

ADAMS (J. F. A.)

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PREVENTION OF DISEASE
IN
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OF PITTSFIELD, MASS.

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THE PREVENTION OF DISEASE IN MASSACHUSETTS.

MR. PRESIDENT AND FELLOWS
OF THE MASSACHUSETTS MEDICAL SOCIETY :—

THE professional life of the founder of the Shattuck fund extended over the first half of the present century. Preventive medicine, as a science and an art, had in the United States as yet taken no root; but, in the prophetic minds of the medical thinkers of that time, the seed was germinating which was in the next generation to put forth the tender leaf, and in our day to grow into a goodly tree. Science and philanthropy united in teaching these wise medical fathers that to prevent disease is even better than to cure it; and in the front rank of these scientific philanthropists was Dr. George Cheyne Shattuck. In selecting therefore for this paper a title relating to the prevention of disease, choice has been made of one of his favorite themes. In confining it within the geographical limits of the Commonwealth of Massachusetts, respect is had to the patriotic preference expressed in the terms of his bequest.

To what extent is it possible to prevent disease in this Commonwealth? What has been accomplished in this direction, and what more remains to be done? What are the special needs which to-day are calling for concerted action on the part of the medical profession? In asking your attention to a consideration of these questions, I feel confident of a sympathetic hearing; for the subject is one in which the Massachusetts Medical Society has not only a lively interest but a peculiar title of proprietorship. It cannot be wholly relegated to health officials and special

associations, for it is the medical practitioners, as a body, who give vitality to the work. It is the Doctors who, in their daily intercourse with the people, are educating them in sanitary matters, it is the Doctors who have been instrumental in the enactment of sanitary legislation, and it is the Doctors who stand behind the health authorities with ever ready help. The Massachusetts Medical Society is imbued with a true missionary spirit. Its members gladly spend themselves in this cause, which not only brings no pecuniary return, but even threatens to deprive them of a livelihood. Its efforts for the prevention of disease began before any official action was inaugurated. To us as a Society belongs much of the credit for what has been done, and upon us largely rests the responsibility for its effective continuance.

It is well known that Massachusetts was the first State in the Union to establish a State Board of Health, and that the founder of the Board was a distinguished member of this Society. It was Dr. Bowditch's writings on sanitary subjects and his personal influence upon public men which brought this Board into being; and it was he who, as its first President, gave it a successful start in its useful career. Since our last meeting, this great and noble-hearted man has passed from among us; and profound grief for his loss is the dominating sentiment of this occasion. How can we better do honor to his memory than by occupying ourselves for a time with one of the departments of medicine in which he was a pre-eminent leader?

During the twenty-two years which have elapsed since the establishment of the State Board of Health, our State has enjoyed the benefit of systematic sanitary work, the great scope and thoroughness of which is known to those who have watched its operations or read its series of Annual Reports. Investigations of the utmost practical value have been carried on, and with the aid of local Boards of Health

a vigorous warfare has been waged against the causes of disease, with a special view to the prevention and suppression of epidemics. An interesting sketch of the work of the Board was given by its President, Dr. Walcott, in the Annual Address before this Society in 1889.

Now, after twenty-two years of this excellent work, we are justified in inquiring as to the results, and even in confidently looking for such results in the statistics of mortality. Although it would not be fair to judge this work wholly by statistics, yet there is no other test which has the merit of accuracy. The trustworthiness of the Massachusetts Registration Reports is generally conceded, our State being no less distinguished among the others in this respect than in that of priority of sanitary legislation. Nowhere, therefore, in the United States are the conditions so favorable for estimating the value of public health measures as in this State of Massachusetts.

In inquiring what change has taken place in the death rate of our State, are we not justified in expecting to find a material decline? For my own part, I had hoped to discover quite a handsome reduction. Imagine, then, my surprise and disappointment at finding that the death rate of Massachusetts has remained practically unchanged. The average for the past 40 years has been 19.35 per 1,000, while for 1890 it was 19.44, a trifling increase. Dividing this period of 40 years into decades, we find the average death rates for each decade to be 18.24, 19.43, 19.81 and 19.59. Thus there was a slight increase in the death rate which reached its maximum in the third period. The average for the fourth decade was slightly less than the third, and yet was higher than either the first or second. The best that can be said is that the upward tendency was arrested about 1884, since which time there has been a slight irregular downward tendency.

But, unsatisfactory as this showing is, we must not be

hasty to conclude that nothing has been accomplished and that the movement for the prevention of disease has proved a dismal failure. Let us rather analyze the death-rate, to ascertain whether there are any special directions in which an improvement can be discovered. My own studies in this direction have proved profoundly interesting, and have resulted in the discovery that the mortality from certain diseases is decreasing while that from others is increasing, the gain and the loss so nearly balancing each other as to produce but little impression upon the general death rate.

In order not to weary you with statistics, I have prepared diagrams which show at a glance the comparative mortality from twelve principal diseases or classes of disease during the forty-one years from 1850 to 1890.

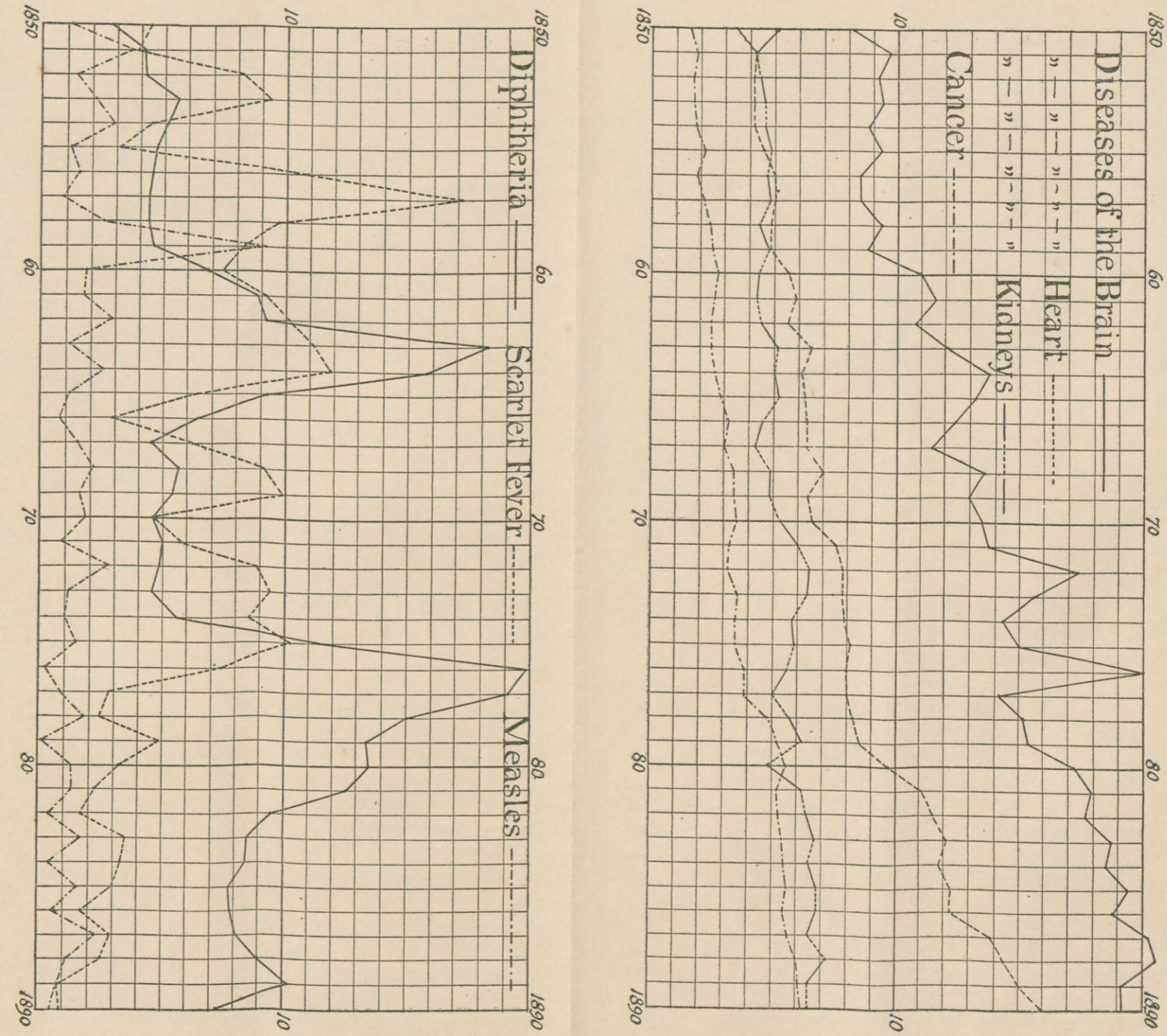
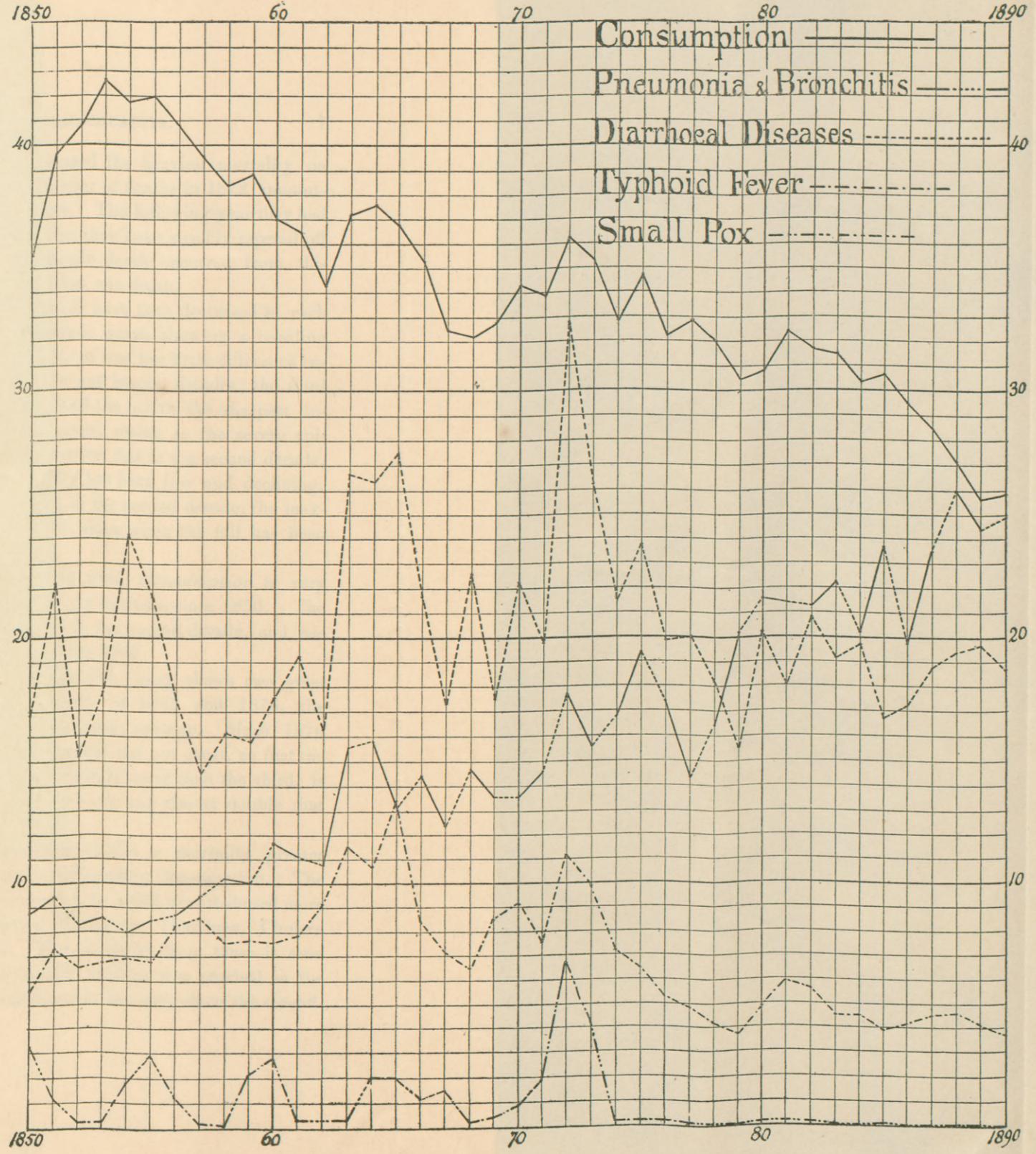
In these diagrams, the vertical lines correspond to the number of years, and each horizontal line represents one death to 10,000 of population. Each of the irregular lines, or curves, therefore, indicates the number of deaths from a specified disease, in each year, to every 10,000 of population for that year.

In the preparation of these statistics, I am indebted for much valuable aid to Dr. S. W. Abbott, Secretary of the State Board of Health.

An examination of these several curves shows that five of them have a decided downward tendency. These are

Small-Pox,
Scarlet-Fever,
Measles,
Typhoid-Fever,
Consumption.

Observing these in detail, we find that *Small-Pox* declined irregularly from 1850, recurring in epidemics about once in five years, the epidemics lasting two to three years, until 1872-73, when a great epidemic which extend-



ed all over the country caused the heaviest mortality on record in this State, the number of deaths in 1872 amounting to 1029, and in 1873 to 668. The following year they had fallen to 26, since which time they have steadily tapered off until 1886, when not a single death occurred from this cause. In 1890 there was but one death.

Scarlet-Fever and *Measles* have both decreased in each decade since 1850, the epidemic waves showing a receding tide. For *Scarlet-Fever* there was but little difference between the average of the first and second decades; the third showed a marked decrease, and the fourth the sharpest decline of all. *Measles*, however, owing to the severe epidemic of 1859, made the greatest fall in the second decade, since which time the mortality has been low and declining.

Typhoid-Fever increased in the second decade, the maximum being reached in 1865, since when the fall has been decided, though undulating.

The fall in the death rate from *Consumption* is very striking, each decade showing a decrease since 1850. The decline was the most marked in the second decade, and has been comparatively steady since 1860.

The curve for *Diphtheria* and *Croup* shows two great epidemics, reaching their height in 1863 and 1876, the third decade having the highest average. Since 1876 there has been a fall, well marked but not great, so that the average for the last decade, though lower than the third, is still a trifle higher than the second, and almost double that of the first.

The *Diarrhæal Diseases* exhibit a mortality greater than any of those yet mentioned, except *Consumption*. The list includes *Cholera Infantum*, to which are attributed more than half of the deaths, *Dysentery*, *Diarrhœa*, *Cholera Morbus* and *Enteritis*. The mortality from these is seen to be irregular. The highest average was reached in the third decade, which was however but little above the second.

The fourth is lower than the second or third, but still a little higher than the first. The highest point was reached in 1872. A more favorable showing could be made by selecting Cholera Infantum and Dysentery; but the figures are liable to be so largely affected by uncertainties of diagnosis and nomenclature that it has seemed best to consider the diarrhœal diseases only as a whole.

If we now examine the curves for Bronchitis and Pneumonia, Diseases of the Brain, Heart and Kidneys, and for Cancer, we find one observation to be true of them all, namely, that they have all increased in mortality, and that each of them has increased in each decade since 1850.

The most remarkable increase is shown in the case of Bronchitis and Pneumonia, the death rate from which was more than three times as great in the last decade as in the first. This increase has been enough to slightly more than compensate for the decline in Consumption. The query, therefore, which naturally presents itself, is whether we have not here, again, to deal with a question of diagnosis rather than of fact. Very likely we have, to a certain extent; but an examination of the ages at which the deaths occurred will convince us that this is not the only explanation. Thus we find that *1st*, the increase of Bronchitis is largest during the first two years of life, and next largest after the age of fifty, these being the ages when Consumption is least fatal; and *2d*, that if we add together the total deaths from Consumption, Bronchitis and Pneumonia for the several age periods, for the two years 1861 and 1890, we find an increase of these aggregated lung-diseases under the age of five years and between the ages of forty and fifty; but a decrease between five and forty, and over fifty. The most marked decrease is between the ages of fifteen and thirty. As the gain therefore is greatest at the ages most prone to Consumption, we may safely conclude that there is an actual falling off in the mortality from this disease.

The increase in the mortality from diseases of the Brain, Heart and Kidneys, and from Cancer, is very remarkable. Diseases of the brain have increased two-fold, those of the heart three-fold and cancer nearly three-fold, while diseases of the kidneys and dropsy, taken together, have increased about 50 per cent. This means, of course, in proportion to the population. The actual increase has been twice as much, the population of the State having doubled in the forty years.

Thus we may provisionally classify diseases in two groups, those which are decreasing and those which are increasing. Let us now inquire what other features characterize these two groups.

In the first place we observe that all of the decreasing diseases except consumption, belong to the zymotic class. Even consumption it is hardly possible, at the present day, to exclude from this group, though the nosologists still retain it among the constitutional diseases. Now, these same zymotic diseases are the very ones which are most amenable to preventive measures, and against which these measures have been chiefly directed.

Small-pox has been vigorously fought by vaccination, quarantine, inspection of imported rags, isolation of cases and disinfection. The result is one of the greatest triumphs of sanitary science, for this disease, once so frightful in its ravages, is for the present practically stamped out.

Scarlet-Fever and *Measles* have been combated by isolation and disinfection, and by the protection of school children by forbidding the attendance at school of any children liable to convey the infection.

For the prevention of *Typhoid Fever* every effort has been made to ensure the purity of drinking water, the improvement of sewerage and local cleanliness. The thorough and systematic work of the State Board of Health in relation to the water supply and sewerage of the State is of

inestimable value, both present and prospective, and is worthy of our grateful recognition.

The decline in the mortality from these four diseases, small-pox, scarlet fever, measles and typhoid fever, has been so marked during the past twenty years, since the establishment of the State Board of Health and the generally increased attention to sanitary measures, that it is impossible to avoid the conclusion that these facts stand to each other in the relation of cause and effect, and that to our sanitary laws and their careful execution may be attributed the falling off of the death rate from these diseases.

That the same notable decrease is not found in the case of the diarrhœal diseases and of diphtheria and croup is disappointing, and yet it is satisfactory to find that, though the improvement is less, it is not insignificant, and that it has been continuous for periods of fourteen and eighteen years respectively. The great difficulty in the case of diphtheria is its virulent contagiousness and persistent infectiousness, facts which have been very strongly presented by Dr. S. W. Abbott, in his recent admirable paper on "Diphtheria in Massachusetts"; but which, as yet, appear to be inadequately understood by the public. The causes of the diarrhœal diseases are difficult to reach, the controllable factor of local or general filthiness being influenced powerfully by the uncontrollable factor of intense summer heat; while a third factor, namely bacteria in milk, is liable to elude the most active vigilance. But all of these problems are receiving the careful attention of the sanitary authorities, and their satisfactory solution may be hopefully expected.

The zymotic diseases as a class have diminished from 474 to each 100,000, in 1870, when the State Board of Health began its work, to 360 to each 100,000 in 1890. This is equivalent to a saving of over 2500 lives in 1890, and is a result of which the Board and every citizen may well feel proud.

How far the decrease of *Consumption* may be attributed to sanitation is a question not readily answered. The agencies likely to affect this disease have been the better ventilation of school-houses, factories and public halls, the improvement of tenement houses, the drainage of wet cellars, and the weeding out of tuberculous cows. While some good results from these agencies are to be expected, yet they are wholly insufficient, and are not likely to have caused the very marked decline which the statistics show. One important fact which must not be overlooked is the removal from the State of great numbers of consumptives to more favorable climates where, if they die, their deaths are not charged to the State of Massachusetts.

While thus we find that all of the diseases which are decreasing are those against which the efforts of the sanitary authorities have been actively directed, the converse fact is equally striking, namely, that the increasing diseases are either not amenable to public preventive measures, or have not yet been subjected to such measures. No official method of preventing diseases of the brain, heart, lungs or kidneys, or of cancer, has yet been discovered, and in the present state of science we cannot expect the Health Boards to control them in any way whatever. The increase of these diseases cannot therefore be attributed to any lack of efficiency on the part of the health officers, nor is there any just debit to offset the 2500 lives a year which we have just placed to their credit.

The second general feature which characterizes these two groups of diseases is this: that the diminishing diseases are chiefly those of early life, while the increasing diseases are those of later life.

Of the deaths from measles in 1890, nearly all were under ten years of age, and more than half under two years. From scarlet fever and diphtheria the maximum mortality was between five and ten years; and nearly all of the deaths

occurred from the former under fifteen years, and from the latter under thirty years. From the diarrhœal diseases, more than 83 per cent. occurred under five years. Typhoid fever and consumption are especially diseases of early adult life, and both attain their highest mortality between the ages of twenty and thirty. In striking contrast with these are the increasing diseases. Diseases of the heart are most fatal between the ages of fifty and eighty; brain diseases between seventy and eighty, and kidney diseases and cancer between sixty and seventy. As regards pneumonia, although the first year of life is the most fatal, yet one half of the deaths occur after the age of forty, and the most fatal period after the first year is between the ages of sixty and seventy.

At this point it is necessary to inquire what relation this excessive mortality at the later ages bears to the number of persons living at those ages. The census of 1880 shows that the population of Massachusetts embraced in that year a larger percentage of persons over sixty years of age than any other of the United States with the exception of Maine, New Hampshire, Vermont and Connecticut. It also included a smaller proportion under five years of age than any other State with five exceptions. Moreover, the population under fifteen years is decreasing, and over fifty is increasing. Yet neither of these facts will explain the decrease of mortality in early and the increase in later life; for when we compare the deaths at given ages with the number of persons living at those ages, we find a decrease at all ages below forty, and an increase at all ages above forty. The decrease is greatest between five and thirty, and the increase grows greater and greater in each ten years from forty upward. The natural effect of this condition is to increase the number of persons living to middle age, but to reduce the proportion of very old people. The effect upon the average duration of life has been to increase this average in the last forty years from 27.07 years to 34.13 years, a gain of over

seven years; a remarkable fact when taken in connection with the unchanged death rate and the increased mortality of old age. This gain, therefore, belongs wholly to early life, and shows that children have now a better chance than forty years ago of living to maturity, and of passing safely through the producing and reproductive age. The change is therefore in that direction which is, beyond all others, of material value to the Commonwealth.

It is difficult to institute any comparison between the statistics of Massachusetts and those of other portions of the United States, partly because the compilation of the vital statistics of the census of 1890 is not yet completed, and again because the superior accuracy of the Massachusetts registration gives our State an excessive death rate as compared with other States, which is more apparent than real. But when the new census is completed, we may expect results of great value, worked out under the skillful supervision of Dr. John S. Billings. One observation however may here be made, which is that the diseases which are here decreasing are those which in 1880 were in Massachusetts below the average for the United States, and those which are increasing were, in that year, well above that average; showing that these disease-tendencies are, at least in their excessive manifestation, peculiar to our own section of the country.

In order that we may have a more definite basis for comparison, let us refer briefly to the vital statistics for England and Wales. From 1850 to 1880 the death rate of Massachusetts was almost invariably lower than that of England and Wales, but since 1880 the rates have been almost identical, the death rate over there having showed a pretty steady decline since 1875, and now having crept a little below ours.

An examination of the causes of death in England and Wales shows a very similar state of things to that which

exists in Massachusetts, namely, that the zymotic diseases and consumption are decreasing, while there is a decided increase in acute diseases of the lungs and in diseases of the heart, kidneys and cancer. The chief exceptions are the following: *diphtheria*, which decreased in earlier years, while it was increasing in Massachusetts, has since 1880 been on the increase in England and Wales. The decrease in small-pox has not been so remarkable as in Massachusetts. The mortality from diseases of the brain in England and Wales shows no marked increase, but still is much higher than in Massachusetts, where the increase has been very rapid.

In regard to the actual mortality, the chief differences between Massachusetts and England and Wales are these: we have a larger proportion of deaths from diphtheria, diarrhœal diseases, fever and consumption, while England and Wales have a larger proportion from small-pox, measles, scarlet-fever, acute lung diseases, diseases of the brain, heart and kidneys, and from cancer.

For the data for these comparisons I am indebted to Longstaff's "Studies in Statistics," a book which might appropriately have been entitled "Arithmetic made Interesting." It was not till after my examination of the Massachusetts statistics that this delightful volume came into my hands, and I was much interested to find so strong a general correspondence between the disease tendencies of these two widely separated communities, a correspondence indicating the presence of similar social forces. Concerning the decrease in the zymotic diseases, Longstaff says (p. 235):

"It seems impossible to dissociate this great saving of life from the operation of the Public Health Acts, and more especially the indirect results of this as shown in the proceedings of such bodies as the Sanitary Institute, the exhibition of sanitary appliances under various auspices, and other proofs that public attention has been drawn to these matters. The fall in the death rate from fever is without

doubt the great triumph of the sanitary reformers. Typhus has been driven out from place after place by measures taken to check over-crowding and want of ventilation until it now lingers only in the lowest quarters of a few large towns. Things are not perfect yet, far from it; but they were once much worse, and that not so long ago."

"Things are not perfect yet." These words used by Mr. Longstaff concerning his own country are equally true in Massachusetts, where more than 8,000 persons died in 1890 from the zymotic diseases alone. If 8,000 lives are destroyed in a single year by preventable diseases, surely prevention has not yet done its perfect work. We must remember also that the baleful influence of the zymotic diseases cannot be measured by their mortality alone; for many who recover from them are left with weakened constitutions or with some organic affection which impairs their usefulness and shortens their lives. Such are diseases of the kidneys resulting from scarlet-fever, of the lungs from measles, and of the heart from diphtheria. The results thus far accomplished, however, are substantial and encouraging, and a sufficient vindication of our sanitary laws and the mode of their enforcement. The indications for the future are that these efforts must be no whit relaxed, but must, on the contrary, be increasingly strenuous. To relax them at any point would entail direful consequences. The contagious and infectious diseases are like fire which must be fought unceasingly until it is extinguished. Left to itself it will burn until the inflammable material is all consumed. With all that has been done, we have seen how small are the results in some very important directions. Small-pox is the only disease which can be said to be almost extinguished; and yet the smouldering spark of even a single case of small-pox is sufficient, with the least removal of the agencies which hold it in check, to flash up into the blaze of a desolating epidemic. Even in our present immunity

lurks a future danger ; for the further we get away from an epidemic and a scare, the larger will be the proportion of persons unprotected by vaccination.

Our aim should be the ultimate extinction of all germ-diseases ; but when this will be accomplished I do not venture to predict. The condition most favorable for such a happy result would be an isolated community holding absolutely no intercourse with the rest of the world. Here a war of extermination against all disease germs might be successfully waged, supposing such an isolated people to be possessed of the requisite intelligence or to find life sufficiently interesting to care for its preservation. But Massachusetts is not thus isolated, nor is it possible in this age that such a condition should anywhere obtain. Emigration, trade and travel cause a constant intermingling of peoples. Quarantine, to be sure, acts as a check upon the importation of disease from abroad ; but evidences of the impotency of quarantine are alarmingly frequent, and interstate quarantine is impossible. Our State might be free from zymotic diseases today, and yet by tomorrow a full assortment of them might be brought within our borders. Herein lies the great obstacle to the stamping-out process ; and it is therefore safe to say, if pressed for a prediction, that the epidemic diseases cannot be eradicated from Massachusetts until they are likewise eradicated from every part of the world. That such a time may come we may venture to hope. Whether or not we believe in it as a practical possibility, we should be satisfied with no lower ideal.

But if epidemics cannot be kept *out*, we may reasonably hope to keep them *in* ; and here is the true principle which should guide our efforts. Every city and town should see to it that no epidemic disease is allowed to spread beyond the first case, and on no account to pass beyond its borders. This is already the aim of the Boards of Health ; but in order to achieve success, these Boards must be aided by an

intelligent public, and especially must they have the active and watchful co-operation of the whole medical profession.

There is one particular direction in which, it seems to me, that we Doctors can, at this time, render material service in this cause; and that is by making a concerted effort to secure the general adoption of *disinfection by steam*. The modes of disinfection now in use after a case of infectious disease are very diverse, and seldom sufficient. If the germs do happen to get destroyed, it is apt to be at the cost of a ruinous destruction of property. Especially is there no thorough and convenient way of disinfecting mattresses, pillows and carpets. What is needed is a receptacle of sufficient size in which these may be placed and subjected to a moist heat in the form of steam under pressure. By a pressure of ten pounds, a temperature of 230° F. is obtained, a continuance of which for fifteen minutes is found to be sufficient. Dry heat requires a much longer exposure, at least two hours, and even then is not certain. Superheated steam, which is practically dry heat, has been tried and found wanting. But steam under pressure can be kept at a sufficient temperature and forced into the centre of any porous material, with the result that every germ becomes thoroughly cooked. Various forms of apparatus for this purpose are made in France, England, Germany and Holland. They have not yet come into general use in this country, though this method is employed, in some form, in most of our large hospitals. It has also been adopted, within two or three years, at the quarantine stations at New Orleans and Charleston. At New Orleans superheated steam had previously been tried on a large scale, but abandoned. The disinfecting oven made by Geneste, Herscher & Co., of Paris, is very complete, and may be taken as the type of this form of apparatus. This consists of a sheet iron cylinder, sheathed with wood to prevent radiation, with a door at each end fastened by clamps.

Within the cylinder, above and below, are coils of steam pipe for the preliminary heating of the chamber, to prevent condensation. Another pipe pierced with small holes traverses the side of the cylinder and admits the steam to its interior. The articles to be disinfected are placed in a carriage or rack which runs upon a track into the oven. After the doors are fastened a dry heat is first obtained by admitting steam to the coils of pipe. Steam is then admitted directly into the cylinder and the air allowed to escape. Then the outlet is closed and the pressure of steam kept up for about five minutes. The steam is then permitted to escape, and admitted a second time. By this intermittent action, the most complete penetration of the articles under treatment is secured. Even the heart of a mattress becomes as hot as its surface. These ovens are made both stationary and portable. The stationary form is built into a wall in such a way that the opposite ends open from separated rooms, whereby any mixing of infected and disinfected articles is avoided. These ovens are from 7 feet to $7\frac{1}{2}$ feet in length, by 3 feet 8 inches to 4 feet 4 inches in diameter. The portable apparatus is smaller, has a door only at one end, and with its upright boiler strongly resembles a steam fire engine. This weighs 2400 kilogrammes (5291 lbs.), is drawn by a pair of horses, and costs in Paris \$1,340. The stationary form costs \$980 to \$1282, according to size. These are extensively adopted in France, and are under municipal control, being placed free of cost at the service of the public.

The steam disinfector of Washington Lyon of London is similar in principle, but is made with a double casing instead of the steam coils. It is also oval in form and is only made stationary. I see no reason why disinfectors of this type should not be made in our own country, and cheaper than they could be imported. If every town in Massachusetts, or at least the larger ones, owned such a disin-

factor, the arrest of epidemics would become a much easier matter than it is at present. If the portable form were adopted, it could be sent to neighboring towns or villages. If the stationary form, the articles to be disinfected would be packed in bundles or bags and conveyed in a special wagon to the disinfecting station.

Let us all make a business of calling the attention of the authorities and the public to this matter.

The reduction of the mortality from *consumption* is one of the greatest of sanitary needs; for this is, in our climate, the most destructive of all diseases. Great as has been the apparent decline in the last forty years, it still holds its place at the head of the list, having caused in 1890 5791 deaths. Moreover, its mortality being greatest in the most active period of life—that of young manhood and womanhood—the loss to the community is peculiarly heavy. In Massachusetts the mortality from this disease is greater in the eastern than in the western counties, and is greater in the cities than in the country. Our Irish population suffer more severely than any other class, and the large proportion of this nationality in our population is one cause of our high death rate from consumption.

The discovery of the tubercle bacillus adds consumption to the list of germ diseases, and indicates modes of prevention from which we are justified in expecting great results. Hitherto, our efforts have been directed to the overcoming of hereditary tendencies and the improvement of the environment; now it appears that there is one element in the environment more dangerous than all others, and this is the venomous little bacillus. That consumption is both contagious and infectious can no longer be doubted. Instances of evident contagion have come under my own observation; and doubtless many members of this Society could report similar cases. How else can we account for the phenomenon which is frequently presented to us of several brothers

and sisters in a family dropping off, one by one, from this disease, with no hereditary tendency and no unsanitary surroundings? And what can we say of those cases where a healthy young person suddenly breaks down with consumption shortly after nursing or paying a loving visit to a consumptive friend? Hereditary predisposition exists in not over 30 per cent. of all cases, and this is probably an excessive estimate. Of the deaths in Massachusetts therefore, in 1890, 70 per cent., or 4,053, had no consumptive antecedents. Without contagion, this is a puzzling fact, but granting contagion the mystery is removed.

That the bacilli which swarm in phthisical sputa are capable of conveying the disease to a healthy person, whether in the fresh or dry state, is now so positively determined that it becomes the duty of all medical men to explain the matter to their patients and their patients' families, and to insist upon such precautions as tend to prevent the spread of the disease. These precautions may be summed up in a few simple rules such as these:—

1. Let all sputa be carefully collected and destroyed by fire.
2. Let sputa never be deposited on handkerchiefs, carpets, floors, or any other place where it may dry and become mingled with the atmosphere.
3. Never drink from the same glass with a consumptive.
4. Never kiss a consumptive upon the mouth.

These rules are equally applicable to pneumonia and perhaps also to bronchitis. It will therefore be best to call them, not rules for consumptives, but for *all persons who cough and expectorate*. This will save the patient from the shock of a positive and perhaps too hasty diagnosis.

The investigations concerning tuberculosis in cattle show how carefully we must watch the milk supply of our patients, and especially since Dr. Ernst has demonstrated that a cow tuberculous in any part may yield tuberculous

milk. This fact also emphasizes the importance of forbidding a consumptive mother to nurse her offspring.

Boards of Health have already begun to publish rules such as the foregoing; but in order that they should be so generally and intelligently followed as to produce any positive results, it is necessary that physicians should persistently teach the public of their necessity.

Having thus hopefully and even confidently placed consumption among the preventible diseases, why are not the acute lung affections entitled to the same distinction? We know that they have their specific germs, and we believe in their communicability; and though our knowledge of the natural history of these germs is as yet very limited, their very existence opens up possibilities of future prevention, and should lead us to add them, at least experimentally, to the preventible class.

Having now broadened out the boundaries of the preventible diseases to extreme and perhaps you will say unwarrantable limits, let us see for what portion of the mortality these are accountable.

For the five years ending in 1890 the zymotic diseases caused 18 per cent. of all the deaths. Consumption and the other tubercular affections caused very nearly the same proportion, namely 17 per cent., while pneumonia and bronchitis were responsible for 11 per cent. These amount in the aggregate to 46 per cent., or not quite half of the total deaths. Of what, then, is the other half of the death rate composed? For one thing, it includes old age, to which are attributed $4\frac{1}{2}$ per cent. of all deaths. The rate to the population has remained practically unchanged in forty years, being from eight to ten to 10,000. But this is not a disease. On the contrary, a death from old age, since it implies living to old age, is the greatest triumph of human vitality; and the *ultima thule* of preventive medicine is to render old age common, hereditary and even con-

tagious. We may therefore exclude old age from the list of non-preventible diseases, and the same may be said of violence, which causes 4 per cent. of all the deaths.

This will leave as a remainder about 45 per cent. of all deaths. More than half of this number is made up of diseases of the brain, heart, kidneys, and of cancer, and the balance comprises the diseases of the digestive organs, including the liver, of the organs of generation and locomotion, of the developmental diseases, and disorders of nutrition. It is among these, or a portion of them, that the great increase in mortality is taking place. How to arrest this mortality is one of the most important medical problems of the day, and one which it behooves the medical profession to set itself resolutely to solving.

We have seen that these increasing diseases are largely those of the latter part of life, or at ages above forty. In some respects the loss to the community is somewhat less of persons of this age than of the same number of persons between twenty and forty, which is the age of production and of re-production. These older men and women have reared their families and have passed the age of greatest strength and activity; but they are possessed of something which we cannot spare, namely, the experience and wisdom which belong to ripe maturity. Many and many a brilliant leader of men in politics, literature or the professions, is cut down in what should be the prime of life, between 40 and 60, when he ought to have lived to 70 or 80 to give the world the benefit of those well seasoned powers which had but just attained their full development.

These diseases of later life are largely of the degenerative type, the disintegration of tissues in one organ or another. Our great Poet Doctor has sung to us of chaises which "break down but never wear out," and therein has typified the human vehicle, which, like a chaise, has "always *somewhere* a weakest spot." How shall these weak spots be

made strong? How can the human chaise be made to run "a hundred years to a day," or even keep in good repair for three-score years and ten? How, in short, can the long life and perennial youth of the writer of the "One Hoss Shay" be made less exceptional among men?

Before attempting to answer these questions, it is necessary to inquire what are the causes which contribute to the increase in the diseases of later life. These, it seems to me, can be grouped under two general heads, of which the first is that *this is the natural tendency of an advancing, but still imperfect civilization.*

In comparing the effects of the diseases of men with those of the lower animals, we find a marked difference. Animals, like men, are not born equally vigorous, and in the struggle for food and against enemies the weaker are soon weeded out. These also more readily fall a prey to diseases, which are chiefly of the zymotic type, and since they receive no care from their kind, they cannot obtain food, and necessarily die. It is therefore the strong and healthy only who reach maturity and become the parents of the next generation. This is "natural selection," or "the survival of the fittest." Moreover, the lower animals, being guided by instinct, naturally tend to adapt themselves to their environment. Without knowing why, they select such food as is most suitable for them, and adopt such habits as are best for their physical well-being.

But with man, and especially civilized man, the circumstances are changed. The law of the survival of the fittest is still in force, but is modified in its action by the fact that man is governed by *will* and not by instinct, and also possesses intellectual and moral faculties whereby the selfish and cruel propensities of the brutes are, or may be, overcome. By these qualities the physical character of the race is affected in several ways. The delicate children receive the most tender care and are often enabled to grow to

maturity and procreate children of their own. Diseased persons are cared for in homes or hospitals and not allowed to starve, as the brutes are; but those who have recovered from disease are often, if not usually, left with some impairment of structure or function which is then liable to be transmitted to the next generation. Again, as it is a matter of choice with men "what they shall eat, what they shall drink and wherewithal they shall be clothed," they may and frequently do choose such a mode of life as is incompatible with integrity of structure, however perfect originally. Man's freedom of action leads him more naturally to self-indulgence than to self-restraint, and self-indulgence leads inevitably to physical degeneracy. Savage man very nearly resembles the brutes, as regards natural selection, but the tendency of civilization is not to the survival of the fittest physically, but to the preservation of impaired lives, the impairment of healthy lives, the hereditary transmission of weaknesses of structure, and consequently to the development of a race in which perfect health is almost unknown, and tendencies to disease are an universal heritage. With these tendencies we all have to contend. They are the structural weaknesses with which we are born, and which, though they may not show themselves for years, are ever ready to yield to some special strain which a perfect structure would successfully resist. To these are added mental and moral inherited defects, weakness of will or overmastering desires, which cannot fail to influence the physical development.

The fundamental reason for this state of society seems to be that man is still in a transition state. He is neither a brute nor has he yet become a perfect man. The brute is well equipped for life with an unerring instinct. Man has endowments which are capable of rendering him far better service, namely, a will, an intellect and a conscience. If this machinery were perfect (and in the ideal man it must

be perfect), man would emancipate himself from all the ills which now enslave him, and disease would vanish from the earth. But thus far, a perfect co-ordination between the will, the reasoning power and the conscience is seldom found; and the age when it shall become so constant as to acquire the force of an hereditary racial characteristic must be regarded as extremely remote.

The conclusion is here forced upon us that a high physical condition of the race is impossible without a high moral condition, with the self-restraint which this implies; and hence that even for the physical uplifting of the race, science requires the aid of religion.

The second general cause which appears to contribute to the increase of the diseases of mature or advancing age is *the rapid growth of cities*. It is in cities that the degenerative tendencies of civilization are strongest. The environment is more artificial, and therefore the struggle for existence is more desperate than under the more natural conditions of rural life. To the conditions which exist in the worst part of a great city the term "necessarily fatal environment" has been not inaptly applied. In London, a native of the city, of the third generation, among the lowest classes, is practically unknown. If one is occasionally discovered, he is found to be a wretched creature, stunted in body and mind, though probably the descendant of vigorous grand-parents who came from the rural districts to seek their fortunes in the great city. This does not apply, however, to those city families whose means enable them to live in comfort and to spend a portion of the year in the country; and yet there are certain influences which affect all classes. The endless excitement of city life, the furious competition, the desperate struggle which all are making, some for wealth or position, and others for the bare necessities of life—these are fruitful sources of disease which affect both rich and poor.

Associated with a life of great mental excitement, is a general insufficiency of muscular exercise. This leads to a general prevalence of dyspepsia and lithæmia, which we know to be the under-lying causes of many organic diseases. The excessive use of alcoholic stimulants also, which is most common in cities, is one of the most fruitful causes of disease. In London it was estimated by a committee of the Harveian Society that alcohol is responsible, directly or indirectly, for 14 per cent. of all deaths.

In Massachusetts we must lay our plans with special reference to the city environment, for our State is approaching the condition of a mere group of cities. By the census of 1890 it has 70 per cent. of urban population, being a larger proportion than any other State in the Union except Rhode Island. Though our State is one of the smallest, being 44th in respect of area, it is the seventh in population and the second in density. The increase of population during the last decade has been greater than that of any State east of the Mississippi, with four exceptions. Moreover, this increase has almost all been in the cities, and some of the smaller towns are actually dwindling.

A third cause which may contribute to the increase in the diseases of later life is the influence of the late war. A great number of our most vigorous young men were killed or died in the service, and of the survivors a large proportion were shattered in health, while of those who did not enlist, many were prevented from doing so by physical disability. Our veterans are now mostly between the ages of forty-five and sixty-five, and it is evident that the average vigor of men at these ages must be less than it would have been but for the destructive effects of the war upon the young men of thirty years ago. The death-rate for veterans is, according to Dr. Billings, slightly higher than the average for men of corresponding age, while the health of living veterans is below the average standard. But just how far

this cause may affect the death-rate, I am unable to determine. A comparison of the male and female mortality has given only negative results. The death-rate for males was higher than for females in 1892; but so it was also in 1860, and the ratio between them for these two years is almost exactly the same. It was, in 1860, for males 19.2, and for females 18.2; while in 1890 it was for males 20, and for females 18.9. An examination of the comparative mortality from diseases of the brain, heart and kidneys in the two sexes, shows that while these are all somewhat more fatal among men than women, the ratio between the sexes was very nearly the same in 1890 as in 1860.¹

These observations upon the causes of the increasing diseases are intended as suggestions only, and not as a complete enumeration of those causes. The subject is one which needs further investigation, and I commend it to this Society as one of the most serious and urgent of medical problems. Among the causes mentioned there are a few which stand out conspicuously, and seem to demand our especial attention. These are:

1. The general prevalence of digestive disturbances, due in part to a diet generally too rich in albuminoids and in part to a weakness of digestion caused by lack of exercise and mental strain. From these result lithæmia and disorders of the liver, with Bright's disease as one of the remote effects, while they constitute an important factor in the causation of diseases of the heart and brain.

2. A lack of general vigor due to insufficient exercise, resulting from sedentary occupations, cheap modes of con-

¹ The number of deaths from *unknown* causes is, through increased accuracy of registration, decreasing year by year, and this of course increases the number from *known* causes. The deaths from unknown causes in 1871 were 1290, and in 1890—515. The difference between these figures is 775, and allowing for increase of population would be 946, and if this number of deaths had been correctly returned in 1871, we might now find a less marked increase in some of the diseases. But the increase in diseases of the brain, heart, kidneys and cancer alone is four times this amount, and therefore the increase cannot be accounted for by increased accuracy of the returns.

veyance, and a climate which, during half the year, makes out-door exercise unattractive.

3. The excitement and anxiety which pervade all occupations at the present day, when men must wear themselves out in trying to keep pace with the mad rush of this age of steam, electricity and desperate competition.

4. The intemperate use of alcoholic stimulants, than which no other cause of disease is so potent and destructive. This is an old enemy ; and yet one whose assaults are ever new.

In applying preventive measures of these diseases, it is evident that the campaign must be largely educational. Frugal living, self-restraint and tranquillity of mind cannot be enforced by act of legislature, while even the legal suppression of intemperance has not yet been accomplished. The work must chiefly be done by medical men in their daily intercourse with their patients. Anticipating the dangers with which they are threatened, and helping each to so order the course of his life as to pass through these dangers unscathed, constitutes the highest and the most difficult branch of preventive medicine. Though a branch which we all are practising, it is capable of broader development and demands more persistent application.

There are, however, certain ways in which much benefit may be reaped from measures of a public character.

Two of these relate to the public schools. One consists in an increased attention to *instruction in hygiene*, and the other to the general introduction into the schools of *physical training*, and in giving this a conspicuous place in the curriculum. The absence of such training has, in the past, been the greatest defect in our school system. That this defect is already being remedied in Boston and elsewhere is a most hopeful sign ; and we, as physicians and humanitarians, can render the public inestimable service by using our influence to have such instruction introduced into the

schools of every city and town of the State. This should be a systematic course of gymnastic drill, extending through every grade of school, from the lowest to the highest, preference being given to the Swedish system, or something of like nature; and should be under the direction of specially trained instructors. Facilities for the training of such teachers already exist in Boston, and it would take but very few years to built up such a system of physical training that the graduates of our schools would be possessed of a sound bodily development which would give them a better chance for a long and useful life than they now have, while this would in no way hinder, but, on the contrary, would greatly help, their intellectual development.

As a result of this inquiry into the practical effects of sanitation in the State of Massachusetts, we have found that these effects are not only tangible but brilliant, and constitute veritable triumphs of preventive medicine. But, on the other hand, we have found that with these triumphs we must not rest satisfied; for, while the hostile army of disease has been weakened in one part, it has gathered strength in another, and our partial victory is offset by severe reverses. The zymotic diseases, against which our sanitary army now chiefly directs its attack, cause but a paltry 18 per cent. of all deaths. In twenty years they have suffered a reduction of 30 per cent.; and supposing it were possible to keep up this rate of decrease by arithmetical progression, they would, in fifty years more, be reduced to zero. But, even if this extraordinary thing should happen, and the present increase of the local diseases should continued unchecked, the year 1940 would find us with a still undiminished death-rate.

We cannot longer, therefore, confine our efforts to the suppression of this small minority of diseases, but must plan a new campaign against the greater foe. Here new and

even greater difficulties confront us, for we have to contend with causes remote, complex and intangible; but to seek out and attack these causes is a duty which we now see to be imperative, and the forces of preventive medicine must be brought to bear upon them with new weapons and new modes of warfare. The Boards of Health cannot do this alone, but the whole medical profession must be the attacking army. May we all do good and valiant service against these treacherous foes which are sapping the vitality of our race and retarding the evolution of the perfected type of manhood.

