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THE SANITARY ENGINEERING PROBLEMS OF WATER SUPPLY AND SEWAGE DISPOSAL IN NEW YORK CITY[1]

THE Section on Public Health of the New York Academy of Medicine is formed at a peculiarly opportune time. Never before has sanitary information of a reliable, authentic character been so much desired by the public, nor so difficult for the public to obtain.

Our great universities have, for the most part, failed to recognize the vast popular and educational value which would attach to the establishment of adequate facilities for teaching sanitary science, hygiene, public health or preventive medicine, as that body of knowledge which relates to the prevention of disease is variously termed, and have left this kind of teaching largely to the newspapers and to the general practitioner of medicine. Unfortunately, physicians do not always appreciate their importance as sanitary teachers.

It is in consequence of this that vast stores of scientific facts which are being constantly collected, and which bear upon the causes and ways of preventing disease,

[1] Address delivered at the opening of a Section on Public Health of the New York Academy of Medicine, January 8, 1907.

are locked up in severely technical journals or brought out, often with an entirely mistaken interpretation, in the public press.

Aside from the collection of new sanitary facts, therefore, the members of this section can perform an extremely valuable service in assimilating the data made available by scientists and other busy workers and help to mold public opinion toward a proper consideration of the endless number of topics which relate to the public health.

The beneficial fruits of these labors will certainly be far-reaching. It has been well said that the eyes of the whole country are upon the metropolis. To a considerable extent what is found to be good here is likely to be thought desirable elsewhere.

At the initiation of this section, it may be well to take a brief glance at some of the larger sanitary engineering problems which now concern New York and consider how, in view of present and future circumstances, these problems should be studied.

We have in New York a singularly good example of a city of the largest class, wherein the highest requirements of sanitation are demanded and are, at the same time, capable of being satisfied. The population is not only great; it is concentrated, and in race, habit and social condition, exceedingly diverse. Practically all of the conditions necessary to maintain life in a wholesome way have to be secured through a most careful observance of sanitary rules and principles. This relates not only to the food, clothing and habitations of the people, but in a peculiar degree to the care of their wastes and the wastes of those who have to do with the city's food and drink. Upon the prompt and adequate disposal of these wastes largely depends the security of the city against disease.

These, in the briefest terms, appear to be the necessities of the present. What the exactions of the future will be, when more refined standards of hygiene are established and the public sense of decency and morality becomes correspondingly elevated, it is impossible to say. It is evident that the subjects which are to concern our future guardians of public health are not to be related solely to the more obvious causes of disease.

Thus far, in the history of sanitation, the great strides of progress have usually resulted from emergencies, most of which have pointed in a striking manner to the fact that the grosser human wastes were not being properly dealt with. Unfortunately this method of progress still prevails to a great extent through the country, as witness the large quantities of filth of all kinds which accumulate in our northern villages and cities through the winter and the epidemics of typhoid fever which occur every year.

Sanitary emergencies, such, for example, as infected water supplies, capable of producing epidemics, now rarely occur in our largest centers of population and are no longer to be expected in the city of New York, which rightfully boasts one of the most efficient health administrations known anywhere.

Sanitation in cities of this class now and in future may be expected to progress along more scientific and conservative lines. The conditions to be avoided must be discovered and corrected as far as possible before they result in nuisance or disease. Large schemes for sanitary improvement must be made and made after careful investigation and preparation while yet there is ample time.

Two large sanitary engineering problems which now confront the city of New York are being studied in this manner, and as they well illustrate what is meant by these remarks, they will be briefly referred to.

The water supply is being enlarged.

Competent authorities have studied the matter exhaustively and decided upon what it is best to do. This problem has now entered upon its second stage, that of construction.

The project is, as you know, to enlarge the supply of all the boroughs of the city by bringing water from the Catskill Mountains. The quantity to be delivered will be from 80,000,000 to 150,000,000 gallons per twenty-four hours at first, and will probably reach 500,000,000 gallons, or more, in time. It is estimated that this, with the present sources of supply, should be enough to meet the needs of the increasing population until 1925. The present supply of Croton, which is consumed in Manhattan and Bronx, is about 292,000,000 gallows per day with a per day increase each year of 14,000,000 gallons, as shown by the records of consumption for the last ten years.

The quality of the new water will be superior to that of the Croton. It will be softer to begin with, and will be filtered through slow sand filter beds, located near White Plains, such as have been extensively used in various parts of Europe and America for many years. It is practically certain that the Croton supply will be filtered in the same manner.

Although a part of the new water will be available for the boroughs of Brooklyn and Staten Island, it is considered highly desirable that Brooklyn, if possible, should avail itself of supplies now stored in the sands of Long Island east of the present sources of supply.

As pointed out by the mayor, in his message of January 7, 1907, since the New York Board of Water Supply was appointed in June, 1905, remarkable progress has been made by its engineers in the preliminary work necessary to construction. About 40 per cent. of the line of the principal aqueduct of 86 miles from the Catskills to what is known as the Hill View reservoir, located near Yonkers, has been located, as has the site of the dam for the great Ashokan reservoir and the 10,000 acres of the reservoir itself. About 15 per cent. of this aqueduct has been prepared for contract. To accomplish this result, 550 miles of surveys and 12 miles of subsurface borings have been made.

At this rate of progress, it would not be surprising if water from this new source would be available considerably within the eight years allowed by the engineers.

As pointed out by the mayor, the new water supply is to cost over $160,000,000 and it is highly desirable that the taxpayers should understand the benefits to accrue from it.

The need of this work did not arise from any emergency. No epidemic pointed to its necessity. The work is being carried out largely in anticipation of the needs of the future, as pointed out with infallible accuracy by the teachings of sanitary science.

The problem of disposing of the sewage of New York and neighboring municipalities so that it shall not create a nuisance, or in other ways interfere with health, comfort or convenience has been the subject of official study for three years and is likely to continue to be investigated for several years to come. And the question here is not so much to improve present conditions, although this object may be accomplished in the end, as to protect our tidal waters against the vastly increasing pollution of the future.

Hitherto there has been no question as to the efficacy of the method of sewage disposal pursued by New York and its neighboring municipalities. House sewage and street washings have been discharged, without purification of any kind, into the nearest tide waters. Recently, communities remote from the shore have joined together

to bring their combined sewage through miles of sewers to the bay. One of these projects is unprecedented in the quantity of sewage to be carried. By a curious coincidence, the contemplated point of discharge is near the statue of Liberty Enlightening the World.

To say the least, it is disquieting to contemplate the discharge of so much potential danger into the waters which flow by our doors; which so many of us cross and recross daily; which is the scene of many of our most imposing national and municipal pageants; where some of us bathe—and many of us get our oysters.

If the wastes are rendered innocuous, they are destroyed in ways which are not understood. Our knowledge of the fate of the sewage of New York may be said to extend no farther than the outfalls of the sewers.

It is unwise to count blindly upon the purifying action of sea water and the tides, for to what extent the flow of the ocean in and about the great rivers and harbors which intersect the metropolitan district transports and renders innocuous the five hundred million gallons of dangerous matters which are discharged into them every day, it is impossible to say.

Perhaps the sewage is flushed out to sea; perhaps it is consumed by minute animals and plants; perhaps some of it is turned into gas, some into liquids, some oxidized or burnt up by the nitrifying bacteria in the water. Perhaps much of it is stored in pockets and sludge banks until freshets in the Hudson flush it out to sea. We do not know what becomes of it.

Obviously, the harbor, as a whole, has a large digestive capacity for sewage, but it would be curious, indeed, if that capacity had no limit. There are few persons who have been actively interested in studying this problem who do not consider that eventually some other method of sewage disposal than the present one will be necessary for a large part of the Metropolitan District. It is only a question of time. How long, nobody knows.

These two questions, the supply of pure water and the disposal of this water after it has been turned into sewage are sanitary problems of the largest kind. The estimated cost of constructing the new water works of New York exceeds the estimated cost of building the Panama Canal. If it becomes necessary to collect and purify all of the sewage of the metropolitan district, it may be a costlier task still.

The highest skill, wisdom and efficiency are none too great to enlist in devising safe and suitable works of such magnitude. The sciences of pathology, chemistry, biology, physics, meteorology and mechanics must contribute generously to the fund of information necessary in order that the plans may be brought to that high point of perfection which engineers characterize as 'necessary and sufficient' in their works.

And there is another consideration which has, so far, received little thought, but which must be taken into account in dealing with the sewage disposal problem. For work to be done at all, it must be done within permissible limits of cost. The charter of New York, which intentionally omits to restrict expenditures for water supply, confines the cost of sewerage and sewage disposal to within the constitutional debt limits of the city.

In thus giving emphasis to two of the problems which New York is attempting to solve, it is not intended to draw attention from other sanitary engineering problems, some of which are of almost equal prominence.

The double problem of cleaning the streets and disposing of the wastes so collected is one of the greatest magnitude. It costs the city over $6,000,000 per year to

maintain the department of street cleaning. In no other comparable city in the civilized world is this question in such unsatisfactory shape or so difficult to cope with, under the practical conditions which exist, as in the metropolitan district which we are considering.

The time will come when New York City will insist upon clean streets and find a way to have them. Eventually the public will demand that the refuse from our tables, kitchens and factories shall be disposed of at a minimum of offense and a maximum of economy and despatch. But until this problem is made the subject of competent study and a broad, comprehensive plan of administration and procedure is laid down, we may expect slow improvement in the primitive methods which have always been an offense to the eyes and nose in New York City.

The solution of this problem is probably far beyond the unaided capacity of any person who may be placed at the head of the street-cleaning department, and these remarks, therefore, reflect in no wise upon the ability of any official of the city, past, present or future. If it can be solved at all, and there is a very general impression that it can, the problem can be solved only as the other great sanitary engineering problems of New York have been, and are being, solved. That is, with the help of qualified experts, acting without prejudice, political bias or other ambition than to serve the best interests of the city.

GEORGE A. SOPER

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION A—MATHEMATICS AND ASTRONOMY

Vice-president—Dr. Edward Kasner, Columbia University, New York City.

Secretary—Professor L. G. Weld, State University of Iowa, Iowa City, Iowa.

Member of the Council—Professor G. B. Halsted, State Normal College, Greeley, Colorado.

Sectional Committee—Dr. Edward Kasner, vice-president, 1907; Dr. W. S. Eichelberger, vice-president, 1906; Professor L. G. Weld, secretary, 1904–1908; Professor Ormond Stone, one year; Professor E. B. Frost, two years; Professor E. O. Lovett, three years; Professor Harris Hancock, four years; Professor A. N. Skinner, five years.

Member of the General Committee—Professor James McMahon, Cornell University, Ithaca, N. Y.

Press Secretary—The secretary of the section.

Professor E. O. Lovett, of Princeton University, was elected vice-president for the year 1908.

The following mathematicians and astronomers were elected to fellowship in the association:

Baker, R. H.,	Maclay, James,
Brown, G. L.,	Manning, H. P.,
Dugan, R. S.,	Olds, G. D.,
Faught, J. B.,	Plimpton, G. A.,
Gates, Fannie C.,	Poor, C. L.,
Glenn, O. E,,	Riggs, N. C.,
Graham, W. J.,	Schultz, L. G.,
Granville, W. A.,	Smith, F. H.,
Hadley, S. M.,	Washburne, A. C.,
Leavitt, Henrietta L.,	Wilson, N. R.,
Lowell, Percival,	Young, Anna S.

The address of the retiring vice-president, Dr. W. S. Eichelberger, entitled 'Clocks, Ancient and Modern,' was presented on the afternoon of Thursday, December 27, in Fayerweather Hall of Columbia University. This address has already been published in SCIENCE for March 22 of the current year.

A joint session of Section A with the American Mathematical Society and the Astronomical and Astrophysical Society of America was held on Friday forenoon, December 28, in Schermerhorn Hall. The chair was occupied by Professor Simon Newcomb, past president of each of the participating societies. This was perhaps the most largely attended and the most generally interesting of any of the meetings in which any of the participating societies had a part. The following program was