HYGEIA IN MANHATTAN.

BY RICHARD WHEATLEY.

THAT beautiful Greek myth of the goddess Hygeia is an eloquent prophecy of the character and functions of all bodies like the Board of Health of the Health Department of New York. Perfectly organized, intelligent, wide-awake, and with genuinely feminine qualities, she is ideally adapted to the work assigned to her doing. Daughter of Æsculapius, father of the healing art, from whom she received her knowledge of herbs and mastery of medicinal and surgical science, she was lovingly worshipped at Athens, Corinth, and other cities. The Board of Health also is held in high critical esteem. It includes women, other than stenographers and type-writers, among its co-laborers, and develops the motherly element of humanity in all its members, while cultivating the close observation, keen judgment, and scientific helpfulness distinguishing the corps of Asclepiads whose headquarters are in the Criminal Court Building, bridge-connected with the gloomy Egyptian edifice so sorrowfully known as the Tombs, or City Prison.

New York is not, and never has been, exempt from epidemics of infectious and contagious disease. Malarial fever, small-pox, diphtheria, and consumption are common scourges; yellow fever and Asiatic cholera are not unknown afflictions. The city lost more than five hundred inhabitants from yellow fever in 1702. The first quarantine against the introduction of small-pox and spotted fever was established in 1737. Dr. Colden, in 1742, in view of the prevalence of yellow fever, recommended sanitary precautions, whose adoption was prolific of excellent results, and won for him a vote of thanks from the Common Council. Multitudes of physical ailments, with imposing Greek titles, aid the ordinary morbific complaints in preventing rapid increase of the population, and in impairing the health and efficiency of those already on the ground. Specific febrile (zymotic), constitutional, nervous, organic, respiratory, digestive, urinary, and developmental diseases diligently work deadly mischief. Poisons—principally alcoholic—accidents, and injuries increased the mortality to 40,175 in 1888, and to 43,420 in 1895. Pneumonia and phthisis are the most destructive of human ills, and with bronchitis caused 28.19 per cent. of deaths in the city in 1888, and 28.79 per cent. of deaths from all causes within the previous ten years. Typhus fever rarely occurs, except in connection with Hebrew and Italian immigrants. Leprosy and kindred diseases, indigenous to hot countries, seldom make their appearance, save in the persons of recent arrivals.

Experience has emphatically taught the lesson that "diseases are more easily prevented than cured, and [that] the first step to their prevention is the discovery of their exciting causes." These exciting causes may be chemical or organic—chemical, as in the case of bad smells from fertilizer or oil-refining factories and gas-works, or of poisonous exhalations from sewers, decaying animal or vegetal matter, or offensive chemicals; organic, such as the specific germs of sickness, so abundant in the earth on which we tread, the air we breathe, the water we drink, the foods we consume, the moving dust and innumerable objects with which we come in contact. Like Milton's angels, "they thicken air, darken heaven, and rule this lower world." Alonzo Gray affirms that millions of them would not equal the bulk of a grain of sand, and "yet each of them performs the functions of respiration, circulation, digestion, and locomotion." Biologists say there is no essential difference between the protoplasmic cells which make up the sum of animal life and those which compose the vegetable world. Whether these germs be animal or vegetal, or of both kinds, is not always clear. Dr. C. F. Chandler asserts that some are known to be animal in character, others vegetable. All kinds of food contain them. Any liquid containing animal substance, exposed to the air, soon swarms with them. Hay is always rich in bacilli. Human beings are never free from them. They are in plants and living bodies, in saliva, in all the secretions; crowd the mucous membrane of the alimentary canal, the skin, the bronchial passages, and teem wherever air, water, or aliment is brought into contact with the body, externally or internally. All consist in differing proportions of oxygen, hydrogen, nitrogen,

and carbon. All, or most, draw their sustenance from inorganic materials.

Nature is essentially cannibal. Distributed through the dough, yeast plants —a billion of which may be bought in a single yeast-cake for a cent—feed on flour, salt, and water; and, after the baking, their remains are consumed by human beings and other animals. Like fate awaits the yeasts or microbes that occasion fermentation of liquors. Those familiar to us under the name of moulds ordinarily escape it. Whether animal or vegetal, the bacteria abounding in nearly all waters attack and destroy impurities for their own nourishment, and in turn are devoured by higher organisms, until in the form of fishes they become nutritive food for the human family. But for the voracity with which the mother devours her own offspring, one bacterium, in the course of a single year, might monopolize her entire domain. Some bacteria are colorless, others iridescent, others phosphorescent; and all may be useful—although the usefulness is not always evident—in natural economy.

Whence derive these beings of the infinitely little their origin and life? Physiologists, like Carpenter and Huxley, conclude that organization is not the cause of life, but that life is the cause of organization—precedes it, fashions it, builds it up. "Only like can beget like. Spontaneous generation is a chimera." Conditions decide the species of all germs, and these conditions are fixed by actual energy working with seeming intelligence to purposed ends. Reproductive formal ideas are in the supreme force which organizes them, as classified or unclassified. This supreme force, R. W. Wright contends, is specified in Genesis, i. 11 : "And God said, Let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit *after his kind, whose seed is in itself, upon the earth.*" Correctly translated, the italicized words should read, "whose germinal principle of life, each in itself after its kind, is upon the earth." The germ-ideas, living and indestructible, of all organisms, animal or vegetal—man alone excepted—are in the earth, embody themselves wherever the necessary encircling conditions are present, and disembody themselves when the needful environment ceases to be.

It is with the germs of disease that hygienic science is mainly concerned. Bacteria is their generic designation. Not all bacteria, however, are malignant. Many, or most, are benignant. They embrace "many families of very similar physical structure, but endowed with very different chemical powers." One class attacks nitrogenous organic matter, and liberates the nitrogen in the shape of ammonia; while another class of bacteria determines the conversion of carbonaceous organic matter and ammonia into simple organic bodies—carbonic and nitric acids. They cause the return, through fermentation and putrefaction, of dead organic matter to the atmosphere and to water, maintain the equilibrium between living nature and dead nature, assure the same composition always to the atmosphere, and impart fertilizing quality to water. Pasteur claimed that their presence is indispensable to the germination of seeds, the growth of plants, and the digestion of food, as well as to the diseases of silk-worms and grape-vines. As ferments, they change the juice of the grape into wine, transform cider into vinegar, sour liquids and foods, ripen cheese, rot timber, and putrefy all organic masses. Much is known of their functions, and more remains to be known. Bacteria morphologically, or in respect of shape, may be the same, and yet in action on living matter so different that while some are pernicious, others appear to be harmless.

Not only is the fame of Pasteur inseparably associated with the germ theory of disease, but also with the art of varying the virulence of germs, increasing or decreasing it at will. Attenuating the virus and hypodermically injecting it—finding in the evil its own remedy—he gave immunity to animals so treated. These not only bore with little, if any, inconvenience strong doses of attenuated virus, but powerful doses of strong virus, that in their normal condition would have proved speedily fatal. His methods were soon adopted generally. By their application in France, the epidemics of carbuncle that emptied stables of horses, and of cholera that swept barn-yards clear of chickens, soon existed only in the memories of farmers. Equal service was rendered to purveyors of sumptuary supplies, and owners of flocks and herds in danger of decimation from anthrax or splenic fever, by his system of preventive vaccination. He also proved that in the human body living germs are the causes of

transmissible and contagious disease, and that the injection of attenuated virus will give immunity against such disease, and arrest its development where already begun. This is the secret of his treatment of hydrophobia. The perfecting of his methods is reserved to the future. Bacteriology is still in sturdy infancy. It

TETANUS BACILLI.*

knows how, by isolation and disinfection, to avert contagion and to stamp out epidemics in the places of their beginning. The world is not likely to suffer in the future, as in the past, from devastating plagues. Hygeia is under obligations to him for aseptic and antiseptic treatments in surgery. The purulent infection of sores, erysipelas, and septicæmia, which formerly infested hospitals, has practically disappeared. Puerperal fever is now almost unknown to obstetrics. There is no one in the world to whom medical science owes more than to Pasteur. "His scientific career is a luminous track in the profound night of the 'infiniment petit,' on the lowest levels of being, where life originates." Of tender heart, he was the most merciful and reasonable of vivisectionists. The salvation of human health and life was his end in all experiments. "Are ye not of more value than many sparrows?" was his conclusive reply to cranky critics.

Haeckel classes bacteria as a special group with the zoomonera, or animal developments of the monera, the simplest discoverable forms of life; says they are nourished by the acquisition of plasma from other organisms, and change the elasticities obtained from them into the living power of warmth and mechanical motion. Of many and various forms—globular (*e. g., micrococcus*), rodlets (*e. g., bacillus*), filamentous, curved, spiral (*e. g., spirillum*), or exhibiting peculiar quivering movements (*e. g., vibriones*)—most of them are so minute of size as to be invisible, except under a very powerful magnifying-glass, and many even then only when colored. A single drop of putrid water may enclose milliards of them. All are homogeneous little lumps of plasma, without trace of sexual organs, and increase simply by fission, or self-division. "Many of the most dangerous illnesses" (cholera, tubercular diseases, erysipelas, splenitis, chicken-cholera, and swine-plague), continues the German philosopher, "are produced by peculiar species of bacteria." In the shortest space of time these minute protista, developing in masses, and producing a peculiar poison (ptomaine) from their own chemical substances—often indicated, as in putrid meat, by evil-smelling gases—characteristically ruin the tissues and corrupt the fluids of the human body, and thereby cause death. This is certain, but more or less of what is affirmed about them is uncertain. Scientists reason from the known to the unknown, and in so doing find ample scope for the play of imagination and the trustfulness of faith. The bacterial germs of influenza, typhoid fever, cholera, diphtheria, consumption, tetanus, glanders, splenic fever, and septicæmia (blood-poisoning) have been identified; those of rabies, scarlet fever, small-pox, and typhus have hitherto eluded the complete knowledge of bacteriologists. Any one of the specific bacteria may originate a thousand consecutive generations, of which the last will be endowed with precisely the same properties as the first. The bacterium of diphtheria never passes into that of tuberculosis. Of all and every one the specific antitoxine neutralizes its own poison. Thus, in one cage at the Willard Parker Hospital lay a dead guinea-pig, inoculated with diphtheritic poison, while its companion, inoculated by Dr. Park with the same poison and also with its correspondent antitoxine, seemed to be a little ragged and under the weather, but otherwise in cheerful spirits and condition. Dr. Park states that "some bacteria, such as tetanus and diphtheria, produce

* For the diagrams used in this article to illustrate the appearance of bacilli under the microscope we are indebted to the courtesy of William Wood and Company.—EDITOR HARPER'S MAGAZINE.

in the organism an antitoxine; others, such as typhoid and cholera, produce in the blood a specific bactericidal substance, which kills the disease bacteria, but produces no effect on the poison already elaborated; and probably still others act in still different ways, and tend to limit and cure diseases." Others of the less-known bacteria, in passing through the successive phases of life history, present differentiations of form that may be mistaken for generic or specific characteristics. Spores or resting-cells are minute bacterial granules that selfishly appropriate all the protoplasm, cover themselves with a dense envelope, are capable of immediate germination, or may be kept for months or years, during which they preserve vitality, being very resistant to desiccation, heat, and cold. It is almost impossible to kill the spores of certain bacilli by cold, or by a temperature of 110° C., or by several weeks' immersion in absolute alcohol. These and all noxious bacteria cause specific disease where their presence is constantly detected, and with constant malignant disposition toward tissues, organs, etc., when they can be cultivated in nutrient media outside the body, and when inoculation with a small amount of pure cultivation reproduces the specific disease in a healthy animal. High condition of bodily health is the surest safeguard against these insidious foes. Fatigue and fasting greatly diminish the power of resisting them. Normal healthy tissues are always effective germicides.

Hygeia's assistants long since discovered that bacteria multiply in milk exposed to germ-laden air, or conveyed in cans previously washed in contaminated water. Typhoid fever, preceded by the "feeling miserable," is frequently communicated through these media. The bacillus causing it has been proved to survive a journey of nine miles in closed water-pipes and a freezing of four days in ice. Bacilli will grow slowly in an ice-chest. In cheese and milk bacilli allied in shape to diphtheritic germs but destitute of their poisonous quality are microscopically detected. Germ-infested and adulterated milk, with Herodian cruelty, brings on the *cholera infantum*, so fatal to multitudinous little ones in large cities. Disease is frequently caused by virulent bacteria diffused throughout the offensive materials employed in many trades. The London *Lancet* shows that bread contains many kinds of living bacteria, and infers that many unaccountable disorders may eventually be traced to their agency. Deadly diphtheritic bacilli are known to pass from the throats and lips of pupils in public schools by means of pencils and sponges used by infected scholars, and redistributed every day. They infect following users, and frequently cause epidemics. The perils of travel by rail are multiplied by bacilli exhaled by consumptives, or conveyed to cushions and bedding by contact with the skins of sufferers from other maladies.

Hygienic research into the origins of sicknesses, to be of the highest value, must be comprehensive and exhaustive. As the enemy is everywhere, he must be sought, assailed, and conquered everywhere. In water is one of his favorite lurking-places. Epidemics of cholera, typhoid fever, and sundry other scourges are not infrequently attributable to water used for cooking and drinking purposes. Pathogenists trace visitations of Asiatic cholera to the sacred well Zem-Zem at Mecca,

BACILLUS TUBERCULOSIS.
Magnified one thousand diameters.

whose water, poisoned by innumerable bacteria, infects the Mohammedan pilgrims, who devoutly drink it, and whose homeward route is marked by the graves and bones of those who die on the way. From them the pestilence passes on to western Europe, and thence by steam and sail to the United States. Hamburg in 1892 suffered severely from cholera induced by using the water, filtered or unfiltered, of the sewage-laden Elbe. Dr. T. Mitchell Prudden (*Harper's Magazine*, August, 1892) lays great stress on the danger to civic health latent in water pumped

from streams or reservoirs contaminated by the discharges of communities resident on their banks. Freezing does not purge it wholly from the disease germs introduced with human waste. This is true particularly of the typhoid bacillus, the most fatal of sewage germs. Vegetable bacteria, so hardy that no pressure or degree of cold can extinguish their vitality, constitute the ice flora, and after release by warmth are as potent for good or ill as before they were ice-bound. Snow contains more of them than clear ice. Innocent when the ice has been formed from pure water, they are dangerous if it has been polluted by matter from the bodies of men or animals afflicted by maladies. Distillation of such water through charcoal filters is no security against the peril, but rather enhances it, because the filters are too often breeding-places of the pest. Some bacteria are so small that they will pass through any filter. It is not because of bacteria simply as bacteria, but as disease-producing bacteria, that many portions of the ice flora are invested with practical importance. Neither oxidation nor sedimentation, as urged by belated scientists and unscrupulous dealers, can justify the use or sale of ice cut from sewage-polluted waters, whether of the Hudson or of any other stream. The late typhoid-fever epidemic with its grim death-roll at Elmira, New York, is ascribed to the use of water and ice swarming with bacteria from that open drain the Chemung River.

Professor Chandler's reports on the hygienic properties of Hudson River water at Albany and Troy express a different opinion. Spontaneous purification of water, he says, goes on in running streams; vegetable and animal life assists the process; atmospheric oxidation may complete it. Chemical tests will not detect the specific poisons of zymotic diseases in water; and yet, Dr. Tidy affirms, wherever drinking water has occasioned outbreaks of disease, such water "would have been unhesitatingly condemned on analysis by the chemist," as excessively charged with putrescent organic matter. The bacteriologist rather than the chemist is the preferable authority on all questions of water-supply. That the water of certain London wells has disseminated cholera poison does not prove that Thames water taken from the river above London is unwholesome; for visitations of cholera in London and elsewhere have been to low levels in proximity to tidal rivers, densely populated, badly sanitated, and drawing their cooking and drinking water from wells heavily charged with excrementitious matter oozing through the gravelly soil from the surface and from the local tide-locked sewers, while the people in the same districts using the Thames water were almost wholly exempt. Like remarks apply to American cities, and not least forcefully to Manhattan.

Dr. Koch detected the comma bacillus in the intestines of persons who had died of cholera in Egypt and at Calcutta. He also discovered it in East Indian tanks, the filthy waters of which were utilized for all domestic purposes. That the comma bacillus was the cause of cholera was subsequently demonstrated at Lucknow by the experience of the East Lancashire regiment, of which Company E escaped the scourge altogether, while the other companies, under identical conditions of barracks, food, and water-supply, suffered severely. All the water was pumped from deep wells, germ-free, into filter beds whose sand had been taken from the banks of the river below the city at a point exposed to every sort of contamination. This sand was alive with cholera bacilli, and poisoned the water seeping through it. The cause of the epidemic was explained by this discovery, but not the immunity of Company E. The cause of this also was made plain by the statement of the color-sergeant, who asserted that his company had precisely the same supply of water as its fellows, and that he ought to know the fact, because he boiled the water himself. *Boiling the water* had killed the germs, and completely protected the users. It is the simplest of germicides. Electrolized sea-water, solutions of carbolic acid and corrosive sublimate, moist steam, and the actinic rays of solar light are also inclusible in the list.

Cholera is not only propagated by germs in water, but also by microbes in the air. Its contagion is carried from house to house by persons and soiled clothing. From whatever source it may spring, or by whatsoever means it may spread, anticholeraic inoculation is the safest and best means of estopping its march. This is signally true of India. In that country Dr. Haffkine, "the Jenner of India," and the disciple and colleague of Pasteur, employed a weak vi-

rus, prepared by passing air and oxygen over a cultivation of the cholera bacilli at a high temperature. After a few days he inoculated with a strong virus, artificially rendered highly virulent. Not a single injury to health ensued from 42,445 inoculations. In the vast majority of cases immunity from the disease resulted.

The water of lakes and reservoirs, in the warm months, is often fishy in taste and unpleasant in odor, from the presence of innumerable microscopic confervoid plants or algæ, abounding in a volatile odorous principle, and soluble to some extent in water. These, however, do not perceptibly affect the healthfulness of the fluid. Water also absorbs acid and sulphurous gases, and dissolves mineral and organic matters in the form of atmospheric dust that is precipitated by falling rains. Ehrenberg detected 320 species of organic forms in aerial dust. Subsurface impurities from limestones and chalks, coal measures, salt, and petroleum, often impart objectionable qualities to water. Organic impurities owe their poison to noxious bacteria. Microscopic fungi, looking like dust upon the water, and dense slimy strata of *oscillatoriæ* in stagnant pools, are no less deleterious. These and other plants give an oily appearance, greenish or brownish color, and repulsive odor to water.

Practical acquaintance with menacing dangers is absolutely essential to successful effort to ward them off, and even more needful to counteract them when in actual operation. Perfect knowledge of present and possible ills is not as yet in scientific possession. With partial knowledge of the causes and occasions of disease, and of the best means of preventing their ravages—knowledge not always of the clearest, but still invaluable—the members of the New York Board of Health, through collated experiences, close study, and elaborate experiment, strive to attain comprehension of entire truth and widest practical usefulness. The Board of Health consists of President (Charles G. Wilson) and Commissioner of Health (Dr. George B. Fowler), appointed by the Mayor; Health Officer of the Port (Dr. Alvah H. Doty), and President of the Board of Police Commissioners (Theodore Roosevelt), are *ex officio* members. A secretary with thirteen clerks and employees, and an attorney and counsel with four clerks, give effect to legal instructions in harmony with the sanitary code of the city. The Health Department, under these officials, is divided into two bureaus, of which the Sanitary is under the charge of Dr. C. F. Roberts, who as superintendent enforces the sanitary code, and all laws relating to tenement and lodging houses. The bureau itself works in four divisions—that of contagious diseases and special medical sanitary inspection (Dr. C. S. Benedict); of pathology, bacteriology, and disinfection (Dr. H. M. Biggs); sanitary inspection (Alfred Lucas); offensive trades, and food inspection, including chemistry (E. W. Martin). One hundred and eighty—more or less—subordinates discharge the duties of clerks, sanitary and medical inspectors, chemists, and disinfectors; inspectors of milk, fish, fruit, meat, tea and coffee, offensive trades, contagious diseases, vaccination, and virus.

The second bureau is that of Records, to which, under a medical registrar (Dr. R. S. Tracy) with twelve employees, is intrusted the registration of marriages, births, and deaths, the grant of burial permits, the study of topographic causes of sickness, the circumstances of unusual deaths, and the classification and filing of vital statistics in two forms—viz., by name, street, etc., and also by specific disease.

Ten honorary consulting officials of commanding professional eminence lend their aid in matters requiring expert acquaintance with hygiene, pathology, meteorology, sanitary engineering, veterinary science, and dermatology. The Riverside Hospital, on North Brother Island, for the care of contagious patients, is supervised by resident physicians, assisted by thirty-seven nurses and employees; the Willard Parker and Reception hospitals, at the foot of East Sixteenth Street, are in charge of two resident physicians with thirty-one employees; the steamboat *Franklin Edson*, in service of the Health Department, is manned by captain and crew of five members, and the Floating Hospital by captain and engineer.

Such is the organization and such the army chosen by American metropolitans for self-protection against assaults on public health and happiness by countless legions of enemies, visible and invisible. Let us watch the whole in counsel and action. The interests of the civic and

national public are deeply involved. Modern municipal government is everywhere exalting the bacteriologist and sanitary inspector, fostering the kindergarten and the technical school, and paying anxious heed to the housing of the people. Sanitary inspection is of dwellings, trades buildings, conductors of gas, steam, and water, external conditions of healthfulness, plumbing, drainage, light, ventilation, and domestic conveniences. That it may be well done plenary powers should be conferred upon the Board of Health as a separate department of the city government. Inspectors should be independent of party politics, and with qualifications ascertained by rigorous examination. Skilled servitors are in imperative demand. The substitution of model domiciles for slum tenements is a humanitarian and patriotic necessity. The slum tenement is too frequently a darkened, malodorous, unwholesome sty, incapable of improvement, and worthy only of demolition.

The labors of regular sanitary inspection cover not only infected but non-infected districts. They are supplemented during the months of July and August by those of a special medical corps, who visit every tenement-house, and especially in the poorer and more crowded sections—where human beings are thicker than on any other spots of similar size upon the earth—prescribe for the helpless sick, impart needful advice, distribute printed rules for the care of infants, and cause all unsanitary conditions to be corrected. Figures impress but a faint idea of the fidelity with which this work is ordinarily performed. More public hospital accommodation should add to its benefits. The city has, or lately had, 10,245 beds in hospitals, of which only 4861 are in municipal charity institutions. It provides about 3.30 beds to every thousand of the population; London has 7.59; Paris, 9.83; Stuttgart, 11; Naples, 12; Rome, 18—the percentage rising in proportion to the poverty of the citizens.

Selection and appointment of officials to positions of honor and emolument may not altogether escape the taint of political partisanship, but, nevertheless, considerations of humanity and public policy outweigh the exigencies of party. Few know or care to know what the political affinities of Chandler, Prudden, Biggs, or any other expert may be, but all feel concerned in the question of professional merit and scientific acquisition. Hygeia in New York chooses of the best for the brain and sinew of her Health Department.

The disinfecting corps of twenty-six men, in charge of a medical man as disinfector-in-chief, is, like the disinfecting plant in East Sixteenth Street, one of the most excellent in the country. To each of fifteen districts into which the city is divided is assigned a disinfector, whose duty it is, when possible, to fumigate and disinfect, by means of three and a half pounds of sulphur dioxide to every 1000 feet of cubic air space, all premises where contagious diseases have been reported, and to give verbal and printed instructions for further action if required. All textile fabrics from the defiled premises are sent in departmental vehicles to the East Sixteenth Street station, there, by heating in an oven with dry heat and steam alternately for three hours, to be rendered innocuous, and then returned without cost to the owner, excepting such as are worthless or past redemption, and therefore doomed to the crematory. The sick of contagious complaints are removed by order of the diagnosticians to the hospital, and there subjected to secondary bacteriological diagnosis. The dead are carried to the Morgue in charge of the department. Nothing excels the tenderness and care with which the sick, and markedly the children, are handled by uniformed attendants, nurses, and doctors at the reception and other hospitals, nor the skill with which surgical manipulation is conducted, measures adopted to prevent the transmission of germs, and to secure proper temperature, pure air, and utter cleanliness. Where two contagious diseases—*e. g.*, measles and diphtheria—meet in the same person, he or she is sent by the diagnostician to the Reception Hospital, and from thence to North Brother Island, where excellent accommodation is provided. The Willard Parker Hospital and its annex are reserved for non-complicated cases of diphtheria and scarlet fever, diagnosed previously at the places whence they were reported. Syphilitic patients are consigned to the Charity Hospital. Minute and comprehensive instructions on the subjects and methods of disinfection are issued in circulars by the Health Department, and the reasons therefor made plain. All things with which families come into contact are comprised. The preparation of deodor-

Dr. A. H. Doty, Health Officer. Theodore Roosevelt, President Police Department. Gen. Emmons Clark, Secretary.
Dr. George B. Fowler, Health Commissioner. Charles G. Wilson, President.

THE NEW YORK BOARD OF HEALTH.

ants and the sterilization of milk for feeding infants are matters of which full information is published.

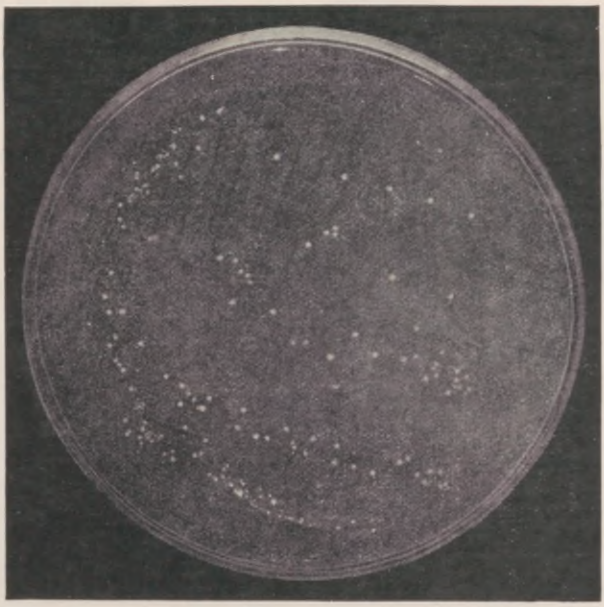
Diagnostician research is curious, attractive, and pivotal. It deals chiefly with diphtheria, one of the most dreaded of germ diseases. Bacteriological investigation of its causes is careful and exhaustive, and diagnosis as thorough as skill and science can make it. Dr. W. H. Park, the special inspector, in common with leading foreign and domestic investigators, finds that practical differentiation of false from true diphtheria is of great sanitary importance. Mistake is easy, and frequent among medical practitioners. During the year 1894 at least one-third of the 4874 cases of diphtheria reported to the board were found to be of other character. The presence of the Klebs-Loeffler bacillus—so called from its discoverers—in the upper air passages is proof of mortal peril and possible infection. To neutralize the first by inoculation and prevent the second by disinfection, an elaborate system is established throughout the city. At about sixty depots—mainly in drug-stores—culture-tubes, swabs, printed blank reports, and instructions for inoculation can be obtained without charge by physicians. The tube, about four inches long and two-thirds of an inch in diameter, is partly filled with a mixture of calf or sheep serum and nutrient beef broth, in the proportion of one-third of the latter to two-thirds of the former, with one per cent. of glucose added. This is the Loeffler blood-serum mixture. The whole is sterilized by heat, and when solidified and protected by cotton plugs in the mouth of the tube will keep for months. The swab is a thin steel rod, six inches long, sterilized, with absorbent cotton attached to one end. Diphtheria antitoxine of high efficiency may also be purchased or obtained free at the same depots. Late in the afternoon of each day the tubes employed are collected, and the entire culture outfits returned to the station from which they were issued.

CULTURE OF TUBERCLE BACILLUS UPON GLYCERINE AGAR.

In the application of the culture outfit each doctor rubs the swab against the infected membrane, then inserts it into the blood-serum tube, and rubs it back and forth a number of times over the whole surface of the serum, but without breaking through it. This is, technically, the culture. The culture tubes, inoculated as described, and deposited in an incubator at 37° C.—the body temperature—are kept there for twelve hours. Then, on inspection, the surface of the blood serum is seen to be dotted with very numerous colonies of bacteria. Part of these are transferred on a platinum needle to a tiny drop of water, placed on a clean cover-glass and smeared over its face. The bacteria on the glass dry in the air. Next the cover-glass is passed quickly three times through the flame of a Bunsen burner or alcohol-lamp, covered with a few drops of Loeffler's solution of alkaline methyl blue, left without heating for ten minutes, then rinsed off in clean water, dried, and mounted in balsam. Seen through the one-twelfth oil-immersion lens is either an enormous number of characteristic Klebs-Loeffler bacilli with a moderate number of cocci, or a pure culture of cocci, mostly in pairs or short chains. Other and different bacilli sometimes appear. Immediate diagnosis by direct microscopic examination of matter exuded from infected membranes may in some instances be of great value, but is not a method suitable for general use. Repeated cultures of bacteria taken from the throats of convalescents show that they remain in the secretions from three days to three weeks after the patient is apparently well. Not until they have vanished is disinfection performed.

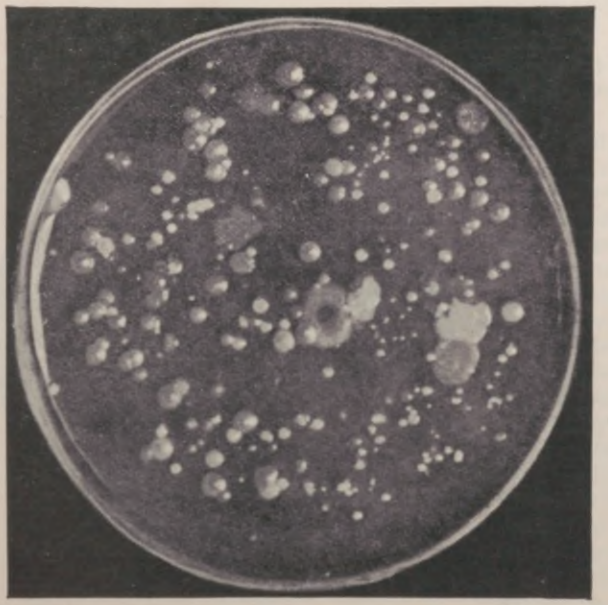
The Loeffler bacilli occur singly, in pairs, or in chains; vary greatly in size and shape, and are readily stained. Multiplying quickly, one may produce, by self-division, about thirty millions in the

course of twenty-four hours. Pearl-gray points on the blood serum grow into colonies one-quarter of an inch thick in the space of forty-eight hours. Edges of colonies show sprouting bacilli, some of which when dried retain vitality for five months. Diphtheritic cultures in flasks containing bouillon cause the latter to present a turbid appearance; cultures of tuberculosis create a dense wavy pellicle on the surface.



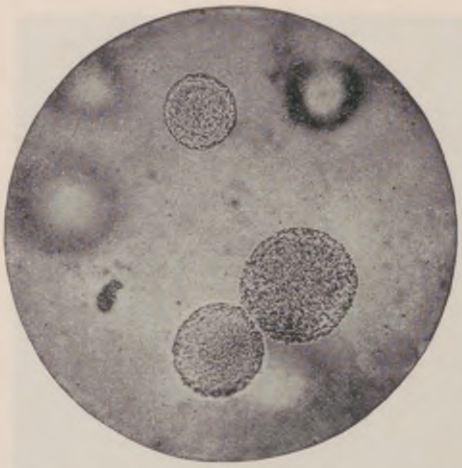
COLONIES FROM DIPHTHERITIC MEMBRANE.

Guinea-pigs, of which, as well as of rabbits, the Board of Health has numerous collections, furnish the media through which may be determined with certainty the virulence of bacilli. Hygienists prize the lively, amusing little animals as valuable adjuncts in the arrest and prevention of disease. They, when about half grown, receive, by subcutaneous inoculation, alkaline glucose broth cultures of forty-eight hours' growth. The amount injected varies from one-fourth to one-half of one per cent. of the body weight of the animal inoculated. When the bacilli are virulent, this quantity causes death in twenty-four hours. Much of the work done in the laboratory is of routine character; not a little of this work, however, is original. It is pursued with an assiduity, patience, exhaustiveness of comparison, and closeness of logic that cannot but yield trustworthy results.



COLONIES OF DIPHTHERITIC BACILLI AND STREPTOCOCCI.

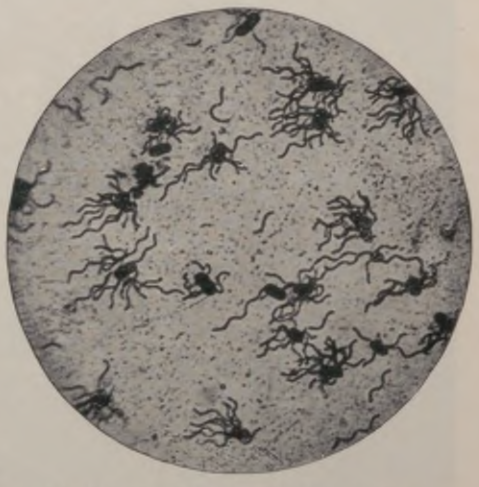
Diphtheria antitoxine, injected with excellent effect in hospitals and the homes of patients, is derived from animals inoculated with the poison generated by the diphtheria bacillus. Its action on the blood, chemically, is like that of the substances created in illness—as in scarlet fever and small-pox—which render an individual insusceptible to a second attack of the same disorder. It is drawn from the blood of animals, mostly horses, rendered im-



COLONIES OF SPIRILLUM CHOLERÆ ASIATICÆ.
Magnified one hundred diameters.

mune against diphtheria bacilli through repeated injections of their toxines. These "toxines are the poisonous chemical compounds produced and set free by the growth of the diphtheria bacilli," the most virulent of which are selected for this purpose. After testing the strength of the toxines on guinea-pigs, the bouillon containing the toxines is injected into horses and other animals. Of the horses subjected to this process there are more than forty, whose health and comfort are sedulously cared for by trained veterinarians, in the stables at No. 154 East Fifty-seventh Street, at the cost of the Health Department. Into each of them about ten drops of the toxine are injected. After reaction against the injurious effect, the doses of toxine are increased in size and frequency, until, in less than five months, the less sensitive horses will receive doses a thousand times larger than the first, without showing any local or constitutional symptoms of serious disturbance. They are then said to be immunized. When from 4000 to 6000 drops have thus been introduced, the horse's blood holds antitoxine in sufficient quantity for healing purposes. The blood is drawn from the jugular vein by means of a canula into sterilized flasks, with capacity of from one to four pints. The horses themselves seem to be indifferent to the operation. From two to four days' storage in an ice-chest suffices for the squeezing out of the serum from the clot. In this serum is the dissolved antitoxine, which has the power of neutralizing the poison secreted by the special bacillus of diphtheria. Different methods ascertain its strength. A small quantity of it is enough to save life if injected some hours before diphtheria poison is introduced. If injected within twenty-four hours from the outbreak of the complaint, recovery is remarkably rapid; if toward the end of its course, little or no improvement follows. Notwithstanding negligence and delay, the mortality in children's hospitals has been reduced from about 55 to 12, and even 8, per cent.—an achievement without parallel in the annals of medicine. The amount of antitoxine required for the treatment of a case of diphtheria is from 1000 to 3000 units, according to the severity of the case. The price of the remedy, as sold by the Health Department, is $1 50 per 1500 antitoxine units.

Vital statistics adduce the measure by which the remedial value of antitoxine may be estimated. Out of 5611 cases of suspected diphtheria studied by Dr. Park and Inspector A. L. Beebe from May 4, 1893 (bacteriological diagnosis beginning on May 6), to May 4, 1894, 3255, or about 58 per cent., were proved to be of true diphtheria. These were of ages between three weeks and seventy years. Forty-five per cent. of those under four years of age died. Paralysis of the heart, or of respiration, extending to the whole body, extinguished all vitality. False



BACILLUS TYPHI ABDOMINATUS, SHOWING FLAGELLI.
Magnified one thousand diameters.

diphtheria is usually due to bacteria (*streptococci*) in the throats of healthy persons, which cause inflammation when the mucous membrane is attacked by cold or other deleterious forces. Nettle-rash (*urticaria*) and insignificant needle abscesses are the only inconveniences that follow antitoxine inoculation of healthy persons. Inspector Beebe, reporting on

applied, but dependent for success on the perfection of detail with which they are carried out. These means are the isolation of the ailing and of those previously exposed to contagion, and the thorough disinfection of all contaminated rooms and materials.

Nor is modern hygiene less successful in opposition to cholera of Asiatic type,

THE WILLARD PARKER HOSPITAL.

the rise and fall of diphtheria and croup in New York from October 7, 1894, when antitoxine was first used, to October 6, 1895, and comparing this period with that between October 8, 1893, and October 6, 1894, expresses them in figures as follows:

	1893–4.	1894–5.
Total cases	8978	9379
" deaths	3073	2125
Average of fatal cases	34.23 %	22.66 %

The death rate of cases in 1891–4, inclusive, was 34.66 per cent.; in 1895 it was 19.43 per cent.—showing a decrease of 15.23 per cent., and the corresponding power of the new treatment.

In the prosecution of its prophylactic and curative mission the Health Department restrains threatened epidemics of typhus fever by means simple and easily

whether indigenous or intrusive. In other forms it is not due to the comma bacillus or spirillum of *cholera Asiatica*. The latter may be diffused by garbage, rags, old iron, bottles, and other refuse. In treating it, part of the discharges from a sufferer are committed to a sterilized bottle, and reported on by the bacteriologists of the board. After diagnosis the patient is transferred to a reception hospital, and his former environment, together with the ambulance and its furnishings, disinfected by fumigation and strong antiseptic solutions. In 1884 the study of epidemic cholera by Dr. Robert Koch elicited the facts that the cholera spirillum in the intestinal discharges of patients is never found in any other disease, that it may be cultivated in various substances out-

PIER AND LANDING, RIVER-SIDE HOSPITAL.

side of the living body, and that its biological characteristics differentiate it with certainty from all other micro-organisms. Further studies by scientists, at home and abroad, have suggested means for excluding the pestilence from the city. The task is all the more feasible in view of the alleged fact that the disease is not one whose germs travel through the air, but must actually enter the body through the mouth. Cleanliness in this case, if not next to godliness, is neighbor to healthfulness. Isolation and disinfection are pretty certain to assure the latter. Broom, pail, and scrubbing-brush, with antiseptic solutions, are among the humble weapons with which our hygienic army combats the assailant. Imitation of and improvement upon the measures of Koch and Haffkine are obligatory upon and will be accomplished by Hygeia in Manhattan should events demand it.

The Board of Health is visibly triumphant in antagonism to another complaint—a thousandfold more to be feared by its clients than cholera. It is consumption. In the heterogeneous mass of folk from over seventy diverse nations that compose the nearly two-millioned citizenship of the American metropolis, the Jews number more than one-eighth. Less than Gentile immigrants or native-born do they suffer from the bane of consumption or tuberculosis. Comparative exemption follows from their custom of killing and examining animals by professional and licensed slaughterers. Flesh infested by disease germs is repudiated as unclean, and only that whose blood and viscera are free from them is accounted *kosher*, or clean, and allowed to enter into family use.

Although the most common and fatal of diseases, over 6000 deaths being due to it in 1892, it is only lately that it has come under the official sanitary surveillance of the Board of Health. More deaths from tuberculosis would be reported were it not that policies issued by industrial companies—a single city company issuing about 400,000—are vitiated wholly or in part if the word *tuberculosis* appear in the death certificate. Consumption is at once communicable and preventable. Pathologists state that it may affect any organ or tissue of the

body. When it attacks the lungs it is known by the qualifying name of pulmonary consumption. In this form it causes about one-fourth of all deaths occurring in the human family. More than one-half of the entire adult population is, at some period in life, injured by it. The germ—tubercle bacillus—is the cause, and the sole cause, of tuberculosis. These germs, finding their way through the mouth into the body, multiply there, if favoring circumstances exist, and produce new growths or tubercles, which tend to soften. Discharges from these softened nodules, containing living germs, are thrown off from the body. Expectoration in pulmonary consumption expels enormous quantities—many millions of them in the space of twenty-four hours. Their power of mischief, even when thoroughly dried, may remain unimpaired for long periods. Tuberculosis cannot happen except through direct communication with some individual or animal afflicted by that disorder.

Meat and milk of tubercular cattle are prolific sources of the evil. Consumption is most frequently brought on by breathing air in which the germs are suspended as dust. The breath and moist sputum of tubercular patients are not perilous, because the germs are not dislodged from moist surfaces by currents of air. One cubic centimetre of sputum is said to enclose from ten thousand to nine hundred thousand bacilli, and four billions of them may be thrown out of the mouth in a single day. Methods of preventing infection include deposit of disinfecting fluid in domestic cuspidors used by patients, pocket paper cuspidors for patients when not at home, and paper napkins to be burnt after use. Pathogenists would prohibit, as the New Jersey legal code is said to do, the common practice of kissing, lest this token of affection should spread contagion. For like reason, individual communion cups are used by fastidious churches. Nowhere should the sputum be ejected where it may dry, and in powdered form mingle with atmospheric dust, and thus become new centres of disease. The ruling entity of zymotic or germ sickness is the microbe—lurking in all dark, mouldy, and unclean places. Its quickest destroyer is the sunbeam, aided by currents of fresh, pure air.

Circulars printed in English, German, Italian, and Jüdisch Deutsch disseminate these informatory items, together with ap-

SCARLET-FEVER HOSPITAL, NORTH BROTHER ISLAND.

DR. PARK'S COLLECTION.

propriate instructions, among the commonalty. The Health Board also requires hospitals, and requests private physicians, to report the name, sex, age, and address of every tuberculous person within seven days from the time such person comes under observation; orders special medical sanitary inspectors to investigate cases reported, but without interference with regular physicians, and to submit specimens of the sputa in doubtful instances for bacteriological diagnostication. It supplies bottles for the collection of such sputa, and blank forms for report, without charge, at the depositories where culture outfits are distributed. It urges hospital authorities to set aside proper wards for treatment of the disease, recommends acquisition by the Commissioners of Charities and Correction of a con-

sumptive hospital, and the provision of cuspidors for public and factory buildings. Its war on consumptive exuviæ is perpetual. Deaths from tuberculosis decrease annually.

The Health Department is more than a match for small-pox, which prior to 1877 was one of the worst contagions in respect of numbers and mortality. Its death-rate in 1875 was 122.55 per 100,000 people; in 1884, zero. Since then it has oscillated between the extremes of 6.43 and .06. Inspectors of vaccination have reduced the number of scarred faces formerly seen in the streets, and would reduce it still further if vaccination were compulsory. Revaccination, after a term of from five to ten years, seems to bestow absolute protection. The pure, carefully selected bovine virus, liquid or otherwise, produced in the vaccine laboratory of the department is used exclusively, and its surplus sold to applicants at a fixed price—realizing $3879 in 1892. A new needle with freshly charged quill for each is used for every operation, to avoid the possibility of infection or blood contamination. Primary vaccinations are examined and reported on by colleagues of the operators. The cost of each case to the department is eleven and a half cents; to the subject or parents, nothing. No pupil can legally attend a public school, nor any teacher be employed therein, who has not been vaccinated. All must present certificates of vaccination by medicos in good standing.

Our hygienic army diligently corrects, as lies in its power, all unsanitary conditions within the field of its operation. These unsanitary conditions are unquestionably responsible for much of susceptibility to disease. They derange the physical system by the introduction of poisonous substances, and thus create the abnormal conditions in which pestiferous germs work out deathful issues. Therefore the forceful vacation of dwellings and cellars unfit for human habitation, limitation to the crowding of domiciles by inmates, and effort to supply each with pure air in the proportion of 200 cubic feet to a child and 400 to an adult, pure water to drink, and pure unadulterated food, attainable in sufficient quantities by purchase. The lodging-house, unless lighted, ventilated, and sanitated properly, is a *bête noire*. Defective sewers, canals, bridges, docks, streets, private and public buildings endangering life or health, are scarcely less objectionable, and receive critical condemnation. All, as dangerous, are nuisances; so, legally, is anything that interferes with the proper enjoyment of human existence. Slaughter-houses for quadrupeds and chickens, of which there are from thirty-five to forty in the city, would be pestilent nuisances were it not that the Board of Health sees to it that all offal, blood, refuse, and other offensive matters are promptly removed, and the premises cleansed and deodorized. The Health Board solicitously supervises stables for more than 60,000 horses and cows, and also the health of their occupants; has abolished the sidewalk manure-pit, and regulates the daily disposition of 500 tons of manure.

Bad smells, to the certain knowledge of the hygienic corps, aggravate the dangers coming from another source, and one that is indispensable to popular welfare. Milk—easily soured by one species of bacterium and putrefied by another—impregnated with the germs of many sicknesses, and notably with that of tuberculosis, is a constant peril to health. Tuberculous cows, singly or in herds, are deplorably numerous in rural districts. Guinea-pigs inoculated with their milk develop tuberculosis and die. Sterilization by heat destroys the germs, and permanently prohibits fermentative changes. Armed with lactometer, thermometer, and suitable apparatus, the seven milk-inspectors visit the places where the lacteal fluid is sold, select samples for chemical analysis, and test them for skimming, watering, and other adulterations—such as the addition of salt, sugar, borax, annoto, alkaline carbonates, salicylic acid, and nitrates. Microscopic examination detects the infusion of colostrum, blood, pus, starch, and other insoluble substances. Milk adulterated by anything but water is poured into the sewers, and the venders thereof fined.

So serious a menace to public health is the prevalence of bovine tuberculosis in the State that the committee on tuberculosis appointed by the Legislature of 1895 virtually recommends the destruction of all cattle affected by it. This would stamp out the plague at the expenditure of about a million dollars. Reintroduction by imported animals from other States could be guarded against. The cost of suppression, at first glance, seems to be large, but prevention is al-

ways less costly than cure. In no other way known to science can the disease be extirpated. Koch's *tuberculin*, or its perfected successor, is practically an infallible means of bringing it to light, without injury or risk to sound animals. A million dollars is a small price to pay for future immunity. It costs many millions to counteract the ravages of germ-milk, buttermilk, and skim-milk, which "is so virulent an infective agent that the removal of the cows giving it from dairies is absolutely necessary." Such removal, it is calculated, would save from three to five thousand lives yearly. In the interval between the recommendation and legislative decision the Board of Health demands that the 6163 milk-dealers in the city and those who ship milk to them shall take out permits. It also prohibits the keeping of milk for sale or storage in any room used for sleeping or domestic purposes, or opening into it. Nor must it be transferred from one vessel to another, except at the time of delivery. Bottles and vessels used in the trade must be thoroughly clean, and protected against dust and other impurities.

On duty, offensive and defensive, continuously, our health army daily inspects, to the limits of its power, the markets, commission-houses, and stores where meat, fish, fruit, vegetables, and other sumptuary supplies are offered for sale. Millions of pounds, alive with baleful bacilli, are condemned, seized, and sent to the offal-dock, and millions more will be if public well-being be adequately defended against morbific agencies. Confectionery adulterated with poisonous pigments, often enclosing alcoholic fluids, and thus preparing children for alcoholic inebriety and ruin, falls under the cognizance and ban of the board. So do the dead animals in the streets, the unsaleable provisions in the markets, and the offal from the abattoirs. All are conveyed by the contractor to the offal-dock, and shipped to Barren Island for crematory treatment and conversion into fertilizers and other useful materials.

Reports of weekly analyses of the Croton water by the chemists of the Health Board, and comparisons of it with the water-supply of other cities, are of unfailing interest, and most of all to those familiar with the facts and discussions heretofore recited. These reports are eloquent, as they are instructive, in the statement that the solvent powers of water are superior to those of any other known liquid; that in its extensive range of affinities almost every substance in nature may be dissolved by it; and that it is rarely, if ever, wholly free from impurities. Hence it is of great sanitary importance to determine what impurities are contained in it, and what their action on the human body is. Three-fourths of the human body is composed of the elements of water, with other substances. Pernicious impurities derange its digestive apparatus, and reduce living tissues into peculiar susceptibility to malignant ailments. Purest natural waters contain mineral and organic impurities to the extent of one to eight grains per gallon. The mineral impurities are of one or more of the most extensively distributed metallic elements; the organic, of a few elementary substances, metallic and non-metallic. If nitrogenized, they indicate harmful contaminations, and assuredly so if the product of animal decomposition.

The following analyses, made some years ago, of the waters of Loch Katrine, supplying the city of Glasgow; of the Croton River, supplying New York; and of the Hudson River above Poughkeepsie, show the best attainable minimum of impurities in the supply of large cities:

LOCH KATRINE.

Carbonate of magnesia	.216
Chloride of calcium	.144
Alkaline chlorides	.433
Sulphate of lime	.381
Oxide of iron	Trace
Silica	.170
Organic matter	.900
Total solids	2.244
Hardness, by Clark's scale	.80

CROTON RIVER.

Carbonate of lime	2.67
Carbonate of magnesia	1.90
Chloride of sodium	.402
Chloride of calcium	.86
Sulphate of lime	.158
Sulphate of potassa	.179
Sulphate of soda	.260
Oxide of iron	Trace
Silica	.62
Organic matter	.67
Total solids	7.719
Hardness, by Clark's scale	....

HUDSON RIVER ABOVE POUGHKEEPSIE.

Carbonate of lime	1.059
Carbonate of soda	2.126
Chloride of sodium	.108
Sulphate of soda	2.785
Oxide of iron	3.644
Silica	2.201
Organic matter	.776
Total solids	12.699
Hardness, by Clark's scale	.43

The analyses of Croton water not only

determine its character, metallic impurities in solution, and degree of sanitary purity, but also the number of bacteria in every cubic centimetre. The chemical analysis for 1892 averaged, per United States gallon, 8.56 grains of solid matter.

Chlorine in chloride	.238
Equivalent to sodium chloride	.364
Nitrogen in nitrates	.025
Free ammonia	.0008
Albuminized ammonia	.0128
Total nitrogen	.0372
Hardness before boiling, equivalent to carbonate of lime	4.90
Organic and volatile matter	2.16
Mineral matter	6.40
Total solids	8.56

This analysis demonstrated that the water was not so good as formerly. It was more turbid, of darker color, and more offensive odor than in the previous ten years. These facts led to fresh inspection of the Croton water-shed, further precautions against pollution, abatement of such pollutions as existed, and acquisition of necessary lands by the city. They also led to the conclusion that some effective system of filtration must be adopted, inasmuch as self-purification through the action of plant life, bacteria, aeration, sedimentation, etc., cannot go on while the water in its flow is receiving constant increments of pollution along its several courses. Croton Lake, the distributing reservoir, which has served as settling-pond for many years, has not only largely silted up, but has become so charged with organic matter that it now gives out more or less of it to the outflow as the water rises and falls and as the temperature changes. Hygeia must and will find out the remedy.

Multifarious as the functions of the Board of Health are, and analogous at many points to those of the military in active service, they are exercised with care, force, and fulness. Organization approximates perfection. Scouts and sentries report attacks upon the public health, and of what character and in what locality. Relieving parties hasten to the rescue, report what progress is made in repulse, and what arrangements are established for confining peril to the spot and guarding against its recurrence. Tacticians in the laboratory and strategists in the office lend the aid of their art, science, and resources for checking the progress of the enemy and putting them to utter rout. Highest officials direct the ceaseless campaign. Orders, verbal and printed, issue to the fighting contingents; and returns, verbal and printed, are promptly made to superiors. Thus the warfare rages. Results, for life or death, with all essential particulars, are carefully inscribed in the archives of the department as memories of the past and guides of the future. More than 12,000 applications for authentic information were made in the year 1895. It is incessant warfare—warfare of highest moral character, for it seeks to overcome evil with good—warfare winning peace, prosperity, strength, and longevity for the whole municipality.

The facts and conditions thus indicated are of abiding influence upon the birth-rate as to sex and upon the general death-rate; upon death according to sex, age, and disease in the whole and in special localities of the city. Recorded in the annual report of vital statistics, they enable our modern Asclepiads to fix with some degree of precision the limits of mortality and its causes, and lead to consideration of the causes which bring about a high death-rate. The Bureau of Records is eminently serviceable. It reports 53,731 births during the year 1895. Nearly half—46.24 per cent.—of mothers are attended by midwives, not all of whom report all the advents of the human species into this world, although the civil law makes it compulsory on them to do so. Of the 20,612 marriages recorded it must be remarked that they are only such as were accompanied by some ceremony, sacred or secular, performed by some official legally authorized. Common-law marriages are not recognized. The number of deaths reported was 43,420, or 23.11 per 1000 of a population reckoned at 1,879,195 on July 1, 1895. The average population of New York is 71.07 to the acre, and 45,888 to the square mile. The number of inhabited houses is 87,291, in which reside 1,874,772 souls, besides 4423 who live in boats. The cost of the Board of Health to the city in 1895 amounted to $460,680, including large expenditures for hospitals and burials. This is a sum saved many times over by the practical wisdom with which it teaches citizens how to guide their lives. Hygeia in modern garb and with modern appliances is a public blessing whose worth is beyond estimation.