates. Vol. LXXIII. 1844.

He [Lord Ashley] had been told by operative spinners that, under the present system of working 12 hours a day, their exhaustion was so great that it was absolutely necessary they should have at least 4 meals a day; but that, with a reduced period of labour, they would be content with 3 meals per day. They stated that under the existing system they were obliged to take food even without appetite as a stimulus to enable them to go through the closing hours of their days' work. . . . It was calculated . . . that, if the hours of labour were reduced from 12 to 10, it would have the effect of prolonging by at least 3 years the duration of the working life of the operatives. (Page 1386.)

British Sessional Papers. Vol. XIX. 1873. Reports of Inspectors of Factories (for the half year ending 30th April, 1873).

The house surgeon of a large hospital has stated that every year he had a large number of cases of pulmonary disease in girls, the origin of which he could distinctly trace to long and late hours in overcrowded and unhealthy workrooms. (Page 43.)

British Sessional Papers. Vol. LV. 1873. Report to the Local Government Board on Proposed Changes in Hours and Ages of Employment in Textile Factories. J. H. Bridges, M.D., *and* T. Holmes.

Experience afforded by residence in the worsted manufacturing town of Bradford, and extensive practice among its population during periods of from one to thirty-five years:

A. Amongst the *women* of factory operatives, much more than among the general population, derangements of the digestive organs are common, *e. g.*, pyrosis, sickness, constipation, vertigo, and headache, generated by neglect of the calls of nature through the early hours of work, the short intervals at meals, the eating and drinking of easily prepared foods, as bread, tea, and coffee, and the neglect of meat and fresh cooked vegetables. . . .

Signed on behalf of the Bradford Medico, Chirurgical Society, at a meeting held February 4, 1873.

Sub-Committee,
President, J. H. BELL, M.D.
P. E. MIALL, M.R.C.S.
Secretary, DAVID GOYDER, M.D.

(Pages 39–40.)

British Sessional Papers. Vol. XVI. 1875. Reports of Inspectors of Factories.

The breaking down of the health, the curved spine, the deformity of the extremities are not now to be met with; but we are confronted with a new evil which has come upon us in the development of the factory system which improved sanitary arrangements of dwellings, better water supply, purer air, more satisfactory drainage, are not sufficient to eradicate. I mean the increased and increasing employment of women in factories. . . . Evidence has been given again and again of the unhappy consequences to child-life and infant development of the working of the mothers in factories. A great deal has been advanced lately against the impolicy of placing any restrictions upon the labour of adult women and upon securing to them the power of making contracts as adult men, and even those who admit the force of these principles cannot shut their eyes to the evils which have existed and still exist in the employment of mothers in factories, and which from the demand for adolescent and adult female labour in factories are not likely to subside of themselves. The abstention from factory labour of women for a month or six weeks after confinement would to a small extent mitigate the evil as regards their more certain restoration to health, but it would not touch the evils of the loss to the infant of its natural food and of maternal care and love. . . . Here is a question which demands our most serious consideration, whether, either by means of legislation or by other less direct but as effective means, the health of the mother and well-being and physical development of the offspring can be protected, so as to prevent eventual deterioration, and to promote health and happiness in so large a population as our factory operatives. (Pages 25–26.)