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REPORT ON NATIONAL VITALITY

ITS WASTES AND CONSERVATION

PREPARED FOR THE NATIONAL CONSERVATION COMMISSION

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NATIONAL VITALITY, ITS WASTES AND CONSERVATION.

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ACKNOWLEDGMENTS.

The materials upon which this report is principally based were collected during the last ten years. They are far from complete, and I had expected to make use of them at my leisure for a series of special articles, but the opportunity which suddenly presented itself of utilizing them in the construction of this report was one which could not be resisted, despite the fact that the time available was only three months. In the endeavor to make the best use of this time I have been compelled in some cases to rely on secondary sources of information. The number of such cases has been greatly reduced, however, through the kindness of colleagues, friends, and correspondents who were appealed to for suggestions, criticisms, and supplementary material. I am greatly indebted to Prof. Lafayette B. Mendel, of the Sheffield Scientific School of Yale University, for helpful comments and detailed criticism of the whole report, and especially of those parts relative to the physiology of nutrition; to Prof. Yandell Henderson, for many helpful suggestions; to Prof. Henry W. Farnam, for suggestions regarding the topics of industrial conditions; to Prof. M. V. O'Shea, of the University of Wisconsin, for carefully revising the major part of the section on school hygiene; to Dr. Charles Wardell Stiles, Chief of the Division of Zoology, Hygienic Laboratory, United States Public Health and Marine-Hospital Service, for information on the extent and burden of the hook-worm disease; to Surg. Gen. Robert M. O'Reilly, of the United States Army, for statistics of army hygiene; to Dr. Prince A. Morrow, of New York City, and to Prof. C. R. Henderson, of the University of Chicago, for carefully prepared notes in regard to "the social evil."

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To the help received from these persons will be due in large measure whatever of value this report may have. I could not, single-handed, have done justice to even a portion of the subject. Except for a few statistical monographs and papers cited in it, I have contributed little original material. It has been my task to interpret material brought together from many sources. Despite all the aid received, I am aware that the report abounds in sins of omission. Great pains have been taken to avoid those of commission. Doubtful material has been eliminated so far as possible, and where exact figures were unobtainable, every effort has been made to see that the statements made should be cautious and conservative.

For aid in the difficult work of incorporating into the manuscript the numerous suggestions received, I am indebted to Profs. J. Pease Norton, William B. Bailey, Fred R. Fairchild, and Dr. L. W. Zartman, of the economic department of Yale University; and to Dr. M. M. Scarborough, of the Yale Medical School, and Dr. F. B. Standish, of New Haven. For criticisms on the form of presentation, I am indebted to Mr. Edwin Bjorkman, of New York City; to Mr. Michael Williams, of Oak Bluffs, Mass.; and to Mr. Herbert A. Smith, of the U. S. Forest Service.

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IRVING FISHER.

YALE UNIVERSITY, *November, 1908.*

SUGGESTIONS FOR READERS.

In order that this report may be read and used as widely as possible, it has been arranged with reference to five classes of readers:

1. The "Contents by sections" and the index will facilitate the use of the report for reference purposes.
2. The "Abstract" is chiefly intended for those who have no time to read more.
3. The "Summary" is a somewhat fuller résumé.
4. The "Summary" is also designed to enable those who so desire to read some parts of the report more fully than others. To this end the "Summary" is arranged to correspond to the main report, chapter by chapter and section by section. The reader who, after reading any particular part of the "Summary," wishes to read the corresponding part of the main report has only to turn to the chapter or section having the same number.
5. Those who read the entire report will probably prefer to read the "Summary" or "Abstract" last.

ABSTRACT.

The problem of conserving natural resources is only one part of the larger problem of conserving national efficiency. The other part relates to the vitality of our population. The two parts are closely interwoven. Protection against mining accidents, forest fires, floods, or pollution of streams prevents not only loss of property, but loss of life. The prevention of disease, on the other hand, increases economic productivity.

So far as we can compare vital and physical assets as measured by earning power, the vital assets are three to five times the physical. The facts show that there is as great room for improvement in our vital resources as in our lands, waters, minerals, and forests. This improvement is possible in respect both to the length of life and to freedom from disease during life.

Contrary to common impression, there is no iron law of mortality. Recent statistics for India show that the average duration of life there is less than twenty-five years. In Sweden it is over fifty years, in Massachusetts forty-five years. The length of life is increasing wherever sanitary science and preventive medicine are applied. In India it is stationary. In Europe it has doubled in three and a half centuries. The rate of increase during the seventeenth and eighteenth centuries was about four years per century, during the first half of the nineteenth century about nine years per century, during the latter half of the nineteenth century about seventeen years per century, and in Germany, where medical and sanitary science has reached the highest development, about twenty-seven years per century. The only comparative statistics available in this country are for Massachusetts, where life is lengthening at the rate of about fourteen years per century, or half the rate in Germany.

There is no need, however, of waiting a century for this increase. It could be obtained within a generation. Three-fourths of tuberculosis, from which 150,000 Americans die annually, could be avoided. Eighteen experts in various diseases, as well as vital statisticians, have contributed data on the ratio of preventability of the ninety different causes of death into which mortality may be classified. From these data it is found that fifteen years at least could be at once added to the average human lifetime by applying the science of preventing disease. More than half of this additional life would come from the prevention of tuberculosis, typhoid, and five other diseases, the prevention of which could be accomplished by purer air, water, and milk. In Lawrence, Mass., after the installation of a pure-water supply, the death rate from typhoid was reduced by 80 per cent. For every death thus saved from typhoid, two or three deaths are saved from other diseases.

Judging from the English statistics of illness, we must conclude that at all times in the United States about 3,000,000 persons are seriously ill, of whom about 500,000 are consumptives. Fully half of this illness is preventable.

If we appraise each life lost at only $1,700 and each year's average earnings for adults at only $700, the economic gain to be obtained from preventing preventable disease, measured in dollars, exceeds one and a half billions. This gain, or the lengthening and strengthening of life which it measures, can be secured through medical investigation and practice, school and factory hygiene, restriction of labor of women and children, the education of the public in both public and private hygiene, and through improving the efficiency of our municipal, state, and national health service. Our National Government has now several bureaus exercising health functions, which only need to be concentrated under one department to become coordinated parts of a greater health service worthy of the nation.

SUMMARY.

Summary of Part I.—*Length of life versus mortality.*

SUMMARY OF CHAPTER I—THE LENGTH OF LIFE.

Section 1. *In different places.*—President Roosevelt has pointed out that the problem of conserving our natural resources is part of another and greater problem—that of national efficiency. This depends not only on physical environment, but on social environment, and most of all on human vitality. Modern hygiene is the reaction against the old fatalistic creed that deaths inevitably occur at a constant rate. The new motto is that of Pasteur: "It is within the power of man to rid himself of every parasitic disease."

It was once believed that human mortality followed an "inexorable law." Facts, however, show that mortality varies in different places and is decreasing as hygiene comes into use. The length of life in Sweden and Denmark is over fifty years; in the United States and England about forty-five; in India less than twenty-five.

Sec. 2. *At different times.*—In Europe, according to one authority, the length of life has increased in three hundred and fifty years from less than twenty to about forty years; in England, in less than half a century, it has increased about five years; in Prussia, in the last quarter of a century, over six years; in America it has also increased, although good life tables are lacking excepting for insurance experience. The tables for Massachusetts for 1893–1897 show an average duration of life in that State of forty-five years, as compared with forty in 1855, and thirty-five, an estimate of 1789, based, however, on doubtful returns.

SUMMARY OF CHAPTER II—THE MORTALITY RATE.

Section 1.—*Relation of longevity to mortality.*—As duration of life increases the death rate decreases. A death rate is the ratio of the number of deaths in a year to the population. Under normal conditions where the population is "stationary"—that is, neither increasing nor decreasing nor subject to immigration or emigration—the death rate and the duration of life are "reciprocals." In such a population, if the death rate is 20 per 1,000, the duration of life will be $1{,}000 \div 20 = 50$ years.

This relation, however, is disturbed in most countries to-day, and especially in America, by immigration and emigration and by the birth rate being in excess of the death rate. Nevertheless, death rates, if compared under similar conditions, furnish a fairly good index of vitality. They vary in different places and at different times.

Sec. 2. *Mortality in various regions.*—In the registration area of the United States the death rate is 16.5 per 1,000; in France it is 20; in India 42. In different States of the United States it varies from 14 in Michigan to 18 in New York.

Sec. 3. *Urban and rural mortality.*—The death rate is higher in the city than in the country, and the larger the city the higher the death rate. In European countries among the cities with the highest death rate are Dublin (40) and Moscow (37); among the lowest, Frankfort on the Main (16) and The Hague (16).

Sec. 4. *Race and condition.*—The colored death rate greatly exceeds the white. The death rate among the poor exceeds that among the rich, being in Glasgow and Paris over twice as great.

Sec. 5. *Mortality historically.*—Death rates have been decreasing during several centuries. In London, where now the death rate is only 15, it was during the seventeenth and eighteenth centuries 40 to 50, and during 1680 to 1728, a period of pests, it rose as high as 80. Similar reduction has also been experienced in this country. In Habana the death rate after the American occupation fell from over 50 to about 20.

SEC. 6. *Adult and infant mortality.*—The greatest reduction has been effected among children, although the death rate is still undoubtedly high. Statistics show that during the last thirty years the death rate up to 50 years of age has decreased, but that beyond 50 it has remained almost stationary.

SEC. 7. *Particular diseases.*—The mortality from certain special diseases has greatly decreased. The tuberculosis death rate is now in England only one-third of what it was seventy years ago. The death rate from pneumonia now equals that of tuberculosis. Typhoid fever is decreasing. In Munich during 1856 the mortality was 291 per 100,000 of population. The city at that time contained many cesspools. After these were filled up the typhoid rate fell to 10 per 100,000 in 1887, making a reduction of 97 per cent. In Lawrence, Mass., after the public water was filtered in 1893 the typhoid-fever rate fell from 105 to 22. Doctor Kober has shown that death rates from typhoid fever are greatest in cities in which the rivers' waters are polluted, the average for these cities being 62, as compared with 18 for cities using unpolluted water of impounded and conserved streams. Doctor Rosenau concludes that any community having clean water and uninfected milk supply may be free from typhoid.

Smallpox has greatly decreased since vaccination has been employed. In Prussia the death rate per 100,000 from smallpox between 1846 and 1870 was 24. In 1874 vaccination was made compulsory, and the death rate for the years 1875–76 fell to 1.5. Similar figures can be given for other places. The present outcry against vaccination is based on misinformation and on the general reasoning that it is unnatural to introduce a poison into the blood. Statistics show clearly that vaccination decreases smallpox and lengthens life. Even though it were shown that the virus is injurious, it would be the lesser of two evils.

Yellow fever in Philadelphia in 1793 caused the death of one-tenth of the city's population within six and one-half weeks. In 1900 it was found that a species of mosquito transmits this disease. The result of this applied knowledge is that the disease has practically disappeared in America.

SUMMARY OF PART II.—*Breadth of life versus invalidity.*

SUMMARY OF CHAPTER III—PREVALENCE OF SERIOUS ILLNESS.

SECTION 1. *Loss of time.*—Life is shortened by death and narrowed by invalidity. The ideal life, with respect to health, would be free from illness and disability of every kind. To approximate such an ideal is the aim of hygiene. It is usually true that the healthier a life the longer it will last. Humboldt maintained that he had lived four working lives by retaining a working power double the average for double the average number of years. According to Farr, for every death there is an average severe sickness of two years, or for each death per year there are two persons sick throughout the year. This would mean in the United States that, as there are about 1,500,000 annual deaths, there will always be about 3,000,000 persons on the sick list, which is equivalent to about thirteen days per capita.

SEC. 2. *Particular diseases.*—There are constantly ill in the United States of tuberculosis about 500,000 persons, of whom about one-half are totally incapacitated, while the remainder are half incapacitated. The causes of various diseases are closely interwoven. Professor Sedgwick tells us that "Hazen's theorem" shows for every death from typhoid fever avoided by the purification of a polluted water supply two or three deaths are avoided from other causes. Hook-worm disease in the South is a chief cause of incapacitation, especially among the poor whites. For this reason the hook worm has been nicknamed the "germ of laziness." It is believed that a sufferer from hook-worm disease is incapacitated from one-fourth to one-half of the time.

The number of syphilitics in the United States has been estimated at 2,000,000, though from the nature of the case this figure is chiefly conjecture. The social diseases, syphilis and gonorrhea, are responsible for the existence of a large proportion of defectives of various kinds which fill our institutions. Among the troops in the Philippines the venereal morbidity, during the year 1904, was 297 per 1,000, largely exceeding the morbidity from malarial fevers and diarrhea, as 22 out of every 1,000 soldiers were constantly ineffective from venereal disease—four times as many as from any other disease. The statistics outside of army and navy service are impracticable, but there is some reason to believe that they might show an even larger morbidity. The social diseases, which certainly are preventable, are one of the gravest of the menaces to national efficiency.

American railways in 1907–8 killed nearly 11,800 and injured nearly 111,000 persons. The deaths and disablements from accidents in industry, although less carefully recorded, also represent a great and needless impairment of efficiency.

SUMMARY OF CHAPTER IV—PREVALENCE OF MINOR AILMENTS.

SECTION 1. *Importance of minor ailments.*—Minor ailments are far more common than most persons realize. They are chiefly functional disorders, such as of the stomach, heart, nerves, liver, kidney, etc. These deserve more attention than they have hitherto received, because they are the gateway to more serious troubles. For instance, those who neglect colds, or what seem to be colds, will be far more likely to become victims of tuberculosis or pneumonia. No statistics of the prevalence of minor ailments exist. Physicians, whose experience gives them good opportunity to judge, place the time lost annually for each person from minor ailments at three or more days a year.

SEC. 2. *Preventability of minor ailments.*—Practically all minor ailments can be avoided by proper hygiene, public and private. Neurasthenia, so common in America, is one of the most serious and insidious introductions to grave disorders, and is usually due to needless worry or failure to have adequate recreation.

SUMMARY OF CHAPTER V—PREVALENCE OF UNDUE FATIGUE.

SECTION 1. *Strength, endurance, and fatigue.*—Strength is measured by the force a muscle can exert once; endurance by the number of times it can repeat an exertion requiring a specified part of the strength. Fatigue is a chemical effect, due to "fatigue poisons." Far greater differences exist between different persons in respect to endurance than in respect to strength. Some "well" people become tired by a short walk, while others withstand hours of walking, running, or climbing.

SEC. 2. *Alcohol and fatigue.*—The "Committee of Fifty" found that alcohol gives no persistent increase of muscular power. It is well understood by all who control large bodies of men engaged in physical labor that alcohol and effective work are incompatible. Rivers, writing on the influence of alcohol on fatigue, found that when workmen were provided with a moderate amount of wine it resulted in a considerable diminution of their capacity for work.

SEC. 3. *Tobacco and fatigue.*—Athletes recognize that smoking interferes with one's "wind" or "staying power." "Inhaling" tobacco smoke brings carbon-monoxide directly into the blood stream. It is found that smoking increases blood pressure, which fact possibly partly explains the reduction in endurance.

SEC. 4. *Diet and fatigue.*—When excessive amounts of the protein element in food (exemplified in white of egg or the lean part of meat) are taken, they putrefy in the large intestine, producing "auto-intoxication." For this and other reasons, there is a present tendency among physiologists to advise a reduction in the use of such foods from the amounts customary in many countries, and especially in the United States. Auto-intoxication induces fatigue. The endurance of those using high protein and of those using low protein shows in general, although with some exceptions, that the former have less endurance than the latter. Whether the latter are vegetarian or not does not seem to matter. Experiments show that thorough mastication leads instinctively to a reduction in protein.

SEC. 5. *Exertion and fatigue.*—Oxygen, whether taken naturally or artificially, increases the capacity for exertion. A judicious amount of exercise is perhaps the chief factor in producing the highest state of muscular efficiency. Physical training, comprising exercise and other hygienic measures, will probably make the capacity to withstand great exertion three or four times that possessed by most persons.

SEC. 6. *The working day.*—The present working day, from a physiological standpoint, is too long, and keeps the majority of men and women in a continual state of overfatigue. It starts a vicious circle, leading to the craving of means for deadening fatigue, thus inducing drunkenness and other excesses. Experiments in reducing the working day show a great improvement in the physical efficiency of laborers, and in many cases results in even increasing their output sufficiently to compensate the employer for the shorter day. Several

examples of such a result exist, but the real justification for a shorter work day is found in the interest of the race, not the employer. One company, which keeps its factory going night and day, found, on changing from two shifts of twelve hours each to three shifts of eight hours each, that the efficiency of the men gradually increased, and the days lost per man by illness fell from seven and one-half to five and one-half per year. Public safety requires, in order to avoid railway collisions and other accidents, the prevention of long hours, lack of sleep, and undue fatigue in workmen.

SEC. 7. *The importance of preventing undue fatigue.*—The economic waste from undue fatigue is probably much greater than the waste from serious illness. This is because the number of fatigued persons is great enough to more than outweigh the fact that the incapacitation from fatigue is relatively small. Moreover, the relatively slight impairment of efficiency due to overfatigue leads to greater impairment from serious illness. A typical succession of events is, first, fatigue, then "colds," then tuberculosis, then death. The prevention of undue fatigue means the arrest at the start of this accelerating chain of calamities.

SUMMARY OF PART III.—*Methods of conserving life.*

SUMMARY OF CHAPTER VI—CONSERVATION THROUGH HEREDITY.

SECTION 1. *Heredity and environment.*—A wise and farsighted economy will lead the nation to conserve its vital resources by every possible method. These resources depend on two primary conditions, heredity and hygiene, or conditions preceding birth and conditions during life. In other words, vitality is partly inherited and partly acquired. A sound physical and mental inheritance is a greater asset than the inheritance of extraneous advantages like wealth. Even in the Old World a degenerate nobility in the end receives less respect than a virile middle class. The effort to improve vitality reaches its highest point in a nation when its health ideals affect marriage.

SEC. 2. *Eugenics.*—Galton, Pearson, and others are attempting to found the new science of "eugenics," by which is not meant any scheme of general governmental interference with marriage, but the gradual establishment in public opinion of fundamental standards. Just as to-day the marriage of brother and sister is unthinkable, Galton suggests that the time may come when marriage which obviously promotes degeneration will be equally tabooed. The result would be, not to make marriage more artificial, but less. Health, beauty, and vitality are much more natural objects of youthful admiration than titles or wealth, which now exercise, for the most part, a baneful influence on marriage. To lessen the esteem for those false attractions and increase that for natural attractions will tend not only to increase the number of healthy marriages, but to give greater importance to natural and normal love. The effect will be felt both in bringing about a larger proportion of marriages among the healthy and a smaller proportion among the unhealthy. It will also lead to a partial segregation by which the healthy will to a large extent marry among themselves, and thus leave the unhealthy either unmarried or compelled to make alliances in their own class. The result will be, in the struggle for race supremacy, that the healthy, thus separated off from the relatively unfit, will have a distinct advantage both in the number of offspring and in their vitality.

SEC. 3. *Eugenics and law.*—The only government influences which have been seriously suggested by eugenists are two: First, the offering of prizes or bounties to couples who conform to certain standards, in the same way as the French Government has encouraged the increase of its population by offering inducements to couples of the poorer class who raise seven or more children; second, to prevent marriage alliances among criminals, paupers, and the feeble-minded. Some laws on these subjects already exist in Connecticut, Michigan, and especially Indiana, where there is a prohibition of marriage of all persons suffering from transmissible diseases. It is also now provided in Indiana that confirmed criminals, imbeciles, and rapists, when it is deemed advisable by experts, shall be unsexed. What such laws might accomplish may be judged from the history of two criminal families, the "Jukes" and the "Tribe of Ishmael." Out of 1,200 descendants from the founder of the "Jukes" through seventy-five years, 310 were professional paupers, who spent in all two thousand three hundred years in poorhouses, 50 were prostitutes, 7 murderers, 60 habitual thieves, and 130 common criminals. The loss of potential usefulness, cost of

prosecutions, expense of maintenance of jails, etc., Dugdale estimated to be $1,300,000 in seventy-five years, or over $1,000 for each member of the family. All these unfortunate results could have been avoided had the original criminals in this family been sterilized under a law like that of Indiana.

We have the more agreeable record of excellent human qualities inherited through successive generations in the Darwin, Hohenzollern, and other families.

SUMMARY OF CHAPTER VII—CONSERVATION THROUGH PUBLIC HYGIENE.

SECTION 1. *Municipal hygiene.*—The benefits of improved heredity can be enjoyed only by future generations. But we of the present day may conserve our vital resources through hygiene, practiced in one or all of three ways—public, semipublic, and personal hygiene. The first refers to governmental regulation of health, the second to the professional or institutional care of health, and the third to the private life of the individual and the family. Every city now has its health board, yet few citizens realize that the protection rendered by these boards is more important than the protection by the police or fire departments. Much as is done by these boards, there is enormous room for improvement, both in making regulations and in enforcing them by the aid of a more enlightened public opinion. The abatements of the nuisance and menace from spitting and from vitiation by smoke are cases in point. Pure air is one of the primary necessaries of life, but only a small fraction of our countrymen actually enjoy this boon. To this end proper drainage and garbage removal and clean streets are needed. The transmission of disease by insects, flies, and vermin needs to be checked. A constant cause of mortality, among infants especially, is an impure milk supply. The same danger exists in other dairy products, cream, butter, cheese, and ice cream. In Washington, owing apparently to the enactment of a law in 1895 regulating the sale of milk, the death rate from diarrhea and inflammation of the bowels among children under 2 years of age was reduced from 160 or 170 to 135, then 109, 104, and in 1906 to 97. Similar reports come from many other cities in this country and abroad.

SEC. 2. *State hygiene.*—The regulation of the labor of women and children is usually a state matter. It has been suggested by Doctor Stiles that every woman should be allowed once a month to leave a factory without being asked questions or losing wages. The employment of mothers before and after childbirth should be prohibited, as it is now in a number of European countries. This single reform would help greatly to conserve the vitality of the next generation. Child labor in the South is in many cases the lesser of two evils, the other being exposure to the hook-worm disease on polluted farms. In these cases, the abolition of child labor should be preceded by the abolition of hook-worm disease. Hours of labor have been steadily decreasing, and should be decreased further. Accidents are unnecessarily frequent on our American railroads, as well as in industrial establishments. Statistics do not exist for the latter. Special trades have special dangers. Among such trades are those using lead and other dangerous poisonous chemicals, as well as the dust-producing trades which tend to pulmonary troubles. The dark room tenements are a common means in our large cities of depleting national vitality.

SEC. 3. *Federal hygiene.*—This includes quarantine, the inspection of immigrants and exclusion of those with infectious diseases, administration of government hospitals, of pure-food laws and meat inspection, and cooperation with state boards of health in fighting yellow fever, bubonic plague, etc. Federal power needs extension, however. Our interstate railroads should be improved in respect to the sanitation of sleeping cars, smoking cars, etc.

The movement to secure a more intelligent national organization of health is now being pushed by the President, President-Elect, and Members of Congress, and has found expression in the recent platforms of both political parties. What is needed is that the Federal Government should make the national capital a model of sanitation, should provide for more investigation in health matters and the dissemination of information on the prevention of tuberculosis, etc., should cooperate further with state and municipal authorities, and should check the pollution of interstate streams and prevent the transmission of disease-bearing meats or other food from one State to another. Lastly, it should secure, through whatever constitutional means exist, some method of collecting statistical information as to our national mortality and morbidity. Our shortcomings in this respect are now a national disgrace. There is no accurate record of births in any part of the United States, and that of deaths includes less than half our population. As a statistician has said of one of the States,

"It buries its dead people with no more ceremony than it buries its dead dogs." Obviously, no intelligent control of epidemics and other diseases can be made unless the facts in regard to those diseases are known; in other words, unless there exist mortality and morbidity statistics of real value.

SUMMARY OF CHAPTER VIII—CONSERVATION THROUGH SEMIPUBLIC HYGIENE.

SECTION 1. *Medical research and instruction.*—Semipublic hygiene comprises that relating to institutions and the medical profession. The hygiene of the future must depend more on discoveries in preventive medicine than on any other single factor, and institutions such as the Pasteur Institute, the Rockefeller and the Carnegie institutes, and the research laboratories of the Government and universities offer the most promising means of increasing this most useful and practical of all human knowledge. The knowledge is dispensed through medical schools in the training of physicians. These schools are improving so as to introduce more of hygiene and preventive medicine. We are still far, however, from having facilities for training public health officers, or giving them such a degree as D. P. H. (diploma of public health), as is given in England.

SEC. 2. *The medical profession.*—Antiseptic surgery has in the last century been the greatest triumph of the medical profession, and has given it a greater prestige than ever before. It has greatly reduced the mortality from operations, and is illustrated by the figures in army operations. The mortality of the wounded in the Crimean war among English troops was 15 per cent. The mortality in the Transvaal war, 1900–1901, was less than 6 per cent.

In the practice of medicine, the tendency is progressively to give up the use of violent drugs and to depend more on hygiene. Through the modern fight against tuberculosis, physicians have come to prescribe fresh air in their practice generally. They are now turning in like manner to exploit the resources of diet, exercise, bathing, and mental hygiene.

There is danger that these new fields will be preempted by quacks. Many quacks to-day, far from using patent medicines, oppose the use of any drugs whatever. In order that modern hygiene shall be applied by trained physicians, it is necessary that they provide more facilities in this direction. The leaders of the profession are making every effort to raise all members of their profession to their own high standard. This standard not only aims to prevent malpractice and unethical operations, but to set an example to the people in public service and in personal hygienic living.

SEC. 3. *Institutional hygiene.*—Hospitals have done much to prevent disease by segregating infectious cases. Institutions for the deaf and blind and other defectives have led to a better utilization of their powers. Institutional care of the insane has done much, too, but can do more. Mental hygiene as a whole needs to be more carefully studied and taught in all its relations—heredity, alcohol, syphilis, and environment.

The modern sanitarium has become a useful institution for prevention of serious illness, as distinct from the hospital, of which the function has been to cure. Department stores, hotels, and other commercial institutions are installing ventilating and other hygienic apparatus. The churches are also taking part in the health movement, especially the Emmanuel Church in Boston.

SEC. 4. *School hygiene.*—The hygiene of school children is especially important because of its application to human life in its early stages. There is a world-wide movement, led by Switzerland and some other countries of Europe, to obtain and apply knowledge of how to educate the mind without weakening the body. As it is, school children are especially exposed to contagious diseases, which under present conditions often sweep through a whole school before the local health board even hears of it. Quite as serious, if not more so, is the protecting of school children from imperfect seating, lighting, ventilation, and sanitation.

Backward children, with defects of eye, ear, nose, or throat, are numerous, but experiments have shown that the majority could be improved both in intellect and in morals.

In respect to school hygiene, it is not so much lack of knowledge as lack of application of knowledge which is at fault. In order to find and then correct defects of eyes, ears, teeth, etc., and properly apply our knowledge, medical inspection is necessary. Such inspections as have been made disclose an astonishing amount of ill health, the percentage of morbidity being from 20 to 60 per cent. The committee on physical welfare of school children in New

York found that 66 per cent needed medical or surgical attention or better nourishment; 40 per cent needed dental care; 38 per cent had enlarged glands of the neck; 31 per cent had defective hearing; 18 per cent had enlarged tonsils.

Eye strain is a particular evil of civilization, and makes its first appearance in school when the scholar tries to accommodate the eye to the short range which reading requires, but for which the eye mechanism is not well adapted by nature. The evil effects of eye strain are not confined to that organ, but extend to the whole nervous system, and indirectly to the whole organism. Doctor Gould, who has made a special study of this subject, goes so far as to maintain that "eye strain is the chief source of the functional diseases of our citizens."

At present medical inspection is the exception rather than the rule. Only 70 cities in the United States outside of Massachusetts, and 32 cities and 321 towns in Massachusetts, have systems more or less complete. New York employs 150 physicians, who visit each public school once a day to examine children set aside for that purpose by the teacher. In Providence a fresh-air school for children suffering from tuberculosis has been established. The cost of the school per capita is about 50 per cent more than the ordinary schools, but the results justify the expenditure.

Our scholars are being seriously injured by nervous overstrain. Probably this is not because too much work is being required, but because the performance of this work is not accomplished economically. Some experiments seem to indicate that children could accomplish as much intellectually with far less dissipation of nervous energy if they were in the schoolroom about half of the time now spent there. High pressure and long hours are bad economy in schools as in factories.

Playgrounds conserve child vitality and are far superior to formal gymnastics. They provide physical training which accords with child instincts, and keep the child out of mischief and often out of jail. Here, as elsewhere, the suppression by civilized and urban life of the instinct for play and amusement is responsible for much of what we call "crime" and "depravity." In school children should not only be surrounded by hygienic environment, but should be taught the value of hygiene. The suggestion of an annual "health day" or "health week" may prove a fruitful one for this purpose.

Sec. 5. *Voluntary and business organizations.*—Societies to prevent the spread of tuberculosis, social diseases, insanity, etc., or to advocate labor or health legislation (state and national), are now numerous and active. It is being found that philanthropy and profit are not always antagonistic. Labor organizations are connecting the health movement with the eight-hour movement. Farsighted employers are providing social secretaries to watch over the health, comfort, and happiness of their employees, and are often eager for practical suggestions in these matters.

Corporations that have installed apparatus for ventilation and sanitation, even sometimes for the benefit of their machinery rather than their employees, have in known instances gotten back the cost in lessened illness and greater efficiency of work.

An interesting experiment near Paris was that of a mill employing 44 men and 75 women and children. Largely through the services, instruction, and suggestions of a medical officer there was not a single death in three years.

The temperance reform has to-day a powerful impulse in the demands by employers for more efficient labor and by the public for greater safety in travel. Locomotive engineers, conductors, and ship captains who drink can not get employment.

Life-insurance companies may possibly in the future realize their opportunity to make financial gains by participation in the health movement.

Finally, one of the greatest potential agencies for bringing about health reform is the public press. It is already interested and active in the movement, although the good it does is often undone by inserting quack advertising. This not only does direct harm, but often ties the hands of the editor, preventing him from expressing any disapproval of nostrums, however injurious or immoral.

SUMMARY OF CHAPTER IX—CONSERVATION THROUGH PERSONAL HYGIENE.

Section 1. *Its importance.*—Personal hygiene is not only of direct importance to the individual, but furnishes the public opinion from which, and from which alone, sound public and semipublic hygiene can spring. Public hygiene will be

ineffective unless supported by personal hygiene. The milk and water supply of a city may be ideal as supplied at a dwelling, but may be carelessly contaminated there. Observation shows that many of the world's most vital men and women have practiced hygiene and often thereby turned weak constitutions into strong ones. Cornaro, the Venetian nobleman, about to die at 37, adopted the "temperate life," taking especial care not to overeat. He lived to be nearly, or quite, 100.

SEC. 2. *Branches of personal hygiene.*—Personal hygiene comprises hygiene of environment (air, soil, dwellings, clothing), hygiene of nutrition, and hygiene of activity. The ideal conditions of health require purity in air, purity and proper use of food, and a proper balance between mental and physical activity, rest, and sleep. The present world-wide interest in personal hygiene and physical education is not due to any startling discoveries, but to the rediscovery of the importance of truths long insisted upon by the medical profession.

SEC. 3. *The hygiene of environment.*—The prime factor in environment is the atmosphere. Originally man was doubtless an outdoor animal. Civilization has brought him an indoor environment, and with it tuberculosis. Experiments in hospitals have shown that the agitation of the air by dry sweeping greatly increases bacteria. Air in a confined room may be contaminated by chemicals contained in wall paper, plaster, or mortar. The one place in which the individual has most control over his air supply is the bedroom. The fashion now of sleeping with wide-open windows, or even out-of-doors, is certain to improve American vitality. The windows of living and work rooms also may be open even in winter if a window board is used to deflect the air upward and prevent a cold stratum forming on the floor. The outdoor life or the abundant use of fresh air is an almost certain preventive of colds. This fact was commented upon by Franklin over a century ago, and has been rediscovered many times since, especially in the experience of army troops. The evils of bad air are not confined to its chemical content. A room is sometimes "close" simply because it is hot or overmoist or devoid of any air current.

The effect of air on the skin and of radiation of heat from the body is important. Consequently, a proper use of air involves a proper use of clothing, which needs to be both porous and light.

Closely connected with air hygiene is the hygiene of light. "Where sun and air enter seldom the physician enters often." The lighting of dwellings and schoolrooms is especially important with reference to the eyes. This is true also of even the color and texture of the printed page we read. Probably one-fourth of all educated people in America suffer from disturbances due more or less to eye strain and its numerous indirect effects.

SEC. 4. *The hygiene of nutrition.*—The scientific study of diet has only just begun, and few authoritative results can yet be stated. That diet has a distinct relation to endurance has been rendered probable by many investigations, which seem to show in particular that avoidance of overeating, and especially of excess in protein, and thorough mastication are wholesome rules. In the choice of foods the individual must be given a wide latitude. His own instinct, restored and educated by avoiding food-bolting which blunts it, will probably be a truer guide than the wisest of physiologists. Diseased foods, such as oysters polluted with sewage, may transmit typhoid and other maladies.

SEC. 5. *Drug habits.*—Poisons, whether taken into the body or produced within, are injurious. The commonest form of intoxication is alcoholic. Its evils are becoming more apparent than ever before. As Metchnikoff says, it lowers the resistance of the white corpuscles, which are the natural defenders of the body. It predisposes to tuberculosis and numerous other diseases. The findings of the "Committee of Fifty" for the investigation of the liquor problem are important evidence of the evils of the use of alcohol, and these have not received the attention which they deserve. Absinthe in France is being recognized now as a distinct menace to the nation, and in Germany there is a tendency toward a lessened use of alcohol in all its forms. But the movement against the abuse of alcohol has reached its highest point in America.

The evils of tobacco are less and are less appreciated. Its stunting effects on the growing child are especially harmful.

SEC. 6. *Activity hygiene.*—It is an encouraging sign of the times that baths are coming more into vogue, both through the private bath tub for the wealthy and the public baths for the poor. During the last generation the importance of exercise has come to be acknowledged, due largely to the growth of modern athletics. The athletic ideal of the Greeks was, however, higher than that

which now prevails in this country. Overexertion, physical and mental, is one of the chief American faults. The danger signal of fatigue is seldom observed, and the instinct for recreation and amusement is often stifled.

SEC. 7. *Sex hygiene.*—Undue reticence on this subject is responsible for the general ignorance as to the extent to which the abuse of the sex relation is injuring this and every nation, physically, mentally, and morally. Syphilis poisons the blood and affects all parts of the body. It makes the individual a "bad risk" for life insurance companies for several years, and is likely to be transmitted to others through a kiss or through the use of a common towel, while the danger of transmitting from husband to wife, or vice versa, continues for many years. Syphilis is one of the few really hereditary diseases, and the saddest of all facts connected with it is that the guilty parent may escape and the innocent children suffer. Gonorrhœa, while usually cured without apparent impairment of health, destroys fertility, and for years after it has apparently ceased may be rearoused. It is responsible for a large number of the cases of infantile blindness and for a larger percentage of many of the serious troubles of women. The social diseases, while seldom assigned as a cause of death, are known to predispose to other diseases and greatly to shorten life.

SEC. 8. *Personal hygiene in general.*—The cumulative effect of hygiene, or of lack of hygiene, needs emphasis. Breathing, eating, working, and sleeping are matters of daily habit. If they are wrong, the evil, however slight, being repeated every day for many years, produces cumulative effects more subtle, but often more powerful, than the effects of sudden infection or accident.

SUMMARY OF CHAPTER X—ARE HYGIENIC MEASURES EUGENIC?

SECTION 1. *The prolongation of weak lives.*—The question has been raised whether reduction in infant and child mortality will not weaken rather than strengthen the race by interfering with natural selection and favoring the survival of the unfit. It is pointed out that the mortality at later ages of life has not decreased, as has that in the earlier ages. There is probably, however, a sufficient explanation of this in the fact that the improvement in hygienic living has not as yet affected adults as much as children. Parents are quick to apply for the benefit of their children new methods of preventing disease, such as sterilizing milk, but do not take the same precautions for themselves. The hurry and stress of modern life has in fact tended to produce in some respects more unhygienic habits among adults than prevailed under the simpler conditions of a generation ago.

SEC. 2. *Children's diseases impair both fit and unfit.*—It must be borne in mind also that the same children's diseases and other causes which tend to kill the unfit child also tend to injure the proper development of the fit. Consequently a lessening of children's diseases will have the effect of not only prolonging weak lives, but also of prolonging and developing the strong. Statistics, so far as available, appear to show that where infant mortality is the highest, mortality at all ages is high.

SEC. 3. *Fitness is relative to environment.*—What is sometimes called degeneration does not deserve that name. A lessening of physical strength, for instance, can not be called degeneration if conditions under civilization do not require the same physical strength as our barbarian ancestors needed. It is adaptation to existing conditions which measures fitness.

Whatever danger of degeneration there may be from the care of the insane and defective classes can be avoided if the health ideals of the nation are strong and broad enough to meet the situation, for with these high health ideals will come a demand which will prevent the perpetuation of the unfit and through the mere force of public opinion lead in general to healthier marriages.

SUMMARY OF PART IV.—*Results of conserving life.*

SUMMARY OF CHAPTER XI—PROLONGATION OF LIFE.

SECTION 1. *Life is lengthening.*—So far as we can judge from statistics of the average duration of life, it has been on the increase for three hundred and fifty years, and is now increasing more rapidly than ever before. During the seventeenth and eighteenth centuries the increase was at the rate of about four years per century; during the first three-quarters of the nineteenth century the rate was about nine years. At present in Massachusetts life is lengthening at the

rate of about fourteen years per century; in Europe about seventeen; and in Prussia, the land of medical discovery and its application, twenty-seven. In India, where medical progress is practically unknown, the life span is short (twenty-five) and remains stationary.

Sec. 2. *Table showing further practicable prolongation.*—It is possible to estimate the effect on the length of life of the partial elimination of various diseases. Using the statistics, experience, and estimate of 18 physicians as to the preventability of each of the list of 90 causes of death, we find that the length of life could easily be increased from forty-five to sixty, an increase of one-third, or fifteen years. This would result in a permanent reduction in death rate of about 25 per cent. The principal reductions would be from infantile diarrhea and enteritis, over 60 per cent of which could be prevented, with the result of an addition to the average length of life of 2.32 years. Bronchopneumonia, also an infant disease, could be prevented to the extent of 50 per cent, whereby life would be lengthened by 0.60 year. Meningitis, which is usually fatal at the age of two, could be prevented by at least 70 per cent, and this prevention would lengthen the average life by 0.60 year. Eighty-five per cent of death by typhoid fever is unnecessary, and if avoided would lengthen life at least 0.65 year. It would be feasible to prevent at least 75 per cent of cases of tuberculosis of the lungs, and thereby to lengthen life by about two years. If the deaths from violence were reduced only 35 per cent, human life would be increased by 0.86 year. The prevention of 45 per cent of cases of pneumonia would lengthen life by 0.94 year. These seven diseases alone could easily be reduced by these amounts so as to lengthen life by eight years. This could be done simply through insistence by the public on pure milk, pure water, pure air, and reasonable protection from accidents.

Sec. 3. *Diagram showing effect of prolongation at different ages.*—If we take the diagram representing the life table of Massachusetts for 1893–1897, we may use it as the basis for constructing an ideal curve to show the effect of prevention if applied according to the ratios of prevention given in the preceding table. The results agree substantially with those found in the table and show that about thirteen or more years could easily be added to the average duration of life. The diagram also shows the extent to which the additional life would fall in different ages. The per cent of life which would fall to the ages between 17½ and 60, taken as the working period, would remain the same, namely, about 55 per cent.

Sec. 4. *Fifteen years a safe minimum estimate of prolongation possible.*—The estimate of fifteen years is a minimum because, first, it takes no account of future medical discoveries, such as a method of curing or preventing cancer and of postponing old age, as would Metchnikoff; second, it takes little account of the cumulative influence of hygiene. The full benefit of hygiene can not be felt until it is practiced throughout life, and not at the approach of specific danger. Most so-called "causes" of death are merely the last straws which break the camel's back. When a pure water supply prevents deaths from typhoid fever, it prevents two or three times as many deaths from other causes. Third, it takes no account of the racial effects of new health ideals leading, in a general way, as they must, to healthier marriages.

Sec. 5. *Need of lengthening human life.*—With increase of knowledge the period of education or preparation for life must constantly increase. This fact creates a need for a longer life, with the later periods of life increased in proportion. The result of such a prolongation will be not the keeping alive of invalids, but the creation of a population containing a large number of vigorous old men. Metchnikoff says, "The old man will no longer be subject to loss of memory or to intellectual weakness; he will be able to apply his great experience to the most complicated and most delicate parts of the social life."

Sec. 6. *The normal lifetime.*—It is usually recognized that human life is abnormally short, but no exact determination has ever been made of what constitutes a normal lifetime. Flourens maintains that a mammal lives five times the length of its growing period, which would mean, since the growing period for man does not cease until about 30, a normal human lifetime of one hundred and fifty years. Another method of estimating normal life is to reckon the length of normal life as the time when old age now sets in, 83 years. But clearly, if Metchnikoff is right in thinking that old age itself is abnormal, the normal lifetime must exceed 83. Many remarkable cases of longevity are on record, but most cases of reputed centenarians are not authenticated. Drakenburg's record was authentic, and he lived to be 146. Mrs. Wood, of

Portland, Oreg., recently died at 120. To what extent these exceptional cases could be made common can not, as yet, be known.

SUMMARY OF CHAPTER XII—THE MONEY VALUE OF INCREASED VITALITY.

SECTION 1. *Money appraisal of preventable wastes.*—Doctor Farr has estimated the net economic value of an English agricultural laborer at various times of life by discounting his chance of future earnings after subtracting the cost of maintenance. On the basis of this table we may construct a rough estimate of the worth of an average American life at various ages, assuming that only three-fourths of those of working age are actually earners of money or housekeepers. It gradually rises from a value of $90 in the first year to $4,200 at the age of 30, and then declines until it becomes negative for the higher ages. This estimate assumes $700 per year as the average earnings in middle life. This is largely conjecture, but is regarded as a very safe estimate. Applying this table to the existing population at various ages in the United States, we find that the average value of a person now living in the United States is $2,900, and the average value of the lives now sacrified by preventable deaths is $1,700. The latter is smaller than the former because the age of the dying is greater than the age of the living. Applying the $2,900 to the population of eighty-five and a half millions, we find that our population may be valued as assets at more than $250,000,000,000; and since the number of preventable deaths is estimated at 630,000, the annual waste from preventable deaths is 630,000 times $1,700, or about $1,000,000,000. This represents the annual preventable loss of potential earnings.

We saw in Chapter III that there are always 3,000,000 persons in the United States on the sick list, of whom about 1,000,000 are in the working period of life and about three-quarters are actually workers and must lose at least $700, which makes the aggregate loss from illness more than $500,000,000. Adding to this another $500,000,000 as the expense of medicines, medical attendance, special foods, etc., we find the total cost of illness to be about $1,000,000,000 per year, of which it is assumed that at least one-half is preventable. Adding the preventable loss from death, $1,000,000,000, to the preventable loss from illness, $500,000,000, we find one and a half billions as the very lowest at which we can estimate the preventable loss from disease and death in this country. The true figures from the statistics available may well amount to several times this figure, but when statistics are based partially on conjecture, they need to be stated with special caution.

SEC. 2. *The cost of conservation.*—In Huddersfield the annual deaths of infants for ten years had been 310. By systematic education of mothers, the number in 1907 was reduced to 212. The cost of saving these 98 lives was about $2,000, or about $20 each. Gen. Leonard Wood declared that the discovery of the means of preventing yellow fever saves annually more lives than were lost in the Cuban war. The hook-worm disease in the South impairs the earning power of its workmen by 25 or 50 per cent. To restore this earning power costs, by curing this disease, on an average, less than $1 for each case. These and other examples show that the return on investments in health are often several thousand per cent per annum. Probably no such unexploited opportunity for rich returns exists in any other field of investment. An actuary suggests that if insurance companies should combine to contribute $200,000 a year for the purpose of improving the public health, the cost would be one-eighth of 1 per cent of the premiums, and it would be reasonable to expect a decrease in death claims of much more than 1 per cent. Even this 1 per cent would make a profit of more than seven times the expense.

SUMMARY OF CHAPTER XIII—THE GENERAL VALUE OF INCREASED VITALITY.

SECTION 1.—*Disease, poverty, and crime.*—Money estimates of waste of life are necessarily imperfect and sometimes misleading. The real wastes can only be expressed in terms of human misery. Poverty and disease are twin evils and each plays into the hands of the other. From each springs vice and crime. Again, whatever diminishes poverty tends to improve health, and vice versa.

SEC. 2. *Conservation of natural resources.*—The conservation of our natural resources—land, raw materials, forests, and water—will provide the food, clothing, shelter, and other means of maintaining healthy life, while the conservation of health likewise tends in many ways to conserve and increase

wealth. The more vigorous and long-lived the race, the better utilization it will make of its natural resources. This will be true for two reasons in particular: First, the greater inventiveness or resourcefulness of vigorous minds in vigorous bodies. Civilization consists chiefly in invention and the most progressive nations are those whose rate of invention is most rapid. Second, the greater foresight and solicitude for the future. As it is usually the normal healthy man who provides life insurance for his family, so it will be the normal healthy nation whch will take due care of its resources for the benefit of generations yet unborn.

SUMMARY OF CHAPTER XIV—THINGS WHICH NEED TO BE DONE.

SECTION 1. *Enumeration of principal measures.*—Federal, state, and municipal boards of health should be better appreciated and supported. Their powers of investigation, administration, and disseminating information should be enlarged. School hygiene should be practiced, and personal hygiene more emphasized. The multiplication of degenerates should be made impossible.

INTRODUCTION.

At the conclusion of his White House address on the "Conservation of Natural Resources," President Roosevelt said:

> Finally, let us remember that the conservation of our natural resources, though the gravest problem of to-day, is yet but part of another and greater problem to which this nation is not yet awake, but to which it will awake in time, and with which it must hereafter grapple if it is to live—the problem of national efficiency.

The conditions on which national efficiency depend may be classified under three heads: Those relating to physical environment, those relating to social environment, and those relating to human nature. Under the first head comes the problem of the conservation of land, forests, minerals, and water. The second comprises social questions, whether political, economic, or religious. The third covers the study of the characteristics of man himself—physical, mental, and moral.

This report falls under the third head, concerning as it does vitality, the measure of life itself, and the basis of all human qualities. The object is to review briefly the condition of American vitality, contrasted with the vitality of other nations; to show the extent to which it may be increased; and to point out the value of such an increase in years of life, enjoyment of life, and economic earnings.

The world is gradually awakening to the fact of its own improvability. Political economy is no longer the "dismal science," teaching that starvation wages are inevitable from the Malthusian growth of population, but is now seriously and hopefully grappling with the problem of abolition of poverty. In like manner hygiene, the youngest of the biological studies, has repudiated the outworn doctrine that mortality is fatality, and must exact a regular and inevitable sacrifice at its present rate year after year. Instead of this fatalistic creed we now have the assurance of Pasteur that "It is within the power of man to rid himself of every parasitic disease," as well as the optimistic writings of Metchnikoff and others.

Many evidences of a world-wide awakening to the importance of improving human vitality can be given. Among them are the recent English parliamentary report of the interdepartmental committee on physical degeneration (prompted by the fact that the English army recruits were decreasing in stature); in America, the many societies and congresses to prevent and control tuberculosis, insanity, alcoholism, social diseases and vice, and infant mortality; the growth of preventive sanatoria, dispensaries, and similar institutions; the establishment of numerous journals of preventive medicine, both technical and popular; the increased attention to the subject of health in the public press; the spread of athletics and the physical training movement; the growth of the custom among city people to

organize country clubs, and the increasing popularity of golf and similar recreations; the constant agitation and legislation in reference to child labor, slaughterhouses, impure foods, milk supply, and water contamination; the increased vigilance of health boards; the growth of sick-benefit associations and insurance among working men; the efforts toward improving the sanitary surroundings and hours of labor of workmen, and especially of women and children, and, finally, the movement to secure a national organization of health at Washington.

A number of universities are supporting special investigations in physiology, hygiene, and preventive medicine. Some schools also have placed the allied subjects of domestic science and dietetics on their curricula, while physical education is receiving constantly increasing attention. Within a generation every important college, school, and branch of the Young Men's Christian Association has come to have a gymnasium and classes in gymnastics. Research institutions are being established, such as the Rockefeller Institute for Medical Research, the fund established by Mrs. Sage to study diseases of old age, and the Memorial Institute for Infectious Diseases. The home-economics movement is rapidly growing and seems destined to improve greatly the management of American homes.

The practice of medicine, which for ages has been known as the "healing art," is undergoing a gradual but radical revolution. The change is based on the conviction that an ounce of prevention is worth a pound of cure. As teachers and writers on hygiene, as trainers for athletes, as advisers for the welfare departments of large industrial plants, and in many other directions, physicians are finding fields for practicing preventive medicine. There is a still higher stage of medical science than that of fighting or preventing disease in the individual—the stage which has been called "biological engineering," i. e., the study of the conditions under which the individual may reach his highest efficiency. In the development of this science physicians are turning from private practice to public service and are acting as health officers in federal, state, and city governments, as heads of sanatoria and as medical inspectors of schools, factories, mines, and shops. Even the family physician is in some cases being asked by his patients to keep them well instead of curing them after they have fallen sick.

Finally, we have also the suggestion by Sir Francis Galton of the new science of eugenics, which seeks to study the hereditary conditions of human vitality. He has established a research fellowship on the subject at the University of London. Already Karl Pearson and others have made valuable contributions to the study of human degeneration, the effect of tuberculosis on the race, the comparative number of offspring of various classes, and the extent to which mating is "assortative," so that like marries like.

With all these facts in view it requires no great prophetic vision to see that among the rising generation there will be a great movement to conserve human life and health. The power and success of this movement will depend upon the realization of its stupendous importance. A chief object of this report is, in a conservative and cautious manner, to help make this importance clear.

Part I.—THE LENGTH OF LIFE VERSUS MORTALITY.

Chapter I.—*The length of life.*

Section 1.—*In different places.*

By those who have never considered the problem, death and disease are accepted as a matter of course. In individual cases it is recognized that a death or an illness might have been prevented, but the idea that the death rate could be changed in any appreciable degree, or controlled, is quite foreign to the mind of the average man. Charles Babbage wrote: "There are few things less subject to fluctuation than the average duration of life of a multitude of individuals." [a]

If this statement were correct, we should find the average duration of life [b] and the death rate substantially the same in different places and at different times. The facts do not conform to this view. Modern life tables show that the average length of life in the leading countries of the world varies remarkably, as the following figures will illustrate.[c]

Modern duration of life.

Country.	Males.	Females.
Sweden, 1891–1900	50.9	53.6
Denmark, 1895–1900	50.2	53.2
France, 1898–1903	45.7	49.1
England and Wales, 1891–1900	44.1	47.7
United States (Massachusetts, 1893–1897) [a]	44.1	46.6
Italy, 1899–1902	42.8	43.1
Prussia, 1891–1900	41.0	44.5
India, 1901 [b]	23.0	24.0

[a] Samuel W. Abbott, M. D.: "Vital Statistics of Massachusetts for 1897," Thirtieth Annual Report of the State Board of Health of Massachusetts, 1898.

[b] Statistiques Generale de la France: Statistiques Internationales, etc., 1907, p. 566. See also J. A. Baines, "The Peradventures of an Indian Life Table," Journal Royal Statistical Society, 1908, Vol. LXXI, part 2, p. 310, where the average duration of life for males is given as 23.6.

When we consider that the average duration of life in India is scarcely more than one-half that of France and less than one-half

[a] Charles Babbage: "A Comparative View of the Various Institutions for the Assurance of Lives," p. 15. London, 1826.

[b] By average duration of life or the life span is meant the average length of life among a large number of persons born taken at random. It is not the same as the average age at death in a community during a year, since that community may contain an abnormally large proportion of infants, or of any other "age group."

[c] Some of the figures, especially those for India, rest on imperfect data, but they are believed to be sufficiently accurate for general comparison.

that of Sweden, we must conclude that the length of human life is dependent on definite conditions and can be increased or diminished by a modification of those conditions.

Section 2.—*At different times.*

Striking corroboration of this conclusion is found as soon as we compare the average duration of life at different periods of time. The earliest attempt to discover a law of human mortality appears to be that of Ulpian, a Roman pretorian prefect, about 220 A. D. The meaning of his table is somewhat doubtful, but it is assumed to refer to "expectation of life," which for ages up to 20 is given as thirty years.[a]

This estimate is so crude and vague as to be of little value for comparative purposes. Professor Finkelnburg, of Bonn, estimates that—

> The average length of human life in the sixteenth century was only between eighteen and twenty years, and that at the close of the eighteenth century it was a little over thirty years, while to-day it is between thirty-eight and forty years.[b]

In Geneva the records go back over three centuries showing the following life span:[c]

16th century	21.2
17th century	25.7
18th century	33.6
1801–1883	39.7

Here we see an increase in the span of life of 100 per cent in three or four centuries. The last few decades, moreover, tell a striking story of increase. It is one of the boasts of the nineteenth century that the splendid medical and scientific advances of that period have aided in a distinct lengthening of life.

In 1693 the British Government borrowed money by selling annuities, and in 1790, a century later, it did the same thing. While the first venture proved satisfactory, the second caused a great loss to the Government, owing to the improvement in longevity which had taken place, and which was estimated, for the annuitant class, at 20 years.[d]

If we compare Ogle's English life tables for 1871–1881 with those of Farr for 1838–1854, we find an increase in life span of 1.4 years for males and 2.8 for females.[e]

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[a] See Irving Fisher: "Mortality Statistics of the United States Census," publications of the American Economic Association, Monograph on Federal Census, 1899, p. 157. Taken from Assurance Magazine, VI, p. 314; note.

[b] George M. Kober, M. D.: "Conservation of Life and Health by Improved Water Supply," publications of conference on the conservation of natural resources, 1908, p. 23. Washington, D. C., privately published. From Finkelnburg's "Organisation der öffentl. Gesundheitsphlage in der Kulturstaaten" in Handbuch der Hygiene, 1893.

[c] From Mallet in "Annales d' Hygiene," XVII, 169; quoted by Dr. Edward Jarvis, "Political Economy of Health," in Fifth Annual Report, Mass. Board of Health, 1874.

[d] See Dr. Southward Smith, Transactions British Social Science Association, 1857, p. 498, quoted by Dr. Edward Jarvis, ibid.

[e] R. Mayo-Smith: "Statistics and Sociology," p. 178. New York (Macmillan); 1895.

A still greater improvement has been effected since Ogle's figures of 1871–1881:

Lifetime in England and Wales:	
Males—	
1838–1854	39.9
1891–1900	44.1
Females—	
1838–1854	41.8
1891–1900	47.8

Similar improvements are observable in other countries.

Lifetime in France:	
Males—	
1817–1831	38.3
1898–1903	45.7
Females—	
1817–1831	40.8
1898–1903	49.1
Lifetime in Prussia:	
Males—	
1867–1877	35.3
1891–1900	41.1
Females—	
1867–1877	37.9
1891–1900	44.6
Lifetime in Denmark:	
Males—	
1835–1844	42.6
1895–1900	50.2
Females—	
1835–1844	44.7
1895–1900	53.2
Lifetime in Sweden:	
Males—	
1816–1840	39.5
1891–1900	50.9
Females—	
1816–1840	43.5
1891–1900	53.6

It is difficult to obtain American life tables that go far enough back into history to display increases in the life span similar to those just presented; yet comparisons of Abbott's Massachusetts life tables for 1893–1897 with Elliott's Massachusetts tables for 1855 and Wigglesworth's Massachusetts and New Hampshire life tables of a century ago give us a progressive increase from 35 in 1789 [a] to 40 in 1855 [b] and 45 in 1893–1897.[c] Unfortunately no tables exist for the United States as a whole from which similar comparisons might be made. Good and reliable vital statistics are among our most crying needs. Meech's life tables, based on the census figures of 1830, 1840, 1850, and 1860, showed a life span for the whole country of 42.[d]

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[a] E. Wigglesworth: "Table showing the probability of the duration, the decrement and the expectation of life in the States of Massachusetts and New Hampshire, formed from 62 bills of mortality on the files of the American Academy of Arts and Sciences in the year 1789." Memoir of the American Academy of Arts and Sciences, Vol. II, p. 133.

[b] Proceedings American Association for the Advancement of Science, 1857, pp. 61 and 69.

[c] Abbott, loc. cit.

[d] Levi W. Meech: "System and Tables of Life Insurance," ed. of 1886, pp. 255–259. The figures for life span at different periods given in this paragraph have been secured by averaging the figures for males and females.

The census of 1880 gave some 70 sets of life tables for different registration States and cities. The expectation of life for white males was given for Massachusetts as 44, New Jersey 46, District of Columbia 41, and New York City 33, but in constructing the tables "the census was too prodigal as to quantity and somewhat careless as to quality. It is difficult to separate the wheat from the chaff. The table should have been accompanied by a running criticism. The general defect was that no attempt was made to correct the deficiencies in the returns for infants."[a] The census for 1890 gives only a few life tables, and that for 1900 none.

In striking contrast to these recent increases of the life span in progressive countries is the table for backward India, which showed no advance in twenty years.[b]

Lifetime in India:

Males—	
1881	23.7
1901	23.6

Chapter II.—*The mortality rate.*

Section 1.—*Relation of longevity and mortality.*

The average duration of life and the death rate[c] are two complementary magnitudes. An increase in the life span means a decrease in the death rate, and vice versa; in fact, in a "stationary" population (a population in which the annual number of deaths equals the annual number of births, and without emigration or immigration), it will be true that the average duration of life and the death rate are mathematically the "reciprocals" of each other.[d] Thus, if the death rate is 20 deaths per annum for each 1,000 of population (i. e., twenty one-thousandths per annum), the average duration of life would be $\frac{1}{20}\frac{0}{0}\frac{0}{0} = 50$ years.

If this reciprocal relation between duration of life and mortality held true in every population, it would be easy to translate death rates into average duration of life, and conversely; but unfortunately such a simple calculation is impracticable under conditions existing in America, and even in most countries of Europe. With the exception of France, few countries have even approximately an equality between deaths and births and an absence of emigration and immigration. In America, where the deaths are exceeded by the births, and where there is a large immigration of young men and women in the prime of life, the death rate is smaller than it would be if our population were "stationary." The annual death rate in the United

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[a] Fisher: "Mortality Statistics of the United States Census," American Economic Association Monograph on the Federal Census, 1899, p. 160.

[b] Baines: "The Peradventures of an Indian Life Table," Journal of the Royal Statistical Society, 1908, Vol. LXXL, pt. 2, p. 310.

[c] A death rate is the ratio of the number of deaths during a year to the population, taken at some point in the year, usually the middle.

[d] For a short explanation of this reciprocal relation, which is more fully explained in works on actuarial science, see Fisher: Mortality Statistics of the United States Census, pp. 149–150. It is interesting to see the graphic interpretation of this reciprocal relation by means of the diagram in Chapter XI of this Report.

States is probably about 18 per thousand[a] of population. The reciprocal of this would be 1,000÷18, or 55 years, which is altogether too high an estimate for the average length of life in the United States.

It is possible to "correct" the death rate for "age distribution" so that its reciprocal will be the true average duration of life, but the calculation is a difficult and tedious one. We are forced, therefore, to get along in most cases with the "crude death rate," or the quotient of the number of deaths in a year divided by the population. This figure is much easier to obtain than a corrected death rate or its reciprocal, the average duration of life.

Our data for death rates are far more voluminous than our data for the average duration of life. Although theoretically death rates are not an unerring indication of longevity, they furnish in practice very valuable information. In a general way death rates may be compared with each other, especially in the same community. For instance, a decrease in the death rate in New York City from one year to another is practically a certain indication of improvement in vital conditions.

SECTION 2.—*Mortality in various regions.*

Forty years ago the variations in the death rates of the different sections of Europe were given by Quetelet[b] as follows:

Death rate per 1,000 population.

Northern Europe	24.3
Central Europe	24.5
Southern Europe	29.7

To-day the death rates of various countries compare with each other as in the following table:

Modern death rates per 1,000 of population.[c]

Denmark (1906)	13.5
Sweden (1906)	14.4
England and Wales (1906)	15.4
United States (registration area) (1907)	16.5
Germany (1905)	19.8
France (1906)	19.9
Italy (1906)	20.8
Japan (1905)	21.9
India (males,[d] 1901)	42.3

As we found in the study of duration of life, so we find here wide variations from country to country. Italy presents a death rate larger by nearly one-sixth than that of the United States, while famine-tortured and plague-ridden India's mortality rate is twice that of France and three times the rates of Denmark and of Sweden.

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[a] W. F. Willcox: "Death Rate of the United States in 1900," publications of the American Statistical Association, Vol. X, p. 155.

[b] Quetelet, Physique Sociale, Vol. I, p. 281. These figures refer to the experience of different periods between 1801 and 1831.

[c] With the exception of the figures for India, this table is taken from figures furnished by the Bureau of the Census.

[d] Baines, loc. cit., p. 310.

Even the fairly homogeneous population of our registration States in America shows variations in death rates.[a]

Death rate per 1,000 population in 1900.

Michigan	13.9
Vermont	17.0
Massachusetts	17.7
New York	17.9

The death rate in Michigan, at the one extreme, is thus but three-fourths that of New York at the other extreme. This difference may probably be accounted for in part by the difference in the age constitution, as the population for Michigan contains a larger proportion of population in young and vigorous life than does New York.

SECTION 3.—*Urban and rural mortality.*

Comparison of urban and rural death rates also gives us variations.[b]

Death rates per 1,000 population in 1900.

Massachusetts:	
Urban	17.9
Rural	17.1
Michigan:	
Urban	15.3
Rural	13.3
New Jersey:	
Urban	18.8
Rural	15.5

Interesting comparisons may be made of the death rates of American cities varying in size and location. The death rate per 1,000 of population in 1906 was given [c] as 14.2 (probably incorrect) in Chicago, in Boston 18.9, in New York 18.6, and in Philadelphia 19.3. Cleveland, Ohio, was credited with a death rate of but 16, while Cincinnati, in the same State, had 20.8. The causes of such differences are not always attributable to variations in size. New Haven, for instance, a larger Connecticut city than either Hartford or New London, had a lower death rate in 1900 by 2.2 and 2.5, respectively, per 1,000 population. The differences are accounted for partly by differences in age constitution, partly—it is unfortunately true—by differences in the accuracy of the collected statistics, partly by differences in size and location, and partly by differences in the vigilance of the public and private health authorities.

European cities show even greater variations in mortality than these just given for the United States.

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[a] Twelfth Census of the United States, Vol. III, p. LVIII.
[b] United States Census Bulletin, No. 83, 1901.
[c] Seventh Annual Census Report on Mortality Statistics, 1906.

Death rates of European cities per 1,000 population, 1897.[a]

Locality.	High.	Locality.	Low.
Dublin	39.9	Frankfort on the Main	15.6
Moscow	36.9	The Hague	16.2
Belfast	31.3	Berlin	17
St. Petersburg	31	Amsterdam	17.8

[a] One must doubt, however, the accuracy of some of these figures, especially the Russian. The rates in Moscow and St. Petersburg in 1906 are reported as 25.8 and 25.5, respectively, which do not comport with the rates for 1897.

Section 4.—*Race and condition.*

The variations in death rates among different races are well known. The black race, for example, always suffers a higher mortality than the white. In Boston during the half century from 1725 to 1774 the death rate per 1,000 is given as ranging from 56 to 87 for the blacks and only from 30 to 41 for the whites. Thus the maximum white death rate was lower than the minimum black death rate.[a]

In 1906 the death rate per 1,000 in all registration cities having not less than 10 per cent colored inhabitants was 17.2 for whites and 28.1 for blacks.

These racial differences may be ascribed in part to different habits and conditions of life, but probably in part also to varying racial susceptibility to disease.

The relation of social status to the rate of mortality has been often discussed and offers a partial explanation of racial or national variation of death rate. That a well-to-do class, properly fed and clothed and with opportunity for leisure, will be less susceptible to disease and death than a poverty-stricken class, ill-fed and overworked, has been repeatedly shown by statistics. Newsholme has stated,[b] for example, that in Glasgow the death rate among tenants of large houses is much lower than among the tenants of smaller dwellings:

	One and two room houses.	Three and four room houses.	Five rooms and over.
Death rate per 1,000 occupants in 1885	27.7	19.5	11.2

In Paris comparison has been made between two quarters known to be rich, on the one hand, and, on the other, a third quarter known to be poor.

Death rate per 1,000 population.[c]

Rich quarters:	
Elysee	13.4
Opera	16.2
Poor quarter:	
Menilmontant	31.3

[a] Lemuel Shattuck, "The Vital Statistics of Boston," p. xiii. Reprinted in "Bills of Mortality, 1810–1849," city of Boston, 1893.

[b] Arthur Newsholme, "Vital Statistics," London (Swan Sonnenschein), 1899, p. 163.

[c] E. Levasseur, "La Population Francaise," Paris, 1891, Vol. II, p. 403.

In Russia a similar comparison has been made between peasants who own no land, those who own less than 13½ acres, those who own between 13½ and 40½ acres, and so on up the scale of proprietorship.[a]

Peasant death rate per 1,000, Government of Voronezh, 1889–1891.

Class of household.	Per 1,000.
Having no land	34.7
Having less than 13.5 acres	32.7
Having 13.5 and less than 40.5 acres	30.1
Having 40.5 and less than 67.5 acres	25.4
Having 67.5 and less than 135 acres	23.1
Having more than 135 acres	19.2

Occupational comparisons are often made; and while they must be handled with great care, especially because of differences in age, the following may be said to display roughly the variations in death rate among social classes.

Death rate of males per 1,000, according to occupations, for registration States, 1900.[b]

Mercantile and trading	12.1
Clerical and official	13.5
Professional	15.3
Laboring and servant	20.2

Special industries have high death rates from special diseases. Among dusty trades, for instance, tuberculosis is very common.[c]

Finally, the experience of industrial life-insurance companies, which deal largely with the poorer classes of society, shows a higher death rate than that displayed by the experience tables of other insurance companies.[d]

Insurance mortality per 1,000.

Age.	Ordinary insurance, English experience.	Industrial insurance, Metropolitan Life.
20	7.3	10.5
25	7.8	14.1
35	9.3	17.2
55	21.7	35.2
70	64.9	91.0

We find also great variations in death rates dependent on varying climatic or seasonal conditions, on the prevalence or absence of certain pests, on the fluctuating virulence of specific diseases, and on numerous natural differences. Other significant factors in mortality are historical events, such as wars, plagues, and epidemics. Hard times bring increased mortality, whether due to natural or politico-economic causes. There remain to be mentioned also deaths by accident in all its many forms.

[a] I. M. Rubinow, "Poverty's Death Rate," publications of the American Statistical Association, December, 1905, p. 348.

[b] "Twelfth Census of the United States," Vol. III, p. cclxi.

[c] See Frederick L. Hoffman, "Mortality from Consumption in dusty trades," Bulletin No. 79 of the U. S. Bureau of Labor.

[d] Haley Fiske, "Industrial Insurance," The Charities Review, March 1898, p. 33.

Section 5—*Mortality historically.*

Not only does the death rate vary greatly from place to place and from one social class to another, but it changes in a most marked fashion from period to period in history. The records of old cities show that a decided decrease in mortality has been steadily going on. In London, for example, the rate per 1,000 has fallen from 50 in 1660–1679 to 15 in 1905, a decrease of 70 per cent. In the plague years, 1593, 1625, 1636, and 1665, the death rates per 1,000 were 240, 310, 130, and 430.[a] The "black death" in 1348–9 probably swept away half of the population in many localities throughout Europe.[b]

Mortality in London.[a]

Year.	Rate per 1,000.
1660–1679	50
1680–1728[b]	80
1729–1780	40
1905	15.1

[a] Kober, *loc. cit.*, p. 25.
[b] These years include the period of pests.

Within a quarter century London has cut her death rate in half, while Vienna, if we may trust the figures, has within a century reduced her rate from 60 per 1,000 of population to 23.[c] Similarly, the mortality rate in Boston has been lowered from an estimated 34 per 1,000[d] in 1700 to 19 to-day.

Mr. John K. Gore, actuary of the Prudential Insurance Company, shows[e] that the average death rates per 1,000 of population among typical American cities was, for the white population, as follows:

Years.	Death rate per 1,000.
1804–1825	24.6
1826–1850	25.7
1851–1863	28.3
1864–1875	25.4
1876–1888	22.9
1889–1901	21.0

The record even of the last thirty years displays a fall in death rates that may inspire us with buoyant hope for the future. The mortality rate per 1,000 has fallen in Berlin from 33 in 1875 to 16 in 1904; in Munich, from 41 in 1871 to 18 in 1906; and in Washington, from 28 in 1875 to 19 in 1907.[f]

Between 1890 and 1906 New York lowered her death rate per 1,000 from 25.4 to 18.6, and Boston from 23.4 to 18.9. The mortality rate in the whole registration area of the United States fell from 19.6 per 1,000 in 1890 to 16.1 in 1906, although the area in the last-named year included a larger proportion of urban population.

[a] See Farr, "Vital Statistics," London, 1885, p. 131.
[b] See Abbot Gasquet, "The Black Death of 1348 and 1349," London (Bell), 1893.
[c] A. F. Weber, "The Growth of Cities," New York, 1899, pp. 355, 356.
[d] Shattuck, *loc. cit.*, pp. xii-xiv.
[e] "On the Improvement in Longevity in the United States during the Nineteenth Century."
[f] Kober, *loc. cit.*, p. 25.

We have also vital records for the city of Habana, running back over a century. These show that while the death rate in 1802 was given as 54.6 per 1,000, rising in cholera years even as high as 103.4 (1833) and in the last year of Weyler's concentration methods as high as 91, the rate during the eight years from 1899–1906 ranged from 20.4 to 33.6.[a]

These records also show the remarkable and sudden fall that may be brought about by a change in the living conditions of a community. During the three "concentration" years of 1896, 1897, and 1898 the mortality rate per 1,000 was 51.7, 78.7, and 91, respectively. In 1899, the first complete year of American occupation, the rate dropped to 33.6, and since then it has ranged between 20.4 and 24.4. There can be no question that the improvement was almost wholly due to the sanitary reforms introduced by Colonel Gorgas, and the other United States Army surgeons under Gen. Leonard Wood.

The record of American Army sanitarians in the Panama Canal Zone shows as striking results as in Cuba. The death rate in Panama during 1887, when the French canal companies held occupation, ran over 100 per 1,000. In 1906 the death rate was 49 per 1,000, while in 1907 it fell to less than 34. Colonel Gorgas attributes the decrease in the general death rate in great part to improved sanitation, though he adds that "increased wages, better food, and better clothing have no doubt played a considerable part in the general improvement of the health."[b]

Section 6.—*Adult and infant mortality.*

Mortality varies greatly with age. The improvement in the city death rate of the past half century has been especially marked among the young.

It is true that in countries of the same degree of civilization the infant death rate is remarkably constant,[c] but this is probably accounted for by the similarity in the methods of feeding of infants. Certainly where there is a difference in conditions there will be found a difference in mortality. Thus, the comparison between the mortality of infants fed on cow's milk and those fed on mother's milk shows that the former is five to ten times that of the latter.[d]

Although the infant mortality rate is probably falling,[e] the decrease is not accompanied by a lowering of the mortality of later life. There is an increased mortality beyond the age of 50 years. In Massachusetts the death rates by age changed during thirty years as follows:

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[a] "Report of the National Sanitary Department of the Republic of Cuba," Habana, 1906, p. 78.

[b] Letter from Col. W. C. Gorgas, chief sanitary officer, Canal Zone.

[c] See E. B. Phelps, "A Statistical Study of Infant Mortality," quarterly publication of the American Statistical Association, September, 1908. Mr. Phelps shows the utter unreliability of most statistics of infants under 1 year of age, especially in the United States.

[d] See Harald Westergaard, "Mortalität und Morbilität," Jena, 1901, p. 364.

[e] Edward E. Graham, M. D., "Journal of the American Medical Association," September 26, 1908; also "British Medical Journal," February 1, 1908, p. 271.

Death rate in Massachusetts per 1,000 of population in each age period.[a]

Age.	1865.	1895.
5–9	9.6	6.2
10–14	5.1	3.2
15–19	9.6	5.3
20–29	12.6	7.1
30–39	11.7	9.7
40–49	12	13
50–59	17	20
60–69	33	39
70–79	70	82
80 and upward	168	185

[a] "Vital Statistics of Massachusetts," 1856–1895, p. 755.

Here, while the death rate for all age periods under 40 has materially decreased, the later periods of life have suffered progressive increases in mortality rate.[a]

As Frederick L. Hoffman has expressed it:

> There is, of course, no question whatever that the American death rate, using the term in a very comprehensive sense, has substantially declined within the last fifty years, but it is equally evident that this decline has been at the younger ages, and not during the period of life which, economically, is of the greatest value. There is no doubt that the mortality of adult ages is still decidedly excessive.

The same tendency, viewed from the standpoint of the expectation of life,[b] is disclosed in the study of two Massachusetts life tables, compiled nearly a century apart—one, Wigglesworth's life tables for Massachusetts and New Hampshire in 1789, though not very accurate; the other, Abbott's Massachusetts life tables for 1893–1897.

Expectation of life in Massachusetts.

Age.	1789.	1897.	Age.	1789.	1897.
0	35.5	45.4	60	15.4	15.1
10	43.2	50	80	5.9	6.1
20	34.2	42	90	3.7	3.4
40	26	28.2			

These figures indicate that the expectation of life at the earlier ages is much greater than a century ago, but that for the age of 60 and upward it has remained practically stationary.

[a] At first sight it would seem that this increased mortality in later ages could be explained away as due to the larger number of persons who are saved from earlier death and tend to produce a higher mortality at the older ages. I speak of this because very intelligent persons have drawn this conclusion. But it is obviously fallacious, since the figures do not indicate the *number* of deaths in different periods, but the death *rates* in different periods of life per 1,000 at each period. There are, to be sure, as a consequence of saving lives in the past, more old men now living than otherwise there would be, and there will be more deaths, but the figures show that these old deaths have increased faster than the number of old men. This fact raises the suspicion, therefore, that the lives which have been saved by the hygiene of a generation ago are weak lives. Whether this is a tenable hypothesis or not will be discussed in Chapter X.

[b] "Expectation of life" at any given age is the mean after-lifetime of persons who reach that age. Thus 100 persons have an expectation of life of 50 at the age of 10, if the total life to be lived by those 100 persons before death is five thousand years.

English life tables [a] for three decades ending 1900 display the same tendency.

English life tables—Expectation of life.

MALES.

Age.	1871–1880.	1881–1890.	1891–1900.
0	41.4	43.7	44.1
20	39.4	40.3	41
60	13.1	12.9	12.9
80	4.8	4.5	4.6

FEMALES.

0	44.6	47.2	47.8
20	41.7	42.4	43.4
60	14.2	14.1	14.1
80	5.2	5	5.1

These tables show that there is improvement at the younger ages for the period 1891–1900 over the period 1871–1880. For ages over 60 there has been a retrogression. It is observable, however, that between the periods 1881–1890 and 1891–1900 the figures for 60 years have remained stationary, and for 80 have slightly improved.

In other words, a baby to-day has in prospect a much longer average lifetime than did the baby of two generations ago; but a man or woman 60 years old has in prospect an average after lifetime no greater than formerly.

The proximate cause of this contrast would seem to lie in the fact that the mortality from many of the diseases of later life has been and is on the increase. The death rates from diabetes, heart disease, and Bright's disease have all doubled in thirty years.[b]

Cancer is probably on the increase,[c] and "to-day one in every 21 men who have reached the age of 35 and one in every 12 women who have reached 35 eventually die of that disease."[d]

In addition, there may be mentioned other diseases, arteriosclerosis, nephritis, apoplexy, paresis, disorders of the liver, and all manner of degeneration, all of them maladies of adult life, and all of them apparently tending to increase.

SECTION 7.—*Particular diseases.*

We turn now to the ravages made by particular diseases in the modern world. The death rate in the United States from tuberculosis of all forms equals the combined death rate from smallpox, typhoid fever, diphtheria, cancer, diabetes, appendicitis, and meningitis.

[a] "Supplement to Sixty-fifth Annual Report Register-General of England and Wales," pt. 1, 1907, p. XLVIII–LI.

[b] Norman E. Ditman, M. D., "Education and its Economic Value in the Field of Preventive Medicine," Columbia University Quarterly, Supplement to June, 1908, p. 38.

[c] Elie Metchnikoff, "The Nature of Man," English translation, New York (Putnam), 1903, pp. 213, 214; see also "United States Census mortality statistics, 1906," p. 29.

[d] Ditman, loc. cit., p. 38.

The death rate from tuberculosis of all kinds in the registration area was 183.6 per 100,000 in 1907.[a] The rate is high among negroes.[b] Large as these figures are, they represent a considerable decrease since 1900.[c] Tuberculosis is a preventable disease.

On a par with tuberculosis in the number of its victims in this country stands pneumonia.

The mortality statistics of the last census show that in the registration area of the United States pneumonia is responsible for 11 per cent of all deaths. Pneumonia is now known to be a communicable disease, the germ of which is very widely distributed; but there is great need for special researches into the modes of spreading this formidable disease. In the meantime the best protection is to "keep in condition." While the germ of pneumonia is the exciting cause of the disease, predisposing causes are acute or chronic alcoholism, exposure to cold, extreme exhaustion, and debility of any kind.

Typhoid fever is in some places yielding to preventive measures in a most striking manner. The fall in the death rate from typhoid in the registration area from 46.3 per 100,000 of population in 1890 to 33.9 in 1900,[d] and to 32.1 in 1906,[e] may be safely ascribed to improvements in the water and milk supplies of our cities. The surprising reduction of the typhoid-fever death rate in individual cities, resulting from definite improvements in the water supply, gives direct confirmation of this statement.

The typhoid mortality in Munich during 1856 was 291 per 100,000 of population. The city at that time contained numerous cesspools, and the water supply was largely obtained from wells and pumps. From 1856 to 1887 there was great activity in the filling up of cesspools, the abandonment of pumps and wells, and the installation of modern sewers. A pure water supply was also secured, the water being brought from a distance. The typhoid-fever death rate fell in 1887 to 10 per 100,000 of population—a reduction of 97 per cent.[f]

In Hamburg the typhoid mortality for 1880–1892 ranged from 24 to 88, averaging 39.7 per 100.000. In May, 1893, a filtration plant was opened, and the rate fell in that same year to 18. For the five years following it averaged only 7.2, showing a reduction of over 80 per cent.[g]

The introduction of a water filter in the town of Lawrence, Mass., in 1893 was followed by a reduction in deaths caused by typhoid from 105 in 1892 to 22 in 1896, one-fifth the previous figure. Filter-

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[a] For a careful statistical study of tuberculosis see "Tuberculosis in the United States," United States Census, issued for the International Congress on Tuberculosis, 1908. See also "Bulstrode's Report in Thirty-fifth Annual Report of (English) Local Government Board, 1905–6," and Arthur Newsholme, M. D., "Prevention of Tuberculosis," 1908.

[b] For the prevalence of tuberculosis in the negro, see F. L. Hoffman's valuable monograph, "The American Negro," publications of the American Economic Association, August, 1896.

[c] This decrease is shown by the exact figures (not estimated) in the registration area.

[d] Twelfth Census of the United States, Vol. III, p. cxliv.

[e] Mortality Statistics, U. S. Census Office, 1906, p. 30.

[f] Ditman, loc. cit., p. 17.

[g] A. C. Abbott, M. D., "The Hygiene of Transmissible Diseases," Philadelphia, Saunders, 1899, pp. 88–89.

ing the city water in several other American cities has shown abrupt declines in the typhoid death rate almost as remarkable.[a]

Another method of pointing out the importance of a pure water supply is to compare the mortality rates from typhoid fever of cities that secure water from various sources of supply, as the following table shows:[b]

Death rate from typhoid fever per 100,000 of population, 1902–1906.

4 cities using ground water from large wells	18.1
18 cities using impounded and conserved rivers or streams	18.5
8 cities using water from small lakes	19.3
7 cities using water from Great Lakes	32.8
5 cities using surface and underground water	45.7
19 cities using polluted river water	61.1

Thus far our studies indicate that typhoid fever will cease to be a "problem" in any community having clean water and an uninfected milk supply, and in which cases of the disease are treated as dangerous and contagious."[c]

Unfortunately such communities are too rare at present.

Perhaps the most common and neglected source of danger of infection from typhoid is the ordinary house fly or, as Dr. L. O. Howard, chief of U. S. Bureau of Entomology, would have us call it, the "typhoid fly."

Smallpox, another disease that yields readily to preventive measures, has decreased greatly in virulence and mortality since the introduction of vaccination. In Prussia, for example, the death rate from smallpox per 100,000 population was 24.4 in the period from 1846–1870. In 1874 vaccination, which up to that time had been only intermittently utilized, was made compulsory, and the death rate per 100,000 fell at once to 1.5 for the years 1875–1886.[d]

Other European States, however, have been more lax than Germany. In 1886 the death rate from smallpox in Switzerland was fifty-fourfold that of Germany; in Belgium, forty-eightfold; in Austria, eighty-onefold, and in Hungary, six hundred and sevenfold.[e]

Babbage[f] states that "it has been shown by M. Duvillard that the introduction of vaccination has increased the mean duration of human life about three years and a half." Before Jenner's utilization of vaccination to guard against smallpox that disease was causing one-tenth[g] of all deaths of the human race, just as does tuberculosis to-day, while "nearly twice as many were permanently disfigured by its ravages. In England 300 per 100,000 population died annually from it. It is computed that during the eighteenth century 50,000,000 people died of smallpox in Europe."[h]

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[a] See Kober, loc. cit., pp. 18, 19.

[b] Kober, loc. cit., p. 15.

[c] M. J. Rosenau, L. L. Lumsden, and Jos. H. Kastle, "The origin and prevalence of typhoid fever in the District of Columbia," Hygienic Laboratory Bulletin No. 44, 1908, p. 9.

[d] Ditman, loc. cit., p. 8.

[e] Floyd M. Crandall, "A century of vaccination," American Medicine, December 7, 1901.

[f] Loc. cit., p. 8.

[g] Crandall, loc. cit., p. 6.

[h] Ditman, loc. cit., pp. 6, 52–3.

Boston was visited twelve times by smallpox epidemics in the century and a half ending 1800.[a]

Yet where vaccination has been made compulsory, or where it is generally resorted to, smallpox has virtually disappeared. The last census reported but 3,500 deaths from smallpox in the United States in 1900. Even as long ago as 1826 Denmark was enforcing the practice of vaccination so vigorously that not a single case had appeared for eleven years.[b] Habana, during the eight years prior to the American intervention, reported 3,132 deaths from smallpox. In 1899, the year following the American entry, there were four deaths, and three more during the next seven years—a virtual uprooting of the disease.[c]

The present outcry against vaccination is based on a misunderstanding, and is one of many evidences of the imperative necessity of the diffusion of correct knowledge among the people on matters of hygiene and preventive medicine. Whether vaccination should be made compulsory is a fair question, but that it is efficacious is not open to question. The argument that because some unvaccinated persons escape during an epidemic all would escape is too absurd to deserve serious consideration.[d]

Yellow fever first appeared in serious form at Philadelphia in 1793, when one-tenth of that city's population died of it in the space of six and a half weeks. Since 1793 the United States has had 500,000 cases, resulting, it is estimated, in about 100,000 deaths. In 1900 it was discovered that a species of mosquito is responsible for the transmission of this fever, and in consequence of this knowledge and its application the disease is now practically banished from this country.[e]

The marked decrease in the death rate from yellow fever in Habana since the American intervention in 1898 is shown in the following table. The deaths from yellow fever numbered 4,420 in the eight years from 1891 to 1898, while in the eight years from 1899 to 1906 they numbered but 465.

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[a] Shattuck, loc. cit., p. xiv.

[b] Crandall, op. cit.

[c] Report of National Sanitary Department of the Republic of Cuba, Habana, 1906, p. 79.

[d] For the most scientific statistical studies of vaccination see W. R. Macdonnell, Biometrika, Vol. I, 1902, p. 375, and Vol. II, 1903, p. 135. J. Brownlee, Biometrika, Vol. IV, 1905–6, p. 313. F. M. Turner, Biometrika, Vol. IV, p. 483. Karl Pearson, Biometrika, Vol. IV, and Philosophical Transactions of the Royal Society of London, Series A, Vol. 195, p. 43. Humphreys, Journal of the Royal Statistical Society, 1897, p. 503. For the best of antivaccination literature see Alfred Russell Wallace, "The Vaccination Delusion," and Milnes, Journal Royal Statistical Society, 1897, p. 552 (Comment by G. U. Yale, p. 608). For both sides see Report of the Royal Commission on Vaccination, 1897.

[e] Ditman, loc. cit., pp. 11–12.

Yellow-fever death rate in Habana, 1870–1906.

[Rate per 100,000 population.[a]]

Before American intervention.		After American intervention.	
1870	300.5	1898	67.8
1880	324.5	1899	42.5
1890	153.6	1900	124.0
1895	275.8	1901	6.9
1896	639.5	1902	0
1897	428	1903	0
		1904	0
		1905	8.0
		1906	4.3

[a] Report of the National Sanitary Department of the Republic of Cuba, 1906, p. 79.

These results have been due partly to the elimination of the contagion-carrying mosquito and partly to the general improvement of the city's sanitary appointments.

A similar contrast might be drawn between the death rates from yellow fever at Panama during the efforts of the French to dig the canal and during the American work under the sanitary regulations of Colonel Gorgas. If the same thoroughgoing measures used in Habana and at Panama were employed among our own people, the resultant blessings would be almost equally striking.

The impressive figures just presented, showing the fall in mortality from so many of the most dangerous diseases, point clearly to the value of preventive measures in the conflict with disease. The fall in tuberculosis mortality is directly due to the growing use of hospitals, which have tended to isolate[a] consumptives, and to a use of our recently acquired knowledge of the efficacy of fresh air and the outdoor life; typhoid fever has virtually disappeared when water and milk supplies have been made pure, the open privy abolished, and flies and other carriers of the specific cause of the disease have been provided against; smallpox has given way before vaccination; yellow fever is fast disappearing now that the agent of transmission is known; while many of the less serious diseases are losing their power, purely owing to preventive methods.

Some diseases, once the scourges of humanity, have practically disappeared from the civilized world.

Scurvy up to the latter half of the eighteenth century decimated the armies and fleets of Europe and afterwards proved a menace to the civilized population. During Anson's famous expedition about the year 1750, 600 out of 900 died, chiefly from scurvy. The use of lime juice and fresh vegetables has practically eradicated the disease.[b]

"Cholera was wont to visit the cities of the Atlantic coast in the past about every ten years, and it was a standing menace to the world every summer. It was not uncommon for the disease to decimate whole towns and cities. Since the discovery of its cause, however, it has been robbed of its terrors, and the children of to-day will probably never know of it except by name."

Malaria has been on the decrease ever since the discovery that the malarial organism is transported by a species of mosquito. Even the

[a] See Arthur Newsholme, "The phthisic death rate," Journal of Hygiene, July, 1906.

[b] Ditman, loc. cit., 14–15.

five years ending 1906 show a progressive decline in the death rate from malarial fever in the registration area. The figures are 5.4, 4.3, 4.2, 3.9, and 3.5 deaths per 100,000 of population, for the five years in question. In themselves, the figures are so small as to show the virtual disappearance of the disease, at least from the Northern States. It is still very common in the Southern States. Its evil is by no means to be measured by the deaths it causes. It produces chronic disability and predisposes to other diseases.[a]

Finally, the furnishing of pure milk to the infant population of the cities is eliminating year by year the infant scourges—diarrheal diseases and related maladies.

There are of course diseases which show no sign as yet of decreasing. The census volume, "Mortality Statistics of 1906" (p. 29) gives only one important disease (diabetes) as actually on the increase within the registration area, but several which are given as having "fluctuating rates," such as cancer, heart disease, and Bright's disease, seem still to have an upward trend.

It is known that malaria is preventable. Why, then, is it not prevented in the South? Probably for two reasons. First, the facts are not generally known, owing to lack of vital statistics in the Southern States. Second, owing largely to this ignorance no adequate effort has yet been made. As an example of what can be done we have the cleaning of Habana by Colonel Gorgas. The following table, supplied by him, shows the deaths from malaria from 1899 to 1907:

Year.	Number of deaths.	Year.	Number of deaths.
1899	909	1904	44
1900	325	1905	32
1901	151	1906	26
1902	77	1907	[a] 23
1903	51		

[a] Annual Report of the Sanitary Department for the City of Habana for the year 1907.

"The first year quoted, 1899, the malarial deaths were excessive, owing to the crowding into the city of the 'reconcentrados' and the starvation and misery thereby involved.

The next year, 1900, was about the normal rate. The next year, 1901, begins to show the effect of the antimalarial work done in connection with the yellow-fever work; 1901 was the first year of mosquito work in Habana. The last year, 1907, shows only 23 deaths from malaria. This means practically the extinction of malaria in Habana. The item of 23 deaths in 1907 from malaria would probably be covered by the malarial cases coming in from the rural districts and by mistakes in diagnosis."

The preventability of accidents is beginning to be appreciated. It is now proposed by Mr. W. H. Tolman to establish in New York a museum of safety and sanitation to demonstrate this fact. Mr. Frederick L. Hoffman, statistician of the Prudential Insurance Company, estimates the number of deaths among male workers alone in 1908 as between 30,000 and 35,000.[b]

[a] See "Report to the Conservation Commission" of L. O. Howard. "Economic loss to the people of the United States through insects that carry disease."

[b] "Industrial accidents," Bulletin of the Bureau of Labor, 1908.

Part II.—THE BREADTH OF LIFE VERSUS INVALIDITY.

Chapter III.—*Prevalence of serious illness.*

Section 1—*Loss of time.*

Length of life is but one indication of vitality. Everyone recognizes that the life of a valetudinarian or an invalid, however long, is but a narrow stream. We may therefore conceive, besides the dimension of length, another dimension of life which may be called its "breadth." By the breadth of life we mean its healthiness. Just as length of life is limited by and opposed to mortality or death, so breadth of life is limited by and opposed to invalidity or illness.

An ideally healthy life, free throughout from ailment and disability, is rarely if ever found. But it is the aim of hygiene to approximate such an ideal. Some persons imagine that length of life can be purchased only at the expense of breadth, and counsel the deliberate shortening of one's life for the sake of living it faster. In exceptional cases such a policy may be justified, but the study of longevity reveals the fact that, as a rule, length and breadth of life are not opposed, but that, on the contrary, the one can seldom be increased without an increase of the other. Centenarians are usually persons who have been exceptionally free from illness[a] and who have performed a large amount of work. This work is usually physical labor out of doors, although the few mental workers completing the century have also lived busy lives.

Chevreul, the distinguished French chemist who died twenty years ago at the age of 103, lived a life of great activity and usefulness as laboratory experimenter, as industrial chemist, as university professor, and as a writer and lecturer. It was said of Alexander Von Humboldt, who was 90 at the time of his death, that he had not only lived twice as long as others in years, but that in work accomplished he had lived twice as much per day, thus enjoying four times the average lifetime.

It is shortsighted to spend more vitality each day than we earn. Such a policy must not only prove suicidal sooner or later, but tends to narrow one's life in every way long before the arrival of death. The ordinary individual burns the candle at both ends. The result is an almost universal invalidism in some degree. While statistics are lacking, a wide observation seems to justify the conclusion that it is difficult to find a man or woman over 40 whose health has not become impaired in some manner. Few who have not studied the facts realize how common illness is, although we all know it is sufficiently common to make the question "How are you?" the ordinary form of salutation.

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[a] Metchnikoff, "The Prolongation of Life," English translation, New York, (Putnam's) 1908, p. 145.

Serious illness is such as totally incapacitates a person from work, whether or not he is confined to his bed. The burden of serious illness is felt in several distinct ways. There is the annual idleness entailed by this illness, the cost of maintaining institutions devoted to the care of the sick, and the cost to the individual of medicines, medical service, and nursing.

The amount of invalidity or illness in a community has been estimated by a number of different investigators, and in a number of different ways. While the results vary somewhat, on the whole they harmonize fairly well.[a]

The most careful consideration of the various illness statistics available was made by Farr. He finds that the rate of invalidity increases with age, and at the later ages increases with great rapidity. The material he has used has come chiefly from various friendly societies in Great Britain and Scotland, and especially from the East India Company. His final conclusion is probably nearly as valid to-day as then. It is that corresponding to each death in a community, there are a little more than two years of illness.

Another way of expressing the same fact is that for each annual death, there are on the average two persons constantly sick during the year. Applying this estimate to the United States,[b] in which about 1,500,000 persons die per annum, there are probably at all times about 3,000,000 persons seriously ill. This means an average of thirteen days per annum for each inhabitant.[c]

Returns gathered from 79 benefit societies in Scotland, aggregating over 100,000 members, and based on the experience of various periods between 1750 and 1821, showed that the average duration of sickness for each member under seventy years of age was ten days per year, 2 of which were assumed to be "bedfast" days, five as days of walking sickness, and three as days of permanent sickness.[d]

Section 2—*Particular diseases.*

It has been estimated that the number of persons in the United States constantly suffering from tuberculosis reaches 500,000. Of this number probably about half are totally incapacitated, while the remainder are able to earn about half of the ordinary wages.[e]

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[a] See Farr, Vital Statistics, London, 1885, pp. 501–514. Harald Westergaard, Mortalität und Morbilität, Jena, 1901, p. 683. See also a pamphlet by Hiram J. Messenger, actuary of the Travelers' Insurance Company, Hartford "The Rate of Sickness;" Pettenkofer, quoted by Uffelman, Handbuch der Hygiene, p. 3. Edwin Chadwick, "The Health of Nations," ed. by B. W. Richardson, 2 vols. (Longmans), London, 1887, Vol. I, p. 57; Mayo-Smith, "Statistics and Sociology," New York, (Macmillan) 1895, p. 158; "Statistische Jahrbuch für das Deutschen Reich, 1908," pp. 304–305.

[b] Judging from the experience of sickness insurance, there is more sickness in the United States than in England. See Dr. Edward Jarvis, "Political Economy of Health," Fifth Report of Mass. Board of Health, 1874. Dr. Jarvis also points out that estimates of illness are based on experience of provident persons among whom illness is a minimum, and that the estimates of illness take no account of chronic ailments or "decrepitude."

[c] Farr, Vital Statistics. p. 513.

[d] Edwin Chadwick, "The Health of Nations," vol. 1, pp. 56–57.

[e] Irving Fisher, "The Cost of Tuberculosis in the United States and Its Reduction," paper read before International Congress on Tuberculosis, Washington, 1908; see also Huber, "Consumption and Civilization," Philadelphia, 1906; and Bardswell, "The Consumptive Workingman," London, 1906.

For every death from typhoid fever, there are about 8 cases of illness, averaging seventy-five days of incapacity. But this is not the only loss. Professor Sedgwick has said, "Hazen's theorem asserts that for every death from typhoid fever avoided by the purification of a polluted public water supply two or three deaths are avoided from other causes. Working under my direction Mr. Scott MacNutt has recently been able to confirm this surprising theorem, and even to establish it as conservative. We have also gone further than Hazen and discovered what the other causes are from which deaths are thus avoided; and, although our results are not yet all published, I may say that conspicuous among these are pneumonia, pulmonary tuberculosis, bronchitis, and infant mortality."[a]

The prevalence of the hook-worm disease in the South has been a matter of investigation for several years by Doctor Stiles[b] of the Public Health and Marine-Hospital Service. The disease is remarkable not so much for its fatality, though that is large, as for the chronic incapacity for work which it produces. For this reason the hook worm has been nicknamed the "germ of laziness." The disease extends over the whole South, and is responsible for a large part both of the sickness (the so-called "laziness") and of the poverty of the "white trash."

There are no satisfactory statistics as to the extent of hook-worm disease; but it has been estimated that the sufferers are incapacitated for labor from one-fourth to one-half of their time. Most striking is the fact that the disease is easily preventable through the introduction of sanitary measures as well as curable by the proper (drug) treatment of the present victims. It has been largely eradicated from Porto Rico.[c] Hook-worm disease weakens when it does not kill and is known to be a precursor of tuberculosis.

Malaria is one of the diseases which are fatal relatively seldom, but which shorten life by predisposing to other causes of death, and narrow life by reducing working efficiency by a large percentage. Doctor Howard states that each year there are probably 3,000,000 cases of malaria in the United States, most of which are in the South. This is practically all preventable.[d]

Dr. Prince A. Morrow says that the number of syphilitics in the United States has been estimated at 2,000,000. This disease is not only in itself a danger, but it also causes a large number of diseases of the circulatory and nervous systems.

Doctor Morrow says that the extermination of social diseases would probably mean the elimination of at least one-half of our institutions for defectives. The loss of citizens to the State from the sterilizing influence of gonorrhea upon the productive energy of the family, and the blighting destructive effect of syphilis upon the offspring are enormous. In the opinion of very competent judges social

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[a] W. T. Sedgwick, "The Call to Public Health," Science, 1908, p. 198.

[b] "Report upon the Prevalence and Geographic Distribution of Hook-worm Disease in the United States," Hygienic Laboratory, Bulletin No. 10, February, 1903, Washington.

[c] "Reports of Commission on the Suppression of Uncinariasis, 1904, 1905, 1906–7, 1907–8, San Juan, P. R." This commission has been succeeded by a bureau, the "Anemia dispensary service."

[d] See L. O. Howard, Report to Conservation Commission, "Economic loss to the people of the United States through insects that carry disease."

disease constitutes the most powerful of all factors in the degeneration and depopulation of the world.

Among the troops stationed in the Philippines, the venereal morbidity during the year 1904 was 297 per 1,000, largely exceeding the morbidity from malarial fevers and diarrhea; 22 out of every 1,000 soldiers were constantly ineffective from venereal diseases, four times as many as from any other disease.

The statistics of the Navy Department show during the same year, that venereal disease was chargeable with a percentage of 25.2 of the total number of sick days in the hospital from all causes combined. In four years 949 men were discharged from the navy for disability from venereal disease. The statistics of the English army show that among the troops stationed in India 537 per 1,000 were admitted to the hospital for venereal disease. Of the troops returning home to England after completing their time of service in India, 25 per cent were found to be infected with syphilis.

No statistics exist for venereal disease in civil life. It may be more prevalent than in the army and navy service, since the inhibitory influence of military restraint and discipline do not exist and the opportunities for licentious relations are more abundant.

Neisser, a distinguished German authority, states that "fully 75 per cent of the adult male population contract gonorrhea and 15 per cent have syphilis."

What syphilis and gonorrhea represent in the lowered working efficiency of our population—to say nothing of the still more important subject of increased mortality—is impossible to estimate; but it would be difficult to overemphasize the grave danger to national efficiency from these and the other venereal diseases. And here again the most striking point is that the venereal diseases are preventable.

Alcoholism and drug addiction are maladies of frightful prevalence. They are so familiar as to be taken by many as a matter of course.

Venereal diseases and inebriety, whether alcoholic or drug, frequently lead to insanity. Statistics are not yet able to prove conclusively that insanity is increasing, though this is the opinion of the best judges.[a]

Dr. C. L. Dana, formerly president of the New York Academy of Medicine, believes the increase in insanity to be real as well as apparent. He says: "The annual increment of insane in Massachusetts, according to the Massachusetts board of lunacy, is 400 in about 10,000, or 4 per cent." At this ratio the annual increment for the United States would be approximately 5,600. "We may say that in the last twenty-five years the ratio of insane to sane has shown an apparent gradual increase from 1 to 450 to 1 to 300, and this latter seems to be about the ratio in those communities of North America and Europe in which modern conditions of civilization prevail. This average has varied but little in the last few years; the slight yearly increase probably will not change rapidly and probably not continue, for when the increase in the insane reaches a certain point of excess society will have to take notice of it and correct it."[b] There are no accurate fig-

[a] For a critical examination of statistical data on insanity, see Humphreys, (Noel, A.), "The alleged increase of insanity," Journal of the Royal Statistical Society, June, 1907.

[b] "Psychiatry in its Relation to Other Sciences," section on psychiatry at the International Congress of Arts and Sciences, St. Louis, September, 1904.

ures of the number of insane. Mr. Sanborn estimates that the number exceeds 250,000 in the United States.

Among defective and disabled classes are to be especially mentioned the feeble-minded, paralytic, crippled, blind, and deaf mutes. The aggregate disability of these groups is greater than is commonly recognized. The preventability is still less appreciated.

With reference to the losses each year from industrial accidents:

The statistical report of the Interstate Commerce Commission for the year ending June 30, 1907, shows that during that year 11,800 persons were killed and 111,000 injured on our American railways, these figures including passengers, employees, and all other persons. A large number of the victims were railway employees, for whose safety Congress has passed a number of laws. The total number of cases of industrial accidents can not be estimated, owing to the lack of statistical information; but Census Bulletin 83 gives the number of deaths by accident and violence in 1900 at 57,500.

" Of 29,000,000 workers in the United States over 500,000 are yearly killed or crippled as a direct result of the occupations in which they are engaged—more than were slain and wounded throughout the whole Russo-Japanese war. More than one-half this tremendous sacrifice of life is needless." [a]

Mr. Frederick L. Hoffman estimates [b] that the number of accidents among men employed in the United States in 1906 was 208,000, of which about 5,000 were fatal. These figures are exclusive of mining, railway, and shipping accidents.

John Mitchell [c] estimates that for every 100,000 tons of coal produced in the United States one mine worker is killed and several injured. In 1907 the figures were 2,500 coal miners killed and 6,000 seriously injured.

In Wisconsin from October 1, 1906, to October 1, 1907, the total number of accidents reported which incapacitated the victim by at least two weeks was 13,572. The accidents to employees constituted 53 per cent of this number.[d]

Special trades have special perils for workmen. "Among diseases to which workmen are most often subject are the so-called 'inanition, scrofula, rachitis, pulmonary consumption, dropsy;' also rheumatic troubles, pleurisy, typhoid fever, gangrene, and the various skin diseases. Every epidemic, be it typhoid, smallpox, scarlet fever, dysentery, cholera, etc., draws its greatest army of victims from this class. For every death that occurs among the richer and higher classes there are many in the working class. It is the workman engaged in unhealthy factories first of all who fills the hospitals and their death chambers." [e]

It is the pollution of the air breathed by workmen, whether the pollution come through poisons or through dust, that makes many trades dangerous. Among poisonous trades are the many lead-using

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[a] Ditman, loc. cit., 43.

[b] In an article contributed to the "New Encyclopedia of Social Reform," 1908.

[c] Speech before the Governor's Conference on Conservation, White House, May, 1908.

[d] Thirteenth biennial Report, Bureau of Labor and Industrial Statistics, Madison, Wis., 1908.

[e] C. F. W. Doehring, "Factory Sanitation and Labor Protection," Bulletin Department of Labor No. 44, January, 1903, p. 2.

industries, foundries, and chemical factories. Investigations of the dust-producing trades have been made, showing the results on the respiratory systems.

Hirt's statistics show that men employed in dust-producing occupations suffer much more frequently from pneumonia and consumption than do those not exposed to dust. The relative frequency of these diseases per 100 workmen is as follows:

Cases of consumption and pneumonia per 100 workers in certain occupations.

	Consumption.	Pneumonia.
Workers in metallic dust	28	17.4
Workers in mineral dust	25.2	5.9
Workers in mixed dust	22.6	6.0
Workers in animal dust	20.8	7.7
Workers in vegetable dust	13.3	9.4
Workers in nondusty trades	11.1	[a] 4.6

[a] George M. Kober, M. D., "Industrial Hygiene," Bulletin of Bureau of Labor, March, 1908, p. 477.

Mr. Owen R. Lovejoy, secretary of the national child-labor committee, has condensed a table from Indiana reports [a] showing the high injury rate suffered by children in the industries.

Injuries to children in Indiana, 1907.

Proportion of adults injured	5 per 1,000 to 3 per 1,000
Proportion of children injured	20 per 1,000 to 10 per 1,000

The injury rate for children is shown to be three to four times as great as for adults.

Chapter IV.—*Prevalence of minor ailments.*

Section 1.—*Importance of minor ailments.*

The statistics of morbidity which we have given refer to forms which are relatively acute; but there are many milder forms which do not incapacitate the patient from work or compel him to take to his bed. The extent of these milder ills is not generally appreciated. They are often carefully guarded secrets. The individual often knows only his own physical troubles, but is unaware of the fact that almost every person about him has such troubles also. Once you penetrate beneath conventional acquaintance there will almost invariably be found some functional impairment of heart, liver, kidneys or bladder; or dyspepsia, gastritis, jaundice, gallstones, constipation, diarrhea; or insomnia, neurasthenia, nervousness, neuritis, neuralgia, sick headache; or tonsilitis, bronchitis, hay fever, catarrh, grip, colds, sore throat; or rupture, hernia, phlebitis, skin eruption; or rheumatism, lumbago, gout, obesity; or decayed teeth, baldness, deafness, eye ailment, spinal curvature, lameness, broken bones, dislocations, sprains, bruises, cuts, burns, or other "troubles."

[a] "Eleventh Annual Report of the Department of Inspection of Indiana, 1907," Exhibit C, pp. 166–198.

These so-called "minor ailments" will undoubtedly in the next few years receive much more attention than now. Until recently the physician has been accustomed to treat only acute diseases, but as preventive medicine gradually replaces curative medicine the physician will be more called upon to treat minor ailments. These are generally the first warnings of more serious troubles. If what seem to be "mere colds" were less commonly neglected, tuberculosis would more often be caught in its incipiency, and pneumonia and diphtheria would often be prevented.

From the "common colds" also tonsilitis and abscess of the ear can and do come, purulent inflammations of the pneumatic and venous cavities of the face and skull, and meningitis and cerebral abscess—all of which destroy many lives annually; or the lives may be saved by a surgical operation after a serious and prolonged illness. Tonsilitis, in turn, in addition to lighting up furious inflammations in its own immediate vicinity, can be held responsible in a certain number of cases for serious diseases at a distance from its own site. These are septic arthritis (inflammation of joints), septic peritonitis, appendicitis, endocarditis (valvular disease of the heart)—severe and frequently fatal diseases. Gastritis or gastroenteritis, sick headache, jaundice, lumbago, are not usually of serious import, but sometimes are the signs that point to an underlying cause (alcoholism, overeating, chronic protein intoxication, worry—business or domestic—sedentary life, etc.) which will lead later to arteriosclerosis, chronic nephritis, toxic amblyopia (optic nerve blindness), cirrhosis of the liver, cerebral hemorrhage or valvular disease of the heart.[a]

If the first twinges of rheumatic pains were heeded, gout and the dreaded arthritis deformans would lose most of their terrors. We could then arrest a great majority of serious affections at the very gateway. It can hardly be doubted that even such diseases as cancer, whose causation is not yet understood, gain a foothold through lowered vital resistance, manifesting itself at the first in minor ailments of some kind.

The American neurasthenia, widespread and subtle, has its grip on thousands of men and women, driving them from home and offices annually to sanitaria or various health resorts, and so breaking down their average vitality as to render them much more liable to serious sickness and death.

This, the most widely prevalent of all nervous disorders in this country, seems to be on the increase. It is very commonly found among persons who take no reasonable recreation—many business men, among others—and the loss of time and incapacitation for work are very great, often weeks and months at a time.

As to the extent to which minor ailments exist, no statistics are available. Doctor Castle, of Cincinnati, estimates, from an experience of many years in the medical supervision of institution employees and general practice, that there is an average of at least three days' time lost annually for each person in the population because of such minor ailments. Similarly, Dr. J. F. Morse, of the Battle Creek Sanitarium, who has had a long experience in dealing with a large number of cases, estimates that the average "well man" loses on an average five days a year from work on account of headaches, toothaches, "colds," and similar minor ailments which do not come under the head of any of the diseases reported.

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[a] Letter from Dr. Chas. H. Castle.

Section 2.—*Preventability of minor ailments.*

That almost all minor ailments can be avoided is scarcely to be doubted. Doctor Gulick is "inclined to believe that something like nine-tenths of all the minor ailments that we have, and which constitute the chief source of decreasing our daily efficiency, could be removed by careful attention." "With the removal of nine-tenths of our disabilities and the conservation and further development of our natural powers," he adds, "the average person can increase his efficiency 100 per cent, that is, he can be twice as effective. This does not refer to doing merely or mainly twice as much work, of course, but by making less mistakes, and by working at a higher degree of speed when he does work. By working under conditions so that the work does not need to be repeated, the whole total will be much greater—I think not too much to say twice as great—as under ordinary conditions."

Minor ailments are preventable by leading a reasonably hygienic life and by revising the modern gospel of "hustle"—which latter usually means crude, imperfect, and slovenly work, whether mental or manual. The prevention of these diseases would "cost" nothing—for it costs nothing to stay well.

If, again, we consider the experience of those who have made a serious attempt to avoid minor ailments, their preventability becomes clear. Personally, I have known of scores of cases in which the tendency to catch cold has been almost completely overcome. In one case a physician, who as a boy had suffered from continual colds and hay fever, succeeded, through the simplification and control of his diet, in attaining almost complete emancipation, which has lasted over forty years. Another physician reports that for ten years, during which time he has taken special means to produce complete evacuation, he has not caught a single cold. A large number of cases observed are of persons, physicians as well as laymen, who have taken the outdoor cure for tuberculosis or nervous prostration. These persons not only succeeded in combating these serious troubles, but in completely freeing themselves from liability to colds. Evidently, if the outdoor life had been adopted simply as a preventive of colds, it would have prevented originally, as it cured subsequently, their more serious disorders.

Chapter V.—*Prevalence of undue fatigue.*

Section 1.—*Strength, endurance, and fatigue.*

When a person is free from all specific ailments, both serious and minor, he usually calls himself "well." There is, however, a vast difference between such a "well" man and one in ideally robust health. The difference is one of endurance or susceptibility to fatigue. Many "well" men can not run a block for a street car or climb more than one flight of stairs without feeling completely tired out, while another "well" man will run 25 miles or climb the Matterhorn from pure love of sport. The Swiss guides, throughout the summer season day after day, spend their entire time in climbing. A Chinese cooly will run for hours at a stretch. That the world regards such performances as "marvelous feats of endurance" only

shows how marvelously out of training the world as a whole really is. In mental work some persons are unable to apply themselves more than an hour at a time, while others, like Humboldt or Mommsen, can work almost continuously through fifteen hours of the day.

As Mosso [a] and others have proved, muscular fatigue is a chemical effect, due to the circulation of "fatigue poisons" in the blood. This has been strikingly shown by experiments by Weishardt and others on dogs; when blood is transfused from an exhausted dog to a "frisky" one, the latter immediately wilts and becomes fatigued like the former, although he has not exerted himself in the least. In order to reduce fatigue, therefore, we should keep down fatigue poisons. It is not unlikely that almost all poisons produce fatigue, whether the poisons come from infections, from drugs, from impure or excessive food, from bad air, or from exertion.

It should be noted that endurance is a quality quite distinct from strength.[b] Strength is measured by the utmost force a muscle can exert once; endurance by the number of times it can repeat an exertion requiring a specified fraction of available strength at the start. Thus, if each one of two men is barely able to lift a dumb-bell weighing 100 pounds, their strengths are equal, but if one of them can raise a dumb-bell weighing 50 pounds 20 times, while the other can raise it 40 times, the latter may be said to have double the endurance of the former. Another mode of expressing the same thought is that endurance is measured by the slowness with which strength decreases through exertion.

Section 2.—*Alcohol and fatigue.*

Of all poisons in ordinary use, alcohol and tobacco are the most common. That alcohol increases fatigue is now commonly recognized by athletes. "Alcohol gives no persistent increase of muscular power. It is well understood by all who control large bodies of men engaged in physical labor that alcohol and effective work are incompatible." [c]

One of the most interesting features of the cycling sport, when long tours were the fashion a few years ago, was the fact that the wayside seller of drinks found himself forced to supply chiefly "temperance drinks." The cyclists discovered that they could not make their "century runs" on alcoholic beverages. Two friends report that they stopped for refreshments and drank beer. Resuming their ride they found it hard to propel the machine, and both imagined some obstruction had lodged in the gears. Only after having dismounted and satisfied themselves to the contrary did they come to the conclusion, whether rightly or wrongly, that the resistance was in their own legs and was due to the beer.

Careful experiments with alcohol in relation to fatigue have been reported by Rivers,[d] who shows that alcohol diminishes the capacity

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[a] See "Fatigue," English translation. New York (Putnam), 1904.

[b] See Irving Fisher: "The Effect of Diet on Endurance." (Publications of Yale University, Transactions of the Connecticut Academy of Arts and Sciences; New Haven, 1906, p. 1.)

[c] "The Liquor Problem, a summary," report of subcommittee of committee of fifty on physiological aspects of the liquor problem. New York (Houghton-Mifflin), 1905.

[d] W. H. R. Rivers: "Influence of Alcohol on Fatigue, etc." London (Edward Arnold), 1908, pp. 89–90.

for exertion. Experiments carried on by Professor Aschaffenburg with four typesetters, all users of alcohol, showed that on days when Greek wine, containing 18 per cent of alcohol, was given the men there was considerable diminution of the capacity for work. On the alcohol days two of the men did decidedly less work, while the work of the remaining two was marked by great irregularity.

The injury from alcohol is mitigated, but not excluded, through combination with sugar, malt, and other beneficial ingredients, as in beer.

SECTION 3.—*Tobacco and fatigue.*

As to tobacco it is a common observation that smoking interferes with one's "wind" in running. The poisons which probably bring about this result include others than nicotine. Possibly the most important poison is carbon monoxide, which has a great affinity for the iron in the blood.[a] When the smoker "inhales," this poison, probably joined with others, enters directly into the blood stream.

In an experiment carried on by Doctor Lombard, "smoking was found to have a very depressing effect upon the strength of the voluntary muscular contractions. * * * Undoubtedly the effect of tobacco to lessen the voluntary power is due to its influence upon the central nervous system."[b]

It is the testimony of many users of tobacco that the habit of smoking leads to nervousness and disinclination to exertion directly after smoking.

Experimentation has shown that smoking increases blood pressure. The greater resistance to circulation offered by the blood is presumably due to the excitation caused by the introduction into the blood stream of foreign matter from the tobacco. There is reason to believe, though the fact has not been established, that endurance is lessened by high blood pressure.

SECTION 4.—*Diet and fatigue.*

Poisons may also enter the system through food. Many poisons come from diseased, contaminated, or adulterated foods; but they may also be due to excess of food or wrong preparation of foods, and especially to the decomposition of protein (the principal ingredient of white of egg and lean meat) in the colon. The absorption of such poisons causes auto-intoxication.

It has long been known by physiologists that the putrefaction in the intestines is the putrefaction of protein. But only recently have they raised the question whether a reduction of the protein element of food would be feasible and whether the resulting reduction in putrefaction and auto-intoxication might not be advantageous.[c] These questions are still under debate, but the trend of physiological opinion is increasingly in favor of protein reduction. Practically this means a lessening of the consumption of lean meat and eggs.

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[a] "The toxicity of tobacco smoke," The Lancet, CLXXV, 1908, p. 104.

[b] Warren P. Lombard, M. D., "Some of the influences which affect the power of voluntary muscular contraction." Journal of Physiology, Vol. XIII, 1892, p. 48.

[c] See C. A. Herter, "Bacterial Infections of the Digestive Tract," New York (Macmillan), 1907.

Evidence has accumulated, though it has not yet been put in proper experimental form for absolute proof, that auto-intoxication is not only an exceedingly common affection, but also the chief cause of undue fatigue. Most persons know the heavy feeling and disinclination to exertion which generally accompany constipation, and, on the other hand, the relief which comes with a complete evacuation.

Leaving auto-intoxication aside, Professor Chittenden is of the opinion that waste products from combustion of protein are probably responsible for fatigue. Whatever the explanation, Professor Chittenden found in his classical experiment[a] with a squad of soldiers, that strength and endurance were increased by a reduction of the protein. Thirteen soldiers were placed for six months on a diet containing a much smaller quantity of protein food than what is prescribed by ordinary dietary standards and containing only one-third of what is demanded by common American usage. Professor Chittenden's results are gaining recognition, but they will need to be further tested before any unanimity of opinion can be reached.

Analysis of the diet of several hundred vegetarians shows that on the whole they are lower in protein than the average American. Comparative experiments on 17 vegetarians and 25 meat eaters in the laboratory of the University of Brussels have shown little differences in strength between the two classes, but a marked superiority of the vegetarians in point of endurance. The average superiority was 53 per cent. The vegetarians recuperated from fatigue more quickly than the meat eaters.[b] To what extent, if at all, the superiority of the vegetarians was due to vegetarianism as such, and to what extent to the fact that they made a more moderate use of protein, can not be exactly determined, although the evidence indicates that the lower protein is the essential factor. The virtues and drawbacks of vegetarianism as such have as yet received almost no scientific study.[c] Professor Chittenden is now engaged in such a study.

In another experiment, comprising 49 subjects and contrasting those on high and low protein diets, it was found that the low protein subjects had greater endurance.[d] For instance, the test of "deep-knee bending" showed that whereas the high-protein subjects could seldom exceed 400 or 500 times, the low-protein men could frequently exceed 1,000, and in one case reached 2,400.

The writer has in his possession several hundred unpublished individual records of men on a low and high protein diet. These, on the whole, seem to show a considerable superiority in endurance among those using the lesser amounts of protein. But while the trend of evidence seems at present to favor a reduction in protein, the question is not yet settled.[e] There exist many conspicuous cases of high

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[a] See Russell H. Chittenden, "Physiological Economy in Nutrition," New York (Stokes), 1904, and "The Nutrition of Man," New York (Stokes), 1907.

[b] "Enquete Scientifique sur les Vegeteriens de Bruxelles," par Mlle. le Dr. J. Ioteyko and Mlle. Varia Kipiani, Bruxelles (Lemartin), 1907. For English abstract see "Diet and Endurance at Brussels," Science, Vol. XXVI, 1907, pp. 561–563.

[c] An exception is Caspari, "Physiologische Studien über Vegetarismus," Bonn (Hager), 1905; see also Gautier, "Diet and Dietetics," English translation, London, 1906.

[d] Irving Fisher, "Influence of flesh eating on endurance," Yale Medical Journal, March, 1907.

[e] See, for example, Prof. F. G. Benedict's paper on "The nutritive requirements of the body," American Journal of Physiology, Vol. XVI, 1906, pp. 409–437.

protein and great endurance. A striking instance is that of the pedestrian Weston.

In an experiment on nine healthy students, the writer found that thorough mastication seemed to cause a gradual decrease in protein. The significance of the experiment lay in the improvement in physical endurance of eight of the men, which increased over 90 per cent in five months. The ninth man—the only one whose protein was not greatly reduced—failed to improve in endurance.[a]

Section 5.—*Exertion and fatigue.*

Exertion increases combustion of oxygen, and the capacity for exertion is intimately related to the completeness of this combustion.

Experiments in artificially administering oxygen to athletes have been made in England by Hill, Flack, Pombrey, and others.[b] Following these, a series of experiments in swimming recently took place at Huntington, L. I. The swimmers to whom oxygen had been administered surpassed their nonoxygenized competitors as well as their own previous natural records. Doctor Bising, who carried on the experiment, states that the effects of oxygen inhalation are useful for short efforts only. At most the oxygen exercises its influence for not more than three minutes.

Perhaps the most important of the common influences affecting the capacity to resist fatigue is physical exertion. It is well known that a man "in training" has greater endurance than one who attempts exertion without previous systematic exercise or training. In general, it may be said that a person in the "pink of condition" is fit not only for physical but also for mental exertion. The great majority of adults are far from being "in condition," suffering either from lack of exercise or from too much exercise. The ordinary man errs either in one direction or the other. The brain worker lives too sedentary a life, while the manual worker, through fatigue caused by long hours, is in a continual state of overexertion. Could these conditions be remedied, endurance, as measured by capacity to withstand prolonged strains, might be greatly increased.

Experiments have shown that physical endurance can be doubled by dietetic causes alone, or doubled by exercise alone. By both together it is not unlikely that it could be tripled or quadrupled. But when it is said that the endurance, or capacity for exertion, of the ordinary healthy man could be thus multiplied, it is not meant that the hours of his daily work, or even his daily output of work, could be increased in such a ratio. What it does mean is the removal of the fatigue limit, a freer and more buoyant life, and a visible increase in the quantity and quality of work per hour.

In an ideal life fatigue would seldom be experienced. But in most lives, unfortunately, fatigue is a daily experience. A workman who gives intelligent and systematic care to the body writes that when after a long day's work the factory whistle blows at night he, unlike his fellows, feels as fresh as when he began work in the morning. Workmen can by such self-care mitigate some of the evils of

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[a] Irving Fisher, "Effect of diet on endurance," loc. cit.

[b] British Medical Journal, 1908, August 22, p. 499; also August 29, p. 578, Journal of Physiology, 1908, XXXVII, 77–112.

"the long day." But they are amply justified, both in the interest of their own and of national efficiency, in continuing their efforts toward a shortening of the work day.

Section 6.—*The working day.*

The present working day is a striking example of the failure to conserve national vitality. In order to keep labor power unimpaired, the working day should be physiological—i. e., it should be such as would enable the average individual to completely recuperate over night. Otherwise, instead of a simple daily cycle, there is a progressive deterioration. A reduction in the length of the work day would be a chief means of improving the vitality of workmen, as well as the worth of life to them.

The fatigue of workmen is largely traceable to their long work day and serves to start a vicious circle. Fatigue puts the workman in an abnormal frame of mind. He seeks to deaden his fatigue by alcohol, tobacco, exciting amusements, and excesses of various kinds. The momentary relief which he thereby obtains is purchased at the expense of an increasing susceptibility to fatigue, resulting sooner or later in complete depletion of his vital energies and in the contraction of tuberculosis or other fatal disease. The decrease in the length of the working day has not diminished the total output.

An instance in which the eight-hour day superseded the nine-hour day with entire success is the case of the Salford Iron Works, of Mather & Platt, at Manchester, England, which changed to the eight-hour day in 1893. As the firm's products were subject to keen competition in both home and foreign markets, it was obliged to look carefully after the labor cost, and its conclusion that such cost did not increase in consequence of the reduction in working hours was reached after extremely accurate comparisons by accountants, who of course took into consideration the saving in consumables, wear and tear, fuel, etc. The Bureau of Labor inquired of Messrs. Mather & Platt if they were still on the eight-hour basis, and received a reply dated May, 24, 1904, in which they stated that—

> our experience since the first year in which it (the eight-hour system) was tried has fully borne out the conclusions then arrived at, and we are fully satisfied that as regards the comparison between eight and nine hours per day the balance of advantages is in favor of the shorter period.[a]
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> In 1894 the hours of labor of about 43,000 workmen in British government factories and workshops were reduced to forty-eight per week. Of this number, 18,600 received a reduction of five and three-fourths hours a week, and 24,300 had their time reduced two and one-half hours a week. With no change in piece rates the workmen were able to earn as much as formerly. Day workers received an increased hourly rate of pay to make their earnings per week of forty-eight hours equal to those per week of fifty-four hours. It was not found necessary to increase the number of day workers.[b]

In 1899 the owners of the great Zeiss optical goods factory at Jena, Germany, introduced the eight-hour day and then made careful records of the results. In 1903 it was announced that although the aggregate number of hours worked had decreased 15 per cent the output per hour had increased 16.2 per cent.[c]

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[a] New York Labor Bulletin No. 25, June, 1905, p. 240.

[b] Board of Trade Labor Gazette, July, 1905, reported in New York Labor Bulletin No. 28, March, 1906.

[c] New York Labor Bulletin, No. 25, June, 1905, p. 240.

At Liege it was found in a sulphuric acid establishment similar to a foundry [a] that shortening the working day from eleven hours to ten, from ten to nine, and so on gradually down to seven and one-half, resulted, in each case, in an increase of the output.

The Solvay Process Company, of Syracuse, installed in 1892 a system of three eight-hour shifts in place of the two previous shifts of eleven and thirteen hours, respectively. It was stated by the assistant general manager in 1905 that the change had considerably lessened the wear and tear on the men, and that they could be called on to do their work at their highest state of efficiency, which had not been possible on the two-shift basis. President Hazard of the company writes:

> In general, I can say that the results of the change from a twelve-hour shift to an eight-hour shift were very satisfactory and have continued to be so. While the immediate result was to considerably increase the cost per unit of product, the efficiency of the men gradually increased, so that at the end of about one year the first increase has been overcome and the cost per unit of product fell to a point even lower than had been obtained under the twelve-hour shift, and further the time consumed per unit of product has since been so reduced that we are today and for some time have been operating with a smaller number of hours per unit of product than we had under the twelve-hour shift.

Further proof of the benefits of the change to the three-shift day is furnished by the records of the Solvay Mutual Benefit Association for 1891 and 1904. The days lost per man by sickness each year fell from seven and one-half days in 1891 to five and one-half days in 1904.

It is not maintained that in all cases productivity will be as great in eight hours as in nine. Cases to the contrary could also be cited. The point to be insisted upon is not that it is profitable to an employer to make the work day shorter, for often it is not, but to show that it is profitable to the nation and the race. Continual fatigue is inimical to national vitality, and however it may affect the commercial profits of the individual it will in the end deplete the vital resources on which national efficiency depends.

In the interests of this efficiency, a longer time at noon for lunch is usually necessary. The present economy of lunch time is short-sighted, tends to food bolting, indigestion, a drowsy and tired afternoon, and inferior work. This has been shown by actual experience.[b]

The accident bulletins of the Interstate Commerce Commission contain frequent records of disasters caused by the long hours of railway employees. In a recent bulletin, No. 27, two collisions are attributed to the mistakes of employees who have been on duty much longer than the instinct of safety should allow. Collision No. 3,[c] which killed 2 and injured 13, was due to the mistake of a station operator who had been on duty from 7 a. m. to 3.30 p. m. and who had returned to duty at 8 p. m. The collision took place at 12.30 a. m. the next morning.

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[a] See L. G. Fromont, "Une Experience Industrielle de Reduction de la Journel de Travail," Brussels, Solvay Institute, 1906.

[b] See especially description of a French experiment cited by Hubert Higgins in "Humaniculture," New York (Stokes), 1906.

[c] Accident Bulletin No. 27, January to March, 1908.

SECTION 7.—*Importance of preventing undue fatigue.*

The economic waste from undue fatigue is probably much greater than the waste from serious illness. We have seen that the average serious illness per capita is usually about two weeks each year. This is about 4 per cent of the year. Expressed differently, about 4 per cent of the population is constantly sick.

On the other hand, the number that suffer partial disability through undue fatigue certainly constitute the great majority of the population. No observer can fail to conclude that this is true of the American working, business, and professional classes, and the latest word among the students of school hygiene is that it is true to a large extent even among children. If therefore we assume that only 50 per cent of the population is suffering some impairment of its best powers through undue fatigue, we are on safe ground. The extent to which the power of this supposed 50 per cent of the population is impaired must certainly exceed 10 per cent. When we consider that young men, supposed to be perfectly well, have the enormous room for improvement indicated in this chapter, and when we consider the gratifying results of experiments with a shorter work day it will be seen that the true impairment is probably several times 10 per cent. Yet if only 50 per cent of the population are suffering an impairment equal to only 10 per cent of its working powers, the result is equivalent to 5 per cent of the population suffering total impairment which is more than the 4 per cent impairment from serious illness.

The relatively slight impairment of efficiency due to overfatigue leads to more serious impairment. Just as minor ailments prove to have an unsuspected importance when considered as gateways to serious illness, so the inefficiency from fatigue is vested with great significance as the first step toward minor ailments. Obviously if overfatigue could be reduced to a minimum, this reduction would carry with it the prevention of the major part of minor ailments, which in turn would lead to a great reduction in more serious illness, and this finally would lead to a great reduction in mortality. A typical succession of events is first fatigue, then colds, then tuberculosis, then death. Prevention, to be effective, must begin at the beginning.

But prevention is merely the first step in increasing the breadth of life. Life is to be broadened not only negatively by diminishing those disabilities which now narrow it, but also positively by increasing the cultivation of vitality. Here we leave the realm of medicine and enter the realm of physical training. The first and lowest step is gymnastics. This is valuable—far more so than the ordinary sedentary man who neglects it realizes—but it is after all a kind of medicine not altogether pleasant to take and far less valuable to him who takes it than are athletic sports, which constitute the next highest stage. Beyond athletic sports in turn comes mental, moral, and spiritual culture, the highest product of health cultivation. It is an encouraging sign of the times that the ecclesiastical view of the Middle Ages, which associated saintliness with sickliness, has given way to modern "muscular Christianity," typified in Young Men's Christian Associations with their gymnastics and athletics. This is but one evidence

of the tendency toward the "religion of healthymindedness" described by Professor James. Epictetus taught that no one could be the highest type of philosopher unless in exuberant health. Expressions of Emerson's and Walt Whitman's show how much their spiritual exaltation was bound up with health ideals. "Give me health and a day," said Emerson, "and I will make the pomp of emperors ridiculous." It is only when these health ideals take a deep hold that a nation can achieve its highest state of development. Any country which adopts such ideals as an integral part of its practical life philosophy may be expected to reach or even excel the development of the health-loving Greeks.

The means of securing both the negative prevention of invalidity and the positive accumulation of vitality will form the subject of Part III.

Part III.—METHODS OF CONSERVING LIFE.

Chapter VI.—*Conservation through heredity.*

Section 1.—*Heredity and environment.*

That the waste of life through preventable disease and death is enormous appears clearly from the facts already cited. The practical problem is this: If such waste is really preventable, what are the conditions necessary to make prevention an accomplished fact? There are two main conditions. First, a general desire for improvement; second, a general knowledge of how to secure that improvement.

Once the general public recognizes the needless waste of vitality, it will not be content until that waste has been eliminated. To such an awakening the American instinct of economy is in itself a powerful spur. Practical men are coming to consider it "good business" to take some care of their own vital resources. As this view gains ground, habits and fashions will adapt themselves to the change. The folly of the man who loses his health in the pursuit of wealth, and then for the rest of his days spends his wealth to win back health, is beginning to be appreciated.

Human vitality depends upon two primary conditions, heredity and hygiene, or conditions preceding birth and conditions during life. In other words, vitality is partly inherited and partly acquired.

It is well known that cultivated plants and animals have been greatly changed and developed by breeding. "The original apple, as offered by nature to mankind, was the small, sour, bitter crab of the forest, unpleasant, indigestible, innutritious. * * * In 1710 Doctor Davenant, a writer on political economy, estimated that the average weight of dressed cattle did not exceed 370 pounds. * * * In 1846 McCullock stated that 'at present the average weight of cattle is estimated at or about 800 pounds.'"[a]

Human heredity is now dependent on haphazard selection. Little attention is paid by those who contemplate marriage to the question of how much stamina will be transmitted to the next generation. The story was told of a famous dog fancier who, when asked why he paid so much attention to his dogs but delegated the care of his children to nurses, replied: "My dogs have a pedigree." Human pedigrees, no less than canine, rest on a physical basis; yet genealogical records of human beings, while they have much to say of social position, have very little to say of physical capacity or intellectual ability. Those who, like Galton and Pearson, believe in a science of eugenics, hope that the day will come when pride of inheritance will include as im-

[a] See Dr. Edward Jarvis, "Political Economy and Health," Fifth Report, Mass. Board of Health, 1874. Doctor Jarvis adds that human life is as "expansible" as animal life.

portant, if not as the chief items, physical, mental, and moral stamina. A tendency in this direction can be discerned. When the nobility commanded the reverence of all classes, quite irrespective of ability, commoners, however well endowed by nature, could never obtain the same respect. But to-day the English House of Commons is more honored and respected than the House of Lords.

Once the importance of a physical pedigree comes to be rated at its true value, a man's pride in his own inheritance will show itself in a correlative feeling of responsibility for future generations. For the sake of children yet unborn, men and women will set for themselves physical ideals of the highest order.

Section 2.—*Eugenics.*

The whole question of race improvement through heredity constitutes the subject-matter of the new science of eugenics. The devotees of this science are at present engaged in studying the laws of heredity in all its aspects. The Mendelian doctrine of heredity, with the theories of Darwin and Weissmann, are some of the topics which need to be studied in reference to their practical application.

Until more results have been obtained, it would be premature to make great claims for the possible future usefulness of applied eugenics. A word may be said to prevent misunderstanding as to its aims. Many have supposed that the object of eugenics was to bring about suitable marriages by compulsion of the Government. Such a proposal would not only be absolutely impracticable, but would defeat the very ends aimed at. Marriage, above all human choices, must, as a rule, be left to the individual, guided by his ideals alone. By the change of these ideals alone can the character of marriages be influenced. Sir Francis Galton, the founder of the science of eugenics, expects intelligent public opinion to be the chief guide in marriage. Just as the union of brother and sister is tabooed, and the marriage of even first cousins[a] is eyed askance—whether justly or not does not matter—so, if the aims of eugenists are carried out, an obviously unhygienic marriage will be frowned upon. It was somewhat in this way that the ancient Sparta raised its vitality to a high point of physical excellence.

Galton has pointed out[b] that present restrictive rules of marriage selection are endured without any sense of loss of privilege or freedom. For example, members of the European nobility are, in their marriage choice, restricted almost wholly to fellow-aristocrats; yet so much has this restriction become a part of their ideal and creed that the narrowness of the range of choice is not usually realized.

Even granting that some marriages are studiously calculated to win money or title, a much stronger or more pervasive, although unconscious, influence is exerted by the ideals which young men and women at marriageable age have formed of what their companions for life should be. Nothing is more certain than that if from

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[a] In at least 20 States the marriage of first cousins is forbidden by law. An excellent discussion of this subject is contained in "Consanguineous Marriages in the American Population," by G. B. L. Arner, Ph. D., New York (Longmans), 1908.

[b] "Sociological Papers," London (Macmillan), 1906, Vol. II, p. 12.

childhood they were trained to regard vitality as the first essential in an ideal man or woman, this would influence their personal fancy. Health, beauty, and vitality are natural objects of admiration and love. Titles, wealth, and other extraneous attractions are not. To lessen the public esteem for these, and to increase the esteem for natural human merit, will tend to increase not only the number of healthy marriages, but the importance of the rôle played by normal love. If, therefore, eugenic ideals ever hold sway, love marriages will not only continue to exist, but will become more frequent. Love is a primal and natural instinct, and the more natural men and women are, and the more highly they esteem natural vitality, the more will they be guided by mutual attraction.

If a considerable percentage of the population once shall come to regard vitality as an essential endowment, the effect on mating will be felt in two ways: First, a larger percentage of healthy persons will marry, leaving a larger percentage of unhealthy persons single; second, healthy persons will mate with each other, and unhealthy persons, in so far as they marry at all, will do so among themselves. Of mixed matings there will be a smaller number. Both of these results will tend gradually toward the improvement of the race. That the first—the increased proportion of marriages among the healthy—will do so, is obvious. The second—the marriage of like with like in respect to health—would, it seems probable, operate to increase the number of progeny of healthy couples and decrease that of the unhealthy, especially after the first generation.

Since athletics have come into vogue it is well known that the athletic ideal has led to athletic mating. The tendency of the present devotion to athletics must be to elevate the respect for physical prowess. The high esteem entertained in Japan for physical training and for hygiene as a guarantee of the fighting power of the country, constitutes an object lesson, if not a warning, to Americans who wish their country to be the peer of the best. It would be folly, of course, to expect any change in ideals so complete that there would not be numerous exceptions to hygienic mating, but, once the bulk of mankind are guided by a truer principle in forming marriages, the effect on racial development will make itself distinctly felt within a generation. As President Roosevelt has said: "The preservation of national vigor should be a matter of patriotism." Some persons would even make it a matter of religion.

Section 3.—*Eugenics and law.*

It is possible, however, that governmental interference with the birth rate may in future be employed to a limited extent. Two ways have been suggested: One is for the Government to give prizes or bounties to couples that conform to certain specified standards in the same way as the French Government has encouraged the increase of population by offering inducements to couples of the poorer class who raise seven or more children.[a]

The second is to forbid alliances among criminals, paupers, and the feeble-minded. These classes fall under the tutelage of the State,

[a] In 1889, fathers of seven children were made exempt from payment of the personal property tax. This exemption was in 1890 limited to fathers who paid taxes of not over 10 francs each.

and thereby forfeit their right to free choice. Already Indiana,[a] Connecticut,[b] Michigan,[c] and other States in this country, have passed laws of this sort.

Indiana extends the prohibition to all persons suffering from transmissible disease of any sort. This prohibition is called into daily operation in that State. It is in the power of the Indiana state board of health to raise by degrees the standards of health demanded of those who desire license to marry, a provision that aims directly at the improvement of human vitality in the State. Indiana has gone even further and has recently provided[d] that confirmed criminals, imbeciles, idiots, and rapists, procreation by whom is deemed inadvisable by experts, shall be unsexed (or "sterilized") by surgical operation. Under this law over 800 prisoners have been sterilized to date.[e]

The experiments started in Indiana and other States will be interesting to watch, and promise an improvement over the conditions which have prevailed too often in the past. Professor Brewer, of Yale, tells of a case in Connecticut some years ago where a feeble-minded pauper woman, kept as a public ward, was admired by a half-witted farmer living in an adjoining town. A selectman of the town maintaining the woman "to get rid of her support" encouraged their marriage. His short-sightedness, even from the standpoint of immediate money economy, to say nothing of racial economy, became apparent when, a few years later, she and her husband and three idiotic children drifted into the poorhouse of the husband's town.

That laws like the ones discussed, but of gradually increasing severity, will become common in the future seems likely; and, as Professor Lankester has remarked, humanity will probably submit in the future to communal restriction of the right to multiply with as good grace as it has given up the right to rob and to rape.[f]

The effect of restrictions upon free right of marriage is discussed by Doctor Hurty, secretary of the Indiana state board of health, as follows:

> It seems most essential and necessary that we have laws for the prevention of the production of the unfit if society is to be saved from destruction. Modern hygiene, under which I include in this instance all such benevolent institutions as insane asylums and institutions for the feeble-minded, is extending the duration of life of the dependents and deficients, and it might be added that the humane and hygienic care in the prisons is extending the duration of life of the delinquents. In Indiana the life duration of the insane has been extended eight years within the last two decades. This slight extension means a very considerable burden upon the people, and if this class of deficients is unrestricted we can readily see what a burden time will place upon society. The production of the unfit must cease if charity and hygiene continue. Otherwise it seems certain that society will be swamped.

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[a] Indiana Laws of 1905, chap. 126, H. 118, sec. 3.

[b] Connecticut Statutes (revision of 1902, sec. 1354), forbid the marriage of epileptics.

[c] Michigan forbids the marriage of epileptics.

[d] Indiana Law of 1907, chap. 215, H. 364.

[e] Letter from Dr. J. N. Hurty.

[f] E. R. Lankester, "The Kingdom of Man," London (Constable), 1907, p. 41. The recent report of the Royal Commission on the Care and Control of the Feeble Minded recommends such restriction.

While institutional treatment of the insane is right and proper from a humanitarian point of view, by bringing an increase in the average insane lifetime it adds to the public burden and enlarges the figures of the living insane. Mr. Sanborn estimates the average insane life in Massachusetts at thirteen years, of which at least three years occur, on the average, before hospital treatment is applied. He adds:

> I suspect we have come nearer to statistical accuracy on this question in Massachusetts than has been reached in any region of equal population anywhere. The world has been gradually coming round to the conclusions reached by the late Dr. Pliny Earle (of Northampton) and myself, viz, that the changes in the social and sanitary conditions of all civilized countries have increased the number (proportioned to population) of new cases of insanity, while the improved treatment of patients in the meantime has made the average insane life longer than formerly, and that in spite of the well-known increase in forms, like paresis and epilepsy, which may soon end fatally.

Interesting records exist of two families of criminals, the so-called "Jukes" and the "Tribe of Ishmael." From the one man who founded the "Juke" family came 1,200 descendants in seventy-five years; out of these, 310 were professional paupers, who spent an aggregate of two thousand three hundred years in poorhouses, 50 were prostitutes, 7 murderers, 60 habitual thieves, and 130 common criminals.

Dugdale[a] has estimated that the "Juke" family was an economic loss to the State, measured in terms of potential usefulness wasted, costs of prosecution, expenses of maintenance in jail, hospital, and asylums, and of private loss through thefts and robberies of $1,300,000 in seventy-five years, or over $1,000 for each member of the family.

Similarly, the "Tribe of Ishmael," numbering 1,692 individuals in six generations, has produced 121 known prostitutes and has bred hundreds of petty thieves, vagrants, and murderers. The history of the tribe is a swiftly moving picture of social degeneration and gross parasitism, extending from its seventeenth-century convict ancestry to the present-day horde of wandering and criminal descendants.[b]

Had the original criminals in the "Juke" family and the "Tribe of Ishmael" been sterilized under some law like that of Indiana, this country would not only have been spared a widely disseminated criminal, epileptic, and immoral strain, but would have saved hundreds of thousands of dollars paid out for criminal suits and for institutional care, to say nothing of the expenses still to come from the incapacity and criminality of future generations.

These cases present only one side of the case. Over against them may be set illustrious families in which great intellectual ability and moral worth have been passed on through many generations. Such a one is the Hohenzollern family. In commenting on the frequent occurrence of persons of surpassing mental and moral attainments in this family, Woods[c] says: "It is particularly suggestive of what might be done with the human race were mankind ever so inclined." A similar example from a different walk in life is afforded by the Darwin family, where for four generations in direct line (Erasmus, Charles,

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[a] R. L. Dugdale.: "The Jukes," New York (Putnam), 1877.

[b] Oscar C. McCulloch, "The Tribe of Ishmael," a study in social degeneration, "Report of Fifteenth Annual Conference of Charities and Corrections, 1888," pp. 154–159.

[c] F. A. Woods, "Mental and Moral Heredity," New York (Holt), p. 79.

George, Horace, and Francis) as well as in collateral lines (e. g., Francis Galton) scientific ability of the first rank has been manifest.[a]

President Roosevelt has pointed out that "race suicide" is a sign and accompaniment of coming decay. Mere numerical increase is not the whole solution, however; there must be improvement in quality also. A race that can not hold its fiber strong and true deserves to suffer extinction through race suicide. The decline of our Puritan stock, so well pictured in the genteel but worn-out Pyncheon family of Hawthorne's novel, need not alarm us if we can replace it with a new influx from the West or from the vigorous stocks of Europe.

There is one problem which concerns both the numbers and the quality of future generations, which hitherto has received practically no attention except in a partial report upon the subject in Australia. This problem is, What is now and will be the effect of voluntary childlessness upon the size and character of the birth rate and upon morals? It would be useless, here, however, to do more than mention this as one of the gravest problems in the world to-day. Ronald M. Byrnes[b] shows that the fecundity of Yale graduates has steadily diminished from 5.7 for the graduates of 1701–1791 to 2.0 for those of 1867–1886. This reduction is much greater than the reduction for the whole country, which is reported by the census to be from 5.8 in 1790 to 4.6 in 1900. Degenerates have large families. From a study of 150 degenerate families, Doctor Tredgold[c] found that the average number of children per family was 7.3, while the normal average for the country at large (England) is 4. These figures do not specify the frequency of marriage among degenerates or the mortality. Unless the one is sufficiently low and the other sufficiently high, there must follow deterioration. General reduction of the birth rate may end in depopulation. It is not unlikely that this phenomenon will be the stimulus needed to bring about practical eugenic reforms.

What eugenics might possibly accomplish is indicated by one writer in the following manner: "How rapidly the race would advance if mankind should resolve: 'The next generation must be born with healthy bodies; must be nurtured in healthy physical and moral environments; and must be filled with the ambition to again give birth to a still healthier, still nobler, generation.'"[d]

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[a] The Francis Galton Laboratory for National Eugenics, University of London, is soon to issue a "Treasury of Human Inheritance," containing pedigrees illustrating inheritance of various types of intellectual ability, of tuberculous stocks, of epilepsy, physical depravity, etc.

[b] Yale Review, November, 1908.

[c] W. C. D. Whetham, "Inheritance and Sociology," the Nineteenth Century, January, 1909.

[d] Louis R. Ehrich, "Posteritism," an address delivered at the dedication exercises of The Century Chest, Colorado Springs, Colo., 1901. For literature on eugenics, the reader is referred to the following papers and the references therein contained: "Eugenics, Its Definition, Scope, and Aims," by Francis Galton, American Journal of Sociology, Vol. X, pp. 1–6, 1904. "The Scope and Importance to the State of the Science of National Eugenics," by Karl Pearson, Oxford University Press, England. "Social Darwinism," by D. Collin Wells, Papers and Proceedings of the American Sociological Society, Vol. I, University of Chicago Press. "The Human Harvest," by David Starr Jordan, Boston (American Unitarian Association), 1907. "Eugenics," by Prof. Albert G. Keller, Yale Review, August, 1908. "A First Study of the Statistics of Pulmonary Tuberculosis," by Karl Pearson, Drapers Company, Research Memoirs, London (Delau & Co.), 1907.

Chapter VII.—*Conservation through public hygiene.*

Section 1.—*Municipal hygiene.*

Whatever improvements in heredity may sometime be achieved, the benefits of their influence can be enjoyed only by future, perhaps distantly future, generations. We of the present generation have to take our heredity as we find it. We can not follow the advice of the humorous philosopher to begin life by selecting our grandparents; but, through hygiene, we can make the most of our inherited endowment. Even such a limited effort offers large—amazingly large—rewards.

Ideal conditions for health comprise a pure and disease-free atmosphere in which to live and work; pure food and a pure water supply; protection from infection and accident; and a proper adjustment of work, rest, and amusement. Existing conditions are not only far from ideal, but also far from what might easily and speedily be attained.

That the saving power of hygiene is great is now universally recognized; that it will be greater is the hope and belief of those most competent to judge. "If hygiene were able to prolong life when it was little developed, as was the case until recently, we may well believe that, with our greater knowledge of to-day, a much better result will be obtained."[a]

There is every reason to believe that human beings are as amenable to cultivation as other animals and plants. Professor Graves, of the Yale Forest School, states that by protecting trees from infection their lives may often be prolonged a century. Domestic animals are equally dependent on care. Doctor McGee states that the growth of a colt may be stopped by giving it alcohol.

The methods of securing improvement in health conditions may be roughly classified under three groups: Public hygiene, semipublic hygiene, and personal hygiene. The first group refers to activities of the government; the second refers to activities of the medical profession and institutions such as hospitals, sanatoria, schools, and factories, and to voluntary associations; the third group deals with the private life of the family and the individual. Each of these three groups covers phases of all three branches of hygiene, viz, the hygiene of environment, nutrition, and activity.[b]

In this chapter we have to deal with public or governmental hygiene. This branch has been chiefly concerned with pure air and pure food and with organisms producing epidemic diseases. Boards of health are a recent invention, and in this country they have as yet been only imperfectly developed. They can never become the power they should be until, first, public opinion better realizes their usefulness and the fact that their cost to the taxpayer is saved many times over by the prevention of death and disease; second, more and better health legislation is enacted—national, state, and municipal; and, third, special training is secured for what is really a new pro-

[a] Metchnikoff, Prolongation of Life, p. 144.

[b] Since this report was written there has appeared the excellent and inspiring "Civics and Health," by William H. Allen, Bureau of Municipal Research, New York (Ginn), 1909.

fession, that of public health officer—a profession already recognized in England by a special diploma.

The health officer should be supported entirely by the salary of his office and should be absolutely prohibited from practicing medicine. Not only are his duties incompatible with practice quite as much as those of judges with the practice of law, but if he gives them proper attention there is no time for other duties. No court, police, or fire department, or other agency of government, can be more important to a people than this under the complex conditions incident to the rapid growth of both rural and urban populations. It is so important that this be realized that it is worthy of serious consideration as to whether it would not be better for all imperfectly equipped and supported health boards in this country to resign—so that the authorities and people would be brought face to face with the knowledge that they have no real protection except in the emergency of an epidemic—than for existing conditions to continue.

Laboratories, research workers, statisticians, and other facilities for the performance of a national board of health's duties should be furnished in proportion to the power and wealth of the Government and the vast interests it would protect and promote. The results of its scientific and collective investigations should be constantly utilized in promoting health in the army and navy, in protecting streams and soils from pollution, in the construction of interstate waterways, in the reclamation of swamp lands, and in other public works involving health problems of supreme importance to the future of this country.[a]

Public hygiene may be studied under three heads, corresponding to our governmental divisions: Municipal hygiene, state hygiene, and federal hygiene.

Municipal hygiene and sanitation are placed largely in the hands of city boards of health, or equivalent organizations, which have power to issue sanitary regulations, abate nuisances, and even to punish infractions of their instructions by fine and imprisonment. Sanitary legislation is a product of advanced civilization. To-day not a city is without a board of health. The powers of these boards have grown, till to-day they are by no means inconsiderable; yet they must be given even greater authority, if our municipal sanitary conditions are to be what they should. Public apathy and political interference are such that health authorities can not enforce their orders. In addition to the acquirement of greater power, city health boards often need purification of motive and the banishment of political bickerings and personal jealousies.

The simplest ordinances along the line of public hygiene are those against spitting, which now remain so largely unenforced.

The smoke nuisance is another seemingly simple form of air vitiation that is receiving attention to-day. Sulphuric acid is apparently the most injurious factor. The corrosion of stone structures suggests the irritation resulting in catarrh and other respiratory mucous-membrane troubles.[b]

The effect of the introduction of closed sewers on the reduction of tuberculosis should not be overlooked. By closing sewers, impure gases have been confined, thereby removing an important source of air pollution. Some cities realize that pure air spells life and health to its inhabitants, and that pure air is a possibility only when atmospheric particles of soot and dirt are removed.

Regulations governing garbage removal, notification and isolation of disease, and the like are as a rule enforced, and new regulations are being issued constantly. Substantial progress is shown each year

[a] Letter from Dr. J. N. McCormack.

[b] See Journal American Medical Association, September 7, 1907, p. 813.

in the purification of city water supplies, in the improvement of sewage disposal, and in the bettering of drainage conditions. Streets are more thoroughly cleaned and the elimination of public and private nuisances continues without ceasing.

Our city streets have received greater care since Colonel Waring organized his "white wings" brigade in New York City a dozen years ago, thus proving the great effectiveness of clean streets in the elimination of disease. The probable elimination of the horse from our city life, through automobiles, the betterment of our trolley systems, and the introduction of subways (especially freight subways) will go far to improve our city atmosphere. The problem of city air will be half solved when our streets reach their proper state of cleanliness. The gradual elimination of the horse will tend not only to produce cleaner air, but also to reduce the dangers from flies. It is in horse manure that the common housefly ("typhoid fly") chiefly breeds. Doctor Howard attributes the termination of typhoid in certain parts of Washington to the displacement of the horse by the automobile.

Only within a dozen years has the dread importance of insect carriers of disease been realized. That mosquitoes carry malarial germs; that flies are the propagators of typhoid, cholera, and other infectious diseases; that rats breed the fleas which transmit to man the dreaded Asiatic plague [a]—all this knowledge is of recent origin.[b]

Well people are sometimes carriers and distribute typhoid, diphtheria, etc., a fact which complicates public-health regulations.

The simple reporting of all contagious disease to the health authorities immediately on its appearance is often the means of preventing an epidemic.

Smallpox epidemics are prevented both by quarantine and vaccination. Because of the outcry against compulsory vaccination, in some places the responsibility for vaccination is being thrown upon the individual. This is true in Leicester, England, and in Minnesota. Doctor Bracken, secretary of the Minnesota State Board of Health, writes that since the quarantine has been abandoned and the individual has had the option of being vaccinated or not, a larger number has been vaccinated and smallpox has diminished.

We are awaking to the importance of securing for ourselves, through our city health agencies, a pure milk supply. Great danger is also present in cream, butter, cheese, and ice cream. More than one city has inaugurated a policy of careful supervision of the milk supply. Montclair, N. J., has a well-considered plan in operation whereby the bacterial count of each dairy is public to inquirers at the board of health. This species of publicity will some day prove a strong incentive to a better milk supply. Some cities have even established municipal stations, where during the summer season sanitary milk may be purchased at cost. Doctor Goler, of Rochester, has emphasized the fact that "We employ physicians to cure children af-

[a] See Rupert Blue, "The prophylaxis and eradication of plague," California State Journal of Medicine, Vol. V, 1907, p. 304.

[b] A full treatment of the subject of insect-borne disease has been prepared by Dr. L. O. Howard, Chief of the Bureau of Entomology of the Department of Agriculture, for the National Conservation Commission. See also Charles Harrington, M. D., "Practical Hygiene," Third Edition, Philadelphia (Lea), 1905, pp. 637–660.

fected by the diarrheal diseases from dirty milk, while we permit the sale of dirty milk from filthy cattle." [a]

In Rochester, through the efforts of Doctors Goler and Roby, a few municipal milk stations were established in 1897, where during July and August milk in nursing bottles could be bought at a low price. The reduction in the Rochester infant death rate between 1897 and 1906 is doubtless due to many other conditions than the quality of milk; but the special attention drawn to the milk supply and the consequent education of the public, which probably boiled its milk when it could not get it clean, would explain a considerable part of the reduction.[b]

The interrelation of the purity of milk supply and infant mortality is shown by the following excerpt from Doctor Woodward's annual report as health officer of the District of Columbia for the year 1907:

> High as is the infantile mortality even now from diarrhea and inflammation of the bowels, it is far below the figures that formerly prevailed.
>
> The only explanation for the fall in the death rate from infantile diarrhea that I have been able to discover is the enactment on March 2, 1895, of the law regulating the sale of milk in this District and the establishment of dairy and dairy-farm inspection under the provision of that law.

The weekly report of the Cincinnati board of health for August 21, 1908, states:

> As far as we know, there has been but one death among the babies whose food supply has been obtained from the milk stations. When it is taken into consideration the large number of children we have supplied, this statement is certainly a fitting commentary upon the value of a bacteria-free and chemically pure milk.

At the recent International Congress on Tuberculosis, one delegate reported an experiment in England which has not yet appeared in print. In Liverpool the local government board tried the experiment of using pasteurized milk. The amount of illness and death in that city from children's tuberculosis is very great, yet among 1,800 children who were given pasteurized milk and who were carefully watched every week not a single case of tuberculosis developed, which seems to prove conclusively that children's tuberculosis is entirely preventable by the use of pure or pasteurized milk. This is interesting, though at variance with former opinion regarding bovine tuberculosis in children.

In this section should also be mentioned such municipal health agencies as public baths, bacteriological laboratories, and the distribution and administration of specific antitoxin, vaccine, and free medical service. Municipal inspection of local abattoirs is also important, inasmuch as federal inspection covers only establishments engaged in interstate business.

Most important of all is the matter of preventing pollution of the water supply of cities, a topic that will receive fuller treatment later in the chapter.

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[a] See George W. Goler, M. D., "Municipal regulation of the milk supply," paper at the meeting of the American Medical Association, 1907, p. 2. For conclusions based on a study of 330 milk-borne epidemics, see George M. Kober, M. D., "Milk in relation to public health," S. Doc. No. 441, Government Printing Office, 1902.

[b] See George W. Goler, M. D., "Origin, development, and results of municipal milk work in Rochester, N. Y.," Maryland Medical Journal, June, 1906.

The needs of municipal as of state hygiene are not so much new laws as better men to enforce existing laws and an aroused public opinion that will result in the appropriation of funds sufficient to enable health authorities to perform their duties in an efficient manner. Larger appropriations will doubtless bring better men into the public-health service.

SECTION 2.—*State hygiene.*

State hygiene is necessary to supplement municipal hygiene for many reasons. One is that the country often has no other sort of sanitation possible. Another is that the city is dependent on the country for its water, milk, and other supplies. Dr. W. G. Daggett, of New Haven, has emphasized the fact that in origin typhoid is largely a rural disease and must be combated by controlling rural privies and other sources of infection.[a] A competent authority asserts that "old country wells, so much valued by their owners, are a positive menace to public health. Fully 50 per cent of these are unfit for use." Much of the typhoid fever brought by milk is readily traceable to such wells.

In the control of the liquor traffic the State and local units should cooperate.[b]

A state, rather than a municipal, function is the regulation of woman labor and child labor. The growth of public opinion on this point has been rapid. In order to make the working hours meet the physiological requirements of women, two special conditions should be attended to. One is her monthly period; the other is childbearing. The neglect of both is responsible not only for physical impairment of factory women, but also for their inability to perform their functions as mothers of the race. Doctor Stiles, of the Public Health and Marine-Hospital Service, has suggested a very sensible remedy to meet the first of these conditions, and one which has met with the approval of many factory employers. It is that each woman shall have the right, once every month, to walk out of the factory without any questions being asked, and without loss of the day's wages. The matter is further simplified in factories provided with a matron and a rest room. In respect to the second condition—that of childbearing—the evidence is clear and convincing. Women, on account of their imperfectly developed muscular system and more delicate physique, are unfitted for hard work; nor should they be obliged to work steadily in a sedentary position, especially at the sewing machine, or other occupations involving the use of the lower extremities. Special protection should be extended to them during the childbearing period. It is a matter of constant observation that women who have to deny themselves proper rest and care during the next six weeks after confinement are very liable to suffer from hemorrhages and chronic uterine diseases, while miscarriages and premature births are not infrequent results of overwork.[c]

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[a] "The prevention of typhoid fever," Proceedings Connecticut Medical Society, New Haven.

[b] See "Regulation of the liquor traffic," Annals American Academy of Political and Social Science, November, 1908.

[c] George M. Kober, M. D., "Industrial and personal hygiene," "Report of Committee on Social Betterment of the President's Homes Commission," Washington, 1908, pp. 67–68.

The employment of mothers shortly before and after the time of childbirth is prohibited in a number of European countries. American statutes, however, are almost silent on the question.[a] Professor Jevons went so far as to advocate the enactment of legislation forbidding the employment of mothers till their youngest children were at least 3 years old.

The beneficial effect on the mother, and especially on the child, of forbidding the factory to her just before and after childbirth has been proved many times. The case of M. Dollfus, a large employer of women at Mulhausen, in Alsace, has been repeatedly cited. He required mothers to remain away from their work for a period of six weeks after childbirth, during which time he paid them full wages. The decrease in infantile mortality in the first year of the experiment was from more than 40 to less than 18 per cent.[b]

The waste of vitality from unphysiological hours of work is most striking in the case of children. It is hardly to be questioned that children need longer hours of rest and sleep than adults, and that their immature bodies are much closer to the fatigue limit. A little girl in a southern mill replied to Mrs. Van Vorst's query whether she were often tired, "Why, I'm always tired." Except in unusual cases and for limited periods, child factory labor can not be defended on any hygienic grounds. The period of preparation for a wholesome, healthy life should be left free from the cares and evil physical influences of factory life. No child should run the risk of serious accident, deformity, dwarfing, or mental stunting through factory labor. It is true that in the South child labor is often the lesser of two evils, the other being the life on a farm where, through soil pollution, the child contracts hook-worm disease. Here the abolition of child labor should be preceded by the abolition of hook-worm disease.[c]

Closely connected with the restriction of child and woman labor is factory legislation in general, dealing with hours of labor, factory hygiene and sanitation, and dangers from industrial accident.

The hours of labor have for a century been on a gradual decrease. A hundred years ago fourteen and fifteen hours were by no means uncommon. The first public action regarding hours of labor was taken by President Van Buren in 1840, when he set ten hours as the limit of the working day in all government establishments. Thirty years later this was lowered by Congress to eight hours. Since 1850 the fight has been waged for a shorter day, both by labor unions and individuals; and the statutes of nearly all States contain legislation limiting the working hours of women and children in all industries, as well as of all workers in certain industries, especially mining, railroading, and the more dangerous manufacturing industries. The Aldrich report of 1890[d] estimated that the American working day averaged eleven and four-tenths hours in 1840 and ten hours in 1890. Tables based upon annual reports of the Bureau of Labor show a reduction of about 4 per cent from 1890 to 1903,[e] while it is the

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[a] John Spargo, "The Bitter Cry of the Children," New York (Macmillan), 1906, pp. 44–45.

[b] Spargo, loc. cit., pp. 50–51.

[c] See "Report of the Surgeon-General of the Public Health and Marine-Hospital Service for 1907," relating to the investigations of Doctor Stiles.

[d] "Report on Wholesale Prices and Wages." 1890, Vol. I, p. 178.

[e] T. S. Adams and Helen L. Sumner, "Labor Problems," New York (Macmillan), 1905, pp. 516–518.

opinion of United States Commissioner of Labor Neill that the figures for 1908 would unquestionably be lower than for 1903, as the struggle for the shorter working day has been making steady progress each year.[a]

The frightful losses of life and efficiency from preventable accidents can be prevented only by state legislation.[b]

Our employer's liability acts are very unsatisfactory, because they fix no scale of compensation for injuries, but necessitate expensive lawsuits to determine in each case the sum due. A president of an insurance company doing a large business in employer's liability insurance states that of the sums they pay employers only one-quarter reaches the injured employee, who is forced to spend the other three-fourths in litigation. In England the workman's compensation acts have substituted a system of specific sums for which the employer is liable. Not only does this result in larger indemnities reaching the injured, because suits are ordinarily unnecessary, but it has the further beneficial effect of reducing the number of accidents by inducing employers to instal safety devices.

The regulation not only of the place of work, but also of the dwelling place, has come to demand action on the part of the State as well as of the community. The growth in tenement-house legislation during the past ten years has been most encouraging. Standards of sanitation for our large buildings have been raised; provision is increasingly made for good light, air, water, and for protection from fire; and the "rookeries" of old are giving way to improved tenements. Yet New York City still contains 300,000 rooms without a window.[c]

SECTION 3.—*Federal hygiene.*

The regulation of disease has increasingly become a national function. The exclusion of immigrants with infectious diseases is only one instance of this; another is the work of our Public Health and Marine-Hospital Service, which not only regulates the spread of disease from State to State, and regulates by quarantine the entry of disease from without the country, but also assists local health boards in their fights against epidemics and disease scourges. Epecially is this true in coastal cities. The Marine-Hospital Service assisted New Orleans to eliminate yellow fever and San Francisco to rid itself of bubonic plague. In addition, this service treats 50,000 seamen of the merchant marine each year, conducts a large number of hospitals and relief stations, examines pilots, life-saving crews and revenue-service men, and conducts a well-equipped hygienic laboratory.

Federal, state, and municipal sanitation are all concerned with the hygiene of transportation. To-day almost the whole American public travels, and it is therefore most important that the conveyances

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[a] See Bulletin of the Bureau of Labor, No. 77, July, 1908, pp. 6–7; also, "First Annual Report on Changes in Rates of Wages and Hours of Labor in Massachusetts," Boston, 1908, pp. 592–3.

[b] The Federal Government can of course reach interstate railways. A law passed during the last session provided for a safe locomotive ash pan. Previous laws provide for automatic couplers, air brakes, etc.

[c] A. Jacobi, M. D., "The physical cost of women's work," Charities, February 2, 1907.

which they occupy, whether carriage, cab, street car, or railway train, shall be sanitary in respect to ventilation, cleanliness, toilet facilities, spittoons, dust, smoke, sleeping-car accommodations, and the like. In smoking cars, in addition to the smoke itself, the floors are usually befouled with tobacco juice and other expectoration. The efficient remedy here as elsewhere is to be found, not simply in providing facilities for cleanliness, but in fostering the present public sentiment against spitting and other untidy habits. A physician of experience maintains the opinion that "foul air in railway trains and street cars is the cause of serious poisonings called 'colds' and 'grip,' particularly in those many trains where air from the smoker sweeps through passenger cars."

The development of our national quarantine methods is indicated in the following paragraph from Surgeon-General Wyman, of the Public Health and Marine-Hospital Service:

> Until 1893 there was, properly speaking, no national system of quarantine. The colonies had their own quarantine regulations before the formation of the Union, and from that event to 1893 quarantine was left to the care of state governments and by the latter to county governments or to municipalities, as the case might be. There was, indeed, national legislation, but all the acts of Congress up to 1893 relating to quarantine specially provided that the said national measures were in aid of the state and local authorities. Whatever opinions may have been held by members of the national legislature, quarantine was permitted to be exercised by the States as a police function, and even in the present law, which gives national supremacy, it is provided that assistance shall be given the States or municipalities by the government authorities, the supremacy of the latter being asserted only when the state or local authorities fail or refuse to enforce the uniform national regulations.[a]

To-day efficient inspection at our various ports of entry and at disembarking stations abroad keeps out many cases of disease each year, while the quarantine cordon thrown around ports or municipal quarters affected by infectious disease is an important factor in stamping out such disease.

Federal meat inspection chiefly benefits the foreigner, but the administration of the pure-food laws is of value to our own people.

There are two functions of Federal Government which now are very imperfectly served and which might be made of paramount importance. They are the functions of research and of the dissemination of information. A poultry raiser, or a cattleman, or a farmer can secure scientific information to guide him in his selections of fowl, or stock, or seed by applying to the Government at Washington, but information on how to raise children has up to this time been neglected by our Government. Nothing is to-day more significant of future progress than the fact that the President, the President-elect, and many Congressmen are so strongly in favor of a greater federal organization of health. Through the dissemination of information throughout the country, through enactment and administration of effective regulations concerning pure food, inspection of meat, and exclusion of foreign diseases, through research, statistics, and through better standards for state and municipal health service, a great economy of national vitality can be effected. Washington, our national capital, might be made by the Federal Government a model city of

[a] Walter Wyman, M. D., "The quarantine system of the United States," The Sanitarian, November, 1897, p. 3. See also James W. Garner, "Federal activity in the interest of the public health," Yale Review, 1905–6, p. 181.

healthfulness, as a preliminary to its becoming a model in every other way.

Army hygiene in time of war is most important. The lack of such hygiene has shown grave consequences. In the Boer war the British army in South Africa lost more men from typhoid fever than from wounds received in battle.[a]

The efficiency of Japanese hygiene manifests itself in the fact that General Oku's army of 75,000 during the recent Russo-Japanese war had but 187 typhoid fever cases in a seven months' active campaign.

The Japanese reduced their dysentery cases from 12,052 in the Chinese war to 6,624 in the Russian war; their cholera cases from 7,667 to none; and their malaria cases from 41,734 to 1,257. This was in spite of the fact that their army in the Russian war was three times the size of that employed in the Chinese war.[b]

The crying need of better statistics is trenchantly expressed by Dr. Cressy L. Wilbur, Chief of the Division of Vital Statistics of the Census Bureau, whose words should be read and pondered by everyone who desires to see any intelligent conservation of our vital resources:

> Sound vital statistics are the indispensable basis of modern sanitation. A nation that does not consider it necessary, or that is not able, to provide adequate means for registering the births of its own children, or for officially recording the deaths of its citizens, can hardly be supposed to attach sufficient value to human life to enable sanitary measures for its conservation to be adequately carried out.
>
> For the continental United States in 1907 somewhat less than one-half of the total population (48.8 per cent) was represented in the registration area from which returns of deaths were received by the Bureau of the Census. For the remaining 51.2 per cent of the total population of the United States, estimated at 43,774,724 persons, either very imperfect laws were in effect, giving only partial registration, quite worthless for statistical purposes, or else the conditions in many States might be represented by the statement made by one of their health officers, that it buries its dead people with no more ceremony than it buries its dead dogs.
>
> As for the registration of births, a measure which is so supremely important for the knowledge of infant mortality, for the protection of infant life, and for securing the legal rights of children, not a single State in the Union nor a single city of any considerable size makes positive claim that it registers as many as nine births out of every ten that occur. Even the city of Washington, whose law for this purpose is a direct enactment of Congress, does not arise above this low limit of efficiency. The total number of births must be known before one can make a computation of infant mortality which will be comparable with the rates given in the vital statistics of all civilized nations except the United States. This ratio depends upon the comparison of deaths of infants under 1 year of age with total births, and, as we have no exact registration of births, we can not present these important statistics.
>
> In the consideration of the effect of such an important disease as tuberculosis upon the people of the United States there is no means of knowing, within a very wide margin of error, exactly how many persons die from this cause in this country during any year. We have registration of deaths for about one-half of the population only, and the very dissimilar conditions of life and the large proportion of colored population in the unregistered half seriously interfere with any attempts to guess at the exact number. Estimates have varied from 138,000 to 200,000. The truth probably lies somewhere between them, but we certainly ought to have an exact record of the facts and not be obliged to depend upon mere guesswork in entering upon an important sanitary undertaking, such as the prevention of tuberculosis.

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[a] Ditman, loc. cit., p. 17.

[b] L. L. Seaman, "The Real Triumph of Japan," New York (Appleton), 1906, pp. 106–7.

On the question of army diet, see Blackham: British Medical Journal, 1908, August 8, p. 311.

We are laboring, in conjunction with the American Medical Association, the American Public Health Association, and with the sanitary officials of as many States as we can interest, to extend the registration area as rapidly as possible. Ohio has just adopted an excellent law, which takes effect next year. Not a single State in the South has yet succeeded in reaching a satisfactory standard—not one of them in fact has even passed an adequate law. We are depending upon the voluntary cooperation of the States. The Government has no power, it would seem, to collect the statistics or to secure the proper registration of births and deaths by its direct action. If all of the important interests involved could be awakened to the importance of this matter, if Congress would take a direct interest in the accomplishment of this work, we could secure fairly complete registration of deaths for the United States within the next ten years.[a]

CHAPTER VIII.—*Conservation through semipublic hygiene.*

SECTION 1.—*Medical research and instruction.*

By semipublic hygiene is meant hygiene through nongovernmental institutions, including institutions for medical research, the medical profession, hospitals, sanatoria, associations, schools, and factories.

Medical discoveries have usually been made in the laboratories of medical schools, universities, and research institutions. The practical value of these institutions is only beginning to be appreciated. The benefits already received from them are great, and the benefits to come will be incomparably greater. One of the earliest medical laboratories, the Pasteur Institute of Paris, has done splendid work during the past two decades in the study of harmful and beneficent bacteria. Of more recent origin are the British Sanitary Institute in London, the Rockefeller Institute for Medical Research, the Memorial Institute for Infectious Diseases at Chicago, and the Nutrition Research Laboratory in Boston, under the Carnegie Institute of Washington. The recent achievement of Dr. Simon Flexner in finding a serum for the treatment of meningitis is but one example of what well-directed research under the auspices of such institutions can accomplish. The crowning achievement of science in the present century should be, and probably will be, the discovery of practical methods of making human life healthier, longer, and happier than heretofore.

The medical schools in this country number 156. They are rapidly advancing, although the great majority are still ill equipped for providing intending practitioners with the most recent and useful knowledge. The future practice of medicine depends more on the character and aims of the medical schools of to-day than on any other factor. At the dedication of the Harvard medical buildings in 1906, President Eliot laid down as the primary duties of that school the study of the prevention of disease and the education of the public. The need of such a school especially devoted to prevention has been fully discussed by Doctor Ditman.[b] Several universities have courses, or are taking steps to give courses in the fields not only of public hygiene and preventive medicine, but also of personal hygiene and home economics.

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[a] Letter from Dr. Cressy L. Wilbur. See also Irving Fisher, "Mortality statistics of the United States census," publication of the American Economic Association, 1899; and R. Dudfield, "A critical examination of the methods of recording and publishing statistical data bearing on public health," Journal of the (Royal) Statistical Society, March, 1905.

[b] See N. E. Ditman, M. D., "Education and its economic value in the field of preventive medicine," Columbia University Press, Vol. X, supp. to No. 3, June, 1908.

One difficulty in establishing such a school is the lack of students who can afford the means or the time to attend. This was the experience of the George Washington University, in Washington, when a course of this kind was offered. For this reason it is gratifying to see that an effort is being made to throw open the research laboratory of the Public Health and Marine-Hospital Service for the use of health officers detailed from their several States and municipalities. In England the degree of D. P. H. (diploma in public health) is given those who meet the high standard set there for health officers.

During the last few years the American Medical Association has been seeking to study, classify, and improve the medical schools in the United States. A large committee, of which the writer is one member, has been appointed by the association to consider methods of securing such improvements as are deemed necessary. It includes in its scope the important but heretofore little appreciated field of medical economics.

Section 2.—*The medical profession.*

We come next to the part played by physicians, so far as relates to their "private practice." Their work as public health officers has already been mentioned, and does not concern us here. Their work in the home is of primary importance. It is on the physician that the average man relies for protection when he finds himself in the dread grip of disease.

Private practice comprises two main divisions, surgery and general practice. The first important application of the knowledge of germs was to surgery. Antiseptic surgery, originated by Lord Lister, has resulted in the saving of untold thousands of lives and has led in turn to aseptic surgery, which is still more effective. Not only has it reduced the previous mortality from operations, but it has vastly increased the number and kind of operations which can be performed in cases which under the old régime would necessarily have proved fatal.

Of one of the most recent advances the eminent surgeon Dr. W. J. Mayo writes:

> Second only to the germ theory has been the usefulness of the great discovery of Röntgen and the application of the X-ray to surgical diagnosis. It makes certain the diagnosis in a large number of conditions which were previously a matter of speculation, and enables remedial surgical measures at an early date, lessening mortality and morbidity.
>
> Another great surgical discovery is the suture of blood vessels evidenced by the work of Carrel. Its possibilities are astounding. The ability to transplant the kidney of one dog to another and have it continue its function, the amputation of a leg and its resuture, opens up the whole question of the transplantation of sound for diseased organs, especially organs which are double.[a]

In these and other surgical work a certain amount of vivisection is necessary. The present outcry against vivisection is an example of a defective sense of proportion. While needless cruelty should be avoided, the suffering of animals through vivisection, including all cases where the practice has been abused, is as nothing compared with the suffering of human beings which would be caused if all vivisection were abolished.

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[a] Letter from Dr. William J. Mayo.

The progress of antisepsis has so reformed midwifery that puerperal fever, a former scourge of humanity, is now extremely rare. In many cases the child, by being freed from gonorrheal contamination by the mother at birth, has been saved from blindness.[a]

The advance of surgery is shown by the following table of mortality of the wounded in the wars of the nineteenth century. Antiseptic surgery was introduced at the time of the Franco-Prussian war in 1870–1:

	Per cent.
Crimean war, English troops	15.2
French troops in Italy, 1859–60	17.4
German army, 1870–71	11.1
Spanish-American, 1898	6.6
Transvaal, 1900–1901	5.5

In general practice progress is also being made. The use of violent drugs is fast going out of fashion. The recognition of the self-limiting character of most of the acute diseases sounded the death knell of the harsh drugging of the olden time. Laboratory experimentation and careful study as to the physiologic and therapeutic effects of drugs have shown the necessity of subjecting everything material or immaterial, intended for the relief of human ailments, to the crucible of the most rigid scientific scrutiny. This sentiment has grown until in the best medical circles it is properly considered a reproach for a physician to use any preparation without an exact knowledge of its composition and a definite conception of the results expected from its administration. The number of medicines used by physicians is decreasing and will, if the predictions of experts in this field may be trusted, ultimately be reduced to a small fraction of the present pharmacopœia. Many medicines, like quinine and mercury, will of course merit a continuance of use. Syphilis, malaria, hookworm disease, and some other diseases are best combated by drugs.

Serum therapy, although in its infancy as to most diseases, has opened up a field of great promise. For example, antidiphtheritic serum, the one best understood and in most common use, has reduced the mortality in that disease from 50 or 60 to 12 or 14 per cent.[b] Not so much medicines or serums, but hygiene, will probably be the dependence of the next generation of physicians. Possibly the term "medicine" will some day be almost as inappropriate in describing the treatment toward which physicians are tending as the term "leech" now is in describing the physician. The profession has ceased to be hostile to hygienic treatment, and is slowly but surely substituting it for much of the internal treatment formerly employed. The new treatment includes the use of air, light, water, food, rest, massage, mechanical vibration, electricity, exercise, and suggestion, under the names of aerotherapy, hydrotherapy, psychotherapy, etc. These remedies have the great advantage of preventing as well as curing disease.

It only remains for all medical schools and the courses of lectures now gratuitously provided by the American Medical Association for all county medical societies to teach these things in such a thorough and practical way as will reach the whole profession and bring these

[a] Elie Metchnikoff, "The Nature of Man," New York (Putnam), 1903, p. 210.
[b] Metchnikoff, "The Nature of Man," p. 212.

benefactions to the whole people. In proportion as prevention is more important than cure, the rapid advance in the knowledge and practice of preventive medicine will be of value.

"To hygiene belongs without a doubt the place of honor in modern medicine. It is in the prevention of infectious diseases that the interest of the medical art is now mainly centered."[a] The best men are turning to these physiologic methods with enthusiasm.[b] They are learning to take into account the anxiety and other mental reactions of the patient as to what is said in his presence.[c] They are becoming more public-spirited and cooperative,[d] and alive to their responsibility to set patients a good example in living hygienic lives.[e]

The trend toward prevention is indicated in various ways—by the fact, for instance, that some physicians are now employed by families, schools, firms, associations, etc., for the purpose chiefly of preventing rather than curing disease. Women dentists graduating from the University of Michigan have made a practice of attending to children's teeth at a stated amount per month. Employers are increasingly securing the services of competent physicians to care for the health and physical welfare of their employees. This is a preventive measure, and has been found to be a "paying proposition" to the employer because of the resulting enlarged efficiency of the workers.

Their modern fight against tuberculosis has led physicians to a larger use of fresh air in their practice. At first many employed this agent merely as a "specific for tuberculosis," but its utility in all chronic ailments, such as neurasthenia, for instance, was next recognized. Latterly, fresh air has been discovered to be of use in pneumonia and other acute diseases. It is now not unusual to find physicians advising their patients, whether ill or well, to sleep out of doors. There can be no question that man was originally an outdoor animal.

The discovery of the germ origin of Asiatic cholera, tuberculosis, diphtheria, typhoid fever, bubonic plague, influenza, and other diseases, and of the part played by water, impure food, insects, rodents, and other common and almost omnipresent, but hitherto unrecognized, agencies as carriers of disease to man and animals, has awakened a world-wide interest in these subjects which, properly fostered and directed, opens up ever extending possibilities to the humanitarian, the economist, the statesman, and, still more, to the people at large.

The consequence must be a great revolution in medicine in the immediate future. The practice of medicine is destined to become a much more powerful agent than ever before in the suppression and prevention of disease. This result will be reached when the change now going on permeates the rank and file of the profession. It would be a pity if, through undue conservatism of some of its members, the profession should lose some of its prestige hard won during the last generation. Already the ever-present quack is pressing into the inviting field. As the public demands "drugless treatment" and many

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[a] Metchnikoff, "The New Hygiene," Chicago (Keener), 1906, pp. 12–13.

[b] See G. Stanley Hall, "Adolescence," New York (Appleton), 1905, vol. 1, p. 238.

[c] See A. T. Schofield, "Power of Mind," London (Churchill), 1902, 2d ed., p. 277.

[d] See Osler, "Maryland Medical Journal," October, 1905, p. 420.

[e] See Professor Osler's address to St. Mary's Hospital, London, 1907.

physicians fail to see and meet that demand so far as it is rational, the quacks see their opportunity. As a consequence, there is fast developing a species of quack that not only does not use "patent medicines," but condemns their use by regular physicians. Men of this type base their appeals on "naturopathy," become "food experts," prescribe fasting, or two meals a day or five meals a day, give lessons in "deep breathing," conduct outdoor sanatoria, and employ light and air baths, dry cupping, mechanical vibration, intestinal lavage, water cures, electricity, osteopathic manipulations, "divine healing," etc. All these methods have value under certain conditions; the only objection is that when applied by the uneducated they are utilized to poor advantage. The fault lies not in the therapeutic means but in those who use them. Physicians sometimes confuse the two, and make the mistake of opposing the means and user alike. They reject good means of cure because employed by "irregulars."

The result is that the patient sometimes finds the best means of recuperation in the hands not of medical men, but of uneducated "physical trainers." The public will go and should go to those who will render the most effective help. In order that the medical profession may suppress quackery the way must be not to oppose the use of beneficial therapeutic agents in incompetent hands, but to get their use into competent hands by adopting them themselves. There is a quackery that is villainous and injurious. This should be suppressed. But there is another quackery which is well intentioned and which, in spite of ignorance, manages to do some good. The good in it should be appropriated by the profession. By always promptly absorbing the best the profession will be in a position to cast out the worst in "irregular" systems of therapeutics. It may then recover the ground which it has too often lost. There was no reason why it should have lost hundreds of thousands of patients to "Christian Science," except that these patients were for the most part benefited, and greatly benefited, by Christian Science after having received no benefit, and often injury, from the profession. "Easily physicians, without knowing it, can produce sickness by pessimistic prophecies, by anxious looks or words. Thus are diseases suggested (unconsciously) by the physician."[a] Had the profession made use of mental therapeutics not only could they have saved themselves the enmity of these hundreds of thousands, but they could have nipped in the bud the crude metaphysics which teaches the nonexistence of disease and death and the uselessness of any therapeutic agent except those employed by the promulgator. The example of so-called "Christian Science" is only one of several protests, more or less misguided, against the present practice of medicine.

Had all or most members of the profession conceded long ago the harmfulness of many, if not most, violent drugs it might have forestalled the present antidrug movement among the laity. The misguided antivaccination movement is simply the carrying to extremes of the antidrug movement.

The Greeks were probably the most hygienic people that ever lived and they knew nothing of modern scientific medicine, not even of the circulation of the blood. This shows that man's primitive knowl-

[a] Schofield, loc. cit., pp. 215–216.

edge or instincts may be sufficient to enable him to keep and develop health.

The old code of medical ethics, though well-intentioned, was so inelastic and was so susceptible of misconstruction as often to block the way to progress. The magnitude and far-reaching effects of this evil were long ago recognized by leading minds in the profession, and after years of agitation such a revision was unanimously agreed upon in 1903 as makes the modern principles of medical ethics purely advisory and far more liberal than formerly. All restrictions as to consultations were removed, medical societies were thrown open to reputable physicians of every school of practice requiring scientific training, and agencies put in operation for such organization and cooperation and to encourage such liberty of individual opinion as is demanded by the spirit of the age. Under the most active efforts of the medical schools, societies, and journals it will doubtless require years of time for this liberal spirit to reach all members of the profession to the extent which is so desirable. But when this is done and when the public can be made to understand that it has been done the prejudice which has hampered the profession's usefulness, which has made it so difficult to secure and enforce health and medical legislation necessary for the protection of the highest interests of the people, and which has so fostered and given opportunity for quackery, will gradually become ancient history.

A frequent lay comment on some members of the medical profession is that to be true teachers of health they must practice what they preach. A physician can not succeed in controlling drug habits or alcoholism if he has these habits himself. He can not fight "patent medicines" if he uses them himself.[a] He can not effectively fight the social evil if he himself practices abortion. The standards of the profession are high. It is the individual who is at fault. A clergyman who preaches purity from the pulpit while living a double life is disgraced. In the same way, now that physicians are assuming the function of giving instruction in orthobiosis and hygiene, they are being called to account for their own daily lives. Self-interest and altruism alike will lead to needed corrections. The physician in these days of preventive medicine should keep himself well. The challenge "Physician, heal thyself" is being followed by the challenge "Keep thyself well." Example more than precept is a principle to be applied here as elsewhere. He can not induce his patients to diet or take exercise if he himself is addicted to the fleshpots and the easy chair. Many a physician to-day loses patients because he and his family are on the sick list, or because as a man he practices habits which as a physician he does not approve.

The physicians in this country now number about 130,000. Their calling is in some respects the noblest in the world to-day. During the present generation the profession has begun to be appreciated for its great services to public and private health and for its self-sacrifice, which is unequaled in any other profession except the ministry. It has now before it an opportunity such as never before existed. Those of us who believe in its mission look forward to incalculable blessings to suffering humanity from greater knowledge better applied.

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[a] See A. Jacobi, Journal American Medical Association, September 29, 1906, p. 978.

SECTION 3.—*Institutional hygiene.*

The large cities have established special contagious hospitals, where prompt isolation of infectious cases may be enforced. The decrease of tuberculosis may be traced largely to hospital isolation.[a] Leprosy was the first disease to be quarantined [b] and its virtual disappearance in civilized countries has been due, at least in the opinion of many authorities, to the strict isolation methods universally adopted.

Of a different kind is the segregation of defective classes of the community. This has led to considerable conservation of their powers and abilities. Institutions for the deaf and blind in the United States contained 14,700 inmates in 1904, and spent for purposes of maintenance over $3,500,000.[c] In these schools the deaf and dumb and the blind are taught trades and professions, their usefulness being thus much enlarged.

The New York state commission on the blind recommended in 1907 a state board for the blind to conduct an employment bureau for the blind of that State, to establish schools, and to put into operation measures for the prevention of blindness. It is pointed out that of the 100,000 cases of blindness in the United States a great percentage is traceable to disease and accident of a preventable character. The commission estimates that of 1,000 cases in New York, 450 were possibly avoidable and 325 (or one-third) certainly so.

For the checking of insanity the crying need is a study of the causes of the malady with a view to its prevention. For, as Doctor Ditman remarks, nine-tenths of the inmates of our insane asylums are incurable, according to our present knowledge. He adds: "What an argument for the prevention of the disease!" [d] Much may be expected from the Phipps fund, for the study of insanity, recently established at Johns Hopkins University.

In the first place, our medical students should receive constant clinical instruction in mental diseases, particularly in their incipient stages. Almost equally important are popular lectures on the preventable and other causes of insanity given under the auspices of medical schools or local boards of health. Such lectures have been given in New York and Boston, and, judging by the attendance, must prove a valuable agency in diffusing a correct knowledge of the cause and development of mental disease. In this education of the laity popular treatises on mental hygiene would prove most helpful. Such a book as Doctor Clouston's "Hygiene of Mind" could, with advantage, be placed in the hands of every young person, and might even be adopted as a text-book in high schools. Certainly the physiology of mind is as deserving of popular consideration as that of digestion, respiration, and the circulation.

By a clearer insight into the beginnings of mental disease, gained through the popular lecture and a nontechnical literature, society will become so far enlightened that intelligent personal prophylaxis

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[a] See Newsholme, "Phthisic death rate," Journal of Hygiene, July, 1906.

[b] See J. M. Eager, M. D., "The early history of quarantine," Yellow Fever Institute Bulletin No. 12, pp. 4–5.

[c] Census report on "Benevolent institutions," 1904.

[d] Ditman, loc. cit., p. 46.

may be anticipated.[a] A knowledge of danger is the surest means of guarding against it. "The most obvious line of attack must be in the direction of the four great etiological factors of insanity, heredity, alcohol, syphilis, and environment. Abstractly considered these four causes are preventable or removable."[b]

As an intermediate step between home and hospital, the sanatorium offers both cure and prevention. Many tuberculosis sanatoria will take patients only in the incipient and early stages of the disease. Sanatoria are used by many as places of recuperation. The tired business man and the nervous housewife find at the sanatorium the quiet they need, and a week or two of rest enables them to escape threatened serious ills.

Many public institutions, in response to popular demand, are today installing methods and equipment that are essentially preventive. More than one department store in the large cities filters its air in order that patrons and clerks shall not feel oppressed by vitiation of the atmosphere. An indirect result is the prevention of tubercular and other diseases. A leading hotel in Philadelphia has pitched tents on its roof, where a large colony of well people—not sick—sleep out of doors, and the same hotel utilizes its roof in winter for a skating rink. Mothers' clubs are an increasing factor in the spread of a knowledge of hygiene. Recently a case came to light of a new member of a mothers' club who was feeding her 5-months-old baby on sausage, tea cake, etc., and giving it drugs when she wanted to go out. She was greatly surprised when informed of the wrong she was doing.

Growing interest in the science of home economics, already referred to, is an indication of our increasing realization of the importance of healthful homes in the community. While the number of schools and colleges which offer courses in higher domestic science, and in what might be called "true home economics," is growing, they are nevertheless still comparatively few. More teachers should be equipped with scientific knowledge regarding modern sanitation in order that they may give practical courses in grammar and high schools, and higher instruction should include the topics of hygiene and sanitation. Home making may be studied in many details, such as the construction of healthful houses, the purification of food and water supplies, and the cleansing of cities, whereby the enlistment of both boys and girls in all lines of home and municipal hygiene can be secured.

The churches are now joining in the health movement. The lead has been taken by the Rev. Elwood Worcester and Rev. Samuel McComb at the Emanuel Church in Boston. Trained physicians are employed for diagnosis and for general advice, but great emphasis is laid on the power of suggestion and of Christian self-control over bodily ills. The object is to get both patient and physician to stop "thinking sick and talking sick," as Doctor Goler has put it.

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[a] A book which brings the subject home with unusual force to the ordinary reader is an autobiographical sketch by a recovered patient, "A Mind that Found Itself," by Clifford W. Beers, New York (Longmans, Green), 1908.

[b] Charles P. Bancroft, M. D., "Hopeful and discouraging aspects of the psychiatric outlook," address at meeting of American Medico-Psychological Association, Cincinnati, 1908.

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SECTION 4.—*School hygiene.*

In every progressive country to-day the hygiene of school life is coming to be regarded of paramount importance. At the International Congress on School Hygiene, in London, August 5–10, 1907,[a] there were in attendance at least 500 delegates, representing the governments of the world and societies devoted to the advancement of human welfare, and in addition there were 1,500 individuals interested in the improvement of the health of school children and all that this implies. The fact was brought out at the congress that European countries, notably Switzerland, Germany, France, England, and Scotland, are doing more than the United States in the medical inspection of schools and that they are seemingly making plans for the improvement in every direction of the hygienic conditions of school life.[b] Even in Italy the leading statesmen are apparently convinced that the matter of chief importance at the present moment in their educational work is to place it, from start to finish, upon a hygienic basis.[c]

It is the unanimous opinion of all students of the matter that the neglect of the hygiene of school life in the larger sense is, first of all, more or less disastrous to a considerable proportion of the pupils.[d] With us, as well as in most European countries, children are compelled by the state to attend school for a number of years. Many of them suffer constantly from defective vision, hearing, and respiration, from nervous overstrain, and from other ailments which are greatly aggravated by the confinement and stress of school life.[e] Pupils are always exposed to infectious diseases. It is no unusual thing in our country to see a contagious disease sweep through a whole school so rapidly that the local board of health can hear of it and order the school closed only after the harm has been done.

Great as is the injury done by the spread of infectious diseases to children thus massed together in schools, the injury resulting from imperfect seating, lighting, ventilation, and sanitation of school buildings is still more serious. In every part of our country, as well as in the progressive countries of Europe, those familiar with

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[a] The proceedings of the congress contain papers by distinguished physicians and educators upon every phase of the hygiene of school life. Existing evils are pointed out and remedies suggested. Summaries of the papers may be found in the Nineteenth Century, September, 1907, pp. 388–394.

[b] In addition to papers presented at the International Congress on School Hygiene, see the following: A series of articles in the School Review (University of Chicago) for 1907, by Prof. Hermann Schwartz, entitled "The study of experimental pedagogy in Germany." Many articles in the magazine Zeitschrift fur Schulgesundheitspflege show the great interest in Germany in school hygiene. Professor Binêt, of Paris, has established a laboratory for the study of childhood in relation to educational work, and he will give particular attention to problems concerning physical defects and mental and moral shortcomings. For other such institutions see The Psychological Bulletin, Vol. VI, March 15, 1909, pp. 84–103.

[c] See, for example, Professor Garlanda's "Il Terzia Italia," in which he shows the only way in which Italy can regain her old-time vigor and efficiency.

[d] See M. V. O'Shea: "Dynamic Factors in Education," New York (Macmillan), 1906, Part II, where the whole subject is discussed.

[e] See Oppenheim: "The development of the child," Chap. V. Also Tyler: "Growth and education;" Burbank: "The training of the human plant;" Burk: "From fundamental to accessory," etc.; Pedagogical Seminary, Vol. VI. Kræplin: "A measure of mental capacity," Popular Science Monthly, vol. 49.

the situation are appealing most urgently for improvement in the physicial basis of education. This is not the place to recite the disabilities which are said by men competent to speak on the subject to result from keeping children for at least eight years in confinement and at hard mental labor under conditions that waste their vitality and develop bodily defects and habits prejudicial to health. The list of such disabilities is a long and impressive one.[a] Unfortunately, we do not, as a people, sufficiently appreciate that the character of social life with us is changing rapidly, and that consequently our children are particularly susceptible to certain diseases and defects; to wit, those arising from the adoption of an indoor life of comparative muscular inactivity, with greatly increased demands made upon particular organs, such as the eyes and the brain.

Doctor Cronin, of New York, maintains that in a school population of 650,000, 30 per cent of the children were from one to two years behind their proper class. Ninety-five per cent of these backward children were so principally because of defects of eye, ear, nose, or throat, which could easily be detected and remedied through effective medical inspection. Experiments at home and abroad have proven beyond any doubt that the majority of children of this sort, when given proper medical treatment, improve markedly in intellect and general conduct. The State attempts to educate these children, but its effects are to a large extent wasted. Doctor Osler calculated that in the special city to which reference has been made there was, on account of a lack of medical supervision of educational work, a yearly financial loss of $1,666,666; and of course the loss which came from moral deviation due to defective physical functioning was of far greater importance. Doctor Osler said recently, in effect, that he considered it of greater importance to the nation that the question of sound teeth be intelligently considered than that the consumption of alcohol be restricted, important as the latter problem is. In similar vein, Doctor Newton reports a case of an old, unhygienic school building in a small town being fitted up with a ventilating system, with the result that the cost of the improvement was saved in a short time in salaries that otherwise would have been paid to extra teachers for taking the place of those made sick by the foul air in the building.

We now know the major effects at least on intellect and temperament of sense defects, adenoids, decaying teeth, and minor physical deformities; and we also know how such deviation from normality can be readily and inexpensively detected and remedied,[b] but there are whole States where no advantage whatsoever is taken of this knowledge, and in practically every State in the country there are communities in which absolutely no attention is paid to any of these matters. The people go on in traditional ways, trusting to luck and disregarding the changes taking place in society.

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[a] See Shaw: "School hygiene;" Keating: "Mother and child;" Ballantyne, in the Lancet, Vol. 2, 1890; Bancroft: "Physical Education Review," Vol. VII; Rowe, "The lighting of schoolrooms;" Burrage and Bailey: "The Sanitation and decoration of school buildings." The Magazine of School Hygiene, published under the direction of the School Hygiene Association, contains in each issue articles showing the evils resulting from unhygienic conditions in the schools.

[b] See, for example, two books by Doctor Warner, of London: "The Study of Children" and "The Nervous System of the Child." The city of Chicago maintains a department for the study of backward and defective children in the public schools.

The health of our school children, then, should be conserved by a system of competent medical inspection[a] which should secure the correction of defects of eyes, ears, teeth, as well as defects due to infection or malnutrition. In Europe—

all the investigations disclosed an astonishing amount of ill health among school children; and though the variations from the normal were found to differ in degree, they were on every hand alike in kind. In nearly every instance they were more pronounced in girls than in boys, and were often most manifest in scholars of the better social classes. Thus there were discovered the following percentages of morbidity among school boys: In Great Britain, 20; in Denmark, 29; in Germany, 30; in Copenhagen, 31; and in Sweden, 37. The percentages noted among the girls were: In Great Britain, 16; in Copenhagen, 39; in Denmark, 41; in Lausanne, 43; in Germany, 50; and in Stockholm, 62—an average morbidity for boys of 29 and for girls of 42 per cent.[b]

Similar results have been reached in certain cities of the United States. A "committee on the physical welfare of school children" in New York City examined New York school children and found that[c]—

66 per cent needed medical or surgical attention or better nourishment.
40 per cent needed dental care.[d]
38 per cent had enlarged glands of the neck.
31 per cent had defective vision.
18 per cent had enlarged tonsils.
10 per cent had postnasal growths.
6 per cent were undernourished.

Dr. Walter Cornell has been making an extensive study of eye strain among school children. These were his findings:[e]

The relationship of poor vision to scholarship was studied in 219 children. As will be noticed, the difference in marks between those with normal and those with bad vision is greatest in arithmetic and spelling, which studies require more extensive use of the blackboard.

Scholarship percentages obtained.

Children with—	Arithmetic.	Geography.	Spelling.	Average.
Normal vision	79	69	76	75—
Fair vision	70	71	77	73+
Bad vision	66	70	71	69

In New York City 29.5 per cent of 79,069 children examined suffered from defective vision. In London 26 per cent of 20,000 children examined by eight

[a] See Gulick and Ayres. "Medical Inspection of Schools," Russell Sage Foundation Publication, New York, 1908; see also "The Psychological Clinic," especially Vol. ii, No. 8.

[b] G. Woodruff Johnson, M. D., "Effects of school life on children's health," North American Review, vol. 182, p. 831.

[c] Ditman, loc. cit., p. 41.

[d] This seems a low estimate in spite of the fact that it does not include all cases of decayed teeth, but only those that have been neglected. See Dr. William R. Woodbury, "The People's Disease: How to Prevent it," Boston Medical and Surgical Journal, March 26, 1908.

[e] "Backward Children in the Public Schools," Philadelphia (Davis), 1908, p. 7.

ophthalmologists had defective vision, and of this number 12.5 per cent suffered from vision of one-half or less. The author examined personally 1,156 children and found 34 per cent with defective vision, and of this number 6 per cent with vision one-half or less. A small proportion of this number only is fitted with glasses. The rest suffer from real eye strain. The fault of this deplorable condition is divided among physicians, school-teachers, and parents. Ignorance of the existing facts, indifference, and poverty are the real factors to be dealt with.

Eye strain is the chief source of the functional diseases of our citizens. It begins in early childhood and continues until senility is complete. It is bound to occur in every individual some time in his life, to a greater or less degree. It is almost the sole cause of headache, migraine, sick headache, the most frequent and habitually morbidizing of human diseases. It is the frequent cause of gastric and digestional diseases and of nervous and mental diseases. With ocular function it conditions the origin of spinal curvature, either directly or indirectly, through the pathogenic writing posture. Lateral spinal curvature, the effect of visual function, becomes a new secondary source of multifarious morbidities, such as neurasthenia, pelvic diseases, hysteria, etc. • It has been demonstrated that 27 per cent of European school children have lateral spinal curvature at the age of 14, and I have proved that at least 70 per cent of our own 16 to 18 year old young men of the educated classes have this disease. Surprise at the fact will soon become horror at the national and social tragedy which these true figures indicate.[a]

Investigations in other cities and States[b] have shown similar results, in view of which it is a conservative statement to say that from one-half to two-thirds of our school children need medical treatment of some sort.

At least one year in each division of schooling, elementary, secondary, and collegiate, is lost to the majority of students because of unnecessary sickness or dullness caused by improper living.[c]

That physical defects are responsible for much of the backwardness of children, and for a large share of truancy and incorrigibility, is the opinion of many educators.[d] In order to correct physical abnormalities and thereby to hasten mental and moral progress in school life, a number of cities have instituted medical inspection of schools.

So far as inquiry has been able to discover, there were in the month of June, 1908, 70 cities in the United States, outside of Massachusetts, having some form of medical inspection of schools. In the State of Massachusetts 32 cities and 321 towns had systems more or less complete. It is at present impossible to compute, or even to closely conjecture, how many children these systems reach at the present time. It is entirely certain that they do not reach all of the children in the schools of those cities and towns where systems of medical inspection are actually or nominally in operation.[e]

New York City employs 150 physicians, who visit each public school once a day, shortly after 9 o'clock, to examine those children set aside by the teacher

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[a] Letter from Dr. George M. Gould, who perhaps more than any other American has emphasized the evils of eye strain.

[b] See an article by Prof. M. V. O'Shea in the World's Work, Vol. V, in which the results of extensive investigations were given. See also Dr. W. B. Drummond: "An introduction to child study," Chs. IX and X, "Report of Conference of State Sanitary Officers of New York," Buffalo, October, 1907, and various Baltimore and New York City school reports.

[c] Letter from Mrs. Ellen H. Richards.

[d] See O'Shea: "When character is formed," Popular Science Monthly, Vol. LI; Rowe: "Physical nature of the child," Chs. 9, 10, 13, 14; Scott: "Sacrifice of the eyes of school children," Popular Science Monthly, October, 1907; Gould: "The cause, nature, and consequences of eye strain," Popular Science Monthly, December, 1905; Travis: "The Young Malefactor, a Study in Youthful Degeneracy;" Swift: "Mind in the making," Chs. IV and V; Tanner: "The child," Ch. III; Kirkpatrick: "Fundamentals of child study," Ch. XVII.

[e] Letter from Dr. Luther H. Gulick.

as requiring attention. Chicago employs nearly 100 physicians to visit her public schools. In Chicago during the ten months of the school year ended June 26, 1908, the medical inspectors of schools examined 406,919 pupils.[a]

And one health officer, Doctor Chapin, of Providence, has even established a special fresh-air school for children who suffer from certain forms of tuberculosis or who come from tuberculous families. He says concerning it:

> Our fresh-air school has only been running since last January (1908), and, of course, we have no very definite results. All of the children without exception improved in health, and gained in strength, and also showed good mental progress. The cost of the school per capita is only about 50 per cent more than in the ordinary schools, and we believe that the expense is fully justified. If we had a large enough school, so that it could be graded, the cost of education would, owing to saving in fuel, probably be less than in an ordinary school.

Several States are making progress in these directions.

> Connecticut, Massachusetts, and Vermont have passed laws making examination of eyes, ears, and method of breathing of the public scholars compulsory, while New York, Illinois, and some other States of the Middle West depend upon the voluntary cooperation of the teachers in making this examination. It would seem, however, that whether it remains voluntary or becomes compulsory, its success will be greatly enhanced if women who are conducting teachers' institutions in the department of education devote a half hour or an hour to the exposition of the necessity of such an examination and also in explaining the method in detail and the method of tabulating the results, so that the teachers may be familiar with the tests, etc., when they have to make them. With the great power lodged in the department of education in this State, it would seem justifiable to make this compulsory.[b]

We in this country should profit by the experience of older countries in respect to school hygiene. Switzerland has led the nations in its concern for the physical welfare of its children. A number of other European countries are beginning to imitate Switzerland in attaching supreme importance to health and hygiene in educational work. There is now before the English Parliament a bill the purpose of which is to establish a national system of medical inspection of schools, and it seems probable that this measure will be enacted into law.

It is generally recognized by physicians and educators to-day that many children in the schools are being seriously injured through nervous overstrain.[c] Throughout the world there is a developing conviction that one of the most important duties of society is to determine how education may be carried on without depriving children of their health. It is probable that we are not requiring too much work of our pupils, but they are not accomplishing their tasks economically in respect to the expenditure of nervous energy. Some experiments made at home and abroad seem to indicate that children could accomplish as much intellectually, with far less dissipation of nervous energy, if they were in the schoolroom about one-half the time which they now spend there. German educators and physicians are convinced that a fundamental reform in this respect is needed. In fact, among school children we are learning the same lesson as

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[a] A. L. Craig, "Report of the standing committee on contagious, infectious, and hereditary diseases," Associated Fraternities of America, August 1, 1908.

[b] Twenty-eighth Annual Report State Board of Health of New York, 1908.

[c] See Dr. Adolph Meyer, "What do Histories of Cases of Insanity Teach Us Concerning Preventive Mental Hygiene during the Years of School Life?" The Psychologic Clinic, June 15, 1908.

among factory employees, viz, that high pressure and long hours are not economy but waste of time.

In American cities one of the greatest needs to-day, in order to conserve the vitality of children, is the establishment of playgrounds easily accessible to all the children of any community. We are told that the physical and the mental are inseparably joined together, and if the one is defective the other will suffer through sympathy. Now it appears to be impossible to develop the child physically in any way so effectively as through active play. Formal gymnastics can accomplish relatively little. The child must have some end to attain that arouses its enthusiasm, and that demands agility and strength and endurance; then its whole bodily mechanism will work together in harmony to achieve this end. And this is what a physical training seeks to accomplish—to make the body a fit instrument for the mind. Let the child have some place where it may not only play games freely without fear of the police but where it may run and jump and climb and swing and work in sand and throw stones and wrestle, and it will not fail to make the most out of the body nature has given it as a housing for a sound and efficient mind.

Even if playgrounds were of no value in social development, they would still be of inestimable service in keeping children out of crime and lessening expense for police, courts, reformatories, hospitals, and prisons—a point which was strongly emphasized in the report of 1897 of the committee on small parks in New York. If a boy's energies are not used up in wholesome activity they will surely find expression in illegitimate conduct. The boy will prey upon the institutions which prevent him from living a natural life. "The greatest enemy to the police is the boy," said a high Philadelphia official recently. Go to the storekeeper, to the shopkeeper, to the housekeeper, and you will hear the same story. The boys steal, break windows, insult, afflict, upset one thing and another, and would do almost anything they hear or see in order to satisfy that burning instinct for play. "These beginnings of vice and crime were the only outlets they have had for the powers with which nature has endowed them. These practices were their only or chief amusement, and thus happiness to them became synonymous with vice and fiendish delight in evil doing."[a]

But in studying the life on the playgrounds the same official sees that they lay the foundations for—

> strong, manly, bright, and happy lives, rescued from the evil habits and tendencies that produce misery and wretchedness. * * * Through their play in this manner the young are taught how to live together, how to respect each other's rights, how to be kind, gentle, pure, in language as well as in conduct. The boy's mouth is not defiled by tobacco, liquor, or profane language. The disrespectful and vulgar treatment which young boys and girls inflict upon each other in the street is done away with. The playground influences are brought into the home, where the younger brothers and sisters treat each other much differently from the way they do now; or, to put it the other way, the influences of the home, the school, and of the church are thus extended outside over the whole life of the child.[a]

To playgrounds may be joined school gardens, which Superintendent Maxwell in New York has shown would not be expensive,

[a] Secretary of Philadelphia Culture Extension League.

or open-air gymnasia, or any other equipment that will give children the opportunity to develop physically.

Physical education is a part of the training in many public schools and in a still greater number of private schools, but there is room for improvement. After pointing out, in a recent article on physical deterioration, that Germany, France, and Austria have improved their physical development by compulsory physical training in all civil and military educational institutions, the Rev. Percy Stickney Grant advocates the instalment in the United States of:

1. An effective system of physical education as a recognized part of all public-school systems. By "effective" I mean one that does for a boy, as far as his physique is susceptible, what army setting-up exercises do for a recruit.
2. Athletic exercises in schools, using gymnasia, baths, etc.
3. Open-air exercises and sports under efficient supervision.
4. Summer camps free of cost, and compulsory attendance for boys of school age.[a]

The study of hygiene and physiology has been part of the public school curriculum for some time, but has been regarded by physiologists as a somewhat partisan and unscientific treatment of the physiological effects of alcohol and tobacco. It should be recognized, however, that it has had a salutary effect and has given school children a better idea of what alcohol means than the most of them had before.[b] Local topics of sanitation may well be taken up, as in New Haven last year when the interest of all the city school children was enlisted in behalf of a "clean city." Doctor Stiles, of the Public Health and Marine-Hospital Service, has proposed an annual "health week" in the public schools, and this proposal has found favor in several States. In Georgia Chancellor Barrow has proposed an annual "health day" in the public schools of that State, which would be devoted to lectures on sanitation, on the dangers to be expected from unscreened windows, and on the character of the hook-worm disease, with suggestions as to its elimination.

At present the schools look to parents to instruct their children in the supposedly simple matters of regulating eating and drinking, exercise, habits of work, and sexual habits, while the parents vaguely hope (if they think about such matters) to be relieved of these embarrassing duties through the schools. The truth is that neither parents nor schools are to-day able to give this much-needed sort of education. The remedy must be provided by the schools, which in their eagerness to impart conventionalized facts are now quite blind to some of the most pressing needs of their pupils. Through the schools and universities (or other appropriate organizations) the parents of the future must be educated both as to the facts and the moral aspects of bodily hygiene. And it seems not unreasonable to hope that some of the lessons now learned only by bitter experience, after much that is best in life has been sacrificed to ignorance and uncurbed impulse, will be assimilated sufficiently early in life to mitigate materially the lot of a not inconsiderable part of mankind. I believe the lengthening of the span of human life to be among the attainable results of such teaching. Is it not likely that as men grow wiser an increasing number will deliberately strive so to regulate their lives as to improve the expectation of crowning well-spent days with the peculiarly fine satisfaction of old age?[c]

If the school building were a model of ventilation, lighting, and sanitation, it would not only conserve the health of the school chil-

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[a] Rev. P. S. Grant, North American Review, February 1, 1907.

[b] See Dr. Helen Putnam, "Studies of the Present Teaching of Hygiene, Through Domestic Science and through Nature Study," American Academy Medicine (Easton, Pa.), 1905.

[c] C. A. Herter, M. D., "The Common Bacterial Infections of the Digestive Tract," New York (Macmillan), 1907, p. 351.

dren, but also serve as an object lesson for hygienic instruction. In the same way cooking and domestic science classes could be made to serve the double purpose of providing a hygienic noon meal and training the school children, especially the older girls, in the principles and practice of this vitally important subject. Our schools are suffering from the conventional idea that education comes from books. Education is preparation for life, and should make use of every efficient method and element, manual training, athletics, observational nature study, laboratory experiments, and object lessons of all sorts, as well as book instruction.

SECTION 5.—*Voluntary and business organizations.*

A host of distinctly voluntary associations are working for the improvement of hygienic conditions. Among them may be mentioned the National Association for the Study and Prevention of Tuberculosis, the Society for Sanitary and Moral Prophylaxis, the Chicago Society of Social Hygiene, the Connecticut Society of Mental Hygiene, the national and state child labor committees, the Congress on School Hygiene, the Children's Aid societies, the Sunshine societies, the American Playground Association, the Visiting Nurses' Association, the Red Cross Society, the American Association for Labor Legislation, the numerous temperance organizations, university settlements, institutional churches, Young Men's Christian Association and kindred associations, the American Physical Education Society, the Boston Health Education League, and the American Health League established by the Committee of One Hundred on National Health.

That various large bodies of men are waking to the importance of health study is shown by the appointment, at the last annual meeting of the Associated Fraternities of America, of a committee on infectious, contagious, and hereditary diseases, with Doctor Craig, of Chicago, as chairman. Labor unions may well follow this example and provide for the education of their members in the subject of hygiene. This could be effectively combined with their endeavors to shorten the hours of labor. Especially unhygienic is the arrangement by which a man has no interest in his work beyond that represented by his pay envelope. This fact has been recognized by some farsighted employers of labor, with the result that they now employ social secretaries or "welfare workers" to look after the general well-being of employees. A social secretary watches over the health, comfort, and happiness of the force during working hours, establishes lunch rooms, rest rooms, mutual aid associations, thrift funds, and penny provident banks. Employers, as a rule, become eager for practical suggestions and expert advice on the well-being of their employees as soon as the matter is called to their attention. Doctor Favill, president of the Chicago Tuberculosis Institute, after speaking before the Commercial Club, was urged by 15 or 20 of the large employers present to undertake investigation of their establishments and to make recommendations.

Dr. Hubert Higgins describes an interesting experiment carried out in a mill near Paris, where there were employed 44 men and 75 women and children. A medical officer was employed to supervise the sanitary appliances and regulations and to give careful instruc-

tion and explanations. He held practical instruction classes with the mothers, lecturing on diet and cooking, cleanliness, the way to take body temperatures, and how to look at the children's throats.

This experiment was entirely successful, though the doctor lived in Paris. There was not a single death in three years. There were one or two cases of scarlet fever and diphtheria, that were promptly and effectively isolated. This experiment was not philanthropic, but financial, the employer realizing that he had better value in work from healthy hands.[a]

A few factories now use or permit the use of a reader to read to their employees, where the manual nature of their work is such as not to be hindered by listening to a story. Others use a piano and have their employees march in and out to music. The curious physiological relations between rhythm and work are now being observed by physiologists. Laboratory tests with ergometers seem to show that more work can be done under the stimulus of rhythm. Soldiers and sailors have for ages made use of music and rhythm, and it would not be beyond the range of possibility if the factory system should in some cases find more use for it than at present.[b]

Unconsciously, business corporations have also made changes which tend to improve the sanitary conditions under which their employees work. In a large telephone exchange in Chicago the perfect working of the apparatus was much hampered by dust, so that insulation was seriously affected. To obviate this condition an expensive system was put into operation, by which the air was washed and pumped into the rooms under ideal conditions. What the company aimed at was the perfect health of its apparatus, but it gained in addition a decided improvement in the health of its employees.[c]

Another similar organization, the New England Telephone and Telegraph Company, at Cambridge, Mass., ventilated its offices during the winter of 1907–8 with unusual care, with the result that the number of days of work lost by its 60 female employees was cut in half.

The need of industrial efficiency is driving business men to demand temperance or even total abstinance among their employees. This is one of the most powerful motives to-day working against the abuse of alcohol. In the South employers and the public see that negroes who drink are inefficient and dangerous. Railway officers and the traveling public realize that public safety requires sober locomotive engineers and firemen. Even drinking among sailors is being discountenanced. Doctor Grenfell, the missionary among the Labrador fishermen, says: "Why don't I want to see liquor used at sea? Because when I go down for a watch below, I want to feel that the man at the wheel sees only one light when there is only one light to see."

Among semipublic institutions with power to exercise prodigious influence in improving the public health are the life insurance companies. Just as fire insurance companies make efforts to decrease the risk of fire, so life insurance companies might well join in public health movements to effect a reduction in the human death rate.

While the financial motive is sordid, it should be utilized because of its tremendous power. The insurance companies to-day represent

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[a] Hubert Higgins, "Humaniculture," New York (Stokes), 1906, pp. 209–211.
[b] See Karl Bücher, "Arbeit and Rythmus," Leipzig, 1902.
[c] See Outlook, May 26, 1906.

an invested capital of over $3,000,000,000. An actuary recently remarked to me, in connection with this subject, that they could without feeling it contribute great sums annually to the preservation of public health. When insurance companies were established, the old dictum that human vitality followed a fixed law served probably to exclude the idea of preventing death claims rather than paying for them. Now that we are learning the preventability of disease, the time must come when insurance companies will take an active part in the fight. Even a single company would probably make a good investment if it sought to educate its own "risks." But a far more effective method would be a combination of all companies to improve public health through the enactment of public legislation—by Congress, state legislatures, municipal governments, and in numberless other ways.[a]

Among some official agencies meant to promote the social welfare are two recent commissions appointed by the President—the Homes Commission, of 1907, appointed for the purpose of studying the housing conditions in the District of Columbia, and the Commission on Country Life, appointed to study the daily life of the farmer. Farm sanitation will be especially considered.

Finally, there is a public yet voluntary agent in the progress of hygiene that must not be overlooked, namely, the modern periodical. Not only do the daily papers devote much attention to questions of health and hygienic reform, but the popular magazines have taken up the fight against disease, and are educating the popular mind, more surely than is realized, concerning the natural and normal way of life. It is necessary to add, however, that these same periodicals often nullify the benefits derivable from their reading matter by printing the most harmful of patent medicine, quack, drug, and alcoholic advertisements. Public odium should attach to newspapers and magazines that advertise hurtful nostrums. It is impossible to estimate the harm wrought to the public health each year through such advertising.[b]

The daily papers are especially culpable in this regard, but weeklies and monthlies are not wholly clear of the taint. When a newspaper's advertising space is once bought by quacks or nostrum sellers, its news columns become closed at once to matter considered objectionable by such advertisers. Frequently news items reflecting directly or indirectly on quackery are suppressed. Notable examples of publications that have taken strong ground against such advertising are Collier's Weekly, The Outlook, The Ladies' Home Journal, and a few—a very few—daily papers.

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[a] Since the above was written the Committee of One Hundred on National Health has urged this matter before the Association of Life Insurance Presidents, which body has appointed a committee to draw up plans. Also the Metropolitan Life Insurance Company has organized a bureau of cooperation and information to aid in distributing information to policy holders of the "industrial" class.

[b] For further discussion of this topic see a pamphlet by Samuel H. Adams on "The Great American Fraud," reprinted by the American Medical Association from a series originally appearing in Collier's Weekly, and "A Century's Criminal Alliance between Quacks and Some Newspapers," by Champe S. Andrews, Publications of the Committee of One Hundred, 1907.

Chapter IX.—*Conservation through personal hygiene.*

Section 1.—*Its importance.*

Following public and semipublic hygiene, we arrive at what is in many respects the most important subject of all, personal hygiene. It is quite true that the individual is often at the mercy of unclean streets, bad drainage, impure water and food, and other shortcomings of public and semipublic hygiene. On the other hand, his own personal interest is necessary in order to form the public opinion which alone can result in effective public and semipublic hygiene, while that interest is still more necessary to make such hygiene apply directly to his own person. Clean streets are of use only as they make the air breathed purer, but they are of little avail to the household which does not ventilate its rooms or which keeps them in a state of filth. The milk supply of a city may be ideal, but all the pains to make it so will be set at naught if the individual consumer allows the milk to be contaminated after it is delivered. The labeling of foods and drugs will not prevent self-poisoning through alcohol, nor will the elimination of preservatives from foodstuffs and the enforcement of sanitation in their manufacture be of avail if in their preparation for the table they are subjected to disease and dirt. Thus at every point of hygienic progress, there must be individual cooperation with public efforts.

When, contrariwise, health organizations and officials are inefficient, the individual may, in spite of these difficulties, often maintain good health. In New York a woman who was the occupant of a tenement overcame tuberculosis by sitting daily on her fire escape. The air was not the best, but it was much better than indoors. Similar results have been obtained by workmen in Brockton shoe factories, who, in spite of insanitary working places, and without cessation of work, conquered tuberculosis by sleeping on the roofs of their houses at night.

Observation shows that many, possibly most, of the world's most vital men and women have virtually made over their constitutions from weakness to strength. Cornaro, the famous nonogenarian, Kant, and Humboldt are cases typical in different fields of achievement. Cornaro, a Venetian nobleman born about the middle of the fifteenth century and given up to die at the age of 37, forswore all unhygienic habits and began to live "the temperate life," his abstemiousness applying especially to food. His age at death is variously estimated, but he lived to be at least 97. When over 90 he wrote a treatise on longevity, laying down as the chief rules of a normal life, care in eating and drinking, and the avoidance of melancholy and passion.[a]

Centenarians have usually been persistent followers of some rule or rules of rational hygiene, even though unconsciously.[b]

Metchnikoff points out[c] that part of the supposed inheritance of longevity may not be inheritance, but similarity of environment, and that it very frequently happens that husband and wife both live to be

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[a] See L. Cornaro, "The Art of Living Long" (English translation, Wm. F. Butler, Milwaukee), 1903.

[b] Metchnikoff, "The Prolongation of Life," p. 141.

[c] Ibid., p. 86.

over 100. This could scarcely happen by accident, but must be due to similar habits or environment.

Humboldt confessed to a fellow-student that in the first years of his childhood his tutors were doubtful whether even ordinary powers of intelligence would ever be developed in him, and that it was only in the advanced part of his boyhood that he began to show any evidence of mental vigor. As a boy he suffered from debility which not infrequently produced great prostration.[a]

Of recent examples may be mentioned a young physician who was given up to die of tuberculosis five years ago, but who to-day can run 25 miles without a rest; and Horace Fletcher, who in his 46th year was rejected for life insurance, but who later not only obtained his insurance, but proved his powers of endurance by cycling 190 miles on his 50th birthday.

And not only can weakness, if recognized early enough, be turned into strength, but strength, however great, may be dissipated in an incredibly short time.

Personal hygiene means the strengthening of our defenses against disease. Public hygiene seeks to destroy the germs before they reach our bodily defenses. These two branches of hygiene are simply the two forms of warfare, defensive and offensive. Both are of transcendent importance, but the defensive warfare is more within our power. We always have our defending garrison, the white blood corpuscles, to deliver us from our enemies.[b]

Section 2.—*Branches of personal hygiene.*

Personal hygiene comprises hygiene of environment (air, soil, dwelling, clothing); hygiene of nutrition; and hygiene of activity.

Man is more dependent upon the atmosphere than upon any other environmental factor. His body is bathed in air and his most vital function, respiration, depends upon it. Deprived of air, he will shortly suffocate. If the air is confined and impure, his health will be affected. Ideal air should first of all be pure—i. e., free from injurious bacteria, from dust, smoke, and noxious gases. It should also conform to certain standard conditions of humidity and temperature. In this field lie the sciences of climatology and meteorology. Man learned long ago how to make himself almost independent of climatic and atmospheric conditions by the use of dwellings and clothing. These contrivances, however, while protecting him from the elements, have brought evils of their own. The great scourge of tuberculosis, for instance, is principally an indoor disease.

Intimately related to the appropriation, through the lungs, of oxygen from the atmosphere is the ingestion of food and drink through the alimentary canal. Normal health conditions demand in the case of ingested materials, as in the case of respired air, the greatest possible purity, freedom from injurious bacteria, and the absence of substances hurtful mechanically or chemically.

Finally, the ideal conditions of health require perfect balance of work, play, and sleep.

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[a] "Life of Alexander von Humboldt," by Lowenberg Ave-Lallewort and Dore, translated by Jane and Caroline Lassell, New York (Lee & Shepard), 1873, Vol. I, pp. 30–32.

[b] Metchnikoff, "The New Hygiene," p. 14.

While absolutely perfect conditions in these three branches of hygiene are unobtainable, hygienic progress consists in approaching these ideals as closely as possible.

The rules of personal hygiene are expressed in standard medical works on the subject. There is nothing novel in the brief résumé which follows. The radical changes in habits of living which are now being advocated and to some extent practiced imply nothing new. They have, for the most part, long been commonplaces of the medical profession. The knowledge is old. It is the application which is new. Medical men have long been telling their patients to get plenty of fresh air and to masticate their food. But until recently their advice has fallen on deaf ears.

Section 3.—*The hygiene of environment.*

Air hygiene deals first of all with ventilation.[a] The importance of properly ventilating houses is so great that to secure this end the architecture of houses will have to be changed. The worst historical instances of bad ventilation are the imprisonment and virtual suffocation of 146 persons in the "Black Hole" of Calcutta and the confinement of 300 men in an underground room after the battle of Austerlitz. The evils of overcrowding come mainly from exhaled air and from the effluvia thrown off by the skin. Not only does overcrowding bring bad air, but it also increases the opportunity for infection.

The air in our houses has impurities of its own. Oil and gas vitiate it. Electric lights are hygienic in this respect. Air is never quite free from dust impurities. Aitkin estimates that country air carries 2,000 dust particles per cubic centimeter, city air 3,000,000, and inhabited rooms 30,000,000.

In a clean hospital ward, when air was agitated by dry sweeping, the number of colonies of bacteria collected on a given exposure rose from 26 to 532, showing the effect of ordinary broom sweeping. The broom is now being replaced by the carpet sweeper, and the carpet sweeper in turn by the vacuum cleaner. Each step represents progress in the elimination of dust. The removable rug is in this regard an improvement over the carpet.

Air may even be poisoned by the chemicals contained in wall paper or in the plaster of a brick and mortar dwelling.

The one place where the individual has more control over the air he breathes than anywhere else is his sleeping room. He may be powerless to control the air in his place of work, or even in the rooms where he lives during the day. But, except where he shares a bedroom with others who are averse to modern ideas of ventilation, he can largely control the air supply during sleep, and this means during one-third of his whole time. He can open wide his windows and in many cases arrange actually to sleep out of doors. The growing practice of sleeping out of doors is one of the most significant signs of the times. Only those who have tried it realize the benefits. The air supply in public places would be under the control of individuals, if organized in protest; and our churches, theaters, public halls, railway coaches, and railway sleepers would be properly ventilated if the

[a] See Richards and Woodman, "Air, Water, and Food," New York (Wiley), 1904; also Carpenter, "Heating and Ventilating Buildings," New York (Wiley), 1905; Sykes, "Public Health and Housing" London (King), 1901, 216 pp.

public demanded improvement. Such a "score card" as Prof. John R. Commons has devised for measuring the relation of housing conditions to an ideal standard might well be used in measuring the health utility of public places.

The windows of living and work rooms may be opened in summer and somewhat in winter, provided a window board is used, to deflect the cold air upward from the sill. It then does not form a cold stratum on the floor, but mixes evenly with the air of the room. This simple device would go far to solve the question of winter shut-ins and their ailments. In many cities sleeping balconies are not uncommon among the dwelling houses.

The many benefits from a pure air supply are only beginning to be realized. For instance, as long as "the outdoor life" is lived a cold is almost impossible. Army officers have noted that as long as the men are on the march and sleep outdoors they hardly ever have colds, but that they become troubled with these as soon as they get indoors. Franklin, a century ago, knew these facts, though few of the present generation are acquainted with them. He believed "that people who live in the forest, in open barns, or with open windows, do not catch cold, and that the disease called 'a cold' is generally caused by impure air, lack of exercise, or from overeating." He came to the conclusion that influenzas and colds are contagious—a doctrine which, a century and a half later, was proved, through the advance of bacteriological science, to be sound. The following sentence exhibits remarkable insight, considering the state of medical art at that time: "I have long been satisfied from observation that besides the general colds now termed 'influenzas' (which may possibly spread by contagion, as well as by a particular quality of the air), people often catch cold from one another when shut up together in close rooms and coaches, and when sitting near and conversing so as to breathe in each other's transpiration; the disorder being in a certain state." In the light of present knowledge what a cautious and exact statement is that.[a]

John Muir, the geologist and naturalist, says that he finds home the most dangerous place he can visit.

> As long as I camp out in the mountains without tents or blankets I get along very well, but the minute I get into a house and have a warm bed and begin to live on fine food, I get into a draft, and the first thing I know I am coughing and sneezing and threatened with pneumonia, and am altogether miserable.

Atmospheric evils come from improper ventilation, and affect either the respiratory organs of the body or the skin. It has been supposed until recently that the presence of carbon dioxid gas in vitiated air was the chief evil caused by such air. Impure air will affect the lungs harmfully, but not till the amount of carbon dioxid contained is very large. Guinea pigs, on which the effects of bad air were observed, were not seriously affected by the carbon dioxid till it amounted to 14 per cent of the volume of the air. Flügge and others have found that the evil of close atmospheres is largely a result of elevated temperature, humidity, and absence of air currents. Tests were made on men who sat in impure air, but breathed pure air through tubes, and they presented all the symptoms usually resulting from bad ventilation.

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[a] From "Benjamin Franklin as Printer and Philosopher," address of President Charles W. Eliot before American Philosophical Association, April 20, 1906.

Air baths have been shown to be as important for bodily health as water baths. For this purpose porous clothing should be worn and no more of it than is needful. Impervious cloth and rubber are probably injurious as clothing. Loosely woven worsteds, or linen and cotton mesh are best adapted to let the air play on the skin. Clothing, to be hygienic, should not constrict the body. Tight shoes, and especially tight corsets, are distinctly injurious, and the injury to mothers from the latter may be felt by the next generation. Another insanitary feature in clothes is the trailing skirt, which drags indoors the sputum of consumptives and germ-laden dirt from the sidewalk.

Closely connected with air and ventilation is light. The benefit of sunshine in killing germs and improving bodily vigor in every way is too well known to need more than mention. Tuberculosis and other germs thrive only in dark, damp, ill-ventilated places.

Light has its most important bearing on the human health through the sense of sight. Its relation to eye strain has been discussed elsewhere. Headaches, backaches, indigestion, hysteria, and epilepsy are often aided by glasses.

Section 4.—*The hygiene of nutrition.*

A primary necessity for hygienic living is good drinking water. The modern man of means insists upon good water, and, as a result, the traveling public is now able to get first-class water in cars, hotels, and other public places. The improvement was brought about by the appreciation by the consumer of the danger of drinking impure water. It is the consumer who has it in his power to bring about the necessary reforms in public hygiene. When he really values hygienic environment producers will supply it. Professor Sumner has told us that persons in the middle ages sometimes drank out of their castle moats, which contained sewage. Even in New York to-day the roof tanks are sometimes used as baths or laundries; and they accumulate dust and flies very rapidly. Only a few years ago the aldermen in a prominent western town laughed out of court a physician who called their attention to dangers which were real, but which they believed imaginary, from a polluted water supply.

The scientific study of diet has only just begun and few authoritative results can yet be stated. To avoid a lengthy review of controversial literature it seems best to pass the subject over rapidly, referring the reader for further information to some of the principal books on the subject.

We have already seen the surprising improvement in endurance which followed the adoption of thorough mastication in place of the ordinary food bolting. Mr. Gladstone used to be noted for his care in slowly masticating his food, and latterly Mr. Horace Fletcher has aroused the interest of the public in the subject in Europe and America.[a] He has also stimulated a large number of physiologists to study the subject of mastication, the protein ration, and their relation to strength and endurance.

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[a] See Horace Fletcher, "The A, B–Z of our Own Nutrition," New York (Stokes), 1903; Dr. Hubert Higgins, "Humaniculture," New York (Stokes), 1906; and Irving Fisher, "The Effect of Diet on Endurance," publications of Yale University, Transactions of the Connecticut Academy of Arts and Sciences, 1907.

A great deal has been written as to what foods are best. There exist various dietetic cults, such as vegetarians and fruitarians, raw-food advocates, etc. The question of what foods are ideally best is too large a one to be entered upon here. The evidence seems to point to a general conclusion that no hard-and-fast rule of exclusion is advisable, and that the value of different foods varies with the individual and with his activity, locality, physical condition, etc. His own instinct, restored and educated by avoiding the pernicious habit of food bolting, may be made a truer guide than the wisest physician or physiologist. The same rule applies to the amount of food to be eaten, as well as to the proportions of protein, fat, carbohydrates,[a] and mineral salts. Food bolting often leads to overeating.

It should be noted that the conclusions of Chittenden and others are not in favor of a vegetarian régime, but of a low protein régime, whether vegetarian, lacto-vegetarian, or with flesh foods in moderation. The main point is moderation of the foods highest in protein, such as the whites of eggs and meats (especially lean meats).

It would seem that the safest course for the average man is to follow the appetite, simply guiding it toward a low protein diet by thorough mastication, and by giving the benefit of the doubt to foods low in protein. A reduction in the use of meat will increase, and probably cheapen, our national food supply. The raising of cattle requires much more land than the raising of cereals, fruits, nuts, and vegetables yielding the same amount of food value. As this will be a most important economic problem during the next hundred years, the question of the character of our food supply should be most carefully considered in the study of the conservation of natural resources. It is interesting to note, in this connection, that during the last century the consumption of flesh foods in the United States has considerably decreased.[b]

The subject of auto-intoxication as a consequence of excessive protein has already been mentioned.[c] To avoid auto-intoxication the putrefactive bacteria may be neutralized by lactic bacilli, such as are contained in sour milk. Another preventive is regular attention to thorough evacuation.

Diseased foods are, needless to say, dangerous. Oysters are often planted in waters polluted with sewage, with the result that epidemics of typhoid fever have been traced to their consumption.

The housewife must be the guardian of the family in these respects, and in the cooking, preparation, and arranging of food generally. These now constitute "domestic science," which is justly winning recognition as one of the most potent of all hygienic agencies. When

[a] For a short method of measuring these magnitudes, see Irving Fisher, "A New Method of Indicating Food Values," American Journal of Physiology, Vol. XV, No. V, April 2, 1906; and for its practical application see "A Graphic Method in Practical Dietetics," Journal American Medical Association, Vol. XLVIII, April 20, 1907. See also, "Statistics of Diet in Consumptive Sanatoria," American Journal Medical Sciences, September, 1906.

[b] See G. K. Holmes, "Meat Supply and Surplus," Bureau of Statistics, Department of Agriculture, Bulletin 55, 1907, p. 47. Mr. Holmes finds that the consumption of dressed meat per capita in the United States decreased between 1840 and 1900, 40 per cent, and between 1890 and 1900, 25 per cent.

[c] Supra, Chap. V. See also Herter's "Common Infection of the Digestive Tract."

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the kitchen becomes a scientifically conducted laboratory we shall have the basis of a sound "home economics."

Section 5.—*Drug habits.*

It would scarcely be an exaggeration to say that the first rule of hygiene is to avoid poisons. Poisons may be generated within us or ingested from without.

Drug habits take numerous forms, and they are more prevalent than most persons realize. The commonest form of intoxication is alcoholic.[a] It is interesting to observe the change which has come about in the attitude of scientists toward alcohol. From having enjoyed a high place in materia medica, it is in danger of being completely discredited.[b] So far as its habitual use is concerned the only question which remains in debate is whether in minute quantities it may be innocuous or even beneficial. In any except minute quantities it has been shown to be injurious.

It lowers the resistance of the white corpuscles, which are the natural defenders of the body. Although the phagocytes belong to the most resistant elements of our body, yet it is not safe to count on their insensibility toward poisons. It is well known that persons who indulge too freely in alcohol show far less resistance to infectious diseases than abstemious individuals.[c]

Here is the gravest indictment that may be brought against the abuse of alcohol. It is not, however, the only one. The relation of drinking to insanity,[d] peripheral neuritis, Bright's disease, cirrhosis of the liver, inflammation of the stomach, arteriosclerosis (a most common cause of apoplexy),[e] tuberculosis;[f] to crime in all its forms,[g] and to all the possibilities incident to the hereditary transmission of a weakened organism[h] has been pointed out. If personal hygiene is a duty, it is the duty of every man to recognize the danger from alcohol to himself and to his progeny yet unborn. Instead of copying the habits of others, he may consider the responsibility of causing others to copy his.

A subcommittee of the Committee of Fifty for the investigation of the liquor problem published in 1899 a volume on the economic

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[a] For a discussion of the physiological effects of alcohol, see Physiological Aspects of the Liquor Problem, investigations made under the direction of W. O. Atwater, John S. Billings, H. P. Bowditch, R. H. Chittenden, and W. H. Welch, subcommittee of the Committee of Fifty; New York, Houghton & Mifflin, 1903, 2 vols.; and The Liquor Problem, a Summary of Investigations Conducted by the Committee of Fifty, 1893–1903, by John S. Billings, Charles W. Eliot, Henry W. Farnam, Jacob L. Greene, and Francis G. Peabody, 1905.

[b] The rôle of alcohol as a predisposing cause of disease has already been noted. It has long been known that drunkards have a very slim chance of recovery when attacked by pneumonia, and it is noted also that the mortality among moderate drinkers is higher than among total abstainers. This fact has long been known to life-insurance companies as holding good for many diseases other than pneumonia. Osler: Modern Medicine, Vol. II, p. 628.

[c] Metchnikoff: The New Hygiene, p. 25.

[d] See "Twenty-sixth Annual Report of Massachusetts Bureau of Labor," 1905.

[e] Ditman, loc. cit., p. 47.

[f] See John Huber, M. D., "Predisposition to tuberculosis," The Medical News, December 26, 1903, p. 12. Also reports of Phipps Institute, Philadelphia.

[g] See Boies's various works, the "Reports of the Committee of Fifty," and Report of the Massachusetts Bureau of Labor Statistics, 1895.

[h] See Henry Smith Williams, M. D., "Alcohol and the Individual," McClure's Magazine, October, 1908, pp. 704–712.

aspects of the problem. The investigation covered a period of about three years and was carried on under the general direction of Prof. Henry W. Farnam, of Yale University. The general conclusions of this investigation were that of the poverty which came under the notice of the charity organization societies about 25 per cent could be traced directly or indirectly to the use of liquor; of the poverty found in almshouses, about 37 per cent. In the investigation of crime, the conclusion was reached that liquor was a first cause in 31 per cent of the criminals studied, and that it entered in as a cause, directly or indirectly, in 50 per cent.

The investigation made by the Massachusetts bureau of statistics of labor in 1895 indicated the following percentages due to alcoholism:

	Per cent.
Crime	84.41
Pauperism	48
Insanity	35

Several English life-insurance companies—the Sceptre, the United Kingdom, and General Provident and others—have found by their statistics, running over forty years, that abstainers have a death rate about 23 per cent lower than nonabstainers.[a] Since the figures of the Mutual Life Insurance Company of New York[b] give the same advantage to American abstainers (23 per cent lower death rate), it seems fair to take the available computations of the English life insurance companies as a basis for estimating the saving of life that would result in the United States if individuals should decide to give up the use of alcohol. It should be remembered, however, that the favorable figure of total abstainers is partly due to the fact that as a class they practice personal hygiene in all its forms.

A basis for computing the sickness that might be saved by total abstinence is furnished by comparison between the sick rates of abstaining and nonabstaining societies, made by Mr. H. Dillon Gouge, public actuary of South Australia, in 1892. He found that the average weeks of sickness in three societies of abstainers was 1.248; in three societies of nonabstainers the average weeks of sickness was 2.317 (lacking only one-sixth of being twice as much).

Absinthe in France has become almost as clearly a cause of national degeneration as opium in China. Fortunately for our own country there exists here a more determined effort than in most, if not all other nations, to be rid of alcoholism. The movement has been formidable enough to arouse anxiety among those whose capital is invested in breweries, distilleries, and saloons. The movement reaches its maximum momentum in the west and the south of the United States. It is significant of the rapid change of sentiment in regard to the liquor question that physiologists, physicians, educators, and publicists are now becoming so thoroughly impressed with the importance of suppressing the evils of alcohol.

The younger members of the Kaiser's family in Germany are opposed to the German habits in regard to the use of alcohol, and the son of the Kaiser chose for his university one where there was less

[a] Letter from Miss C. F. Stoddard, secretary of the Scientific Temperance Federation.

[b] "Effect of Total Abstinence on the Death Rate," by Joel G. Van Cise, actuary of the Equitable Life Assurance Company of the United States.

drinking than at other universities. President Eliot, of Harvard University, has recently taken a strong position against the use of alcohol, even "in moderation."

Another common, though less injurious, source of self-poisoning is tobacco, which is known to stunt the growth of the young, to lead to sluggishness and weakened hearts ("tobacco hearts"), and to cause dyspepsia and neurasthenia.

Snuff taking has almost disappeared as a habit in this country. Chewing tobacco is still common, though no longer defended by hygienists. "Inhaling" is more common, though also usually condemned on grounds of health. Smoking shows no signs, as yet, of decreasing. In moderation it may not be injurious. There are no definite proofs on either side. But smokers are seldom moderate.

Doctor Seaver, of the Yale Gymnasium, found that of the 187 men in the class of 1891, Yale College, those not using tobacco during the college course had gained over the users of tobacco in weight 32 per cent, in height 29 per cent, in growth of chest 19 per cent, and in lung capacity 66 per cent.[a]

Similar returns for the Amherst graduating class of 1891 showed a gain by the nonusers of tobacco of 24 per cent in weight, of 37 per cent in height, and of 42 per cent in growth of chest. In lung capacity the tobacco users had lost 2 cubic inches of air space, while the nonusers had gained $6\frac{1}{3}$ cubic inches.

The somewhat injurious effect of tea, coffee, and condiments, though less than many other evils, should be included in any list of the imperfections in respect to hygiene of existing habits of life.

Section 6.—*Activity hygiene.*

Only a generation ago there were scarcely any gymnasia in this country, but to-day the importance of regular exercise and bathing is recognized by everyone. This is far from saying, however, that this important method of conserving our vital resources has more than begun to be exploited.

First, the bath for the well-to-do, and, latterly, the public baths for the poor, have given all an opportunity to obtain the cleansing and healing agency of water. And in recent years the application of baths has become a science.[b]

Baths may be used as social agents. Judge Ben. B. Lindsey, of the Denver juvenile court, insists that every child must take a bath before appearing in the court room. Neutral baths, i. e., baths regu-

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[a] Doctor Anderson, of the Yale Gymnasium, finds similar results. He also points out a statistical pitfall into which some investigators have fallen. This is the common statistical fallacy of selection. There are two great groups of college students, roughly distinguished as athletes and scholarship men. (See Doctor Sargent, "Physique of scholars, athletes, and the average student," Popular Science Monthly, September, 1908.) Smoking is more common in the former group. They are not athletes because they smoke, but smoke because they are athletes. The raw figures of smokers and nonsmokers usually show that the smokers have better physical development, but if we compare the smoking athletes with the nonsmoking athletes and the smoking scholarship men with the nonsmoking scholarship men the results are quite different. For similar statistical fallacies, due to failure to subgroup properly, see Mayo-Smith, "Statistics and Sociology," Macmillan, 1895.

[b] See J. H. Kellogg, M. D., "Rational Hydrotherapy," Philadelphia, 1904.

lated to the temperature of the body, have been found valuable in relaxing the nerves of the body, and even in the treatment of mental disease.

As to exercise, a healthy organism must call into play every function daily, both mental and physical. One of the evils of the division of labor which civilization has brought is that the sedentary worker does not have enough physical exercise, but too much mental exercise, while the situation is just the opposite in the case of the workingman.

A well-known physical director, now nearly 50 years old, writes me that he has this year taken up systematic physical training, which he has neglected for several years because of pressure of work. As a result his weight has risen, his chest and arm girths have increased, while his waist girth has decreased, and he is conscious of decided improvement in memory and in sleep. This instance is cited as an example of the physical development possible in a man of middle age.

In its bearing on exercise, the growth of modern athletics and its effects on the physical ideals of men and women is to be welcomed. The revival of the Olympian games and the spread of popular participation in such outdoor sports as golf, tennis, boating, and horseback riding have all had their share in building up a new health ideal. Thus we are getting away from the mediæval idea of mortification of the flesh and approaching more closely the Greek conception of a beautiful body as the covering for a beautiful soul. The Greeks lifted their sports to a higher level than ours by surrounding them with imagination and making them a training in æsthetics as well as in physical excellence.[a] The American idea is at present too closely connected with mere winning, and not enough with development. In the past the physical athlete has been too much associated with the pugilist, and has been looked down upon as having merely brute strength. The intellectual type, on the other hand, has been content wholly to neglect bodily development.

In the last three years considerable evidence has accumulated to show that the sitting posture of the sedentary man tends sooner or later to produce nervous prostration, and that the ordinary chair invites to this effect by producing a bent attitude, both in the forward direction and in the shoulders. The effect of the former is to tax the splanchnic nerves and congest the portal circulation. The splanchnic area, which is enormous, is a sort of overflow tank for the blood. If the muscles of this area are allowed to relax through improper position in standing or sitting, the result is the stagnation of the blood in the abdomen, and this in turn results in a vicious circle of evil effects. Since much of our life is spent in chairs, this fact is of no small importance. Improperly made school chairs and unhygienic habits of sitting in them may start off millions of young lives with round shoulders, curved spines, and the later effects of portal congestion.

Exercise of mind does not simply mean exercise of intellect. The emotions and the will are equally a part of a well-developed healthy man. Late in life Darwin had occasion to lament the fact that his emotional capacity had become cramped because he had exercised

[a] See G. L. Dickinson: "The Greek View of Life," New York (McClure, Phillips), 1906, pp. 131–134.

his mind in his own branch of work to the exclusion of other things. Whatever our ideas of theology or religion are, it is true that we all ought to have a spiritual sense. Some men lack this spiritual sense and are incapable of understanding the spiritual experience of others. "For toil without purposeful and occupied leisure is unfilled purpose, a process arrested midway."[a] Worry and fear are unhealthy. Hope, courage, enjoyment, and an optimistic attitude generally are healthy.[b]

The ordinary workingman works two or three hours too much every day. Nearly every man overworks himself, takes insufficient rest and recreation, and worst of all, cuts off his normal portion of sleep. Fatigue ought to be "avoided like poison," because, physiologically, it is really poison. Worry, fear, and anger also produce poisons harmful to the human body. This is suggested at least by the effect upon a nursing infant of violent paroxysms of anger, or periods of intense fear or anxiety on the part of its mother. The intense exhaustion which follows such paroxysms is another case in point.

An animal lives a much more healthy life than the average man, because an animal follows instinct, while a man to a large extent endeavors to substitute for his instincts rules which are very often false. One of the instincts constantly disregarded by man is that which finds its expression in fatigue. The ordinary man working for some one else is compelled to toil beyond the fatigue limit; and, on the other hand, if a man is in business for himself, he does the same thing of his own will. Although no one knows what sleep is, it serves, according to the best theory, to eliminate poisons and to rebuild tissue. With rest is closely associated recreation. Play practices the power of a child's mind, while contest among children develops self-control.[c] Similarly, adults are rested by play or recreation, their minds and bodies are relaxed, while their contests of mimic warfare develop their powers of will and effort.

Section 7.—*Sex hygiene.*

One element in personal hygiene concerns the sex relation. This can not be treated under other heads, for the sex relation is so purely a personal and individual one. From its normal utilization there is little to fear, but from the effects of illegitimate sexual practices the world suffers enormous yearly losses. It is hardly possible to have promiscuous sex relations out of wedlock without contracting one or the other of the serious venereal diseases. The best authorities report that "every prostitute is diseased some of the time and some prostitutes are diseased all of the time."

One disease, syphilis, infects the blood and therewith all parts of the body. For months after infection with this disease the indi-

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[a] Simon N. Patten: "The New Basis of Civilization," New York (Macmillan), 1907, p. 158.

[b] Du Bois: "The Psychic Treatment of Nervous Disorders," New York, 1905, 465 pp. Saleeby: "Worry, the Disease of the Age," New York (Stokes), 1907. Sidis: "The Psychology of Suggestion," New York (Appleton), 1899, 386 pp. Schofield: "The Force of Mind, or the Mental Factor in Medicine," London (Churchill), 1902, 309 pp.

[c] See President G. Stanley Hall: "Play and Dancing for Adolescents," Independent, reprinted in "Mind and Body," Vol. XIV, 1907, pp. 43–48.

vidual may communicate it by a kiss as well as by cohabitation; and articles moistened by his secretions—towels, drinking glasses, pipes, etc.—may also convey the infection. While under proper treatment the disease is not always dangerous to life in the earlier years, yet the possibilities of transmitting the contagion should forbid marriage for at least three years.

The most serious results of syphilis, some authorities say, may appear years after its acquisition, when the individual has been lulled into a false sense of security by long freedom from its manifestations and considers himself cured. Many cases are practically incurable. Some are fatal in spite of treatment. It may attack any organ of the body. Among the many diseases to which it may lead are apoplexy, paralysis, insanity, and locomotor ataxia; and these often appear after the man has acquired a family that is dependent upon him for support.

The leading insurance companies refuse to insure the life of a syphilitic person for four or five years after the disease was contracted, and then only upon special terms, for their records prove that syphilis shortens life.

That the syphilitic parent may transmit the disease to his offspring is common knowledge. Some of his children are destroyed by the inherited disease before birth; others are born to a brief and sickly span of life; others attain maturity, seriously handicapped in the race of life by a burden of ill health, incapacity, and misery produced by the inherited taint, while still others escape these evil effects.[a]

Forel, in Die Sexuelle Frage, shows that even Weissmann does not deny the possibility of poisoning the germ cell and so transmitting some "acquired characteristics," as in alcoholism and venereal poisoning. One of the saddest facts in both cases is that the parent may escape and the children reap the results in insanity, tendency to consumption, and prostitution.

Another disease—

Gonorrhea, while usually cured without apparent loss of health, has always serious possibilities; it kills about 1 in 200; it impairs the sexual power and fertility of a much larger number; it often produces urethral strictures, which later may cause loss of life.[a]

The persistence of gonorrhea in the deeper parts long after it is outwardly cured leads to the unsuspected communication of the disease to women with whom the individual may cohabit. Much of the surgery performed upon women has been rendered necessary by gonorrhea contracted from the husband. Should she while infected with this disease give birth to a child, the baby's eyes may be attacked by the infection, sometimes with immediate loss of sight. Probably 25 per cent [b] of the blindness of children is thus caused.

Dr. Prince A. Morrow says:

This social danger comes from frequent introductions of these diseases into marriage. The frequency of marital contamination does not admit of exact mathematical expression, as both social sentiment and professional ethics unite to cover up and conceal it. Possibly 10 per cent of men who marry infect their wives with venereal disease.

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[a] Circular No. 2, "Self-protection," Chicago Society of Social Hygiene, pp. 7–8.

[b] "The average of a great many statistics shows that one-fourth of all blind persons owe their affliction to the effects of ophthalmia of the new born." Chas. H. May, M. D., ophthalmic and aural surgeon, New York, Transactions of American Societies of Sanitary and Moral Prophylaxis, Vol. II, 1908.

The report of the Committee of Seven (New York) shows that in private practice nearly 30 per cent of venereally infected women were contaminated by their husbands. The report of the Committee on Sanitary and Moral Prophylaxis (Baltimore) shows that nearly 40 per cent of the infections in women seen in private practice were communicated in married life. "My own observations at the New York Hospital, extending over a period of several years, would indicate that fully 70 per cent of all women who came there for treatment of syphilis were respectable married women who had been infected by their husbands." [a]

Observation shows that gonorrhea is markedly intensified in virulence and danger to the woman in fulfilling the functions for which marriage was instituted. Pregnancy and childbearing open the way for germs. One of the most constant effects of gonorrhea in women is permanent and irremediable sterility. Fifty per cent of gonorrheally infected women become absolutely sterile, and a still larger percentage sterile after the first child is born (one-child sterility). Noeggerath found in 81 gonorrheal women 49 entirely sterile. In 80 sterile marriages Kehrer found 45 caused by inflammatory changes of gonorrheal origin. It is estimated that the husband is directly responsible for 20 to 25 per cent of sterility from his inability to procreate as the result of gonorrhea. In addition the husband, though not sterile himself, may infect his wife, rendering her sterile. The disease is ultimately responsible for about 70 to 75 per cent of all sterility in married life, which is not of choice, but of incapacity. Lier-Ascher's careful statistics place this proportion at 71.2 per cent. These figures relate to absolute sterility. The chief social danger of gonorrhea as a depopulating factor is the creation of secondary sterility, or what has been expressively termed "one-child sterility." The large percentage of marriages in which one child represents the total fecundity of the family justifies the conclusion that this sterility is in many cases not of choice, but of procreative capacity extinguished by gonorrhea.

In addition, the inflammation set up in the maternal organs may render the mother a permanent invalid or compel her to submit to a mutilating operation to save her life.

Gynecologists furnish statistical evidence showing that 80 per cent of the deaths due to inflammatory diseases peculiar to women [b] and about 70 per cent [c] of all the work done by specialists for diseases of women is caused by gonorrhea.

In addition to the effect of a low protein diet on endurance, already discussed, and on general health, its relation to the sexual life should be mentioned. Experiments on this subject seem to show that excessive meat eating and excessive protein intake tend to irritate the sexual organs and to produce abnormal sexual desire just as they do

[a] Morrow, "Social Diseases and Marriage," Philadelphia (Lea), 1904.

[b] In report of special committee of the American Medical Association, 1901, Hunniston says: "Ninety per cent of inflammatory troubles of maternal organs are attributable to gonorrhea." Price says: "That in over 1,000 operations for pelvic trouble 95 per cent were attributable to this infection." Another authority gives a percentage of 75.

[c] Address of Doctor Cleveland, president of American Gynecological Society, at National Congress of American Physicians and Surgeons, Washington, 1907.

a desire for alcoholic stimulation. This fact is of importance in preventing secret vice among the young.

Thanks to the efforts of a few farsighted men like Dr. Prince A. Morrow, Prof. C. R. Henderson, and Mr. Edward Bok, these subjects are being given some of the publicity they deserve. Reticence on these subjects is justified only so far as it makes for youthful innocence. But ignorance is not innocence; on the contrary it is the surest road to guilt.

Section 8.--*Personal hygiene in general.*

Personal hygiene is only beginning to be generally exploited. Most persons leave their health to be attended to by physicians and health officers, just as many people leave their religion in the hands of a priest or clergyman. So far as practiced at all, personal hygiene has been confined chiefly to invalids and athletes. Even by them it is usually practiced to tide over an illness or to prepare for a contest. But it is manifest destiny that a wise economy of vitality will sooner or later be practiced. Waste of vital resources is as irrational as waste of natural resources. Neither is inexhaustible and both must be conserved. Thoughtlessness and ignorance are the reasons for the appalling waste of both now going on. Even people who do not defiantly abuse their strength by definite excesses are liable to waste it gradually. Slightly unhygienic habits grow, and their effects are doubtless cumulative. It is well known that even a so-called "ventilated house," if lived in long enough without sufficient outdoor life, may induce tuberculosis. This must be through the repetition of an infinitesimal injury produced through each respiration eighteen times a minute for twenty-four hours a day for half a lifetime.

So with the use of food preservatives. Food manufacturers have laid much emphasis on the fact that preservatives are "harmless" because used in small quantities, but Doctor Wiley has raised the question whether even very small quantities of these preservatives, if used continuously for a sufficient length of time, are not injurious. The same applies to the repetition of preservatives in a large number of different foods. If only one particular food contained a preservative, the effect would be relatively negligible; but as one food after another has become adulterated, the human stomach is made the daily receptacle of many times the "harmless" amount in any one particular food. The obstacles to hygiene which have accumulated with civilization are almost as numerous and as small as the barnacles which impede a ship. To remove them is in large part to "return to nature." Many of the inventions of which civilization boasts have had an unhygienic side. The invention of houses has made it possible for mankind to spread all over the globe, but it is responsible for tuberculosis, especially after glass was devised, which while letting in the light keeps out the air. The invention of cooking and preparing foods has widened the variety of man's diet, but has led to the decay of his teeth.[a] The invention of the alphabet and printing

[a] See Ottofy, "The Teeth of the Igorots," Dental Cosmos, July, 1908, where it is shown, statistically speaking, that the teeth of Americans are "ten times as bad as those of the Igorots," while the civilized Filipinos have teeth as bad as those of Americans.

has made possible the accumulation of knowledge, but it has produced eye strain with all its attendant evils. The invention of chairs has added to human convenience, but has led to spinal curvature and abdominal congestion. The device of a division of labor has added to wealth, but has destroyed the normal balance of mental and physical work, recreation, and rest. Similar fault may be found with clothing, especially corsets, shoes, and hats, and with numerous other contrivances. Yet it would be foolish, even if it were possible, to attempt to "return to nature" in the sense of abolishing civilization. We must not go backward, but forward. The cure for eye strain is not in disregarding the invention of reading, but in introducing the invention of glasses. The cure for tuberculosis is not in the destruction of houses, but in devices for ventilation. It is a little knowledge that is dangerous. Civilization can, with fuller knowledge, bring its own cure and make the "kingdom of man" far larger, even in respect to hygienic conditions, than "nature" people can ever dream of.

Unhygienic customs and fashions are exceedingly slow to yield, but they do yield in the end. It should be the part of intelligent men to lead in hygienic reform, not by intolerant and impatient abuse of their fellow-men, but by the quiet force of example. The intolerant and impatient reformer does incalculable harm, for he takes no account of that subtle perversity of human nature which resents his interference. Equally harmful is the man who seeks only to imitate the crowd, who condones the vices of his time and country.

But we must always bear in mind what has been called the "psychology of the crowd." Tarde, Le Bon, Baldwin, Ross, and others have shown that society is largely ruled by customs which grow out of imitation. In order that any social custom shall be changed, initiative is necessary. The upper classes should take the lead, for any reform will spread many times more quickly when the initiative comes from above than when it comes from below. Western civilization has made its marvelously rapid progress in Japan for the simple reason that the Mikado approved, and marvelously slow progress in China for the simple reason that the Empress disapproved.

We find the same principle at work in the progress of medicine. Hydrotherapy originated with a peasant and required three centuries to come into vogue. The use of sour milk, on the other hand, has been advocated only during the last two or three years, but the initiative came from Metchnikoff, one of the foremost of medical scientists. The consequence is that the so-called "sour-milk craze" has already led to great industries and affected the business of groceries, soda-water fountains, and even liquor saloons.

The change constituting hygienic reform will be brought about most rapidly by the influences on the young. If children in their homes and schools are given proper models for imitation, the public opinion which they will form may make a revolution in a single generation. Anyone who realizes the almost resistless force of the principle of imitation, especially when applied to children, will receive a new sense of the responsibility he takes in setting an example to the young. There are three classes in particular on whom the responsibility is heavy—teachers, physicians, and parents. If they wish the child to be free from the cigarette habit, they must sacrifice the cigar and pipe habit, even though it be true that cigars and pipes are not injurious to adults. They may believe this, but the children will not. The same

principle applies to other and more serious infractions of the laws of health. It is probably through the love of the next generation, rather than through any selfish care for the present, that men and women now living will take the most pains to secure the best results in bringing about the change in living conditions for which every hygienist hopes.

Chapter X.—*Are hygienic measures eugenic?*

Section 1.—*Prolongation of weak lives.*

We have discussed two factors which cooperate to produce vitality, namely, heredity and hygiene; and two corresponding methods of improving vitality, namely, by utilizing a possible science of eugenics on the one hand and by utilizing the existing science of hygiene on the other. The question now arises, Are these two methods in conflict with each other? It is charged that hygiene prolongs the lives of unfit and defective classes. We have already seen that in Indiana, institutional care of the insane has prolonged the average insane lifetime by some eight years. Referring to the insane, Dr. Charles Dana says:

> For twenty-five years the explanation of this increase in statistics of insanity has been that more cases were observed and more victims kept in institutions than formerly; and this is still the explanation. It is my opinion, however, that the increase is a real one, and it is one to be expected not only from the strenuousness of modern life and increase of city population, but also, because more feeble children are nursed to maturity and more invalid adolescents are kept alive to propagate weakly constitutions or to fall victims themselves to alienation, the period of life susceptible to insanity is longer.
>
> A fourth of the cases of insanity is due to so-called "moral causes:" Emotional strain, shocks, and vicious indulgences. But moral causes are not sufficient to cause insanity if the individual has a strong constitution. Insanity is increased in part, then, because we are saving too many lives by the careful regulations of our health boards. Hence, those who are working so enthusiastically and nobly and successfully in preventing disease achieve results which carry serious responsibilities for the State.[a]

It is true that we prolong the lives of the insane and defective classes, and that they thus make a greater burden on society. We should see to it that certain of these classes are not permitted to propagate their kind. This point has been explained in Chapter VI.

It is further claimed that infant mortality is but the operation of natural selection and should not be interfered with if we are to keep up the vital power of the race. Preventive medicine has certainly prolonged the lives of infants or, at any rate, of children in general.[b] But has this weakened the race? It is pointed out that the mortality later in life has not decreased, and that in some cases it has even tended to increase. But this fact can be explained in either of two ways. One is on the hypothesis of the extension of the lives of weak

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[a] "Psychiatry in its relation to the other sciences," by Charles L. Dana, M. D., before the section on psychiatry at the International Congress of Arts and Science, at St. Louis, September, 1904. See also Janus in Modern Life, by W. M. Flinders-Petri, New York (Putnam), 1907.

[b] See Edwin Graham, "Infant mortality," Journal American Medical Association, September 26, 1908; also Edward B. Phelps, "Statistical study of infant mortality," Quarterly Publications American Statistical Association, September, 1908. Mr. Phelps shows that infant mortality has declined less than is commonly believed, and that its apparent decline is often due to inaccurate and misleading statistics.

infants. The other is on the hypothesis of the comparative neglect of hygiene among adults. It is surprising that this latter alternative has not been given due consideration.

Every detail of infant life has latterly been made the subject of special study, and every mother of common intelligence has tried to learn and to apply the results of that study. The times of the baby's meals, the quantity of its feeding, the modification and sterilization of cow's milk, the hours of sleep, the ventilation of sleeping rooms, and other innumerable details are now attended to with scrupulous care. The change in these respects, even within the memory of most persons now living, is striking. The children have reaped the reward. But no corresponding change has taken place in the habits of the adult population. Many families buy one grade of milk for the babies, and another cheaper grade for the rest of the family. This they regard as "economy." Parents require their children to keep regular and suitable hours for sleep, but "owl it" themselves. They will keep their children out of doors, and send them into the country, but subject themselves to the dust, smoke, and close air of the workroom and places of business. They will not allow their children to use alcohol or tobacco, or even tea or coffee, much less opium, chloral, or other habit-forming drugs, but they take these themselves as a matter of course. They are now insisting on playgrounds for children, but their own amusements are sought in the unhygienic theater, or maybe in the saloon or immoral resort. The child is protected on all sides, with the result that he sometimes lives almost an ideal animal life, with its due proportion of amusement, exercise, rest, and sleep. The parents themselves are tied down to drudgery, overwork, worry, and long hours. The difference, when we reflect upon it, is startling. We make hygiene paramount for our children; for ourselves we neglect it totally, partly from the idea of sacrificing ourselves for the sake of our children, partly from necessity, real or imagined, and partly from the thraldom of habit already formed. With such a contrast between the recent improvement of hygiene in childhood and the lack of improvement in middle life, one need not wonder that the mortality of one period has improved and that of the other has not. We do not need to invoke the aid of the theory that weak lives have been more prolonged than strong lives. The moral is that hygiene should not stop in childhood. It is natural and proper, however, that the first attempt to apply hygienic knowledge should begin with children. It is through children that new ideas usually make their way into custom. "You can't teach an old dog new tricks." Grown persons have habits already formed, and when once a habit is formed it is difficult to change it.

Habits of living among adults have even grown worse in some respects. Observing practitioners comment on the increasing nervous tension in modern life. The rush of the railway train, the telephone, the elevator are at once an outgrowth and an excitant of this increased tension. They are life's pace makers, and the pace is ever quickened. The health officer of New York City attributes to this severer strain the increase of heart and nervous diseases. It would be interesting to know the relative prevalence of adult diseases under conditions of reposeful and exciting surroundings and occupations, but I know of no investigation on this phase of the subject.

While this report was being written the recent figures from Great Britain came to hand. They show that the tendency of the death rates among the later ages to increase seems to have given place to a slightly opposite tendency. The expectation of life at ages 40, 60, and 80 during the decade of 1891–1900 has a little more than held its own as compared with the previous decade.

SECTION 2.—*Children's diseases impair both fit and unfit.*

Another point needs emphasis. When it is said that the lives of weak infants are prolonged it is commonly overlooked that the same causes also prolong the lives of the strong, and, reversely, that unhygienic conditions which tend to exterminate the weak tend also to shorten the lives of the strong. Bad hygiene is merely a common handicap for all classes. The burden of proof is upon those who claim that it has a differential effect and increases the process of weeding out the unfit. This weeding-out process goes on whether there is a great or a small obstruction to overcome. Bad air and children's epidemics are the common environment of all. While this must produce a greater mortality, it remains to be shown that it would be more selective.

That a high infant mortality does not tend to lengthen life, but rather to stunt all life, would seem to be indicated by the evidence, so far as it can be interpreted. Russia, for instance, has a high infant mortality. If the statistics are to be trusted, it is 70 per cent greater than in the United States; yet Moscow and St. Petersburg have a general mortality rate which greatly exceeds that of similar cities in this country.

It may be that the more unfavorable the struggle for existence the more rapidly will natural selection result in improved vitality. But even if this were true, it would not imply that in a more favorable environment selection would cease. And it may not be true. It may be that adversity, if too severe, will crush and injure the survivor as well as eliminate the unfit. We do not look for the best trees on the bleak mountain top, but in the genial valley. As we go up the struggle for existence increases, until even the sturdiest fail to thrive above the "timber line."

The farmer who tries to improve his stock does not select hardships. Cold and starvation are now negligible quantities in the great ranches, and the breeds that were notable for ability to withstand them give way to varieties that may be adapted to neither emergency.[a]

Venereal diseases, hook-worm disease, malaria, and many other maladies shorten and weaken life, whether of weak or strong. Referring to the racial degeneration probably caused by malaria on the sturdy Greek, Maj. Ronald Ross said, in an address before the Oxford Medical Society, November 29, 1906:[b]

Now what must be the effect of this ubiquitous and everlasting incubus of disease on the people of modern Greece? Remember that the malady is essentially one of infancy among the native population. Infecting the child one or two years after birth, it persecutes him until puberty with a long succession of febrile attacks. * * * Imagine the effect it would produce upon our own

[a] Simon N. Patten, "The New Basis of Civilization," New York (Macmillan), 1907.

[b] This quotation is from Dr. L. O. Howard's report to the Conservation Commission on "Economic loss to the people of the United States through insects that carry disease."

children here in Britain. * * * What would be the effect upon our population, especially our rural population—upon their numbers and upon the health and vigor of the survivor? It must be enormous in Greece. People often seem to think that such a plague strengthens a race by killing off the weaker individuals; but this view rests upon the unproven assumption that it is really the weaker children which can not survive. On the contrary, experience seems to show that it is the stronger blood which suffers most—the fair, northern blood which nature attempts constantly to pour into the southern lands.[a] If this be true, the effect of malaria will be constantly to resist the invigorating influx which nature has provided; and there are many facts in the history of India, Italy, and Africa which could be brought forward in support of this hypothesis. * * * In prehistoric times Greece was certainly peopled by successive waves of Aryan invaders from the north. * * * That race reached its climax of development at the time of Pericles. * * * Suddenly, however, a blight fell over all. Was it due to internecine conflict or to foreign conquest? Scarcely, for history shows that war burns and ravages, but does not annihilate. Thebes was thrice destroyed, but thrice rebuilt. Or was it due to some cause, entering furtively and gradually sapping away the energies of the race by attacking the rural population, by slaying the newborn infant, by seizing the rising generation, and especially by killing out the fair-haired descendant of the original settlers, leaving behind chiefly the more immunized and darker children of their captives, won by the sword from Asia and Africa? * * * I can not imagine Lake Kopais, in its present highly malarious condition, to have been thickly peopled by a vigorous race; nor, on looking at those wonderful figured tombstones at Athens, can I imagine that the healthy and powerful people represented upon them could have ever passed through the anæmic and "splenomegalous" infancy (to coin a word) caused by widespread malaria. Well, I venture only to suggest the hypothesis, and must leave it to scholars for confirmation or rejection. Of one thing I am confident—that causes such as malaria, dysentery, and intestinal entozoa must have modified history to a much greater extent than we conceive.

Evolution in human society is a wonderfully complex thing. Survival of the races has long been dependent on a long period of protection of children by parents, and may in future even depend on protection of other kinds.[b]

Section 3.—*Fitness is relative to environment.*

Whether or not degeneration is actually going on is a question for which the data are insufficient for us to form an intelligent generalization. That there are very strong forces working in that direction can not be questioned, but there are also very strong forces working in the opposite direction. In discussing degeneration, one point must be borne in mind which has often been forgotten by writers on the subject. Man's fitness to live is relative to the environment in which he is to live. If muscular strength decreases, it is not a sign of degeneration, provided muscular strength is no longer needed. One does not speak of hothouse grapes as degenerates. They doubtless lack the hardy characteristics of wild grapes, but these characteristics are not needed in a hothouse.

If it should prove true that in some directions humanitarian impulses betray us into favoring the survival of the unfit and their perpetuation in the next generation, such shortsighted kindness must be checked. But all the dangers of perpetuating vital weaknesses can be avoided if proper health ideals are maintained. For when such

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[a] Physicians maintain that some diseases, especially typhoid fever and pneumonia, are more apt to attack the strong than the weak.

[b] See Prince Kuropatkin, "Mutual Aid a factor in Evolution," New York (McClure-Phillips), 1902.

health ideals become a national possession fewer weak infants will be born into the world. This will come about in three ways: First, marriage and "sterilization" laws will reduce the number of marriages of degenerates. Secondly, parents will be more careful of transmitting disease or weakness to their offspring. There is strong reason to believe that inheritance depends largely upon the physical condition of both parents at the time of conception. If at such a time either parent, or both parents, are in a state of intoxication or sufferers from venereal disease, this lack of hygiene on their part will affect the heredity of the offspring. Immorality, which practically means lack of sex hygiene, never strengthened a race; on the contrary it has been the most potent cause of race extinction (of the Hawaiians, Indians, negroes, and others).[a] Thirdly, the influence of higher ideals of health and vitality will tend both to restore the attraction of a strong and beautiful physique to its rightful place among the various attractions which lead to marriage, and to lessen the allurements of such extraneous attractions as wealth.

[a] See F. L. Hoffman, "Race Traits and Tendencies of the American Negro," Publications of American Economic Association, Ch. VII, August, 1896.

Part IV.—RESULTS OF CONSERVING LIFE.

Chapter XI.—*Prolongation of life.*

Section 1.—*Life is lengthening.*

We have already seen evidence of the possibility of prolonging life: In Europe the life span is double what it is in India. The death rate of Dublin is over twice that of Amsterdam, and three times that of rural Michigan. Again, making every allowance for inaccuracies of old records, we have strong reason to believe that life is twice as long as three or four centuries ago, and modern accurate records show that it is to-day increasing more rapidly than ever. The rate at which this lengthening proceeds per century is shown in the following table, based on Chapter I.

Rate of lengthening life (in years, per century).

Country.	Periods.	Males.	Females.
England	1838–1854 to 1871–1881, or 30 years	5	9
Do	1871–1881 to 1891–1900, or 20 years	14	16
France	1817–1831 to 1898–1903, or 76 years	10	11
Prussia	1867–1877 to 1891–1900, or 23 years	25	29
Denmark	1835–1844 to 1895–1900, or 57 years	13	15
Sweden	1816–1840 to 1891–1900, or 67 years	17	15
United States:			
Massachusetts	1789 to 1855, or 66 years	7	
Do	1855 to 1893–1897, or 40 years	14	
India	1881 to 1901, or 20 years	0	

From this table we observe:

First. That the rate of progress is extremely variable in different countries. It is perhaps no accident that the maximum rate obtains in Prussia, which is probably the most progressive country in the discovery and application of scientific medicine. If progress continues for a century at merely the present rate, human life in Prussia will be twenty-five to twenty-nine years longer than at present. The average rate of improvement for all the countries, excepting India, is about fifteen years per century.

Second. It is noticeable that in practically all cases the improvement is more among females than males. This is one expression of the progress which womankind is now making in all lands.

Third. This table, as well as the estimate of Professor Finkelnburg already quoted, shows that not only is the average duration of human life increasing, but that the rate of increase is also increasing. The estimate of Finkelnburg that the lengthening of life during the interval between the sixteenth century and the end of the eighteenth century was from eighteen or twenty years to a little over thirty years shows a rate of increase of about four years per century. During

the following century he estimated that the life span increased from a little over thirty to thirty-eight or forty years, or about nine years per century. In the table we see that in England the length of life was increasing in the middle of the nineteenth century at a rate of from five to nine years per century, while during the last quarter it was increasing at from fourteen to sixteen years per century. In Massachusetts the imperfect data indicate that life lengthened in the first half of the eighteenth century at the rate of about seven years a century. The indication for the last part of the nineteenth century is that it increased at the rate of fourteen years per century.

We may briefly summarize chronologically the general rate of increase as follows:

Lengthening of human life per century.

	Years.
During seventeenth and eighteenth centuries	4
During first three quarters of the nineteenth century	9
Present rate in Massachusetts	14
Present rate in Europe	17
Present rate in Prussia	27

SECTION 2.—*Table showing further practicable prolongation.*

It would be surprising if the future should not witness a further lengthening of human life, and at an increasing rate. Of course there is a limit to the further increase of human life, but there is good reason to believe that the limit is still far off.

The following table [a] shows that at least fourteen years could be added to human life by the partial elimination of preventable diseases according to the stated ratios of preventability. This is equivalent to a reduction in the death rate of about 25 per cent. The table is based on the causes of death given in the census volume for mortality statistics for 1906. These causes are arranged according to the average, or rather median,[b] age at death from the disease. This median age is given in the second column. The order in this column shows at a glance the successive onslaught of, or rather fatality from, the various causes of death. The table shows the successive bombardments of disease to which human life is subject.

The third column gives the average lost "expectation of life;" [c] that is, the expectation cut off by each particular cause of death.

The fourth column represents the percentage which the deaths from each particular cause bear to the total number of deaths in 1906 in the registration area. It shows the relative importance of the different causes of death in the present death rate, but has no reference to the age at death.

The fifth column contains an estimate, made by physicians, of the ratio of preventability of deaths from each cause named.

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[a] For detailed statement in regard to the construction of this table, see appendix to this chapter.

[b] By the "median" age at death is meant the age such that one-half of the deaths occur earlier and one-half later than this age. The "median" is a species of average, but differs from the ordinary arithmetical average. It has the great advantage of ease of computation.

[c] The "expectation" is taken from the figures of Abbott for Massachusetts, 1893–1897, and is the average of expectation of males and females. See Report State Board of Health for Massachusetts, 1898.

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The items in the sixth column are found by multiplying together those in the fourth and fifth columns, and express the percentage which the preventable deaths from each cause named bears to the total number of deaths from all causes.

The seventh and last column gives the figures for which the table is constructed, namely, the amount of prolongation of life which would come about through preventing deaths according to the ratios of preventability in column 5. When it is said that a death is preventable, it is not, of course, meant that the person saved from it will never die, but merely that his death is postponed. The term "postponable" would avoid a great deal of confusion on the subject.

The principle on which the last column is constructed is simply the principle of averages. The column shows the prolongation of life which would be caused by postponing the "postponable" deaths by the amounts indicated in column 3. To illustrate this principle, suppose ten magnitudes to be averaged arithmetically, and that their average is thirty. To fix our ideas, we may suppose these ten magnitudes to be represented by ten lines drawn on a sheet of paper. It is evident that if one of these ten lines is prolonged the average of the ten will be thereby increased by exactly one-tenth of the prolongation of that one line.

Possible prolongation of life.

(1) Cause of death.	(2) A. Median age of deaths from causes named.	(3) B. Expectation of life at median age.	[b](4) C. Deaths due to cause named as percentage of all deaths.	(5) D. Ratio of preventability (postponability), i. e., ratio of "preventable" deaths from cause named to all deaths from cause named.	(6) E=CD. Ratio of "preventable" deaths from cause named to all deaths from all causes.	(7) F=BE. Years added to average lifetime if deaths were prevented in the ratio of preventability of column 5.
	Years.	*Years.*	*Per cent.*	*Per cent.*	*Per cent.*	*Years.*
1. Premature birth	1	50	2	40	0.8	0.4
2. Congenital malformation of heart (cyanosis)	1	50	.55	0	.....	.....
3. Congenital malformations other than of heart	1	50	.3	0	.....	.....
4. Congenital debility	1	50	2.3	40	.92	.46
5. Hydrocephalus	1	50	.1	0	.....	.....
6. Venereal diseases	1	50	.3	70	.21	.11
7. Diarrhea and enteritis	1	50	7.74	60	4.64	2.32
8. Measles	1	50	.8	40	.32	.16
9. Acute bronchitis	1	50	1.1	30	.33	.17
10. Broncho-pneumonia	1	50	2.4	50	1.2	.6
11. Whooping cough	1	50	.9	40	.36	.18
12. Croup	2	54	.3	75	.22	.12
13. Meningitis	2	54	1.6	70	1.12	.6
14. Diseases of larynx other than laryngitis	3	54	.07	40	.03	.02
15. Laryngitis	3	54	.06	40	.02	.01
16. Diphtheria	3	54	1.4	70	.98	.53
17. Scarlet fever	3	54	.5	50	.25	.14
18. Diseases of lymphatics	5	54	.01	20	.002	.001
19. Tonsilitis	8	52	.05	45	.02	.01
20. Tetanus	8	52	.19	80	.15	.08
21. Tuberculosis other than of lungs	23	40	.17	75	.13	.05
22. Abscess	24	39	.08	60	.05	.02
23. Appendicitis	24	39	.7	50	.35	.14
24. Typhoid fever	26	38	2	85	1.7	.65
25. Puerperal convulsions	28	[a]37	.2	30	.06	.02

[a] "Expectation" for females.

[b] As to some inaccuracies in this column, see Appendix to this chapter, section 4.

Possible prolongation of life—Continued.

(1) Cause of death.	(2) A. Median age of deaths from causes named.	(3) B. Expectation of life at median age.	(4) C. Deaths due to cause named as percentage of all deaths.	(5) D. Ratio of preventability (postponability), i. e., ratio of "preventable" deaths from cause named to all deaths from cause named.	(6) E=CD. Ratio of "preventable" deaths from cause named to all deaths from all causes.	(7) F=BE. Years added to average lifetime if deaths were prevented in the ratio of preventability of column 5.
	Years.	*Years.*	*Per cent.*	*Per cent.*	*Per cent.*	*Years.*
26. Puerperal septicemia	28	[a]37	0.4	85	0.34	0.13
27. Other causes incident to childbirth	31	[a]35	.36	50	.18	.06
28. Diseases of tubes	31	[a]35	.1	65	.06	.02
29. Peritonitis	31	34	.5	55	.28	.1
30. Smallpox	32	34	.01	75	.01	.003
31. Tuberculosis of lungs	33	33	9.9	75	7.42	2.45
32. Violence	34	32	7.5	35	2.7	.86
33. Malarial fever	34	32	.2	80	.16	.05
34. Septicemia	34	32	.3	40	.12	.04
35. Epilepsy	35	32	.29	0	.....	.....
36. General, ill defined, and unknown causes (including "heart failure," "dropsy," and "convulsions")	35	31	9.2	30	2.75	.85
37. Erysipelas	37	30	.3	60	.18	.05
38. Pneumonia (lobar and unqualified)	37	30	7	45	3.15	.94
39. Acute nephritis	39	29	.6	30	.18	.05
40. Pleurisy	42	27	.27	55	.15	.04
41. Acute yellow atrophy of liver	42	27	.02	0	.....	.....
42. Obstruction of intestines	43	26	.6	25	.15	.04
43. Alcoholism	44	25	.4	85	.34	.09
44. Hemorrhage of lungs	45	25	.1	80	.08	.02
45. Diseases of thyroid body	46	24	.02	10	.002	.0005
46. Ovarian tumor	46	[a]25	.07	0	.....	.....
47. Uterine tumor	46	[a]25	.1	60	.06	.02
48. Rheumatism	47	23	.5	10	.05	.01
49. Gangrene of lungs	48	23	.03	0	.....	.....
50. Anemia, leukemia	48	23	.4	50	.2	.05
51. Chronic poisonings	48	23	.05	70	.03	.007
52. Congestion of lungs	49	22	.4	50	.2	.04
53. Ulcer of stomach	49	22	.2	50	.1	.02
54. Carbuncle	49	22	.03	50	.015	.003
55. Pericarditis	52	20	.1	10	.01	.002
56. Cancer of female genital organs	52	[a]21	.6	0	.....	.....
57. Dysentery	52	20	.5	80	.4	.08
58. Gastritis	53	19	.65	50	.32	.06
59. Cholera nostras	53	19	.09	50	.05	.01
60. Cirrhosis of liver	54	19	.9	60	.54	.1
61. General paralysis of insane	55	18	.3	75	.22	.04
62. Hydatid tumors of liver	55	18	.002	75	.002	.0003
63. Endocarditis	56	17	.8	25	.2	.03
64. Locomotor ataxia	56	17	.17	35	.06	.01
65. Diseases of veins	57	17	.04	40	.02	.003
66. Cancer of breast	58	[a]17	.4	0	.....	.....
67. Diabetes	58	16	.8	10	.08	.01
68. Biliary calculi	58	16	.17	40	.07	.01
69. Hernia	59	16	.27	70	.19	.03
70. Cancer not specified	59	16	.9	0	.....	.....
71. Tumor	59	16	.08	0	.....	.....
72. Bright's disease	59	16	5.6	40	2.24	.36
73. Embolism and thrombosis	60	15	.26	0	.....	.....
74. Cancer of intestines	60	15	.5	0	.....	.....
75. Cancer of stomach and liver	61	14	1.7	0	.....	.....
76. Calculi of urinary tract	61	14	.03	10	.003	.0004
77. Cancer of mouth	63	13	.1	0	.....	.....
78. Heart disease	63	13	8.1	25	2.02	.26
79. Influenza	64	13	.7	50	.35	.05
80. Asthma and emphysema	64	13	.23	30	.07	.009
81. Angina pectoris	65	12	.4	25	.1	.01
82. Apoplexy	67	11	4.4	35	1.54	.17
83. Cancer of skin	70	10	.2	0	.....	.....
84. Chronic bronchitis	71	9	.8	30	.24	.02
85. Paralysis	71	9	1	50	.5	.04

[a] "Expectation" for females.

Possible prolongation of life—Continued.

(1) Cause of death.	(2) A. Median age of deaths from causes named.	(3) B. Expectation of life at median age.	(4) C. Deaths due to cause named as percentage of all deaths.	(5) D. Ratio of preventability (postponability), i. e., ratio of "preventable" deaths from cause named to all deaths from cause named.	(6) E=CD. Ratio of "preventable" deaths from cause named to all deaths from all causes.	(7) F=BE. Years added to average lifetime if deaths were prevented in the ratio of preventability of column 5.
	Years.	*Years.*	*Per cent.*	*Per cent.*	*Per cent.*	*Years.*
86. Softening of brain	71	9	0.2	0	.....	.....
87. Diseases of arteries	73	9	0.83	10	0.08	0.007
88. Diseases of bladder	74	8	0.2	45	0.09	0.007
89. Gangrene	74	8	0.25	60	0.15	0.01
90. Old age	83	5	2	0	.....	.....
All causes	38	.....	100	42.3	[a]42.3	14.06
RÉSUMÉ.						
Diseases of infancy (having median age 1)	.....	.....	18.5	47	8.8	4.4
Diseases of childhood (having median age 2 to 8)	.....	.....	4.2	67	2.8	1.51
Diseases of middle age (having median age 23 to 49)	.....	.....	43	49	21.2	6.82
Diseases of late life (having median age 52 to 83)	.....	.....	34.3	28	9.5	1.33
All causes	.....	.....	100	42.3	42.3	14.06

[a]Although this is the ratio of general preventability of deaths under existing conditions, the death rate, i. e., deaths in relation to population, will not in the end be affected in this ratio but by only about 25 per cent. The reason for this paradox is that deaths prevented lead to a larger population (See appendix to this chapter, section 3).

Similarly, if of the ten lines three are prolonged each a certain stated amount, or are prolonged that amount on the average, the average of the whole ten will be increased by three-tenths of this amount. Consequently, if the saved lives from typhoid fever (No. 24 in the table) are, on an average, prolonged thirty-eight years, and these saved lives represent 1.7 per cent of all lives, the average life will be prolonged by 1.7 per cent of thirty-eight years. This is 0.65 or two-thirds of a year.

All the calculations are on the assumption of expectations of life, such that the saved lives will die according to the present law of mortality. Consequently, if the table should be corrected by substituting in each case such an expectation of life as would conform to the improved mortality, the result would be an addition (2.1 years)[a] to the estimate of possible prolongation, which would therefore become 16.2 years. The résumé of the table shows that of the 14 years of possible prolongation of life 4.4 would be caused by reducing infant deaths under or near 1 year, 1.51 by reducing mortality from children's diseases, 6.82 from reducing the diseases of middle life, especially tuberculosis and typhoid, and only 1.33 by reducing the mortality of diseases the deaths from which usually come after 50 years of age.

[a] Best estimated graphically, as shown in appendix to this chapter.

The table shows that seven of the 90 causes of death are responsible for over half of the shortening of life, namely, diarrhea and enteritis (No. 7), broncho-pneumonia (No. 10), meningitis (No. 13), typhoid (No. 24), tuberculosis of lungs (No. 31), violence (No. 32), and pneumonia (No. 38). These alone shorten life needlessly by more than eight years. Against these seven causes, therefore, our special efforts should be directed. Pure milk, pure water, pure air, and reasonable protection from accident are the chief means known at present. When the public makes up its mind no longer to endure impure milk, impure water, and impure air, and unreasonable dangers to life and limb, life will lengthen eight years, and probably a great deal more.

In the résumé of the table columns 4, 6, and 7 are found from the original table by simple addition. Each figure in the fifth column is found by dividing the figure in the sixth by that in the fourth.[a]

The final figure in this column, 42.3, is the same as the sum of column 6, and means that according to medical opinion 42.3 per cent of the deaths which occur under present conditions are preventable (postponable). The death rate, however, will ultimately be reduced, not in this proportion, but by about 25 per cent,[b] while the average duration of life will be increased about 33⅓ per cent.

SECTION 3.—*Diagram showing effect of prolongation at different ages.*

The whole process is best seen by means of a survivorship table, a diagram of which will be found facing page 108.

We have here four curves which represent the survivors in successive years from a hypothetical and representative list of 100,000 persons born. The two of these curves which should be noted are the inner two, namely, those labeled "Mass. 1893–97" and "Possible I." The former is taken, in lieu of any better statistics, as representing the existing law of mortality in the United States. The latter shows what the law of mortality would be if the ratios of preventability given in the preceding table were put in force. The curve Possible I is constructed on the supposition that all the deaths prevented or postponed subsequently occur according to the present law of mortality; that is, that expressed in the curve Mass. 1893–97.

The two remaining, or outer, curves are given merely for comparison. The lowest, marked "Mass. 1855," shows the mortality which held true in Massachusetts in that year according to the estimates of the actuary, E. B. Elliott.[c] The difference between this curve and the one above shows the number of years of life actually saved to 100,000 persons subject to the mortality of 1893–1897 instead of the mortality of 1855. The upper curve (Possible II) shows the modification in Possible I on the assumption that the saved lives, instead of following the present law of mortality (Massachusetts,

[a] The result is in each case a weighted average of the individual ratios of preventability for the individual causes of death.

[b] See appendix.

[c] See Proceedings of the American Association for the Advancement of Science, 1857, pp. 61, 69; also Sixteenth Registration Report, Massachusetts, 1857, p. 204.

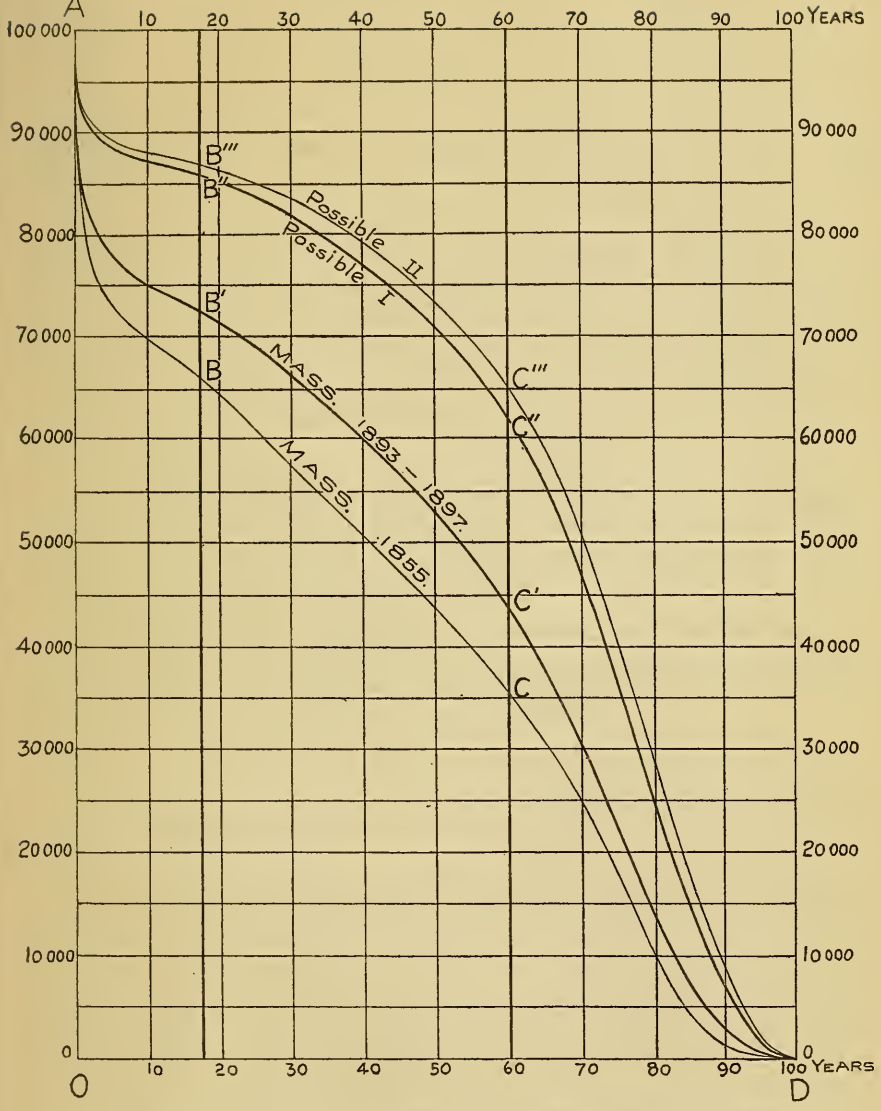
1893–1897), follow the law of mortality represented in the curve Possible II itself.[a]

This diagram shows at a glance what improvement has been made in mortality and at what ages, and what improvement is still possible, and at what ages, according to the preventability known to be easily possible. We see that the curve, Possible I, does not drop as far in the first year of life as the curve Mass. 1893–97. This is because of the great saving of infant lives known to be possible. The years of life which would be saved to the 100,000 persons by the new hygiene are represented by the difference in area between the new curve AB″C″D and the old curve AB′C′D, from which it was constructed by applying the ratio of preventability. This area can easily be measured by a planimeter, and is found to be 1,280,000, which, divided by the 100,000 persons, means an average addition of 12.8 years to the lifetime of each person born. This result differs somewhat from the arithmetical calculation, 14.06, given in the preceding table.[b] If the upper curve be used, which assumes that the "saved" lives die not according to the old but the new mortality, the addition becomes not 12.8 but 14.9 years, as against the 16.1 computed arithmetically. We may hereafter refer to this minimum estimate of possible increase of life as, in round numbers, 15 years. The lengthening of life would be from 45 to 60, or one-third.

The diagram also shows the saving of life which actually took place between 1855 and the period 1893–1897. The area between the curves for these two periods shows that 550,000 years were saved for a supposed group of 100.000 persons, or 5.5 per person. The whole area of the new curve AB″C″D is 5,810,000, or 58.1 years per person, which is the new average duration of life, as compared with 45.3 for 1893–97 and 39.8 years for 1855. We may divide the diagram by two vertical lines drawn at the ages 17½ and 60 in order to discover what part of the added life occurs between these ages—that is, within the working period—and what parts fall on either side. The addition of 12.8 years to the lifetime of each of 100,000 persons, or 1,280,000 years of life in all, is divided into three groups, namely, the years falling in the period of preparation, 200,000; in the working

[a] The method of constructing the curves Possible I and Possible II from the curve Mass. 1893–97 is by means of the ratios of preventability given in the résumé of the preceding table. See appendix.

[b] The discrepancy, 1.3 years, is due to the fact that in constructing the table, based on individual diseases, I was compelled to use for the percentages of deaths by ages (column 4) the percentages obtaining in the calendar year 1906; whereas the diagram is based on the idea of a stationary population, the distribution of the deaths being represented by the shape of the curve Mass. 1893–97. The diagrammatic method is therefore more correct. The abnormal age distribution in 1906 results in making some of the figures in the last column of the table too large and some too small. In a general way, the figures for the earlier ages are too large and for the later ages too small, although the figures which are most too large are probably for ages 30 to 35. Consequently the greatest error in excess is for tuberculosis, which is possibly three-fourths of a year too large. No exact corrections are possible, and any systematic corrections, even inexact, would be very laborious. This would correspond to the elaborate actuarial calculations of Hayward in England and Glover in the United States. See Hayward "On the Construction of Life Tables and on Their Application, etc." Haydock and J. W. Glover, "A Study of Tuberculosis in the United States," Journal of Michigan State Medical Society, February, 1909.



SURVIVORSHIP CURVES, SHOWING SAFE MINIMUM IMPROVEMENT ATTAINABLE.

period, 680,000; in the period of decline, 400,000. The following table will show the whole process:

	Preparatory period (ages 0–17½).		Working period of life (17½–60).		Period of decline (60 and beyond).		Total.	
	Years of life.	Per cent of total.	Years.	Per cent.	Years.	Per cent.	Years.	Per cent.
Mass. 1855	12.6	32	21.9	55	5.3	13	39.8	100
Mass. 1893–97	13.5	30	25.0	55	6.8	15	45.3	100
Possible I	15.4	26	31.8	55	10.9	19	58.1	100

These figures show that in 1855 the average person born lived only 12.6 years of the 17½ years in the period of preparation for life. In 1893–97 he lived 13.5 years. If modern hygiene were applied according to the ratios of the assigned preventability, the figure would then be 15.4 years actually lived out of the 17½. Of the working period of 42½ years (17½–60, the average man living under the mortality of 1855 had only about half, or 21.9 years; under the mortality of 1893–97 he had 25.0. and under the "Possible I" mortality he would have 31.8 years.

In percentage the years in the working period remain 55 per cent of the total life in all cases. This assumes that with the prolongation of life the limits of the working period remain 17½ and 60. Since the prolongation of life carries with it a postponement of the age of disability, it follows that the proportion of working life would actually increase.[a]

It will be seen in comparing the curves on the diagram that the change wrought in the character of the mortality curve by the new hygiene simply continues the change already in progress. The family resemblance between all four curves is striking.

SECTION 4.—*Fifteen years a safe minimum estimate of prolongation possible.*

The estimate of fifteen years as the possible prolongation of life is merely a minimum estimate. This will be seen from the following important considerations:

1. The estimate takes no account of future medical discoveries, which are now coming at such a rate that we have every reason to believe they will soon greatly increase the ratios of preventability. Cancer, for instance, has been put down with zero as its ratio of preventability, but the scientific world is intently seeking for methods of prevention and cure. Likewise "old age" has been assumed as unpreventable. Yet Metchnikoff maintains with reason that this is a malady which can be postponed.

2. The ratio of preventability of the above diseases takes little account of the cumulative influence of hygiene. Certain diseases late in life are now taken to be unpreventable or only slightly preventable on the assumption that people reach those ages in their present degree of more or less imperfect health. But on the assumption that personal hygiene had been practiced since birth, the vital resistance, which is always a deterrent of disease, would have been strengthened.

[a] See Dr. Edward Jarvis, "Political Economy of Health," Fifth Annual Report, Mass. Board of Health, 1874, p. 338, ff.

Professor Sedgwick tells us that evidence will be published demonstrating "Hazen's theorem," that every life saved from typhoid by better water supply means two or three persons saved from deaths from other causes. Our table shows an estimate of at least 85 per cent as the preventability of typhoid, but the coincident preventability of other diseases which this prevention of typhoid would bring about finds no place in the table. The individual estimates given for these other diseases take no account of such indirect action. Similarly, as Metchnikoff has emphasized, venereal diseases, though they seldom cause death, do shorten life, the "terminal disease" being quite different. The same is true of malaria and hook-worm disease, which predispose to tuberculosis and other terminal diseases. But in the table the ratios of preventability of tuberculosis and other diseases were constructed quite irrespective of any effect from reducing venereal diseases, malaria, and other devitalizing diseases.

In the matter of personal hygiene the cumulative influence is still more indirect, and perhaps still more powerful. It is now often remarked by insurance men that the best risks are not necessarily the best physiques, but may be the valetudinarians who practice personal hygiene.

There is a vicious circle of disease and a beneficent circle of health. The so-called "cause of death" given in death certificates is only the terminal cause. It is often merely the "last straw" of a terrible load gradually accumulated through life.

Evidently, to exploit the resources of hygiene, we need to consider a thoroughgoing change in health ideals and a consequent revolution in the conditions and habits of living. What would then happen to human longevity we can only conjecture. The possible addition to the life span might, for aught we know, be several times the fifteen years in the table.

3. The figures for the possible prolongation of life take no account of the ultimate racial effects of the new health ideals. If once a nation becomes thoroughly alive to the importance of maintaining the stamina of its citizens, this will, as we have seen, affect marriages—by putting a premium on health as one of the desiderata in a prospective husband or wife. The longevity of succeeding generations would certainly be improved—how much, it would be useless to guess.

The foregoing considerations, added to the fact that the estimates of preventability were made conservatively, will show that the addition of fifteen years is really only a first step. If clean milk will prevent infantile diarrheal diseases, if clean water will prevent deaths from typhoid and at the same time—according to Hazen's theorem—prevent two or three times as many other deaths, and if clean air will prevent tuberculosis, then it is evident that mere cleanliness in respect to these necessities will suffice to lengthen life by most if not all of the above estimate. Fifteen years is merely the "ore in sight." If we will work for it, we may get an even richer prize.

Within the past few years the knowledge of the causes of disease has become so far advanced that it is a matter of practical certainty that by the unstinted application of known methods of investigation and consequent controlling action, all epidemic disease could be abolished within a period so short as fifty years.[a]

[a] E. Ray Lankester, "The Kingdom of Man," New York (Holt), 1907, p. 36.

SECTION 5.—*Need of lengthening human life.*

If Metchnikoff's noble dream should be some day realized, the lengthening of human life would at once decrease the burden on the productive period. That period tends to remain 55 per cent of the total years lived, on the assumption that the working period remains 17½ to 60, but the upper limit tends to shift forward. In this way, both the absolute and relative length of the working period would be increased.

The further off the burden of old age is shifted, the easier it is for society or the individual to accumulate the wealth to provide for it. At present the burden of helpless old age is extremely serious, as those countries are beginning to realize which, like Denmark, Belgium, Germany, France, and recently England, have enacted laws to provide old-age pensions.

As life becomes more complex it requires a longer period of preparation. Preparation is education, and requires time. As the stock of knowledge increases, the period for acquiring it, or rather only enough of it to enable one to earn a livelihood, is constantly tending to increase. The age of leaving school and college is presumably growing greater.

It would be very much in keeping with the fitness of things if in this century biological science practically applied should shift the limit of the further end of the working period, the limit which we have assumed to be 60, to a later period of life. Human life would then be on a larger scale throughout. It would provide time for a longer and more thorough preparation and at the same time provide sufficient years of working life to repay this investment.

As Metchnikoff[a] well points out, one result of lengthening life will be a greater utilization of accumulated experience. We shall have less immaturity of judgment. The principle which leads to the choice for members of the judiciary of men of ripe years and knowledge will apply to every field of human activity, even those fields which are now preempted by young men because of the necessity of utilizing their vitality. It will lead to a sane and yet a vigorous conservatism. It will give to society a body of old yet hale men of experience, whose influence and worth can not be measured. As Metchnikoff has said:

> Old age, at present practically a useless burden on the community, will become a period of work valuable to the community. As the old man will no longer be subject to loss of memory or to intellectual weakness, he will be able to apply his great experience to the most complicated and the most delicate parts of the social life.[b]
>
> We may predict that when science occupies the preponderating place in human society that it ought to have, and when knowledge of hygiene is more advanced, human life will become much longer and the part of old people will become much more important than it is to-day.[c]

SECTION 6.—*The normal lifetime.*

What is the normal human lifetime?[d] Many estimates have been made, based on all sorts of reasoning, the figures extending from 75

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[a] Prolongation of Life, p. 329.

[b] Nature of Man, p. 295.

[c] Metchnikoff: "Prolongation of Life," pp. 226–227.

[d] On the topic of human longevity, see Metchnikoff: "The Prolongation of Life," Pt. II, Chaps. I, II. Shaler: "The Individual," New York (Appleton), 1901, Chap. III. Lankester: "Comparative Longevity," London, 1870, pp. 88–119.

to 200 years. Flourens's law, of doubtful value, that a mammal lives five times the length of its growing period, can not be applied generally. It is true, the horse full grown at 5 may live 25 years; sheep adult at less than 3 years may live 12; while elephants, which have an unusually tardy development, are reputed to have a lifetime of 2 centuries.

Haller, a distinguished Swiss physiologist of the eighteenth century, thought that man ought to live to 200 years; Buffon was of the opinion that when a man did not die from some accident or disease he would reach 90 or 100 years.[a] In man the growth period is normally continued to some time after the twentieth year; its exact limit has not been ascertained, but from the statistics gathered by the Sanitary Commission during the civil war it seems most likely that it is not usually completed until after the thirtieth year.[b]

One method which has been suggested to ascertain the natural length of life is to suppose all diseases to be completely eliminated and those who now die of them to die of old age. The median age for death from old age is 83. Metchnikoff, however, shows the error of assuming present old age to be normal. We may conclude that the normal life exceeds 83.

There must needs be, of course, a limit to the possible prolongation of life. We find in recent times few authenticated cases of persons who have lived for a hundred years. As Young, former president of the British Actuarial Society, has shown in his interesting book[c] on centenarians, most cases of supposed centenarians are either cases of conscious or unconscious exaggeration or of error in records. For instance, the Countess of Desmond is said to have lived 130 years, owing to the confusion of two persons of the same name, one of whom lived to be 100 years old, while the other, her mother, died at 30, and their lives were combined in subsequent records. There are, however, some authenticated cases. Thus, the Norwegian Drakenberg was born in 1626 and lived until 1772, aged 146. "He was married when 111 years old, and as a widower of 130 proposed to marry again, although without success."[d]

At Portland, Oreg., Mrs. Mary L. Wood died recently at the age of 120 years and under circumstances which permitted the authentication of her case by the Oregon Historical Society. From these and from other cases which might be mentioned, we may conclude that if to-day, notwithstanding all existing chances of death, it is possible for some persons to live beyond 120, the chances in the future for a larger proportion of such persons will be materially improved. Whether this proportion could ever become the major part we have as yet no means of knowing. What is needed is study, and Metchnikoff is right in believing that the study is well worth while from every point of view.

APPENDIX TO CHAPTER XI.—*Method of computing possible prolongation of life.*

SECTION 1.—"*Expectations*" *at median ages as short cut to average expectations.*

The table given in Chapter XI is briefly described in the chapter itself. The following additional explanations are made in regard to the statistical method employed:

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[a] Metchnikoff, "Prolongation of Life," p. 84.
[b] Shaler, loc. cit., p. 61.
[c] T. E. Young: "Centenarians," London (C. & E. Layton), 1899.
[d] See article by Harald Westergaard, (British) Economic Journal, Vol. IX, 1899, p. 315.

The third column, giving the expectation of life which is lost or cut off by each particular cause of death, is estimated roughly by taking the expectation of life pertaining to the median age reached by those who die from the cause named. This expectation of life is taken from the Massachusetts Life Tables, 1893–1897.[a]

The method of using the median age is sufficiently exact in view of the inexact, or rather, safe, minimum estimates of preventability given in column five. A perfectly correct method would be much more laborious. Hayward's monograph on the effect on the duration of life of eliminating only one disease (tuberculosis) requires 190 pages of calculation. The true method consists in averaging arithmetically and weighting these averages according to the number dying at the various ages. Specimen computations show that the error involved by the short cut is not great.

Thus, for tuberculosis it is found that the average expectation of life lost by consumptives dying in 1906 was 32 years, whereas the expectation of life at the median age was 33 years. The former figure is a hundredfold more difficult to compute than the latter. Even the former is not strictly correct, since it applies to the deaths by ages as distributed in 1906, and not as distributed in a "stationary" population.

SECTION 2.—*Basis of estimates of preventability.*

The estimates of preventability given in column 5 need special explanation. In a few cases, these estimates are based on statistical experience.[b]

The great majority of them are based on clinical experience merely, without any exact statistics. They are thus in the nature of expert guesses. The experts in all cases are physicians. I have not entered any estimate of my own, unless item No. 36 might be so designated. This item is the residuum of deaths from unknown causes, or ill-defined causes, and is made up to a large extent of cases not properly reported in the death certificates. Inasmuch as the average preventability for all other causes in the table is over 42 per cent, it seemed safe to assign to deaths from these unknown causes a ratio of preventability of 30 per cent. But even if the preventability were entered as 0, the effect in reducing the result would be less than a year.

Those who gave to the construction of these estimates the benefit of their experience, observations, and reading were especially asked above all to be conservative. In order to avoid any possibility of exaggeration of their estimates

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[a] S. W. Abbott, M. D.: "The vital statistics of Massachusetts for 1897, from the thirtieth annual report of the state board of health of Massachusetts." The expectation is taken as the average of the expectations for males and females.

[b] In addition to the data in regard to special diseases discussed in the text, other pertinent material has been taken into account by those who made the estimates presented in the table. For instance, from smallpox in London in 1901–2 the mortality was 34.6 per cent among the unvaccinated, 20.9 per cent among those vaccinated after the disease was apparent, and 10.3 per cent where there was protective vaccination. In Gloucester in 1895–96 the mortality among the unvaccinated was 40.8 per cent and among the vaccinated 9.8 per cent. For children under 1 year the unvaccinated had a mortality of 72 per cent, while the vaccinated were not attacked. From cerebro-spinal meningitis the average mortality was 70 per cent (Holt); the mortality under serum treatment was 25 per cent (Flexner and Jobling). For typhoid fever, Koch and his assistants stamped out the disease in Trier by isolation of the infected persons and disinfection. (Osler, The Practice of Medicine, sixth edition.) This would probably be impracticable to such an extent in a city on account of the great expense involved and the difficulty of detecting the bacillus carriers. Other figures for typhoid fever are given in the text. For diphtheria in New York City in 1889–1891 we find the mortality was 37.3 per cent, while in 1902–1904 the mortality was 10.8 per cent. The board of health began to use antitoxin in 1895. These facts were furnished by Professor Blumer. Many data on preventability are given by John C. McVail in The Prevention of Infectious Diseases, New York (Macmillan), 1907. See especially pages 16–19. Doctor Stiles, of the Public Health and Marine-Hospital Service, is soon to publish figures showing the absolute preventability of hook-worm disease, a malady prevalent in the South, but not entering into the census tables. These tables do not cover the Southern States.

in the table their average was taken, and then the estimate, as entered in the table, was taken either as that average or below it. In no case was the estimate entered as above the average given. When, as was true in a large proportion of cases, the different estimates agreed fairly well, the average was employed, or rather the nearest figure ending in 0, or 5 next below the average. If the individual estimates diverged widely, an estimate was used below the average, favoring the conservative estimators rather than the optimistic. Also in cases where only a few estimates were obtainable, the estimate as entered was put below the average of those given.

In estimating the percentage of preventability for all the ninety causes of death, 18 estimators contributed. The number of estimates of preventability for each cause averaged nearly eight for each cause of death. It will be seen, therefore, that the table represents in a conservative way medical opinion as to the preventability of disease. The physicians who contributed these estimates are: Dr. Joseph M. Flint, professor of surgery, Yale Medical School; Dr. George Blumer, professor of the theory and practice of Medicine, Yale Medical School; Dr. H. L. Swain, clinical professor, Yale Medical School; Dr. Oliver T. Osborne, professor of therapeutics, Yale Medical School; Dr. J. H. Townsend, secretary of Connecticut state board of health; Dr. F. W. Wright, health officer of New Haven; Dr. Norman E. Ditman, of Columbia University; Dr. Cressy L. Wilbur, Chief of Division of Vital Statistics, Bureau of the Census; Dr. L. O. Howard, Chief of Bureau of Entomology, Department of Agriculture; Dr. William C. Woodward, chief health officer of District of Columbia; Dr. Charles V. Chapin, city health officer, Providence, R. I.; Dr. Henry B. Baker, ex-secretary Michigan state board of health, ex-president American Public Health Association; Dr. J. H. Kellogg, superintendent of the Battle Creek Sanitarium; Dr. Charles H. Castle, of Cincinnati, Ohio; Dr. Harry M. Steele, of New Haven, Conn.; Dr. L. Emmett Holt, of New York; Dr. Edwin O. Jordan, of the Memorial Institute for Infectious Diseases, Chicago, Ill.; Dr. Prince A. Morrow, president of the American Society for Sanitary and Moral Prophylaxis.

Section 3.—*Meaning of "preventable."*

The meaning of the word "preventable" requires some explanation.

1. It is to be noted that column 5 gives the ratio of preventability for mortality and not for morbidity. It means ratio of preventable deaths to all deaths, not to all cases of illness.

2. Since the word "preventable" implies the hypothesis of different conditions from those which actually exist, it is necessary to specify what hypothetical conditions shall be implied in the term. Doubtless tuberculosis would be over 99 per cent preventable if we should conceive as our hypothetical conditions that every individual could live on the prairies of the West, out of doors, be provided with the best of food, most congenial of tasks, and free from overwork and worry. Needless to say, the figures in the table do not imply such Utopian conditions, nor do they imply new medical discoveries. One hundred per cent of every disease might be preventable if we conceived as our hypothesis that the means of prevention are known and applied. The hypothetical condition selected for the meaning of the term "preventable" is contained in the following definition: *A "ratio of preventability" is the fraction of all deaths which would be avoided if knowledge now existing among well-informed men in the medical profession were actually applied in a reasonable way and to a reasonable extent.* The term "reasonable" is of course elastic, and will be somewhat differently interpreted by different persons, but, as in law, where "reasonable care" is often used as a proviso, it is impossible to make any more specific condition.

3. Considerable confusion exists in the minds of many people in regard to the number of deaths which might be prevented, or, as it is popularly expressed, the number of lives which might be saved. Since death is ultimately inevitable for all, no life can be saved except temporarily. It will serve to avoid confusion if "preventable" is explained as "postponable." The question arises when deaths are postponed, How long are they postponed? The answer is, They are supposed to occur according to existing rates of mortality. Thus, those saved from croup (No. 12) at age 2 will later die as do others who are living at age 2, and will therefore have the expectation of life (54 years) pertaining to that age.

4. The above explanation will serve to meet an objection which otherwise would immediately occur to the reader. If diseases of early life are prevented, the result will necessarily be an increase of the diseases in later life. For

instance, if all the causes of death could be abolished except old age, there would be a great increase in the number of deaths from old age, which, instead of constituting the 2 per cent of all deaths, which it does at present, would constitute 100 per cent.

But the fact that all lives saved will add to the later mortality is fully, and more than fully, taken into account in our calculations. When we assume that certain lives now lost at a given age might be saved, we also assume that they would not be saved again (even from the same disease), but would die off according to the old rates of mortality at successive ages. Their new lease of life would simply be the old expectation of life. As a matter of fact, lives now lost could probably be saved, not only once, but several times.

We may here explain the paradox mentioned in the text—namely, that a preventability of 42.3 per cent of deaths under present conditions does not imply that the death rate would ultimately be reduced 42.3 per cent.

The death rate would ultimately depend on conditions of the distribution of ages and diseases entirely different from those now prevailing. This will be clear if we think what would happen if the preventability expressed in the table could be immediately applied. During the ensuing year it would be found that about 42 per cent of present deaths would not occur. A consequence of this, however, would be that the persons whose lives were prolonged would die at a later period, since no death is absolutely prevented, but only postponed. Even if 100 per cent of all deaths were prevented (postponed), but the postponement were for a very short time, the effect in reducing the death rate would be extremely small. On the other hand, if only 1 per cent of the preventable deaths were postponed for a sufficiently long time, the ultimate effect would be to reduce the death rate much more than 1 per cent. After the deaths which had been postponed had reentered, a new equilibrium would be established. Under these new conditions the ratio of the deaths to the population would not be 42.3 per cent lower than at present, but only about 25 per cent. At present the average duration of life, taken from the Massachusetts table for 1893–1897, is about 45 years. The ratio of preventability in the above table would increase this life by about fifteen years, making it 60 years. The ratio of 45 to 60, showing the increase in the life span, will be the inverse of the ratio 60 to 45 in a "stationary" population, which would show the resulting reduction in the death rate. This is a reduction of 25 per cent. Thus the preventability of 42.3 per cent of deaths under present conditions and in the manner indicated in the table involves a lengthening of life of 33⅓ per cent and a reduction of the death rate, after readjustment of deaths by ages, of about 25 per cent.

SECTION 4.—*Error from abnormal age distribution of deaths in 1906.*

The table as given is constructed for deaths occurring in the calendar year 1906. Its interpretation, however, is to be made on the basis of a survivorship table. In a stationary population the age distribution of deaths in any year would be the same as in a survivorship table; but since the United States has not a stationary population, this identity holds only approximately.

The discrepancy accounts for the difference of one and three-tenths years in the prolongation of life, as calculated in the table and by means of the diagram. The latter is the more correct, as it is based on a survivorship table, or—what amounts to the same thing—on such mortality as would exist in a stationary population. The only way in which this diagram can be vitiated by the slightly abnormal age distribution of deaths in the year 1906 is as this abnormal distribution affects the average ratios of preventability used in constructing the diagram. These ratios are based on column (5) of the résumé of the table. The four figures from the table are adjusted by graphic interpolation in the usual way, so as to form a continuously varying series of figures for successive years of life. These ratios are in each case an average of the individual ratios for particular diseases, contained in the same column (5) of the larger table. The "weights" are slightly vitiated by the fact that the age distribution of deaths in 1906 is not the normal distribution of a stationary population. It is only as the "weighting" is thus affected that the diagram can be vitiated through our being forced to use the figures for 1906 instead of those for an ideal stationary population, since such figures are unobtainable. The error from this source is infinitesimal, and we may depend on the results of the diagram, 12.8 to 14.9 years, as practically free from any appreciable error due to the use of short-cut methods.

SECTION 5.—*Ratios of preventability by ages derived from ratios by diseases.*

In regard to the résumé containing the average ratios of preventability holding true during different ages, it will be observed that they are obtained indirectly, by calculating from the individual ratios of preventability for different diseases given in the table itself. Although these diseases are not absolutely limited to the times within which their median falls, there is a fairly distinct line of demarcation between the groups, especially between children's diseases and those of middle life. The table shows no disease with a median age of incidence between 8 and 23 years, and the census table of deaths for 1906 shows that a very small percentage of the total deaths occur between ages 10 and 20. Even if the diseases considered for the four epochs of life given in the résumé did extend somewhat into the regions of the adjacent epochs, the effect would not change the result appreciably and would be as likely to change it in one direction as the other. The reason is that the items of the column in the résumé for "ratio of preventability" are obtained by dividing the figures in column 6 by those in column 4, each of these two being found by adding the individual figures in the table for each age group concerned. The extension of diseases of an age group outside of that group will apply equally to both terms of the ratio, those in the fourth and sixth columns, and will not substantially affect the quotient in the fifth column.

SECTION 6.—*Allowance for weakness of prolonged lives.*

The use in column 2 of the expectations of life derived from the Massachusetts 1893–1897 life table is equivalent to the assumption that if preventable deaths were prevented the lives thus saved would proceed to die off according to the mortality of Massachusetts, 1893–1897. This assumes that since 1893–1897 there has been no improvement in the expectation of life, and that the saved lives will not share in the improvement which the table itself shows forth. The reason that a later life table than for 1893–1897 was not used is that no later life table is available. If it were, it would show larger figures in column 2, and consequently a larger total result for the possible prolongation of life than fourteen years.

The reason the "expectation" in column 3 does not take account of the effect of the improvement in mortality resulting from the table is that this improvement can not be calculated until column 3 is filled, and we prefer to use as a first approximation a conservative figure in column 3, rather than to guess at more likely figures. The conservative assumption used seems also advisable, because of the fact that in the 42.3 per cent of persons in the life table who would be saved from death and given a new lease of life there would be suffered a greater mortality than that of the average persons that now pass that age in safety, for—on the principle of the survival of the fittest—it is intrinsically probable that those who now die at any age are weaker than those who do not.

How much allowance should be made for this factor of differential mortality it is impossible to say with certainty. But in another paper [a] I have dealt with the same question applied to tuberculosis. Taking the figures of Dr. Lawrason Brown, giving the mortality experience among the apparently cured cases of tuberculosis discharged from the Adirondack Cottage Sanitarium, and making certain allowances, it seems that if tuberculosis were prevented its present victims would have more than three-fourths of the expectation of life belonging to others. Let us assume that this ratio is equally conservative as applied to all other cases of prolongable life. Now, it so happens that the expectation of life at birth in the Massachusetts life table of 1893–1897 is almost exactly three-fourths of the expectation which our table and diagram shows would be possible if prevention were properly practiced. This would give 45 years as the expectation of life at birth for the saved lives, 61 for other lives, and 59 for all lives. Surely this seems sufficient allowance for the existence of any possible inferiority among the lives which would be saved.

SECTION 7.—*Diagram "Possible I," making this allowance, compared with "Possible II," omitting it.*

If no allowance for inferiority among saved lives were necessary, the results of the calculation given in the table would be only a first approximation and

[a] "The cost of tuberculosis in the United States and its reduction," read before the International Congress on Tuberculosis, 1908.

would need to be followed by successive and closer approximations. We can get much quicker results by means of the diagram and a planimeter.

If we apply the ratios of preventability for these four groups, we are able to construct the new survivorship table on the basis of Mr. Abbott's for 1893–1897. All that is necessary is to begin the new survivorship table at the same point that the old begins, and continue from that point and every other point throughout its course by the following procedure: Through the point draw a line downward and to the right for one year, at the same percentage slope as Abbott's table shows for that year. This line indicates what survivors there would be if their mortality were not affected at all by the ratio of preventability. The deaths during that year would be represented by the drop of the curve within the year. Next, taking the proper fraction of this drop, as indicated by the ratio of preventability, we pass vertically upward this amount from the end of the line, and from the new point so obtained proceed in like manner for each subsequent year. The result is a series of teeth the upper points of which are points on the required curve. Joining these points, we obtain the curve. This process explains the theory. This gives the table called "Possible I," and takes full account of the fact that the ratios of preventability continue to apply to saved life as much as to other life. The table "Possible I" represents the survivorship table, under the assumption that the lives saved once are given no further advantages, but follow thereafter the old law of mortality, that for 1893–1897.

SECTION 8.—*Reciprocal relation between longevity and mortality shown by diagram.*

We may take this opportunity to explain, for the benefit of the general reader, the reciprocal relations existing between the death rate in a stationary population and the average duration of life. Consider the diagram "Massachusetts, 1893–1897." It shows the life history of 100,000 persons born. Let us suppose a community unaffected by emigration or immigration, and in which there are 100,000 births each year. Let us suppose, further, that the 100,000 persons born each year die afterwards according to the law of mortality represented by the curve "Massachusetts, 1893–1897." Evidently in such a community there will not only be 100,000 births, but there will be 100,000 deaths each year, and the population will be stationary. It will also be true that the same diagram can be taken to represent the age distribution of this stationary population. Thus, those living at age 10 will be the survivors of the 100,000 born ten years ago, and the number of such survivors is the ordinate of the curve at 10 years. Thus, every ordinate of the curve represents not only the survivors to a certain age out of 100,000 births, but also represents the number in the population at that age. The area of the curve therefore represents total population (when regarded as made up of vertical sections). It likewise represents the total number of years lived by 100,000 persons (when regarded as made up of horizontal sections). Now, the death rate is the ratio of deaths to population—i. e., the ratio of 100,000 to the area of the curve. The average duration of life is the total years lived by 100,000 persons divided by 100,000—that is, it is the area of the curve divided by 100,000. These are clearly reciprocals.

CHAPTER XII.—*The money value of increased vitality.*

SECTION 1.—*Money appraisal of preventable wastes.*

Estimates of the money value of preventable wastes depend on the valuation of *human life*, of which several appraisals have been attempted.

Prof. J. S. Nicholson estimated that in Great Britain human labor capitalized was worth five times all other capital.[a]

Engel computed that each child costs 100 marks at birth, 110 marks the first year, 120 the second, and so on. At 20 he will have cost 2,310 marks, or $560. But one-half die before 20. Hence each person who reaches the age of 20 actually costs society much more than $560; possibly as high as $1,000, if Engel's estimates are correct. Professor Mayo-Smith estimated that men and women between the

[a] See "The Living Capital of the United Kingdom," (British) Economic Journal, 1891.

ages of 15 and 45 averaged $1,000 in value.[a] As to the value of immigrants to this country, he says: "Every immigrant must represent labor value with at least the value of a slave. It is figured that each immigrant is worth $875."[b]

The best method of estimating the economic value of life and its increased duration is by the capitalization of earning power. Dr. William Farr, of England, has estimated that a baby born to an English agricultural laborer is worth in capitalized earning power about £5, or $25. This is the discounted value of its future earnings estimated on its probable life less the discounted value of the cost of rearing it during the period of dependence and of maintaining it when helpless through old age. In the same way he estimates the value of a life at other ages—10 years, 20 years, 50 years, etc.[c]

In lieu of any estimates for the United States we may take Farr's figures for agricultural laborers as representing, roughly, the relative worth of a man or woman in the United States. To obtain the absolute figures, therefore, we need simply to multiply these of Farr by a constant factor representing the ratio between the average earnings in the United States and the earnings which Farr uses as the yearly income of an agricultural laborer.

We take, in the absence of any good statistics, $700 per annum as a guess, but a safe minimum[d] for the average earnings of workers of all grades, from day laborers to railroad presidents. This assumes that all of the working years are actually employed in work. But since about one-fourth of the persons of working age are not workers, but are supported (for the most part) by earnings of capital, the average should be cut down to three-fourths of this figure, or $525.

Substituting this figure for the £31 in Farr's table, we can reconstruct it to represent the minimum worth of the average American life at different ages. The following figures are taken from the table thus computed:

Age.	Net worth of a person, in dollars.	Age.	Net worth of a person, in dollars.
0	90	30	4,100
5	950	50	2,900
10	2,000	80	−700
20	4,000		

From the table from which these figures are taken it is possible to base minimum estimates for (1) the average economic value of the inhabitants of the United States by using the census figures for age

[a] Mayo-Smith, "Statistics and Sociology," p. 177.
[b] Mayo-Smith, "Emigration and Immigration."
[c] See Farr, "Vital Statistics," p. 536.
[d] See Fisher "Cost of tuberculosis," read before the International Congress on Tuberculosis, Washington, 1908. This is the estimated minimum used in my paper on the "Cost of tuberculosis." The calculations are based on $1 a day as the ordinary minimum earnings of unskilled labor, and assume a distribution of a number of earners of high amounts according to the scale of distribution which Professor Pareto finds fairly uniform in form, although not in amount in various countries. The late Honorable Carroll D. Wright, whose opinion was worth more, probably, than that of any other man in the United States, stated that he would not regard $1,000 as excessive. The figure is intended to include the earnings of women (including housewives as earners).

distribution of population; this calculated average is $2,900; (2) the average economic value of the lives now sacrificed by preventable deaths, using the age distribution of deaths, and the percentages of preventability; this calculated average is $1,700.

The first figure shows that what might be called the vital assets of the United States for the population of over 85,500,000, as estimated by the census of 1907, amount in value to 85,500,000×$2,900, or $250,000,000,000, which, though a minimum estimate, greatly exceeds the value of all other wealth;[a] the second figure enables us to estimate the needless waste of our vital assets.

If we take the estimate of Professor Willcox of the death rate in the United States, as at least 18 per 1,000 for the 85,500,000 persons estimated by the census as the population of the United States in 1907, we have 1,500,000 as the number of deaths in the United States per annum. Of these 1,500,000 deaths, 42 per cent, or 630,000, are annually preventable or postponable. Since each postponement would save on the average $1,700, the national annual unnecessary loss of capitalized net earnings is 630,000×$1,700, or $1,070,000,000, or about $1,000,000,000.

We saw in Chapter III that, with our present population, there are always about 3,000,000 persons in the United States on the sick list. For the most part these persons are older than the average. Farr gives a table[b] showing that morbidity increases with age in geometric progression. By means of his table we may calculate on the same basis as the previous calculations—that of the 3,000,000 sick, very close to a third, or 1,000,000 persons, are in the working period of life. Assuming that average earnings in the working period are $700, and that only three-fourths of the one million potential workers would be occupied, we find over $500,000,000 as the minimum loss of earnings.

The cost of medical attendance, medicine, nursing, etc., is conjectured by Doctor Biggs in New York to average for the consumptive poor at least $1.50 per day of illness. The cost per day of other illnesses than tuberculosis is presumably greater, and also the cost per day for other classes is higher than for the poor. Applying this to the 3,000,000 years of illness annually experienced, we should have $1,500,000,000 in all as the minimum annual cost of this kind.

The statistics of the Commissioner of Labor[c] show that the average expenditure for illness and death amount to $27 per annum. This is for workingmen's families only. But even this figure, if applied to the 17,000,000 families of the United States, would make the total bill for caring for illness and death $460,000,000. The true cost may well be more than twice this sum. Certainly this estimate is more than safe and is only one-third of the sum obtained by using Doctor Biggs's estimate.

The sum of the costs of illness, including loss of wages and cost of care, is thus $460,000,000+$500,000,000, or $960,000,000.

The above estimate is a general one for all illness. It would be possible to offer figures for the particular losses from particular dis-

[a] Mr. Le Grand Powers, of the Bureau of the Census, Washington, estimates that the total wealth in America (exclusive of human beings) amounts to $107,000,000,000.

[b] Vital Statistics, p. 510.

[c] Eighteenth Annual Report, 1903, p. 509.

eases. Thus, from tuberculosis, the gross loss of earnings by illness and of potential earnings cut off by death, together with the expenses of illness, etc., amount to over $1,000,000,000 per annum.[a]

Of the sum mentioned, the loss to the consumptives themselves amounts to over $660,000,000, leaving $440,000,000 as the loss to other members of the community. At least three-fourths of these costs are preventable. Dr. George M. Kober thinks it is conservative to say that the annual cost of typhoid in the United States is $350,000,000[b] and Dr. L. O. Howard believes that malaria alone costs the country $100,000,000 annually, and the insect diseases generally $200,000,000.[c] He points out that one great item of loss is the reduced value of real estate in malarial regions. By drainage and destruction of mosquitoes most of this waste could be saved. The cost of the care of the insane and feeble-minded is estimated by Charles L. Dana at $85,000,000 annually.[d] What fraction of these costs is preventable it is difficult to say. The economic loss due to alcohol has been variously estimated.[e] Of the billion dollars or more found to represent the cost of illness, by far the major part is certainly avoidable. This is the belief of the best observers, such as Doctor Gulick, Doctor Kellogg, Mrs. Richards, Doctor Anderson, and others. Unfortunately there are no exact statistics of preventability. We feel safe, however, in concluding that at least half a billion could be saved from the present cost of illness. This, added to the loss by preventable deaths of potential earnings of a billion, gives at least a billion and a half of preventable waste. This does not include the losses from inefficient work due to drunkenness or other vicious habits; nor does it include the cost of "undue fatigue," which we have some reason to believe exceeds in its effect on efficiency the loss from illness. But it would not be possible to state this loss in any definite or convincing figures.

The actual economic saving annually possible in this country by preventing needless deaths, needless illness (serious and minor), and needless fatigue, is certainly far greater than one and a half billions, and may be three or more times as great.

Dr. George M. Gould estimated that sickness and death in the United States cost $3,000,000,000 annually, of which at least a third is regarded as preventable.[f]

The trouble is the public does not believe in this waste from being "just poorly," and "so as to be about." It has no conception of the difference between working with a clear brain and steady hand and with a dull and nerveless tool. They must be convinced somehow.[g]

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[a] See Irving Fisher: "Cost of Tuberculosis in the United States, and its Reduction."

[b] See his "Conservation of life and health by improved water supply," read before the White House Conference of Governors, 1908.

[c] Report to Conservation Commission on "Economic loss to the people of the United States through insects that carry disease."

[d] See "Psychiatry in its relation to other sciences," by Charles L. Dana, before the section on psychiatry at the International Congress of Arts and Sciences, St. Louis, September, 1904.

[e] "Economic aspects of the liquor problem." An investigation made for the Committee of Fifty, under the direction of Henry W. Farnam, secretary of the economic subcommittee, 1899, 327 pages.

[f] "Disease and Sin," American Medical Journal, August 31 and September 7, 1901.

[g] Letter from Ellen H. Richards.

SECTION 2.—*The cost of conservation.*

It costs no more to "raise" a man capable of living for 80 years than it does to "grow" one who has not the capacity of living to be 40 years old.[a]

We have seen how much potential value of life is now allowed to be wasted which could be prevented. But the question remains, What would it cost to conserve it? It is, of course, not possible to answer this question definitely and fully. The best we can do is to point out specific instances of the health returns which follow on investments in the improvement of vital conditions.

The following examples will show the returns which may be expected from well-planned expenditures on behalf of public health:

The city of Pittsburg is just installing a great municipal filter plant for the purification of its principal water supply, at an expense of upward of $7,000,000. It is reasonable to estimate that in a year or two this should effect a saving of 100 deaths a year from typhoid fever, for the number of typhoid-fever deaths of late years has been 400 or more yearly. Valuing these lives at $5,000 each, as is customary, the saving effected by the purification works should be half a million dollars' worth of human life annually, making the building of the filter a sound and profitable economic as well as humanitarian measure. But if, as Mr. MacNutt and I have shown, Hazen's theorem is true, then for every 100 deaths saved from typhoid fever at least 200 will be saved from other causes, which means at least $1,000,000 more saved to the city of Pittsburg annually of its present waste of human life.[b]

England reckons that the lives saved through the lowered death rate, from what it was between 1866 and 1875 to what it became in the period reaching from 1880 to 1889, amounted to 858,804. This represents on the English basis of the per capita valuation of each life ($770) a social capital of $650,000.000 saved. In ten years England has more than regained the sum spent in fifteen years for sanitary improvements, though the average annual expenditure has been $42,000,000.[c]

The achievement of Huddersfield, England, is especially noteworthy. The average number of deaths of infants for ten years had been 310. By a systematic education of mothers the number was in 1907 reduced to 212. The cost of saving these 98 lives was about $2,000.[d]

A saving of infant life is recorded by Doctor Chapin in Providence:

We attempted for two years to distribute clean milk to the babies of the poor, but this year we decided that the money could better be spent on trained nurses. Thus far we have expended about $900 for this purpose. Two hundred and thirty-five sick children, of whom very many were very sick, have been cared for. Of these only 20 have died. From a study of our statistics I should judge that the reduction in infant mortality effected by the nurses was at least 25 deaths, and it may be that as many as 40 lives were saved.[e]

At the funeral of Maj. Walter Reed, the man who did so much to prove the correctness of Doctor Finley's discovery that the mosquito is the carrying agent for the yellow-fever germ, Gen. Leonard Wood

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[a] T. S. Lambert: "Sources of Longevity," New York, 1869, p. 6.

[b] W. T. Sedgwick: "The call to public health," Science, 1908, p. 198.

Since the foregoing was written, there has appeared in "Charities," February 6, 1909, "Thirty Five Years of Typhoid" by Frank E. Wing, in which it is shown that there were in 1907, in Pittsburg, 4,921 cases of typhoid, of which 622 died; and that the cost per patient, irrespective of the lives lost, was $128, making the cost for the city $694,000. Reckoning $4,000 as the value of each life lost, the total annual money cost from typhoid in Pittsburg is over $3,000,000, and, according to Hazen's theorem, already mentioned, this is probably not one-half nor even one-third of the total.

[c] Ditman, loc. cit., p. 4. Taken from M. G. Dana: "Results of municipal sanitation," Annals of Hygiene, 1896, Vol. II, p. 391.

[d] Letter from Dr. Charles V. Chapin.

[e] Ibid.

declared that this discovery is saving more lives annually than were lost in the Cuban war, and that it is saving the commercial interests of the world a greater financial loss each year than the cost of the entire Cuban war.[a]

As to what the stamping out of yellow fever means, in money terms, the following is significant:

It has been estimated that the yellow fever epidemic of 1878 invaded 132 towns, caused a mortality of 15,954 persons, and that the pecuniary loss to the country was not less than $100,000,000 in gold.[b]

The economic loss to Philadelphia, caused by the smallpox epidemic of 1871–72, has been estimated by Doctor Lee at $22,000,000. This includes loss to travel and traffic on railroads, loss to hotel keepers, merchants, and manufacturers, cost of care of sick, loss of time, and the expense of burial. A vaccine bureau with physicians, a disinfecting station, and the inauguration of a campaign of education capable of forestalling the whole epidemic would have cost $700,000.[c]

It is reported that San Francisco plans an investment of $30,000,000 in stone and concrete quays to prevent rodents from infecting the city, and this is regarded by experts as worth while many times over.

In respect to hook-worm disease, rating the earning per diem of the southern farm laborer at 75 cents, 28 observers report that average laborers infected with hook-worms earn 40 cents per diem. Ten observers having cotton-mill practice report unanimously that the disease is very prevalent among cotton-mill laborers, and rating the average mill laborers at $1.50 per diem, they consider 75 cents as a fair rating for hook-worm bearing laborers.[d]

It would be difficult to even roughly estimate the cost of this disease to the South, but from what we know of it in this State I would say that it costs South Carolina not less than $30,000,000 per year, and this inability to perform regular and efficient labor is the smallest part of the cost.[e]

It has been figured that the hook-worm disease of the South could be wiped out within a generation[f] through the expenditure of from one to two millions of dollars by federal and state agencies. It costs about 15 to 75 cents (wholesale) for drugs to cure a case of hook worms. In three months the quantity of red corpuscles in the blood can easily be increased 10 to 50 per cent, according to the severity of the case, and the[g] absenteeism of the victims could easily be reduced 25 per cent.

Another noteworthy result of well-directed sanitary effort is the reduction of hook-worm disease in Porto Rico. As you are doubtless aware, this disease causes a tremendous lowering of the physical efficiency of the people of that island. As you may see by the report of the special commission for 1906 and 1907 made to Governor Post, 89,000 people were treated, and for the most part cured, for 54 cents each.[h]

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[a] Ditman, loc. cit., p. 12.

[b] Walter Wyman, M. D., "Quarantine and Commerce," address before Cincinnati Commercial Club, October 15, 1898, p. 8.

[c] Ditman, loc. cit., pp. 8–10, from Bissell, A Manual of Hygiene.

[d] Letter from Dr. W. J. Burdell.

[e] William Weston, "Uncinariasis," South Carolina Medical Association, 1908, p. 8.

[f] Dr. Charles W. Stiles, of the United States Public Health and Marine-Hospital Service, who has studied the hook-worm disease more thoroughly than any one else in the country.

[g] Letter from Doctor Stiles.

[h] Letter from Charles V. Chapin, 1908.

Medical inspection in our schools also returns large dividends on small investments.

Using these data as a basis, we have the annual expenditure for medical inspection of $345,135 in those cities from which we have succeeded in obtaining data. It seems probable, although this is frankly a guess, that the total annual expenditure for medical inspection of schools in the United States at the present time is perhaps $500,000.[a]

The money saved by enabling thousands of children to do one year's work in one year, instead of in two or three years, would greatly exceed the total expense of examining all school children in all boroughs.[b]

Doctor Jessen has shown that the cost of a school dental clinic in Germany is only one mark per year per child.[c] The cost saved must be very many times this sum. Dr. Herbert L. Wheeler, of New York, estimates that the Children's Aid Dental Clinic in New York cost $342 for the last fiscal year (35 cents per operation and 70 cents per child treated). He reckons that the neglect of these slight repairs would later have cost far more in dentistry, as well as over $2,000 worth of lost time. These losses are of course of minor importance compared with the pain, inconvenience, and secondary effects on health and efficiency which are inevitably associated with bad teeth.

Mr. Edwin Chadwick, who was once secretary of the English National Board of Health, stated that a sanitary "engineer ought to contract for the reduction of the sickness and death rate, in such a city as Glasgow, by at least one-third, for a penny a head of the entire population."[d]

It is necessary, if we are to do our utmost, to spend a thousand pounds of public money on this task where we now spend one pound. It would be reasonable and wise to expend ten million pounds a year of our revenues on the investigation and attempt to destroy disease. Actually what is so spent is a mere nothing, a few thousands a year. Meanwhile our people are dying by thousands of preventable disease.[e]

Mr. Hiram J. Messenger, actuary of the Travelers Insurance Company, of Hartford, has constructed and sent me a table showing that life insurance companies could probably make money now by taking a hand in the public-health movement, with the purely commercial object of reducing their death losses. He says:

This table shows that if the companies were to expend $200,000 a year for this purpose and as a result should decrease their losses by the almost insignificant amount of twelve one-hundredths of 1 per cent, they would save enough to cover the expense. If such a plan as this were placed on a purely scientific basis and carried out by good business methods and all the companies pulled together for the common good, I should expect a decrease in death claims of more than 1 per cent. And a decrease in death claims of 1 per cent would mean that the companies would save more than eight times as much as they expended or would make a net saving of more than seven times the expense—which would be about a million and a half dollars a year.

The examples given show tangible returns on the investment of several thousand per cent as a rule. While it would be impossible to

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[a] Letter from Dr. Luther H. Gulick.

[b] Sixty-third Annual Report of the Association for Improving the Condition of the Poor, New York, 1906.

[c] See "Jahresbericht der Städtischen Schulzahnklinik in Strassburg," in Odontologische Blätter 12, No. 15–16, 1907.

[d] Transactions of the British Social Science Association, 1866, p. 580. Quoted by Dr. Edward Jarvis, Political Economy of Health, Fifth Report, Mass. Board of Health, 1874, p. 367.

[e] E. Ray Lankester, "The Kingdom of Man," New York (Holt), 1907, p. 148.

state in general terms how rich a return lies ready for public or private investments in good health, the foregoing examples and numerous others show that the rate of this return is quite beyond the dreams of avarice. Were it possible for the public to realize this fact, motives both of economy and of humanity would dictate immediate and generous expenditure of public moneys for improving the air we breathe, the water we drink, and the food we eat, as well as for eliminating the dangers to life and limb which now surround us.

CHAPTER XIII.—*The general value of increased vitality.*

SECTION 1.—*Disease, poverty, and crime.*

In the preceding chapter we have attempted to estimate in money the preventable wastes from disease and death. Although the figures for national losses strike the popular imagination, they have little significance; in fact, money estimates in this field, even when made on the per capita basis, are of little value except as emphasizing the overwhelming importance of human vitality compared with those interests which are usually measured in money. It is impossible in any true sense to measure human life in terms of dollars and cents.[a]

The measure of life may perhaps be found in happiness, or the satisfactions enjoyed between birth and death, less the dissatisfactions.

Is life worth living? has been a much asked question, especially since Mr. Mallock wrote a book with that title. The witticism sometimes given in answer, "That depends upon the liver," is true in both of its two meanings. A life of happiness is always worth living, and a life of usefulness, which brings happiness to others, is doubly worth living.

It is hardly necessary to recount all the conditions which tend to produce happiness. No one would question that the most fundamental condition of all is health, in spite of exceptional cases in which unhealthy people are found happy, and healthy people unhappy. It would be impossible to express in exact terms the extent to which improved health could increase human happiness; but every observer of human misery among the poor reports that disease plays the leading rôle. Students of criminology and vice agree that these are chiefly the result of morbid conditions and habits. Health reform brings in its train great and lasting reductions in poverty, criminality, and vice.

We began this report by showing the relation between the conservation of health and the conservation of wealth. The broadest view of this relation is, as Emerson has said, that "Health is the first wealth," and as such it is treated by many economists.[b]

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[a] Even as a measure of what economists call "utility," a money estimate is misleading, for the reason that the "marginal utility" of money varies with different persons. For instance, a week's wages of $10 lost to a poor wage-earner is in such an estimate counted on a par with an expenditure of $10 by a wealthy invalid for a dainty morsel of food, although the loss in "utility" to the former is vastly greater than that to the latter.

[b] Among those who have included health in the category of wealth are Davenant, Petty, Canard, Say, McCullough, Roscher, Wittstein, Walras, Engel, Weiss, Dargun, Ofner, Nicholson, and Pareto. See Irving Fisher: "The Nature of Capital and Income," New York (Macmillan), 1906, p. 5.

Without enlarging or insisting upon this concept, it is obvious that by the conservation of health we may ultimately save billions of dollars of wasted values, and that this conservation is intimately related to conservation of all other kinds.[a]

We have already seen the vicious circle set up between poverty and disease, each of which tends to produce the other. Metchnikoff[b] contends that health and morality are correlative, if not interchangeable, terms. A similar idea has been elaborated statistically by Dr. George M. Gould.[c] The subject is worth much further study. National efficiency is crippled by any one or all of the parts of the vicious circle—disease, poverty, vice, vagabondage, crime. It would be interesting to study the tramp problem, which represents an enormous waste of labor power, in relation to all these phenomena.

Section 2.—*Conservation of natural resources.*

It is also true that health begets wealth, and vice versa. Whatever diminishes poverty or increases the physical means of welfare has the improvement of health as one of its first and most evident effects. Therefore an important method of maintaining vital efficiency is to conserve our natural resources—our land, our raw materials, our forests, and our water. Only in this way can we obtain food, clothing, shelter, and the other means of maintaining life. Conversely, the conservation of health will tend in several ways to the conservation of wealth. First of all, the more vigorous and long-lived the race, the better utilization can it make of its natural resources. The labor power of such a race is greater, more intense, more intelligent, and more inventive.

The development of our natural resources in the future will be more dependent on technical invention[d] than upon the mere abundance of materials.

Just as in warfare it is not so much the gun as the man behind the gun that makes for success, so in industry, as Doctor Shadwell[e] has shown, skill, knowledge, and inventiveness are the chief factors in determining commercial success and supremacy. The backward nations, like China, are characterized by lack of modern inventions. The nations which are industrially most advanced have the railway, the steamship, the power loom, metal working, and innumerable arts and crafts. The change of Japan from a backward to a forward nation is at bottom the introduction of inventions. If conservation prevents lessened fertility, invention makes two blades of grass grow where one grew before.

Future industrial competition will be increasingly a contest of invention. The world rivalry to develop the best system of wireless telegraphy or the best airships is but one example. The future will see the greatest strides taken by the nation which is the most invent-

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[a] See Edward Devine, "Efficiency and Relief," New York (Macmillan), 1906.

[b] "Prolongation of Life," p. 318.

[c] "Disease and sin," American Medical Journal, Aug. 31 and Sept. 7, 1901.

[d] Since the above was written, President Charles S. Howe, of Cleveland, has presented this point in detail. See "The function of the engineer in the conservation of the natural resources of the country," Science, Oct. 23, 1908.

[e] Arthur Shadwell in his admirable "Industrial Efficiency" (2 vols.). London (Longmans), 1906.

ive. Now, the primary condition of invention is vitality, a clear brain in a normal body. It is no accident that Edison is a health culturist, or that Krupp, Westinghouse, and other pioneers in industrial development have been men of vigor of mind and body.

Finally, the conservation of health will promote the conservation of other resources by keeping and strengthening the faculty of foresight. One cause of poverty in the individual and the nation is lack of forethought.[a]

One of the first symptoms of racial degeneracy is decay of foresight. Normal, healthy men care for and provide for their descendants. A normal, healthy race of men, and such alone, will enact the laws or develop the public sentiment needed to conserve natural resources for generations yet unborn. When in Rome foresight was lost, care for future generations practically ceased. Physical degeneracy brought with it moral and intellectual degeneracy. Instead of conserving their resources the spendthrift Romans, from the emperor down, began to feed on their colonies and to eat up their capital. Instead of building new structures they used their old Coliseum as a quarry and a metal mine.[b]

The problem of the conservation of our natural resources is therefore not a series of independent problems, but a coherent all-embracing whole. If our nation cares to make any provision for its grandchildren and its grandchildren's grandchildren, this provision must include conservation in all its branches—but above all, the conservation of the racial stock itself.

Chapter XIV.—*Things which need to be done.*

Section 1.—*Enumeration of principal measures.*

In order that American vitality may reach its maximum development, many things need to be done. Among them are the following:

1. The National Government, the States, and the municipalities should steadfastly devote their energies and resources to the protection of the people from disease. Such protection is quite as properly a governmental function as is protection from foreign invasion, from criminals, or from fire. It is both bad policy and bad economy to leave this work mainly to the weak and spasmodic efforts of charity, or to the philanthropy of physicians.

2. The National Government should exercise at least three public health functions: First, investigation; second, the dissemination of information; third, administration.

It should remove the reproach that more pains are now taken to protect the health of farm cattle than of human beings. It should provide more and greater laboratories for research in preventive medicine and public hygiene. Provision should also be made for better and more universal vital statistics, without which it is impossible to know the exact conditions in an epidemic, or, in general, the sanitary or insanitary conditions in any part of the country.

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[a] See Irving Fisher: "The Rate of Interest," New York (Macmillan), 1907.

[b] See John Rae: "Sociological Theory of Capital," edited by Prof. C. W. Mixter, New York (Macmillan), 1905.

It should aim, as should state and municipal legislation, to procure adequate registration of births, statistics of which are at present lacking throughout the United States.

The National Government should prevent transportation of disease from State to State in the same way as it now provides for foreign quarantine and the protection of the nation from the importation of disease by foreign immigrants. It should provide for the protection of the passenger in interstate railway travel from infection by his fellow-passengers and from insanitary conditions in sleeping cars, etc.

It should enact suitable legislation providing against pollution of interstate streams.

It should provide for the dissemination of information in regard to the prevention of tuberculosis and other diseases, the dangers of impure air, impure foods, impure milk, imperfect sanitation, ventilation, etc. Just as now the Department of Agriculture supplies specific information to the farmer in respect to raising crops or live stock, so should one of the departments, devoted principally to health and education, be able to provide every health officer, school-teacher, employer, physician, and private family with specific information in regard to public, domestic, and personal hygiene.

It should provide for making the national capital into a model sanitary city, free from insanitary tenements and workshops, air pollution, water pollution, food pollution, etc., with a rate of death and a rate of illness among infants and among the population generally so low and so free from epidemics of typhoid or other diseases as will arouse the attention of the entire country and the world.

There should be a constant adaptation of the pure-food laws to changing conditions. Meat inspection and other inspection should be so arranged as to protect not only foreigners, but our own citizens. The existing health agencies of the Government should be concentrated in one department, better coordinated, and given more powers and appropriations.

3. State boards of health and state legislation should provide for the regulation of labor of women, should make physiological conditions for women's work and prevent their employment before and after childbirth; should regulate the age at which children shall be employed, make reasonable regulations in regard to hours of labor and against the dangers in hazardous trades, and especially against the particular dangers of dust and poisonous chemicals; should make regulations for sanitation and provide inspection of factories, schools, asylums, prisons, and other public institutions. Where municipalities have not the powers to enact the legislation above mentioned with reference to local conditions, the necessary legislation or authority should be provided by the State. Or where by reason of the small size of the town no efficient local action is possible, the State should exercise the necessary functions. It should in such cases advise and supervise local boards of health. It should have an engineering department and advise regarding the construction of sewers and water supplies. Pollution of such supplies, unless entirely local, should be prevented by the State, which should be equipped with laboratories for the analysis of water, milk, and other foods. Suitable legislation should be passed regulating the sale of drugs, especially preparations

containing cocaine, opium, or alcohol. Legislation—not too far in advance of public sentiment needed to enforce it—should be passed regulating the sale of alcoholic beverages. State registration of births, deaths, and cases of illness should be much more general and efficient than at present.

4. Municipal boards of health need to have more powers and greater appropriations; less political interference and better trained health officers; more support in public opinion. Their ordinances in regard to expectoration, notification of infectious disease, etc., should be better enforced by the police departments.

More legislation should be advocated, passed, and enforced to the end that streets may be kept clean, garbage properly removed, sewage properly disposed of, air pollution of all kinds prevented, whether by smoke, street dust, noxious gases, or any other source. Noises also should be lessened.

Municipalities need also to take measures to prevent infection being carried by flies, mosquitoes, other insects and vermin, and by prostitution. They need to guard with greater care the water supply, and in many cases to filter it; they should make standards for milk purity and enforce them; they should also regularly inspect other foods exposed for sale; provide for sanitary inspection of local slaughterhouses, dairies, shops, lodging and boarding houses, and other establishments within the power of the particular municipality; they should make and enforce stricter building laws, especially as relating to tenements, to the end that dark-room tenements may be eliminated and all tenements be provided with certain minimum standard requirements as to light, air, and sanitary arrangements.

5. School children should be medically inspected and school hygiene universally practiced. This involves better protection against school epidemics, better ventilation, light, and cleanliness of the schoolroom, the discovery and correction of adenoids, eye strain, and nervous strain generally, and the provision for playgrounds. Sound scientific hygiene should be taught in all schools, public, private, normal, and technical, as also in colleges and universities.

6. The curricula of medical schools should be rearranged with a greater emphasis on prevention and on the training of health officers. Sanatoria and hospitals, dispensaries, district nursing, tuberculosis classes, and other semipublic institutions should be increased in number and improved in quality. The medical profession, keeping pace with these changes, should be the chief means of conveying their benefits to the public. Universities and research institutions need to take up the study of hygiene in all its branches. Now that the diseases of childhood are receiving attention, the next step should be to study the diseases of middle life. These are diseases, to a large extent, of nutrition and circulation, and consequently these subjects should receive special attention. Intelligent action must rest on knowledge, and knowledge of preventing disease is as yet extremely imperfect.

7. In industrial and commercial establishments employers may greatly aid the health movement, and in many cases make their philanthropy self-supporting by providing social secretaries, lunch and rest rooms, physiological (generally shorter) hours of work, provision for innocent amusements, seats for women, etc.

Life insurance companies could properly and with much profit club together to instruct their risks in self-care and secure general legislation and enforcement of legislation in behalf of public health.

8. The present striking change in personal habits of living should be carried out to its logical conclusion until the health ideals and the ideals of athletic training shall become universal. This change involves a quiet revolution in habits of living, a more intelligent utilization of one's environment, especially in regard to the condition of the air in our houses, the character of the clothes we wear, of the site and architecture of the dwelling with respect to sunlight, soil, ventilation, and sanitation, the character of food, its cooking, the use of alcohol, tobacco, and drugs, and last, but not least, sex hygiene in all its bearings.

9. The fight against disease will aid in the fight against pauperism and crime. It is also true that any measures which tend to eliminate poverty, vice, and crime will tend to improve sanitary conditions.

10. Finally, eugenics, or hygiene for future generations, should be studied and gradually put in practice. This involves the prohibition of flagrant cases of marriages of the unfit, such as syphilitics, the insane, feeble-minded, epileptics, paupers, or criminals, etc. The example of Indiana in this regard should be considered and followed by other States, as also in regard to the unsexing of rapists, criminals, idiots, and degenerates generally. A public opinion should be aroused which will not only encourage healthy and discountenance degenerate marriages, but will become so embedded in the minds of the rising generation as will unconsciously, but powerfully, affect their marriage choices.