SCIENCE

VOL. 86 FRIDAY, NOVEMBER 19, 1937 No. 2238

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal
Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

CHARLES FREDERICK CHANDLER
1836–1925
NEW YORK'S FIRST PUBLIC HEALTH CHEMIST[1]

By HAVEN EMERSON, M.D.

PROFESSOR OF PUBLIC HEALTH PRACTICE, DELAMAR INSTITUTE OF PUBLIC HEALTH, COLLEGE OF PHYSICIANS AND SURGEONS, COLUMBIA UNIVERSITY

THE chemistry of discovery and its interpretation to the laity are almost the commonplaces of every day's news, and no field of human curiosity and exploration is richer in its contribution of great men and women or in its abundant gifts to the fullness of life.

What concerns us particularly is the use of chemistry through government for social ends, and in this Charles Frederick Chandler was a pioneer who shared with Stephen Smith, Edward B. Dalton, Dorman B. Eaton, Elisha Harris and William B. Worthen the distinction of making the Metropolitan Board of Health of the State of New York a power and a tradition in the public health history of this country.

[1] Chandler Memorial Lecture, given at Columbia University on October 20, 1937.

It will be recalled that immediately upon the close of our Civil War the larger municipal communities in the United States took note of their sanitary shortcomings, and, stimulated by the experience of army camps and hospitals, the successes of the volunteer Sanitary Commission and the return to civil life of physicians and other officers of broad experience, and with ambition and energy for reconstruction, social as well as material, there developed public action to save the people from the devastation of epidemics which swept the homes of the rich and poor alike.

To realize the movement of events one must recall that Edwin Chadwick's classical report to the Poor Law Commissioners on the Sanitary Condition of the Labouring Population of Great Britain which led to

the initiation of the first health service by a national government was presented in 1842 when Chandler was just of school age. Following this in object and spirit came the report by Lemuel Shattuck in 1850 to the State Legislature of Massachusetts in which the prevalence of the common diseases and their excessive death rates prevailing in the cities and agricultural valleys of New England were described. This notable report led in 1869 to the creation of the Board of Health of the Commonwealth of Massachusetts.

In 1865, when Chandler was twenty-nine years of age and had already come under the influence of Agassiz, been through the Lawrence Scientific School at Harvard, won his doctor of philosophy in Göttingen and had his seven years experience in the Department of Chemistry at Union College, he came to New York City for a life of creative activity in the science, the commercial use, the public application, and in the disciplines of chemistry for education and research.

The year 1865 saw completed in this city a piece of voluntary civic work in sanitary inquiry and public health by physicians, largely members of the teaching staff and recent graduates of the College of Physicians and Surgeons, which in thoroughness and practical effect has not been excelled since then.

The Citizens' Association of New York sponsored this study of the sanitary condition of the city by its Council on Hygiene and Public Health.

The report disclosed the shocking neglect of human life in New York and the dramatic fact that at that time deaths exceeded births and that the city absorbed to their own destruction large numbers of immigrants from abroad and many American citizens who came from our own states.

The council of the Citizens' Association was composed entirely of laymen and included a number of men long held in affection by New Yorkers and eminent because of their many contributions to culture and government, such as Peter Cooper, James M. Brown, William E. Dodge, Hamilton Fish, Jonathan Sturges, Morris Ketchum and others.

The Council on Hygiene and Public Health responsible for the conduct of the study and presentation of the report included sixteen physicians, among whom were Valentine Mott, Willard Parker, Stephen Smith, Elisha Harris, Austin Flint, John W. Draper and R. Ogden Doremus, each a contributor of note to the teaching of the art and science of medicine of the day, and all men whose influence determined much of the development of hospital and private practice for the next half century in this city and elsewhere throughout the United States.

In addition to insisting upon what may be called gross as distinct from microscopic cleanliness in the bacteriological sense, which was obviously indispensable for public sanitation, and besides demanding officers of health trained in the application of preventive medicine to the community as a social aggregate, the council called for immediate attention to ventilation, to the prevention of overcrowded living quarters and to the sanitary control of contagious and pestilential diseases.

This classical and almost unique report on the public health problems of cities was published in 1865 and led to the creation of the Metropolitan Board of Health of the State of New York by an act of the legislature in the following year, with powers so broadly inclusive and so skillfully specified by that master of sanitary law, Dorman B. Eaton, that they have stood to this day adequate and sufficient for their purpose. The first report of the Metropolitan Board of Health for 1866 is a worthy supplement and corroborating document for the report of the Council on Hygiene and Public Health of the previous year.

Our particular interest is roused by the second annual report of this board for the year 1867, which was published in Albany in 1868. In Appended Statement III of this volume we find a tabular record of weekly examinations of water at the reservoir in Central Park, at the reservoir on Fifth Avenue, the present site of the New York Public Library, and from the hydrant at Columbia College, Fiftieth Street and Park Avenue, during the summer of 1867.

This contribution on the sanitary qualities of the water supply of New York was attributed to the "kindness and scientific zeal of Dr. C. F. Chandler, the able Professor of Chemistry in the School of Mines, Columbia College."

From this note, and from the fact that his name appears nowhere in the report as an employe or paid consultant of the Board of Health it would appear that this was one of Professor Chandler's characteristic public-spirited undertakings, a free gift of quantitative and qualitative chemistry to the guardians of the public health.

However, in the third annual report of the Metropolitan Board of Health for the year 1868, the name of Charles F. Chandler appears among the officers of the board as an analytical chemist, Edward B. Dalton, M.D., being the sanitary superintendent who, as Colonel Dalton, Retired, United States Army, established the municipal ambulance system which was then unique and has ever since maintained a reputation of distinction. On the façade of the building which now houses the Departments of Health, Hospitals and Sanitation on Foley Square, the names of Edward B. Dalton, Stephen Smith, Lemuel Shattuck and John S. Billings are included as notable for their accomplishments in care and prevention of sickness and rep-

resentative of our post-Civil War renaissance of social and civic endeavor.

No reports of the department of health of this city or any other in this country in the last half century compare in adequacy, in scientific detail, in record of sound theory and application, in promptness of appearance, and in literary form with those issued by the Metropolitan Board of Health in the first ten years of its existence. In the years 1881–1889 no report was issued, and since 1929 there has been no annual printed report from the department of health, statistical tables of births and deaths for 1930, 1931 and 1932 being the only and the most recent contributions to the record.

In Chandler's first official contributions he dealt with a broad range of problems from the daily use of thirty gallons of carbolic acid sprinkled upon the putrefying filth of the city's streets in an effort to reduce summer mortality among infants and to prevent cholera, to systematic chemical and microscopic study of the carcasses of cattle dying in the city of Texas cattle fever, and included special consideration of the quality of the water supply and the hazards of the illuminating gas industry to the residents of the adjacent districts.

The drop in diarrheal deaths after August first of the year 1868 was not unnaturally attributed to the liberal use of street disinfectants, although a similar experience has been common in later years in the absence of such measures, and would be credited to quite different factors.

The plunge into the animal pathology of Texas cattle fever was courageous and creditable, especially since there was not at that time a department of pathology in any medical school on this continent. It was not until 1882 that Dr. T. Mitchell Pruden was appointed to the first academic position in pathology in any medical school in this country, made possible in the College of Physicians and Surgeons by contributions from the alumni for his salary. There was no other way than by direct gross and microscopic inspection of tissues open to the health authorities to learn if possible the cause of this disease among animals, which not only created a serious economic crisis in the food supply of the city but appeared to constitute a potential threat to human beings who handled the cattle or disposed of their products. Chemistry and microscopy were the only aids to the searching eye and mind which had had inklings of cellular pathology and were yet unaware of the implications of the early biological discoveries of that greatest of all chemists, Louis Pasteur. Chandler and Stiles were among the first of a long list of ambitious men who tried to solve the riddle of this plague of cattle, until decades later, in 1893, America's greatest contributor to preventive medicine, Theobald Smith, and his associate Kilbourne settled all uncertainty by proving the insect transmission of the infection and its specific etiology.

History and the experience of two generations of sanitary engineers have confirmed the opinion expressed by Chandler in 1868 that the quality of the water supply of New York City from its then only source, the Croton watershed, was satisfactory. Nowhere along the main stream or its tributaries did he find anything to render the waters impure, thus tying up with personal field observations the results of tests in the laboratory, the two means still used by responsible sanitarians for this purpose.

In a special report on the gas nuisance we have the admirable prototype of a long sequence of similar struggles of municipal government to control industry in the interest of health. The conflict of objectives is perpetual and will doubtless continue to be a major concern of health departments as it certainly is to-day. On the one hand the single determination of the producer to make profits and defend his right to the use of his industrial processes and property, and on the other the general powers of city ordinances broad enough to protect against any hazard to life, but often insufficient in specific instances to be accepted by the court as automatically applicable.

There was then, as there remains to-day, the difficulty of proving that one particular fume or gas arising from a certain factory was the sole and actual cause of demonstrable illness or death of a person or persons. If such proof is available the industrialist challenges any one to produce gas, or whatever the substance may be, by any other method without loss of capital outlay or shareholders' interest in their investment.

Such a situation was like a call to battle to the alert, determined, experienced chemist of the Board of Health who saw, or smelled, and proved a nuisance to exist and brought wide acquaintance with gas production processes abroad and in other American cities to confute the claims of the gas companies. The matter had to be dealt with over several years, but at each public hearing the incisive questions, the resourceful suggestions, the conviction that the interests of the public were preeminent and could and must be sustained, which characterized Professor Chandler's participation, finally prevailed and the nuisance was abated so far as contemporary knowledge permitted.

That the board of health was wise in making a major issue of the gas nuisance is clear in the light of to-day's experience when deaths are still frequent from use and misuse of gas in our kitchens and factories. We can easily imagine that Chandler would have been active among those eager to reduce to an innocuous minimum the carbon monoxide produced

as a by-product in those circulating gas factories we use for transportation, and even welcome into the home, stabled like the family horse under a common roof.

In the past ten years there have been recorded on the average four thousand cases and one thousand deaths annually due to illuminating gas, and a whole system, involving the police and fire departments and the gas companies, has had to be developed to meet the frequent emergencies from accidental or suicidal misuse of gas intended for heat or light or power.

The more dramatic episodes related to the work of the analytical chemist in 1869 were the series of deaths from the use of unsafe quality of kerosene oil in lamps in homes and other buildings for illumination. Chandler found seventy-eight of seventy-nine samples of kerosene collected at retail stores to be unsafe because of their content of benzine, gasoline, naphtha, etc. The evidence of serious personal hazard was convincing, the public was aroused, the Board of Health was prepared to accept their chemist's recommendations, and an ordinance was passed, forbidding the sale of burning fluids if they took fire at a temperature below 110° F., or evolved explosive vapor below that point. As an effective means of enforcement through the purchasing public the names and addresses of violators of the ordinance were published. Thus was established another precedent still availed of in health department practice. This whole problem was settled on its merits in the public's interest, and enforcement of the ordinance was later vested in the fire department, where it properly belonged.

The chemist was equally concerned with threats against nutrition among the poor from the sale of inferior flour and bread, and with the offensive and possibly harmful conditions of the air in schoolrooms, public halls and churches.

While the ventilation experts have accepted physiological evidence that it is not the carbon dioxide which constitutes a toxic factor in the air of overcrowded rooms, as Chandler and his contemporaries here and abroad all believed at that time, he made an observation which is perhaps as significant as could be quoted to indicate the extremes of gross contamination to which the air of rooms was exposed in those days. He found that one half of the dust of rooms was composed of horse and cattle dung. It is a far cry from schoolrooms with four times the number of children per unit of floor space now permitted, and such gross dirtiness of air, to the palatial equipment of many of our present high schools and the air-conditioning of stores, restaurants and theaters, but I suspect no one in this year would think of including churches among the overcrowded enclosed spaces, as Chandler did.

In the year 1869 too, the initial move was made by Chandler in an undertaking which has been uninterrupted from that date to this, and has resulted in an American sanitary preeminence recognized internationally, namely, concern for the nutritional and sanitary standardization of nature's first and best food supply, milk.

Chandler arranged for the chemical analysis of samples of milk collected at every country depot and from each dealer's cart serving the consumers of New York.

He found high butter fat content averaging four and a half per cent., and far above the permissible minimum of to-day, which is three per cent. He found as adulterants water, chalk, flour, sugar, turmeric, sheep's brain emulsion and bicarbonate of soda, the sugar to promote sales to children, the turmeric to hide the blue color of the watered product, the bicarbonate of soda to neutralize the acidity of milk held too long or too warm and sheep's brain to give a sense of thickness and richness to the milk. He found the butter fat down to 1.87 per cent. in milk from cows held in crowded stables and fed chiefly on distillery and brewery wastes. About 26 per cent. of all samples revealed physical or chemical evidence of gross adulteration not uncommonly to the extent of one quart of water to each three quarts of milk. Chandler advised the public that at ten cents a quart for milk the people of New York City were paying each year about four million dollars for the water included as an adulterant. New York's population pays an annual bill for fluid milk and cream now of about $191,625,000. Adulteration is of the greatest rarity, and the uniform purity and nutritive value of the product is at a higher level than at any previous time. The chemist in collaboration with the bacteriologist, the city laboratories and the field inspectors, and those of the producing and distributing companies have the common desire to maintain at least the present standard and teach the public to double its use of this most nearly perfect of all foods for human beings, which still costs less than any other in terms of nutritional values.

It has remained for one of the great chemists of our time, a successor of Professor Chandler, our own Professor Henry C. Sherman, to teach us the indispensability of milk as a factor in human growth and development, and as a protection against other food deficits, the use of which in suitable amounts gives us a sort of guarantee of such health and duration of life as our inheritance entitles us to achieve. To-day after a generation of dominance of sanitary control of milk by bacteriological methods we have returned again to the resources of the chemist by using the methylene blue test for bacterial pollution, and the phosphatase

test to give evidence of the fact and adequacy of pasteurization.

But these epoch-making innovations in the activities of the Board of Health did not bind its chemist to other opportunities which beckoned to him and stimulated his insatiable appetite for testing all things and revealing those that were good.

It happened that he often had to do this by disclosing fraud and damage to health, as in his analysis of cosmetics, especially poisonous hair tonics, washes and skin restoratives, lotions, enamels and skin powders. How modern! How humiliating! How revealing of the perpetual gullibility, the shallow emulation of those females of the species who continue to act as if beauty comes from the drug store instead of the garden and the orchard, or from without instead of within the human economy. As one looks about at the cadaveric finger tips, the enameled toe-nails, the deformed eyebrows, the filled facial creases that try to reveal character but are cheated out of it, the hectic cheek reminiscent of the fever ward of a tuberculosis hospital, the ill-assorted daubs of aniline upon the lips, one wonders if it is worth the while of the Congress to try to enact protective legislation, or of health officers and their laboratories to attempt enforcement of local ordinances, to save a beauty-mad generation from those qualities of cosmetics that threaten to replace the bloom of health with one more appropriate to a dish of wax fruit.

And yet the health officer is at the mercy of the consuming public, which expects protection even in its silliness, and so large sums, much skill and chemical resourcefulness are spent at the taxpayers' cost to reduce as far as practicable the hazards upon which the women of the day squander their annual billions in an ever more strenuous competition which they seem to believe required to make them desired by some actual or hoped-for mate.

While with few exceptions the cosmetics of 1869 contained lead, whether in hair dyes or face powders, this is rarely found in amounts of any significance to-day. Other contents and properties less overt and easy to identify have replaced the heavy metals as decorations of our women's hair and skins.

And lastly, in the items of special interest to us in the report of the Metropolitan Board of Health for 1869 as a contribution to sanitation by the city's analytical chemist was his investigation of lead contained in drinking water, held in cisterns, stagnant overnight in kitchen or cellar pipes, or in the tea kettle filled from a lead lined or fitted hot water boiler. No advice in this field is more to the point, more practical, simple, understandable and easy to follow than are the conclusions and recommendations of the Board based on Chandler's analysis of water used in the households of New York City.

In this, as in many another problem in the borderland of clinical medicine, he showed his natural inclination to detective work involving a science now recognized as a standard educational discipline under the name of epidemiology in every school of public health to-day. It will be recalled that the classical outbreak of "Devonshire Colic" described by Dr. Huxham in 1745 in England was disclosed by simple chemical tests and proved to general satisfaction by the epidemiological studies of Sir George Baker in 1767 to have its origin in the lead dissolved by cider from pipes and containers used in its manufacture, storage or transportation.

So precise and so rapid are the measures of detection and control by the public health chemist of to-day that in a great automobile plant in Detroit, where two years ago there were six thousand cases of lead poisoning, none has been found in the past six months.

It was as the result of the systematic examination of water that Chandler became convinced of the value of routine microscopic as well as chemical study, and his recommendations on this point, followed for many years, led logically and naturally to bacteriological examinations by culture methods, which have brought this particular sanitary control to its present perfection.

A minor activity of the analytical chemist was a study of disinfectants and their relative potency and worth for sanitary needs. The means were not yet at hand to give the final answer through indices of bactericidal properties, but a beginning could be and was made, and useful differentiation was achieved among a variety of commonly used disinfectants.

As might have been expected after so active and productive a year of chemical contributions to the facts of sanitary science and their practical application, an assistant chemist was appointed, a doctor of philosophy like his chief, Herman Endemann by name, and Professor Chandler's appointment was as chemist of the department of health under Moreau Morris, the sanitary superintendent.

The report of the chemist for the year 1870 refers to many of the matters already dealt with, but there was a considerable expansion in the analysis of foods.

The gas nuisance was officially declared to be abated, the danger from kerosene to be increasing, ninety-three of one hundred samples being found dangerous and sold in violation of the ordinance.

Lead piping was condemned for drinking water service pipes.

The chemist recommended publication of lists of poisonous cosmetics. The growing production of

canned vegetables attracted attention, and lead from the solder used in sealing tomato cans was found in significant amounts. Breads and baking powders were subjected to extensive sampling and analysis and in general were freed from the charge of adulteration.

Sugars and syrups were found to be free from adulterants but spices were not.

A special memorandum was submitted enlarging upon the desirability of extending the investigation of foods and cosmetics.

The presence of yellow and relapsing fevers distracted the attention of the department of health and the public from these matters which were, as a matter of fact, of more concern as commercial frauds than as definite health hazards.

The year 1871 was punctuated by the smallpox epidemic and the Orangemen's riot of July twelfth, but the general death rate dropped to 28.6 from thirty-two of the previous years. The Irish immigration, bringing typhus fever in its wake, following their famine at home, constituted a major problem in housing, and so serious was the crowding that among half of the population three quarters of the deaths occurred. A cholera epidemic and an outbreak of meningitis added to the responsibilities of the health department which had but seventeen cents per capita to maintain its inspection service which attempted, and was claimed to reach constantly about half of the population.

Meningitis, like scarlet fever and diphtheria, was attributed by chemists as by others at that time to the escape of sewer gas into the houses from defective drain pipes, which could generally be found.

The annual report on the water supply of the city declared New York to be fortunate beyond all other large cities of the world in control of an abundant supply of remarkable purity, a truth no less important to-day than it was in 1871. Suspended matter was found to be small in amount, harmless and easily removed. Nothing appeared in the analysis to indicate pollution with decaying animal matter, and the people were advised that the occasional discoloration and unpleasant taste from vegetable matter should give no cause for alarm.

For the first time in any official public health publication in this city the Annual Report of the Department of Health of 1871 refers to the relation of occupation to the incidence and severity of tuberculosis, and in that of 1872 there was a special report upon the effect of the tobacco trade upon the workers, and upon the hazards of occupations involving the use of lead and arsenic. A long time to wait for the classic writings of Bernadino Rammazzini of Modena and Venice, 1633–1714, to penetrate into the medical consciousness of the New World? Nevertheless, a health department staffed with eminent physicians and chemists and already developing a tradition and example of leadership for the rest of the country was the most probable birthplace of industrial hygiene in America. It is a matter of some local distinction that New York first among the cities of this country established in 1915 a division of industrial hygiene and an occupational clinic, an eminence and leadership unfortunately lost to this city by the more aggressive and non-political health activities of a number of other cities since then.

Among the major difficulties of the year 1872 which involved the use of chemical disinfectants in a large way was an epizootic of horses, a form of equine influenza which killed almost four per cent. of all the horses in the city.

The almost hysterical dread of diseases of unknown origin is revealed in the fantastic requirement of a sanitary ordinance enacted in 1872 which called for the burial of a dog dying of rabies not less than three feet underground and not nearer than one thousand feet away from any residence.

In 1873 Charles F. Chandler the chemist succeeded Stephen Smith the physician as commissioner of health under Mayor Havemeyer, but there was no lack of medical collaboration, as the presence of Drs. Edward G. Janeway, consulting pathologist, and Edward Curtis, consulting microscopist, assures us. New York's fortunate experience with Chandler as commissioner of health for the next eleven years may well have been the reason why the chemist Ernst J. Lederle was welcomed and medically supported as commissioner of health in 1902 and 1903 and from 1912 to 1913, and it must always be remembered that both the initiation of sanitary milk control and the placing of it on a modern scientific basis by obligatory pasteurization enforced by bacteriological standards occurred during the commissionerships of chemists.

In 1873 Chandler was faced with a population rapidly approaching if not already exceeding one million persons, among whom the annual death rate of thirty per thousand was nearly as high as in the years of entire sanitary neglect. About one third of all babies born alive died before they were five years of age and twenty-six per cent. died in the first year of life. Today with a population of nearly seven and a half million the death rate is below eleven per thousand, the deaths under five years represent less than six per cent. of the births, while the infant mortality rate is less than five per cent.

Overcrowding, cellar habitations and insanitary conditions in public markets, slaughter houses and schools were recognized as constituting persistent hazards to the whole community and enlisted Commissioner Chandler's determined attention.

With the vision and thoroughness of a truly inter-

national and continental scientist, Chandler included in his first report a review of the sanitary condition and essential vital statistics of about a hundred cities here and abroad and some comparison of their health regulations and equipment.

Together with this he developed by personal correspondence with physicians and health officers all over the country such information as to the movement of cholera from state to state and coast to coast as only the United States Public Health Service has ever obtained, and that only within the last three decades.

Chandler was in fact as commissioner of health of New York City the best informed and most alert health officer among those of American cities in his decade of leadership. He knew what he wanted to know about, where to get trustworthy information and how to marshal the assembled facts in a way to impress the public and bring effective action. He encouraged a remarkable study of the diseases of horsecar drivers, and dramatized the miserable barbarity of their employment conditions, which demanded of them regularly fifteen to seventeen hours a day upon their feet. He saw the obligation of the health department to enter the dangerous field of conflict between employer and employe from the point of view of preventive medicine, perhaps a sounder basis of settlement of abuses of employment than some of the arguments pushed for shorter hours and higher wages for the skilled or unskilled worker of to-day.

The scientific objectivity and unbiased attitude of the Department of Health under Commissioner Chandler was characteristic of the man and is illustrated in the report on home versus factory workers in the tobacco industry. Contrary to public opinion then and to much of the amateur propaganda of more recent years the health inspectors of 1874 found that the home workers in tobacco were better off, better paid, had better food and in general lived better lives than was the case with the factory workers in the same industry, and that the children of the home workers were the equal of those of wage-earners in any other field of industry. The only unfavorable condition discovered was a marked relative infertility among the families of the tobacco workers in general. This was the more notable in a community with a birth rate fluctuating between twenty-five and thirty-seven per thousand of the population, the highest in the history of the city.

The first report in any health department on experimental studies of the transmission of diphtheria by animal inoculations appeared from the microscopists of the department laboratory in the year 1875 (Curtis and Satterthwaite), and the first clinical and pathological analysis of the pneumonia situation by Francis Delafield revealed the increasing anxiety of the health authorities about other than the so-called pestilential diseases. As a corollary to this the commissioner's well-known and technical personal contributions to the condition of the air in schools, theaters, etc., were supplemented by a report on smoky chimneys which polluted the air.

From 1876 through 1883, when Chandler was displaced by Alexander Shaler as commissioner of health, the annual reports contain no new subject-matter of other than formal administrative concern. The birth rate remained high and so did the infant mortality, about five times as many of those born dying in the first year of life as is the case to-day.

In the reports of these latter years of the Chandler health dynasty there was to be found more conveniently and comprehensively the statigraphic record of New York's mortality, correlated day by day with the temperature and humidity, and the vital statistics of a hundred and twenty-five other cities here and abroad, than could be had in any other publication, national, state or local.

The population was just over a million in 1876 and at this time twenty per cent. of all deaths from all causes were attributed to tuberculosis. To-day less than six per cent. of all deaths are due to this disease.

With the death rate of the city reaching even in 1880 the very high figure of 26.5 and almost half (46 per cent.) of all deaths occurring in children under five years of age the health protection of the metropolis could not be considered to be substantially better than when the Metropolitan Board of Health was established in 1866. Since those years of embryonic health protection the expectancy of life at birth has risen for New Yorkers from about forty years to 61.37 years. However, certain fundamental principles had already been established and in this Chandler had played an important and often deciding part. Authority for public health control had not only been provided under the law but had been applied, tested against the resistance and resourcefulness of the most powerful interests of property holders and industry, and the actions of the sanitary superintendent and commissioner of health to abate nuisances and correct basic abuses of environment, housing, occupation, etc., had been supported by the courts. It was in many instances the convincing evidence of the analytical chemist and his laboratory demonstrations which overwhelmed doubts and opposition with facts, so simply stated that the layman could appreciate their force and implication.

Chandler established the precedent for experimental laboratory research as a basis for sound theory and practice in public health and sanitation, and took every opportunity to expand the scope of the work of the trained professional members of the staff and consultants of the health department, the microscopists,

the pathologists and later the bacteriologists as indispensable associates of the chemist, who was the first of the family of scientists to be brought into the service of municipal governments as members of a department of health.

A glance at the health officer's bible of to-day, the Sanitary Code with its upward of three hundred sections, reveals many which depend in the main or exclusively for their enforcement upon the methods and the increasing skills of detection and measurement developed by the analytical chemist, whose laboratory is nowadays an integral part of equipment of the bureaus of sanitation and food and drugs here, and generally in all cities with a full-time health department staff. There are no less than sixty-six sections of the Sanitary Code to-day that call for chemical techniques for their effective administrative application.

And still we can see, as Professor Chandler would have seen and indeed himself suggested, almost unlimited and even now but slightly explored fields in the chemistry of food and drugs, and in the occupational hazards of a multitude of industries new and old which have more serious effects upon growth, development, nutrition and human survival to-day than do the communicable and infectious diseases which have been in the past the almost exclusive object of sanitary attack. Almost daily some new and secret-formula product is offered for human use or consumption, untested biologically before commercial exploitation and used widely by the ever gullible public, avid for novelty, convenience or apparent profit, until some unsuspected but irremediable damage to the consumer has developed to warn physicians and sanitarians of a new problem in diagnosis, treatment and prevention.

We must look forward to the time when it will be customary, expected and perhaps required by the ethics of business practice that the acceptance of new products and processes of manufacture involving human exposure or risk either to the workmen who produce them or to the retail purchaser be obtained from health authorities of city, state or nation before, not after they have been put to use in commerce or industry.

There is a veritable whirlwind of dusts, fumes, smokes and pollutions of the atmosphere threatening the laborer indoors and out, and calling for examination of the same order of technical expertness and integrity of professional and personal character as marked the life and contributions of New York's first public health chemist.

His work was well done. The health department's is but barely begun, and we must realize that certain factors, in the everlasting struggle of man to survive in an always widening range of man-made and hazardous environments, are perpetually recurring in shifting but similar form, and only the effective use of each advance in the sciences will secure for us the clean air, water, milk and foods upon which our safety as a community depends.

The chemists Lusk and Sherman have enlarged the field of human physiology and given us the foundation upon which national as well as personal policies in nutrition can be based. It is the chemistry of the Mellanbys in England which has determined the statesmen of Great Britain to make adequate nutrition a national undertaking and an immediate political issue.

It is obvious that the use of chemistry for social ends through civil government under the authority of sanitary law, and implemented by the educational facilities of departments of health, is with us to stay. The community of the future will be fortunate indeed if it is served by its contemporary doctors of philosophy in chemistry, with the alertness, vision, integrity and persistent critical common sense which characterized the public service of our own first public health chemist of the Metropolitan Board of Health, whose memory is so affectionately held by his colleagues and successors in public health as in academic association.

Permit me to read in closing some stanzas from a poem by Dr. Holmes, the most eminent American contributor to preventive medicine of his day, which he wrote for the meeting of the National Sanitary Association in 1860, the predecessor of the American Public Health Association, which was founded in this city by Dr. Stephen Smith in 1872.

Such a call to the highest standards of the sciences and arts of medicine, undoubtedly read by the young Chandler of twenty-four, might well have influenced his practical idealism as it has affected many other young men and women in later years to put their science at the service of the public and of social improvement.

FOR THE MEETING OF THE NATIONAL SANITARY ASSOCIATION

1860—OLIVER WENDELL HOLMES

What makes the Healing Art divine?
The bitter drug we buy and sell,
The brands that scorch, the blades that shine,
The scars we leave, the "cures" we tell?

Are these thy glories, holiest Art,—
The trophies that adorn thee best,—
Or but thy triumph's meanest part,—
Where mortal weakness stands confessed?

. . . . . .

Though on the field that Death has won,
She save some stragglers in retreat;—
These single acts of mercy done
Are but confessions of defeat.

What though our tempered poisons save
Some wrecks of life from aches and ails;
Those grand specifics Nature gave
Were never poised by weights or scales!

God lent his creatures light and air,
And waters open to the skies;
Man locks him in a stifling lair,
And wonders why his brother dies!

In vain our pitying tears are shed,
In vain we rear the sheltering pile
Where Art weeds out from bed to bed
The plagues we planted by the mile!

Be that the glory of the past;
With these our sacred toils begin;
So flies in tatters from its mast
The yellow flag of sloth and sin,

And lo! the starry folds reveal
The blazoned truth we hold so dear:
To guard is better than to heal,—
The shield is nobler than the spear.

OBITUARY

FRANK MORLEY

IN the passing of Professor Morley on October 17, 1937, American mathematics suffered the loss of an outstanding personality. Born in Woodbridge, Suffolk, England, on September 9, 1860, Frank Morley received the A.B. degree at King's College, Cambridge, in 1883. In 1887 he received the A.M. degree and in 1897 the degree of Sc.D. from the same university. After spending the years 1884 to 1887 as master at Bath College, England, he accepted a call to Haverford College in 1887 as instructor in mathematics. In 1888 he became professor of mathematics at Haverford and continued there in this capacity until called to head the department of mathematics as professor at the Johns Hopkins University in 1900. He held this position until his retirement, as professor emeritus, in 1929. During these years he acted as an editor of the *American Journal of Mathematics,* and after his retirement he continued his connection with the *Journal* as a cooperating editor, being a consistent contributor to its volumes.

He became a member of the American Mathematical Society (then known as the New York Mathematical Society) in May, 1891, and helped to shape its early policies. Later he served as the president of the society. He was also a member of other mathematical and learned societies in this country and abroad, and was an active contributor to their proceedings and their publications.

In addition to a notable power of geometric intuition, he possessed great algebraic facility. While most of his work was in the field of geometry, he made a valuable contribution to the theory of elimination in algebra. During his residence at Haverford he collaborated with Professor James Harkness, then of Bryn Mawr, in the publication of two outstanding treatises entitled "Elementary Treatise on the Theory of Functions" and "Introduction to the Theory of Analytic Functions." In them, Professor Morley's artistic and skilful geometric treatment of many topics is plainly evident.

While at Johns Hopkins he developed and refined a powerful apparatus for the study of problems in inversive geometry. Many of his own articles and those of his students on this subject during this time gave evidence of the development of the subject. After his retirement from active professional duties, he finally found time to carry out a project he had long contemplated. With the cooperation of his son, Frank V., he published in 1933 his treatise on "Inversive Geometry." In addition, during the nine years after his retirement in 1928, he continued his active interest in research, a joint paper by him, together with a former student, having appeared in the October number of the *American Journal of Mathematics* of this year.

Like his illustrious English predecessors Cayley and Sylvester, Professor Morley invented the names of many terms in mathematics, both striking and appropriate.

He was a striking figure in any group. Deliberate in manner and speech, there was a suggestion of shyness about him. He was generally very well informed and interested in a strikingly wide range of subjects. He was of an artistic temperament. While many of his papers and lectures seemed involved to the uninitiated, they all possessed a characteristic artistic charm. During their early days of contact with him, his students frequently found difficulty in understanding or appreciating his many illuminating comments and allusions. But as they learned to know his methods better and were aided by his sympathetic interest in them, they found him most inspiring, and many became his loyal admirers and coworkers.

A. COHEN

RECENT DEATHS

DR. EDWARD LEAMINGTON NICHOLS, professor of physics at Cornell University from 1887 until his retirement with the title emeritus in 1919, died on November 10 at the age of eighty-three years.

JUNIUS HENDERSON, for thirty years until his retirement as professor emeritus in 1933 curator of the museum at the University of Colorado, died on November 4. He was seventy-two years old.