THE RELATIONS OF TOPOGRAPHY TO HEALTH IN CONNECTION WITH THE PRINCIPLES AND PRACTICE OF DRAINAGE AND SEWERAGE.

An Address delivered by General Egbert L. Viele, of New York, before the American Public Health Association, at Philadelphia, November 11th, 1874.

The meeting of this association in the City of Philadelphia recalls the fact that the first Sanitary Congress in America was held in this city May 13, 1857. Previous to that event the barbarous quarantine codes, which time had made venerable, were rigidly enforced. The sick were treated worse than criminals, and the restrictions imposed by ignorance and fear to prevent the spread of disease were not only cruel in themselves, but provoked the very results which were so much dreaded.

In the language of Dr. Jewell, "They advocated antiquated and obsolete doctrines, they embarrassed commerce, oppressed the merchant, imposed severe restrictions on the healthy, inflicted cruelties on the sick, and when rigidly enforced became the ready means of disseminating and entailing disease and death."

The great leader of that congress—a true apostle of sanitary reform—was the illustrious Dr. Wilson Jewell, of Philadelphia—a man of whom any city, any State, or any nation, might be justly proud. How long, how well and faithfully he labored in the cause, his co-workers in the field can bear ample testimony.

His words bore the stamp both of faith and of prophecy when he said: "The work of sanitary reform in our country has commenced in earnest, and my desire and prayer is to be engaged in this work in season and out of season, until I behold the first fruits of our united and persevering exertions displaying its rich influence in the organization of a well-ordered sanitary police, embracing both external and internal hygiene through legislative enactments in all our large cities."

None the less earnest as a champion of sanitary reform was the eminent Dr. John Bell, also of Philadelphia. To him the world is indebted for the most learned and exhaustive treatise on the importance and economy of sanitary measures to cities that ever has been or probably ever will be written. Replete with the wisdom and experience of the past, it will be for all time a guide in the future to the practical sanitarian. And so long as mankind is led by humanity and directed by wisdom to provide measures of protection from pestilence, and relief from disease, so long will the names of Jewell and Bell be honored and revered among men.

The crusade against ignorance on behalf of humanity, so well begun under the auspices of such eminent leaders, has been maintained until the present time, with what results let the diminished death rate of our large cities, and their marked immunity from pestilence, bear witness. Those who have been more or less identified with this cause have come together for counsel and guidance; to exhibit what has been accomplished in the past, and to plan what may be accomplished in the future, by intelligent co-operation.
So far as sanitary engineering is concerned, or that particular department of sanitary science which by virtue of my profession has come under my personal cognizance, I find great reason for congratulation in the progress which has been made both in this country and in Europe. It is true that innumerable obstacles present themselves on every hand. The resistance which is always offered, even by otherwise intelligent minds, to what are regarded as new ideas, would be astonishing if it were not so universal. The capacity of the human mind to reject knowledge is very great, and in nothing does it show itself so obstinately as in those matters where science has to contend with social habits. Every step in this direction is opposed by a great force which might be denominated “the inertia of ignorance,” and to overcome it is like removing a mountain.

It has sometimes appeared to me that it required more skill, energy, perseverance, and courage to conduct a sanitary campaign than it does to marshal an army in the field. Ignorance and vice, avarice and greed, politicians and quacks, sordid contractors and corrupt rings, array themselves against progress until experience comes with its terrible lessons to destroy the opposition that no other argument could remove. Hence it is that a convention like the one now in session becomes a great public necessity, for by it important facts are acquired, and through it they are disseminated with the force and power of united action, so essential to success, especially in a case like this, whose magnitude extends to the very limits of human civilization.

Of all the problems embraced within the scope of sanitary science, none are more important or should claim a larger share of attention than those connected with drainage and sewerage. Since, of all the innumerable causes which singly or combined engender preventable disease, the most wide-spread and most certain is the presence of an undue amount of moisture in the soil. When we consider how universal is the presence of water in all created matter forming the larger portion of the great globe itself, and more than three-fourths of all animal and vegetable substance, constituting 795 parts in 1,000 of the blood, 789 parts of the brain, and 756 parts of the muscles; when we consider, also, its amazing power as a solvent, dissolving matter and absorbing its constituent gases with an incomprehensible avidity, when we think of its equally wonderful erosive power, wearing away mountains and plains, and washing the plains into the sea, and recognize it as the prevailing and most potent of all the powers of nature, we cannot wonder at the important part it fills for good and evil in the history of the world. To the action of water is due, to a large extent, the topographical configuration of the earth. The great upheaving forces that elevated the mountain chains were limited in their effects and duration, when compared with the abrading forces of the iceberg, and the erosion of the waters. The latter is unceasing in its activity, destroying and recreating, and were the earth’s internal fires to sleep unmoved forever, so long as the dew falls and the clouds form, so long for all time will the surface of the globe undergo constant and increasing change from the action of water. Does it not, then, behoove all men to know well this element of life and death, to study it not only with the microscope as it exists in the dew-drop, and learn its constituents,
but to study it and know it in its all-pervading character; in the rivulet, the river and the sea; in its hidden channels through the fissures of the primitive rocks, but above all in the *supersaturated soils which surround them on every side*.

Let us follow it for a moment as it rises in vapor on a summer’s day; see it floating upward in fleecy clouds until, in a higher stratum of air, it condenses and gathers into black masses that roll and mingle, while amid quick flashes of electric discharge and reverberating thunder it descends in copious volumes. The parched soil eagerly drinks it. Drooping vegetation revives, and the green earth smiles in beauty from its refreshing influences. Were this to occur only at such times and in such quantities as are alone necessary, man would live in a perpetual paradise; but unfortunately far more water descends upon the earth than is absorbed or required for vegetation. By reason of the physical conformation of the surface a large portion of it passes by the rivers to the sea, but a very large portion is permanently retained in the soil in excess of its requirements. And this portion is the principal source of human misery throughout the world. Man meets it as his great enemy on the threshold of existence. He meets it wherever he goes, in every part of the inhabited and uninhabited earth—in the crowded city, in the secluded hamlet—it follows him like an unseen spectre. Its noisome vapors envelop him like a mantle; they chill the warm blood in his veins; they penetrate into his lungs and disturb all his organs of vitality. When once they gain a foothold in his system, and a burning fever fills his veins with hot blood and his brain with delirium, the crisis of his life has come. Even if he recovers, a power has gone from him, never to return; he rises from his bed like Samson shorn. The old vitality never comes back. I appeal to the medical profession to confirm the truth of this statement. Is there a physician of extended practice in either hemisphere who has not within the last twelve months had under his charge fifty or a hundred cases of sickness, due directly or indirectly to malarial influences? Yet what a strange indifference the great public exhibits upon this subject! But a short time ago the whole British empire was filled with a deep anxiety and expectant sorrow at the severe illness and prospective death of the heir-apparent to the throne—an illness due to a preventable cause arising from imperfect drainage. The destinies of a great nation apparently hung upon this single thread, and the subject became as widely known and discussed as any event of the age, and yet probably not one in a hundred thousand, either in Europe or America, has deemed it necessary to examine the surroundings of his own domicile to see if the like source of disease does not exist at his own door. On the contrary, we have only to look about us to see on every hand individuals constructing edifices, and communities constructing towns and cities, with a reckless disregard of all the warnings of the past, and a reckless indifference to future consequences; in utter violation of those laws and principles upon which depends life itself. Take for illustration the following description of a portion of the city of Salem, from this year’s report of the Massachusetts State Board of Health. Speaking of the location of a very large number of cases of typhoid fever, the report states:

“At the foot of Pingree street is a sluggish body of water, fouled by
refuse of all descriptions, which taints the air of the neighborhood with its oppressive exhalations. Near this water, on low land, are tenements whose occupants use little precaution to protect themselves from the stench of slops and garbage thrown on the surface of the ground, or from shallow and neglected privies. At high tide the waters find their way along the drain into the cellars of the houses. It surely is not strange that in this neighborhood, during the past year, occurred nineteen cases of typhoid fever. There is a sluggish basin of water lying at the north of Howard street cemetery and the jail (fit proximity). This basin is of triangular form, bounded by Ridge street, the Eastern Railroad, and the land lying back of Northey street. It covers three or more acres of flats. Into it flows the drainage from St. Peter's street, Howard street, Oliver street, Northey street, also the drainage from the gas works. Formerly the coal tar from these works was allowed to flow to waste, but since it has become valuable for coloring purposes, it is retained, and only the ammoniacal liquor is allowed to flow away. So that whereas, formerly, some little antiseptic action was derived from this drainage, now it aggravates the baneful condition of the waters by promoting decomposition. Each spring, with the annual cleaning of gardens, flower-stalks, brush, and all sorts of refuse are emptied along the banks of this basin. On the Northey side there is a low shore, overgrown with sedge-like grass. The only outlet for these waters is by a culvert under the railroad, the emptying of the waters with the ebbing tide is so slow that decomposing animal and vegetable refuse settles among the brush and grasses on the shore and on the flats. Near the gas works, leading from Northey street to the basin, is Woodbury court (a short court with five or six houses on each side). In the two houses immediately bordering the water there have been four cases of typhoid fever this season. Half way up the court have occurred two more, and not far from the head of the court three others, making ten cases in the neighborhood this autumn.” In the immediate vicinity there have been twenty-one cases of typhoid fever in all. The report states further that all this is due to defective drainage, and that before vigorous measures can be adopted to improve the sanitary condition of the city, the authorities must appreciate the dangers which are imminent.

“Thus,” it adds, “neither they nor the people seem to do. The nuisance remains the same, although public attention has been repeatedly called to it.” All this refers to a locality in one of the oldest, most refined, and wealthy cities in the intelligent State of Massachusetts, of which Boston, the intellectual centre of the United States is the capital, and yet not even the barbarism of Central Africa could exceed this scene of human degradation and filth.

Of the city of Lowell in the same State the report says: “The system of sewerage in Lowell has always been imperfect. In many places there are no sewers at all, in others the pipes are of insufficient capacity or not low enough in position. There has always been great confusion as to their location, owing to the imperfection or absence of maps. Two years ago there occurred here, especially on Marion and Cross streets, an epidemic of typhoid fever. At that time and since then the sewage filled many of the cellars. On investigation a mass of filth
was found which filled the entire calibre of the drain-pipe for some distance. This pipe was also found to be too small, and not low enough to create a current." These are not cited as exceptional cases. On the contrary, there is reason to suppose that the same state of things can be found to exist in almost every city and town in the country.

Even here in Philadelphia, which we were led to believe, from the remarks of the courteous chairman of the reception committee, was in an exceptionally healthy condition, are some very unwholesome spots, as the following report of yesterday's meeting of the Board of Health will show:

"The Board of Health, at its meeting yesterday, received a report from the Sanitary Committee, regarding the complaint of a nuisance at Forty-second and Haverford streets, caused by the drainage from a large sewer flowing through the section between the point named and Forty-fourth and Sansom streets. The report says the sewer is the channel of drainage for a populous section of West Philadelphia, in which a number of slaughter-houses are located. Blood and offal from these find their way into this sewer, adding greatly to the offensive character of its contents. This sewage flows sluggishly through the low ground east of the Pennsylvania Hospital for the Insane, thence under Market street, and in a southwesterly direction until it empties into the Mill Creek sewer. The emanations arising therefrom, are sickening in the extreme, and threaten the health of all the neighboring population."

The responsibility for such a condition of things is not always due to ignorance; for, unfortunately, while there are many people in this world who know too little, there are also some who know too much. There are quacks in every profession—quack doctors, quack lawyers, quack soldiers, and quack engineers—men who, having been gifted with an excess of conceit and cunning, use these qualities in the absence of more substantial ones, and succeed, by a pretension to knowledge, in imposing upon credulous people. In all local boards there is generally to be found such a character, who thinks he knows more than any one else. The city of London was for a long time victimized in this way. That city, as we all know, has suffered terribly in the past for want of a proper system of drainage and sewerage. The plague carried off 100,000 people, and this was almost entirely due to defective drainage. For a period of ten years they were struggling to attain a correct and thorough system. A new commission being appointed by Parliament nearly every year, each time just as they were arriving at a practical result, some person, generally a member of the commission, or a particular friend of a Commissioner, would bring forward a plan differing from all the others. This would prevent the adoption of any plan; and so it went on until the matter was placed in the hands of one man, Mr. Bazalgette, who has achieved wonders by simply adopting a comprehensive plan based upon common sense principles.

A practical system of drainage is one the key of which is the topography of the site to be drained, and any attempt to carry out a plan not based upon the topography must necessarily end in failure. When I speak of drainage, I do not include sewerage. Drainage and sewerage are entirely distinct and can seldom be combined, and then only to
a limited extent. Drainage is the removal of the surplus water from the soil. Sewerage is the removal of water introduced by means of an artificial water supply, to which is added excrements and other refuse matter which the force of the water conveys into the sewers. It follows that sewers should be close conduits— to prevent the escape of gases— while drains should be so constructed as to admit of the percolation of water into them from the adjacent soil.

Let us suppose, for example, a site to be selected for a future town or city. The topography of the surface indicates a valley between undulating grassy hills, interspersed with meadows and fields, and dotted here and there with trees. Through the valley runs a limpid brook, sedgy and rocky by turns. In its pure, bright waters the sun is reflected as in a mirror. The beauty of the landscape, the surrounding air, the pleasant sounds and delightful odors, shed on all around a grateful influence. A scene so fair as this should certainly not be despoiled in making it a habitation for man; much less should all these attractive surroundings be converted into health-destroying influences. And yet it is universally the case that the occupation of such a territory by a large number of people seems to be the signal for the exercise of every device that human ingenuity can conceive to destroy its pristine purity. The soil soon becomes saturated with putrescent filth; the stream becomes the receptacle of every kind of refuse, and its sluggish waters are black, and filled with poisonous gases. The natural drainage being interrupted by the grading of the roads and streets, the surrounding soil is soaked with water, and the lives of the people pay the penalty. By what simple means can this be avoided? All that is necessary to do is to make the plan of the town conform, if only in a general way, to the topography of the surface. The streets and avenues, instead of being impediments to drainage, may serve to facilitate it. A system of drainage becomes easy to adopt, and the most universal cause of disease is in a large measure avoided. But even if such a course is not adopted with reference to the original plan, it is nevertheless imperatively necessary that the streams and water-courses should be preserved by underground drains, and also that lateral drains should be constructed to take up the water emanating from perennial springs. If this is not done in the beginning, when it can be done easily and economically, it will have to be done in the end, when the task is surrounded with difficulties, and at an enormous cost, when the safety of the lives of the people demand it, and after the pestilence and the graveyard have demonstrated its absolute necessity. The city of New York affords the most striking example of the errors committed in this respect and evils arising therefrom that can be found on either continent. Probably there is no spot in the world so well adapted for a great commercial entrepot as the island on which New York is built. Surrounded on all sides by wide and deep water channels, having a well-defined water shed, combined with every variety of surface, varying in height from five to 150 feet above high water mark, blessed by a climate of unsurpassed salubrity, it has, nevertheless, been ravaged by cholera and yellow fever, while the utmost vigilance is required to prevent the outbreak and spread of small-pox, diphtheria, and the whole class of low fevers. All this is due in a very large degree to the fact
that in laying out the plan upon which the city has been constructed the existence of a vast system of drainage streams was entirely ignored. Miles and miles of running streams, fed by innumerable perennial springs, permeate the original topography in every direction. Over these the streets have been graded, the intervening blocks filled up, and acres of buildings erected, and beneath lies the undrained, saturated soil, giving off its damp, chilling, malarious atmosphere.

It is true that herculean and eminently successful efforts are being made by an energetic and wise Board of Health to remedy all this; but think for one moment of the task before them—the time, labor, skill, and money required to accomplish what might have been so easily done in the beginning. In one small district eighteen miles of underground drains have been laid down within the last three years, at an expense which would have drained the entire city in the commencement. Startling as all this is, every city and town in the United States is following recklessly in the footsteps of New York, and in the end will pay the same penalties. Memphis, in mourning for her decimated population, repeats the sad story.

While this matter of drainage is the first great step for all communities to take, it is none the less necessary to individuals—the residents of the detached villa and farm-house. Wherever and whenever an excavation is made in which to construct a cellar for a house, there necessarily occurs an interruption of the natural drainage of the soil. The underground channels for the percolation of water are intercepted, and must be restored by the construction of a drain below the level of the cellar, and all the surrounding area requires a system of drains connecting with the main outlet. To neglect this is perilous. How many houses constructed after elaborate and well-considered plans, executed under the influences of bright hopes and happy auspices for the future have proved the gateway to death from the neglect of these simple principles? Examine the admirably-designed and graphic charts that illustrate the vital statistics of the last census. The varying shades of crimson tell us that malarial and typhus fevers prevail all over the United States in greater or less intensity, and while knowing that the chief source of this wide-spread calamity is saturated and undrained soil, how painful it is to reflect that the least expensive of all the efforts that man is required to make to secure for himself a healthful and a happy home is the simple draining of the soil! Even for agricultural purposes, draining is the most remunerative of all labor, and experience has shown that draining for agricultural profit has been in many insalubrious districts attended by an immediate diminution in the death rate. In the Dominion of Canada I saw last month the most extensive system of drainage probably ever executed, successfully carried out under the combined action of the Government and individuals. By virtue of an organic law, certain main drains of great extent and capacity are opened by the Government and paid for by a general assessment. Connecting with these are lateral drains opened by the owners of estates at their own expense. Thorough drainage of an extended area is thus secured by a general and uniform system. Those who are directly benefited by it pay the expense, while the public at large obtain immunity from disease. I recommend this wise and
beneficent law for general adoption in this country. One word more
in reference to domiciliary drainage. We observe throughout this
country that on the premises adjoining every isolated or detached resi-
dence there are generally three excavations made, one for a cesspool,
one for a privy, and another for a well. These are also most generally
in near proximity to each other.

The well, of course, is always the deepest, and if the soil is porous, it
necessarily receives the leakage from the other two, especially as all
three excavations are always faced with stones laid without mortar or
cement, precisely in the same manner that drains are constructed to
admit the percolation of water through the interstices.

It seems absurd and almost impossible that the receptacle provided
for securing a constant supply of pure water should be universally so
constructed that every possible opportunity is afforded for destroying
the purity of that water; and not only this, but that a plan should be
generally adopted for positively insuring the contamination of the wa-
ter by so constructing the receptacle for refuse matter that the liquid
can readily percolate through it into the well. And yet nine-tenths of
the homes of our people throughout the land are so arranged. The
use of hydraulic cement in these constructions would obviate all this.
In addition to which the overflow of the cesspool should be made to
pass through charcoal; and, further, dry earth or charcoal deodoriza-
tion should be constantly used in the privies.

There is one great source of evil through soil saturation, which, al-
though almost universal in extent, has not received that attention which
its terrible importance demands. I allude to the construction of mill-
dams. The great variety of surface which characterizes not only a
large portion of the United States, but that of nearly every State and
county and town, naturally results in innumerable valleys, through
which flow the waters which make up the river system of our country.
The rushing torrents of these rivers and their countless branches are
everywhere stopped in their courses and made to furnish the motive
power for ten thousand mills and factories. To do this, dams are con-
structed across the beds of the streams, behind which large bodies of
water are accumulated, to be gradually drawn off, as it may be re-
quired, to turn the wheels which drive the machinery. The water
which is thus dammed back saturates a large amount of soil in every
instance. And this is probably the most fruitful source of malaria in
the country. In addition to this, the bottoms of the artificial ponds
thus formed become a mass of decomposed vegetable matter, to which,
by carelessness, much decomposing animal matter is almost invariably
added. This deposit is necessarily exposed to the direct action of the
rays of the sun each day when the water is drawn down in the work-
ing of the mills. The consequence is that in the vicinity of all these
mills there are always a large number of cases of typho-malarial fever.

In one instance under my own observation there were at one time
1,200 cases of fever due to this cause, and a physician stated to me
that he knew in his own practice of one mill-dam, that did not yield an
income of $400, that had caused the death of twenty persons. This
great evil extends over our entire country. What is the remedy for it?
I would not for a moment propose to interfere with the industrial re-
sources of our land; I would not have a factory stop or a single mill cease to yield its bountiful products. On the contrary, I would increase the number of these necessary adjuncts to an active civilization; I would conserve the latent force of every drop of water that a beneficent Providence sheds upon the earth; but I would do it in such a way that it should be always a blessing and never a curse. I would make every mill-dam throughout the length and breadth of the land what it ought to be—a properly-constructed reservoir of pure water, free from all contamination, instead of being a stagnant pond of putrid filth. I would have their form and construction a matter of statute law, as clearly defined as the law against homicide and arson, and the violation of that law followed by criminal punishment.

A very little additional cost in original construction would confine these mill-ponds to a properly defined space, from which all vegetable matter should be carefully removed and the sides protected by walls from contact with vegetation. This would deprive the water entirely of its malarial influences. The sooner our legislators take intelligent action on this matter, the importance of which cannot be exaggerated, the better will it be for them and our country. And let us hope that the time is not far distant when an ignorance of sanitary laws shall debar the aspiring statesman from enjoying the honors of public position. As well might a man attempt to sail a ship who had never before seen the ocean, as for one to attempt to legislate intelligently for the public good who is ignorant of the laws of health.

I have already stated that sewerage is entirely distinct from drainage, it being the essential accompaniment of a water supply, since, without an amply supply of water, no system of sewerage could possibly be maintained; and yet, even with an abundance of water, I confess, with a great deal of mortification for the engineering profession, that the sewerage of nearly all the large towns and cities of the United States is a failure, since everything may be regarded as a failure that does not accomplish the object for which it was intended. Unfortunately, while the profession of an engineer involves a very large amount of responsibility, including in a great measure that of human life, it is surrounded by no legal enactments like the professions of the law and medicine, by which a certain degree of skill is secured in its practice, and it too often occurs that an ignorant and incompetent person assumes the title of engineer or architect, and through personal or political influence becomes charged with duties for which he is entirely unfit. It was long ago said that "fools step in where angels fear to tread."

The problems connected with sewerage are numerous and intricate. They have engaged the earnest thoughts of able minds for many years. Man finds in it a spirit which he himself has raised, and which it is difficult to exorcise. The illustrious Liebig gave to its economic consideration the widest research and most profound philosophy. The great cities of London and Paris have labored for centuries to control the vast proportions which it has attained through an enormous and increasing population. Its problems and difficulties multiply with every change of circumstance. A system thoroughly adapted to one locality might be utterly useless in another. But the principal cause of failure
arises in most instances from a want of breadth in the original design. It is easy enough to convince people that their particular town or city will one day be a large centre of population; but when it comes to paying for the construction of a main sewer five or six feet in diameter, in anticipation of a large increase in population, while one which is two or three feet in diameter will answer the present purpose, the tax-payers generally decide in favor of the small sewer; so that the engineer is not always responsible. As well might we expect the veins of a child to suffice in capacity for the blood circulation of an adult, as to hope that the system of sewerage which is only sufficient for a small village will answer the purposes of a large city. Any plan of sewerage to be effective must not only be comprehensive in design, but must be based on an anticipated growth of population. The principal points to be considered are:

1. The original configuration of the ground, and natural valleys of drainage.

2. The artificial changes of the natural surface by the grading of streets and avenues.

3. The rainfall, or amount of water discharged from the clouds during the year upon the area to be sewered.

4. The water supply, or amount of water distributed to the inhabitants daily, from the reservoir and water-works.

It will be seen that the surface drainage of graded streets is included in the sewerage system, but this is distinct from the natural drainage through old water courses, from springs, etc.

The imperfections in a system of this kind arise from a want of proper judgment in determining the size, form, and location of the sewers—sometimes from errors, either intentional or accidental, in their construction, and sometimes from want of proper material used. But one of the chief causes of trouble is a want of proper descent to allow a free flow of the sewage. After all, however, the main difficulty is what to do with the enormous accumulation of sewage matter which must result from even the most perfect system. This is the all-important problem which the great cities of the earth are trying to solve. London has endeavored to do it by means of "low, level sewers," and although they have succeeded in purifying the Thames, and thus removing a great source of evil, they have not yet arrived at a satisfactory utilization or disposition of sewage.

The Municipal Council of Paris has, it is stated, adopted a plan for cleansing the Seine, by which the sewage deposited in the river will be directed to the plains of Genievilliers, with what degree of success remains to be determined. Capt. Liernur, a civil and military engineer of Holland, has projected a pneumatic system for the removal of sewage matter, which is now under trial by the City of The Hague. Earth-closets, as a substitute for sewers, are being extensively and successfully used in England and in this country. Of one thing there can be no question. The successful plan which can economically remove, without offense, the refuse matter of cities beyond the precincts, and apply it to the restoration of exhausted soil, will be one of the greatest of blessings. The increasing importance of this subject is more apparent in this country than elsewhere, by reason of the rapid increase in population,
and the establishment and growth of new towns, especially in the interior, where difficulties occur that are not experienced along the seashore. The same stream of water is often the source of water supply and the receptacle of sewage. The consequence resulting therefrom cannot be considered problematical.

For instance, Newark, Hoboken, and Jersey City, in New Jersey, obtain their water supply from the Passaic, while the city of Paterson, a large manufacturing centre, discharges its sewage into the same river at a point higher up the stream than that from which the water for those cities is taken. It is vain to hope that the sewage will be so diffused in running water that it will not contaminate it. Organic matter has always been the readiest means of propagating contagion, and in no way can it be so readily distributed as in water.

There are many minor points connected with this subject which the limited time at my disposal has not permitted me to discuss.

The leading points which have been presented will, it is hoped, stimulate thought and inquiry. The condition of all our cities and towns requires to be carefully examined, especially with reference to improved methods of drainage and sewerage.

The fearful exhibit of the annual mortality, from preventable causes, throughout our otherwise favored land, calls for the active exertions of all intelligent men toward the removal of these causes. Wise counsel and wise legislation are needed. All classes of our people require instruction on this subject. Associations for this object should be formed in every city, town, and hamlet. Public lectures should be delivered, sanitary publications distributed, and the leading principles of sanitary science taught in the schools. Our people, otherwise so intelligent, should not be suffered to remain in ignorance of truths so vital to their welfare. The ignorance of one individual may destroy the health of an entire neighborhood, as the match lighted by a thoughtless child may create an extensive conflagration.

The progress made in sanitary reform during the last decade is a happy augury of what may be accomplished in the future, although the field is large and the laborers few.

Let us not suffer the importance of this great subject to be underrated through ignorance or indifference. The questions involved are of vital moment to every man, woman and child. That the vast majority of men die before their time, is made evident from the fact that so few die of old age; and when we estimate, or rather try to estimate, the sorrow and the misery which must be entailed by reason of the premature loss of the heads of families, not to speak of the desolation which follows the taking away of even one member of a happy domestic circle, the heart sickens at the contemplation, and yet how much of all this sad suffering might be spared by a knowledge of principles so simple that a child can learn them, and the practice of rules so plain that it is criminal to neglect them.