CHAPTER 1

The Historical Setting

Man's attempts to understand the nature of pestilence are probably as old as his efforts to create a religion for himself. Countless diseases and devastating epidemics have plagued him since the dawn of written history, on down through the Middle Ages, and indeed up to and including the twentieth century. Before 1850 this constant threat to man's welfare was enough to force the bulk of the population into an utterly resigned attitude towards pestilential diseases; while others, in seeking an explanation for their uneasy state, must have become amateur epidemiologists, at least of a sort. It was a field not limited to learned doctors.

At one time or another epidemics were attributed to demons, to punishment for incurring God's wrath, and to earthquakes and comets. These explanations have been well described by my senior colleague, the late Professor C.-E. A. Winslow in his book: The Conquest of Epidemic Diseases (1). The story will be familiar also to those who have read the small volume entitled: The History of American Epidemiology (2).

That epidemics were a form of punishment for man's ill deeds was a theory ridden hard for many centuries. Today, in the light of modern concepts, this idea of punishment seems not so far off the beam as was once thought. It at least contained the rudiments of the notion that a highly polluted water supply, air pollution, and dense overcrowding in filthy urban environments swarming with rats and other vermin, were pantheistic crimes against nature and mankind—as, indeed, they may well be regarded today.

According to the late Major Greenwood, one of Britain's most distinguished epidemiologists, the belief that epidemics arose from certain supernatural causes was corrected in the third or fourth century B.C. This marked the beginnings of modern epidemiology, which as Greenwood said, took place "like almost everything else that makes life worth living, in ancient Greece" (3). But after Hippocrates (fifth century) the subject languished for two millennia. The idea that epidemics were worthy of philosophical or scientific study was not developed until comparatively recently. Indeed, the word epidemiology did not come into use until the nineteenth century. Crookshank has, however, maintained (4) that philosophi-

1 This was a volume commemorating the twentieth anniversary session of the founding of the Epidemiology Section of the American Public Health Association, in October 1949.

2 I am indebted to my colleague, Dr. George Rosen, Professor of Medical History at Yale University, who has called my attention to the fact that the word epidemiology is of comparatively recent nineteenth century origin.

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CHAPTER I

cal aspects of the subject date from the sixteenth century, having had their origin in France in the School of Epidemiology founded by Ballonius (1538–1616). These approaches, Crookshank said, have never died out. Ballonius extolled the doctrine of external influences at work in the causation and spread of epidemics, anticipating much that was taught afterwards by Sydenham. This was a forerunner of the multiple sciences which were subsequently to be gathered together and treated as part of the general subject of pathology, which in Europe, eventually emerged in the mid-nineteenth century as one of the medical disciplines or sciences which soon raised the status of clinical medicine from a trade or craft to a profession with scientific standards.

As for the idea of contagion in the spread of disease, the two common ailments, smallpox and measles, had been recognized as contagious for centuries, having been described by Rhazes as such in the tenth century A.D. The communicability of syphilis was also known, but beyond that all was confusion. By the eighteenth and early nineteenth centuries, physicians realizing that there were certain degrees of contagion, were prone to spend their time indulging in speculations as to the differences between contagion and infection. It would seem that the line between them was very indistinct. For instance, an 1811 definition of contagion:

A secreted humour from a living vascular surface of a poisonous quality and capable of exciting disease like to that by which, itself was produced when applied to the living system of a healthy animal of the same species (5).

Whereas, infection was defined contemporaneously as:

That manner of communicating a disease by some effluvia, or particles which fly off distempered bodies and mix with the juices of others which occasion the same disorder as in the bodies they came from. See poisons (5).

One would be hard put to find any real difference between these two definitions and yet in the early nineteenth century when the fine points of various Protestant religious doctrines were argued with such acrimony, physicians, no doubt, found minute nuances of meaning easier to understand.

The idea of contagion was further complicated by certain theories which maintained that the whole environment could be a hotbed of poisons and pestilence. This was expressed by the contemporary term, miasm—something which was thought, now and again, to arise from swamps and exert its evil force locally.

One of the worst afflictions that beset mankind over many centuries was bubonic plague—the Black Death of the Middle Ages, a disease which is usually spread through the agency of the rat flea, although in its most severe form—pneumonic plague, it is transmitted from person to person. Another periodic scourge along the southern and eastern seaboard of the United States was yellow fever. Considering the primitive notions about disease prevalent in the late eighteenth and early nineteenth centuries, there is small wonder that infections spread by vectors such as fleas or mosquitoes encouraged the speculations of proponents of miasmatic theories.

The vitriolic arguments which ensued over the cause and the manner of spread of yellow fever (a mosquito-borne disease) that swept the City of Philadelphia in the 1790s, was a case in point. Could the disease be spread from person to person? Or, was the whole city infected by a polluted atmosphere? Or was it, as Benjamin Rush surmised, due to emanations from piles of rotting coffee brought
from the West Indies and dumped on the docks along Front Street of Philadelphia? Or was it, as that early American amateur epidemiologist, Noah Webster of dictionary fame, claimed, defending his own concept of contagion—a kind of "septic acid" which operated at a maximum distance of 10 paces?" The medical historian, E. H. Ackerknecht, has described vividly the progress of the struggle between the proponents of the miasmatic theory versus the contagionists (6).

Meanwhile disastrous epidemics went on apace. The great pandemics of cholera in Europe in the mid-nineteenth century which first invaded North America in 1832, were examples. Heretofore, this particular infection had been more or less confined to India and the East. Its extension was due in some measure to improved transportation facilities. More people traveled, and their trips were accomplished in shorter time. As a result, trading communities having extensive contacts with countries whose sanitary conditions left much to be desired, were continually exposed to the risk of importation of cases of communicable diseases (7).

It is small wonder that problems concerned with infection and the genesis of epidemics, which still pose difficulties today, defied attempts at solution in the pre-Pasteurian era. Could, for instance, lead poisoning be considered infectious? This question was raised when a number of veritable "epidemics" of lead colic broke out. These were groups of cases caused by the drinking of West Indian rum which had been distilled in coils of lead pipes. Certainly, the high incidence of the "dry-griposes" (or lead colic), among some small communities and classes of people, was enough to raise the suspicion of contagion.

About the middle of the nineteenth century, efforts in Europe and in England to deal constructively with the most important infectious diseases began at last. Things had reached a point in urban communities that some sort of concerted action was deemed absolutely necessary. It was this movement that brought the London Epidemiological Society into existence. The original aim of the founders of the Society had been to promote a forward-looking attitude, one of recognition that, although the situation had gotten out of hand, it might, after all, be subject to some sort of control. The approach was a forerunner of the concept that epidemiology is the basis of preventive medicine.

In North America, medical and epidemiological reasoning at this time was for the most part dominated by folklore. Yet, this was not true of all of it. A timely example of sound early nineteenth century clinical epidemiology can be found in the observations of Nathan Smith who singled out typhoid fever from the jumble of "continued" fevers and identified it both from its clinical and epidemiological behavior, noting particularly its coming and goings in small New England villages, and its capacity to immunize (8). This was a fine piece of scientific reasoning. Smith was one of the original "shoe leather epidemiologists." Thirty-five years later, Dr. W. H. Welch was to liken Nathan Smith's essay to a fresh breeze from the sea amid the dreary and stifling writings of most of his contemporaries (9).

By the mid-nineteenth century another milestone in epidemiological thinking was reached when John Snow made his observations during a cholera epidemic in London. These were published between 1850-54 (10). Snow noted that a well which

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*This term "shoe leather epidemiologist" was invented to describe the efforts of epidemiologists to trace the comings and goings of disease by making house-to-house visits within an epidemic area. It was partially supplanted, subsequently, by the copious use of maps, tables, and charts; and later still by laboratory tests devised by epidemiologists who preferred to work at their benches with more modern methods.
served as the water supply for the surrounding inhabitants in a certain section of London was grossly polluted, and constituted a source of contaminated water which promoted the spread of this enteric infection.

Soon afterwards (1859–60) William Budd, in Bristol, England, studied another enteric disease,—typhoid fever (11). His investigations eminently supported Snow’s doctrine. Thus, the concept emerged that disease could be water-borne.

Although the drinking of polluted water had long been suspected of causing disease, the contributions of these two amateur clinical epidemiologists were crucial in confirming the fact that at least these two specific diseases, cholera and typhoid, could indeed be carried by drinking water.

Another nineteenth century figure who deserves a high place in the development of epidemiological thinking was Peter Ludwig Panum, a Danish physician, who described an extraordinarily severe epidemic of measles which occurred in 1846 in the highly susceptible population of the remote Faroe Islands (12). The outbreak was an example of a common children’s disease behaving differently from its usual pattern, both clinically and epidemiologically. Usually, measles, in an urban environment, is limited to children and is considered a relatively mild illness. Not so, in 1846, with Faroe Islanders who had experienced a long but unknown period of freedom from measles; so, when the virus was finally introduced into this “virgin population,” the result was a devastating disease attacking all ages.

It was a replica of the manner in which untold numbers of American Indians were wiped out when the early seventeenth century settlers brought measles virus to North America. Panum’s report had the effect of focusing attention on the virtual absence of immunity in the population at the time the outbreak began. This major factor made all the difference in the extent of the epidemic, the age groups attacked, and the severity of the disease. Panum’s observations thus emphasized the dominant role played by the condition of the host before the seed (i.e., the etiologic agent, in this case the virus of measles) had been planted.

These three pioneer clinical epidemiologists, Snow, Budd, and Panum made their observations and interpretations before the specific causes of the diseases with which they had been concerned had been discovered. All three were convinced that a hypothetical agent or poison of some sort, that was transmittable to others, was responsible. But what gives their views special significance was the emphasis they placed on the idea that a substandard environment and the prior (susceptible) condition of the population played important roles in setting the stage for epidemics even though the “poisonous” agents remained unknown.

Not all mid-nineteenth century “epidemiologists” were clinicians. Another influence came through the side door, as it were, with the introduction of vital statistics as a means of determining what was happening to certain populations. In the United States, John Shaw Billings, a man distinguished in many fields, was a keen and capable early medical statistician; and Lemuel Shattuck, a Boston lawyer, became interested in sanitary reform and in 1850 produced his famous report on the health conditions in Boston. In England, the movement was led by William Farr. It unlocked the door to the rapid advance of statistical science in that country. The useful pattern established there became a model for all civilized countries. Farr’s task was to make information dealing with birth and particularly death certificates intelligible to the ordinary mind; and of use not only in explaining certain facts but in furthering public health legislation. His figures indicated that when overcrowding was allowed to prevail, mortality among the affected populations re-
mained at high levels, but it decreased as crowding was lessened. These statistics spoke louder than sentimental words about the miserable conditions among the urban poor. They were especially welcome to the leaders of social reform. Physicians as a whole, however, were slow to realize the value of Farr’s findings. They even encountered great difficulty in the use of statistics as a basis to prove anything of a clinical nature. The individual patient, especially if he was well endowed with the world’s goods, was the one who counted with them—not the mass. It was a prejudice which has partially remained almost up to the present. Only gradually has it been erased.

The flowering of the sciences of pathology and physiology in the nineteenth century, first in France, then in England and later in Germany, constituted an abrupt cultural mutation to the surprise and wonderment of everyone concerned. It was a period when the keen minds in medicine had adopted a questioning attitude. That great French physician, Claude Bernard, must have been thinking of the yet-to-be-established discipline of epidemiology, when he wrote:

A physician observing a disease in different circumstances, reasoning about the influences of these circumstances and deducing consequences which are controlled by other observations,—this physician reasons experimentally even though he makes no experiments (13).

The important and growing subject of pathology—the study of disease, which had given substance to the idea that clinical medicine could become a science, had numerous ramifications in the latter part of the nineteenth century. When August Hirsch first published his history of epidemics he resorted to the term geographical and historical pathology to express the nature of his subject (14). It was almost the best title which could have been chosen to describe epidemiology at that particular time, implying as it did the behavior of a variety of diseases and their prevalence in different parts of the world down through the ages. The apparent originality of Hirsch’s contribution is a measure of how little was appreciated in the late nineteenth century about epidemiology as an academic discipline. In the two generations that followed Hirsch, the field of epidemiology was concerned mainly with the recording of famous, or at least noteworthy epidemics. These were exemplified by the contributions of the British writers, Creighton (15) and Hamer (16). The latter acknowledged that in the genesis of epidemics, in addition to the agent and the susceptibility of the population, i.e., the seed and the soil, there was another factor, namely, an intimate local influence, much as Pettenkofer (17) had claimed. Hirsch’s pioneer definitions were to prevail for nearly 70 years. Even at the 1927 meeting in Baltimore, which Godfrey has mentioned in his account of the founding of the AES, Hirsch’s title was adopted, at the request of Frost, as a suitable contemporary definition of epidemiology, i.e., historical pathology, implying as it did the general behavior of different diseases in time and place.

In the first quarter of the twentieth century the idea still persisted that the definition of epidemiology was limited to the study of epidemics and that epidemics sprang de novo from some mysterious influence, from some sudden heaven-sent (or infernally directed) enhancement of virulence of the offending etiologic agent or agents.

Such a concept was espoused by the medical profession particularly at the turn of the century. It still exists today in this present age of specific antibiotics and
prophylactic vaccines, under the doctrine, especially comforting to the therapeutist, which claims that the causes of many infectious diseases can be reduced to a single entity.

But, not so with the epidemiologist. His creed is different. He is concerned with multiple causes. The most apt simile describing three of these causes seems to me that of: the seed, the soil, and the climate. All have their part in producing the growth of a plant just as all are likely to be important in producing disease, chronic ill health or even accidents. Comprehension that these three features apply to the behavior of disease created the twentieth century discipline of epidemiology.

One of the sometimes forgotten champions of the epidemiological climate was Professor Max von Pettenkoffer of Munich (17). Although Pettenkoffer lived to see the acceptance of the germ theory and great advances in the science of bacteriology in the 1880s, he was not swept along by this movement. He, himself, never accepted it to the extent that others did; it is said that he swallowed a culture of cholera vibrios (without ill effect) to prove his point. He must be given credit for having the courage of his convictions and for recognizing that the pathogenesis of enteric infections at least involves more than germs.

It was during the latter half of the nineteenth century that the London Epidemiological Society flourished. There were still plenty of epidemics about that were grist for its mill. Nevertheless, it had graduated from a Society that was concerned only with the existence and severity of epidemics, or where they fitted into the contemporary medical scene. Its members were, for the most part, physicians who would have hardly considered themselves as specialists in epidemiology. The era of specialization in the fields of bacteriology, immunology, epidemiology, and preventive medicine came much later.

I believe that there were three spheres of influence in the late 1800s which all converged to bring the subjects of epidemiology and sanitary science into being. One was the newer knowledge regarding infectious disease, epitomized by the burgeoning science of bacteriology; another was that social reforms were on the move (18). These latter were championed by two pioneer British figures—Edwin Chadwick, who was appointed in 1832 as Assistant Commissioner to enquire into the Poor Laws in England, and John Simon, the Medical Officer of Health of the City of London. London was made painfully aware of overcrowding in its poorer districts. Conditions, besides poverty, that led to the occupancy of cellars included the window tax which put a premium on light and ventilation; it was only one example of social injustice. A third influence was the introduction of vital statistics. This method, easier to understand than the germ theory, had no sentiment about it, but it was one that the public could appreciate.

Thus, it was the development in these three areas—bacteriology, social reform, and vital statistics—that brought about a compelling interest in the discipline of epidemiology in all of its aspects. The movement could not help but point the way for such early pioneers of sanitary science in the United States as Hermann Biggs, Commissioner of Health of the State of New York, and W. T. Sedgwick, of the Massachusetts Institute of Technology in Boston.

However, despite Hirsch's concept of epidemiology as historical pathology, in the last quarter of the nineteenth century, the view still prevailed that the subject was limited to the study of epidemics. This not only implied that epidemiology

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*This definition even appears in American dictionaries of the mid-1950s.*
was concerned mainly with severe outbreaks of illness but that it was closely linked to infectious diseases and the growing science of bacteriology. But, medical scientists in the early twentieth century were not slow in detecting the fallacy of this point of view. They soon set about changing and broadening such a restricted concept.

An abrupt mutation from the earlier definition occurred in 1916 when William H. Welch introduced the view that the discipline of epidemiology really went far beyond bacteriology and embraced the natural history of disease, including the behavior of endemic, chronic infections such as tuberculosis and venereal disease (19). Welch, at this time, had turned his attention away from his old love of pathology, and transferred his interest to fields more along the lines of hygiene and the sanitary sciences. It was a transference to pathology in the mass, or if you will, to use the term that Professor Ryle favored a generation later—social pathology (20). By Welch's definition, epidemiology was not considered to be the study of isolated episodes of illness, but rather, a consideration of the whole range of behavior of a given disease, with its ups and downs, including periods of low or high incidence, whatever the case might be. This was what was meant by the natural history of disease. A decade later (1927), Frost, in championing the same concept, pointed out that an epidemic was only "a temporary phase" in the occurrence of any disease. Subsequently, several wise heads came up with the idea that no epidemic could be studied adequately unless one investigated pertinent events which had preceded it in an already infected population, and also, events which followed it. This could involve examination of long-term incidence trends in a given community; it meant also the correlation of such information with the condition of the hosts, with season, macro- and micro-climate, race, environmental and social conditions.

So, it was at this point that the subject of epidemiology began to emerge as a deductive science. This had implications for the clinical investigator and the biostatistician in their attempts to analyze various chains of inference and perhaps seek out reasons for the increased (or decreased) prevalence of a given condition. No wonder the time was ripe for a discussion club about these features. Yet, the rank and file of the medical profession, even health officers, remained ignorant of such probings and their implications, which they might have considered esoteric.

Before, and shortly after, Welch's definition had been accepted by some of the more academic epidemiologists, there had been professional "epidemiologists" aplenty attached to state and city health departments, but whether many of them had appreciated their role as other than having to deal with local epidemics as single episodic events is doubtful. Stopping epidemics early or late in their course was the function of the "practical" epidemiologists of the early twentieth century. Their job was similar to that of a fireman who rushes to put out fires on an emergency basis. The source of the outbreak was expected to be found and the epidemic brought to a halt as quickly as possible, for the most part using methods of quarantine and fumigation. Here the matter ended.

In Boston, in the 1890s, W. T. Sedgwick was a forerunner in the new field of hygiene in this country. At the Massachusetts Institute of Technology he preached the practical application of the science of bacteriology to a group of eager students who were quick to realize that it had tremendous implications for the field of public health. He laid groundwork for progress in water purification and the treatment of sewage in this country. Here was a beginning of environmental sanitation. Subse-
quently, the Sedgwick "school" at M.I.T. merged with Harvard University, and eventually it was taken over by the Harvard School of Public Health.

Sedgwick’s epidemiologic and practical doctrines had a profound influence upon such men as Haven Emerson of Columbia University and C.-E. A. Winslow of Yale. Both of these were to become prominent members of the Biggs Club, a forerunner of the AES.5

By 1915 the U.S. Public Health Service also had taken steps to enlarge its epidemiological activities. The old Hygienic Laboratory of this service, originally established in 1902 in downtown Washington, had progressively increased its field activities. Frost proved to be an early leader in the movement and contributed his part by the publication of two singularly important bulletins on the epidemiology of poliomyelitis, one in 1913, and the other, with Lavinder and Freeman, in 1918. These would have been recognized as landmarks in the history of epidemiology in any nation—almost ranking in priority with the publications of Wickman on poliomyelitis in Sweden.

Developments in biostatistics at this time also contributed to the strides made in epidemiology. In 1918, Raymond Pearl organized the department of medical statistics and biometry at the Johns Hopkins School of Hygiene and Public Health. His work on fertility, longevity and population growth, though faulty in places by modern standards, provided a model of ways of conducting biometrical research. His book Introduction to Medical Biometry and Statistics appeared in 1923 and was the standard text for a generation. He trained many able students and through them exercised a major influence on the development of biostatistics in this country.

Contemporaneously, there began to be activity in the field of epidemiology as a discipline of academic medicine. The Harvard Medical School had established a Department of Preventive Medicine under Rosenau, who had been recruited from the Hygienic Laboratory in Washington, in 1909. At the same institution, in 1913, Sedgwick had joined forces with a local sanitary engineer and statistician, G. C. Whipple, to form the beginnings of a School of Public Health.

In 1916, William H. Welch had had the vision to implant the idea in the minds of members of the Board of the Rockefeller Foundation, that a fundamental need existed in this country for more adequately trained men in the fields of hygiene and public health. Within a suitable training center, he visualized a department of epidemiology as a major division essential to other public health disciplines. A direct result of Welch’s ambitions and concepts was the founding of the Johns Hopkins School of Hygiene and Public Health, in 1918. For its Department of Epidemiology, Welch chose an outstanding candidate, who by training and experience had shown himself to be one of the most notable epidemiologists in this country—Wade Hampton Frost. Welch, with the instinct of a pathologist, had already conceived of epidemiology as the very basis of preventive medicine, much as pathology is the basis of clinical medicine.

When we entered World War I in 1917, the United States Army took advantage of the recent strides that had been made in preventive medicine. In France in 1917–19, the American Expeditionary Force and the Army of Occupation in the Rhineland, were instrumental in bringing the principles of sanitary engineering to

5 C.-E. A. Winslow, although invited to become a charter member of the AES, had declined, but he kept in touch with the Society through his association with three other charter members, Hiscock, Knowlton and Osborn, all from Connecticut, and he, himself, was a frequent guest at its meetings.
bear under Major Stanhope Bayne-Jones, M.C., and epidemiology under Major Allen Chesney, M.C. Colonel Haven Emerson was put in overall charge of sanitation in France and, for him, it was a thrilling assignment. He was soon to become chief epidemiologist in the AEF. Major Hans Zinsser was made director of Communicable Diseases. Three of those mentioned were to become enthusiastic members of the AES.

The transition which the science of epidemiology underwent in America within a short period, starting in the 1920s, has been well described by Gordon (21). The few schools of Public Health and academic departments of Preventive Medicine, which had come into being in this country, acted as focal points in the rapidly developing and expanding field of epidemiology. In the forefront of this movement, were Rosenau and Aycock at Harvard, Frost at Johns Hopkins, Emerson at Columbia, and to a lesser extent Winslow at Yale. However, immediately prior to the time when the Biggs Society came into being in 1923, those men in the United States who really appreciated what the possibilities of the new science were, numbered less than a dozen. Included among them were: W. H. Welch, C. V. Chapin, H. Emerson, L. T. Webster, Simon Flexner, E. S. Godfrey, M. Rosenau, W. L. Aycock, C.-E. A. Winslow, W. H. Frost, and Hans Zinsser. Others were soon to join them, and quite a few became the founders of our Society. Their collective enthusiasm was enough to give the waters a vigorous stirring. There was no doubt that the time was ripe for the birth of the AES. A tide, which eventually proved to be a strong one, had just begun to run.

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