
DISCUSSIONS

NAJERA: Perhaps we could begin by exploring why, how, when, and where the concept of epidemiology originated. As far as we know, “epidemic” and “endemic” derived from *epidemeion* and *endemeion*. Hippocrates used these words at the School of Cos 2400 years ago, as a way of incorporating a community outlook into the understanding of diseases. Their purpose at that time, and their correct etymology, was to differentiate diseases that visit the community—the verb *epidemeion* meaning “to visit”—from those that reside in it, without the added meaning of an unusual or severe occurrence. We should, therefore, keep this characteristic of “visitor” in mind, because of its usefulness in creating a methodology for studying health problems in the community.

LLOPIS: In addition to using the words “epidemic” and “endemic” in his *Airs, Waters, Places*, Hippocrates also referred to what is now the basis of epidemiological investigations: the distribution of disease in terms of time, space, and the people affected by it. In his aphorisms he studied the distribution of diseases according to season and age. In other works he also emphasized the influence of other conditions such as climate, individual body-build, and habits.

NAJERA: My students and I have been trying to find where and when the word epidemiology was first used, yet we have only been able to discover that it was already in use in Spain in the late sixteenth century. Angelerio, a physician of that time, wrote a study on plague entitled *Epidemiología*. The second edition of this work was published in Madrid in 1598.

Although we have searched in different countries for other books or studies using the word epidemiology, we have not been able to find any further use of the term until the beginning of the nineteenth century. In 1802 it was used in the title of a book written by the Spanish physician, Villalba. This book, *Epidemiología Española*, compiled all epidemics and outbreaks in Spain dating from the fifth century B.C. up to 1801. Although plague is the most frequently described epidemic, all other epidemic diseases are also carefully accounted for. Malaria, for example, is

one disease worth mentioning, since it is a typical epidemic disease with deep roots in people's socioeconomic development. *Epidemiología Española* includes some very interesting observations carried out during the Middle Ages concerning the presence of malaria in rice growing areas. These observations showed that when rice was grown in a previously malarious area, no malaria occurred; yet when grown in a non-malarious area, malaria usually ensued. You see, if the area was already malarious, then it meant it was a wet area. When rice growing started, it became dry for certain periods, thus interrupting the mosquito's life cycle. But when dry areas were irrigated in order to grow rice, malaria occurred because these areas became wet. Those were wonderful conclusions to arrive at in those days. You see, these observations were of extraordinary importance and could be interpreted as one of the first observations of the kind which allow us to arrive at epidemiological interpretations.

The other major Spanish contribution I can think of comes from Casal, a physician who lived and worked in northern Spain, in Asturias, during the first half of the eighteenth century. At that time a new disease, that people called *mal de la rosa* (disease of the rose) because of the dermatitis it produced, was occurring. Later on this disease would be known by its Italian name, pellagra. Casal began looking at why this disease was there and why people said it was new. He concluded that the disease must be a result of diet, since the people most affected were the poorest people in the area. When he looked at the diet, he saw that those who contracted the disease ate no meat or eggs or anything costly at all. They ate corn—the cheapest thing available at the time. Corn had been introduced recently from America as animal feed, which made it very inexpensive, and the poor ate it almost exclusively. In his book, Casal even gives the clinical description of the disease. By studying what he called the natural history of the disease, he discovered that the dementia was the last stage of the *mal de la rosa*, rather than a different disease as had been thought.

TERRIS: Some time after Casal, during the nineteenth century, the theoretical debate was whether diseases were caused by contagion or by miasma. Up to 1874 the miasmatisists were dominant; theirs was the accepted theory. The question of miasma versus contagion was also a political struggle. The contagionists, with few exceptions such as the liberal Henle, were conservatives and reactionaries, representatives of the old regime, who eventually turned out to be correct. The liberals and radicals like Virchow in Germany, Villermé in

France, and Alison in Scotland, who blamed disease on poverty and other social conditions, and the miasmatists like Farr and Simon in England, turned out to be wrong in their opposition to contagionism. The fact that in 1854, at least 20 years before this theory was accepted, Snow used the germ theory of disease to explain cholera, is a remarkable feat—a fascinating demonstration that epidemiologists could be ahead of microbiologists and everyone else.

What happened after 1874 was very interesting. Now medicine had another theory, the germ theory, that was the dominant one. Everything was explained on the basis of this theory. There are marvelous examples, such as beriberi, where the data didn't fit the germ theory, yet they still tried to explain the findings on that basis, just as Farr had tried to explain cholera by the miasma theory. But the first real breakthrough for noninfectious disease didn't come until 1912, when Casimir Funk enunciated the "deficiency" theory of disease. This was the first noninfectious theory of disease, and its acceptance became the basis for development of the whole area of nutritional diseases.

Public health in the modern sense, however, had really started in the early nineteenth century in France, not in England or Germany. This was attested to by the English. Richardson, Snow's colleague, noted in 1855 that the English were far behind the French public health workers, since the latter had a highly developed public health literature based on scientific investigation. Furthermore, the French workers were concerned with all aspects of public health, not merely the epidemic diseases. Perhaps the leading spirit in this movement was Villermé, who wrote on the conditions in the textile factories and clearly demonstrated the relation of economic status to mortality. In 1826, he wrote *On Mortality in the Different Sections of Paris*, which linked poverty and disease. Farr also did work in this area, describing mortality in the different social classes. Farr follows Villermé; they are very much alike. These issues are relevant because an important trend in Latin America today is social epidemiology, the relationship of poverty and occupation with illness and health.

NAJERA: I think, to continue with Terris's line of thought, that one could say that the French Revolution brought the community's interests into the social organization of the state for the first time. Before, the king was the state; his interests and those of the nobility were the only considerations in the organization of the state. The French Revolution brought in the community's interests, so that people like Guillotin or Pinel could work for the people. You see, in a sense, public health existed before. One could claim that

the quarantine measures of the fourteenth century were public health measures, and isolating the sick was done even earlier. But these public health measures were not developed to protect all of the community, just some part of it: the nobility, the king, or trade. These measures were always very limited in scope. The French Revolution broadened this scope, marking the beginning of public health for the community as a whole. This is what I think made the big difference, and what differentiated the new type of work from that of the eighteenth century which was mostly research work: Lind's was really a piece of research and Casal was also mainly a research investigator, but Guillotin and Villermé were really doing public health.

TERRIS: I think we have to discuss the impact of the Industrial Revolution. A big impetus to all the French epidemiologists, and then to the English, was industrialization—the inhuman working conditions, the miserable housing and overcrowding in the cities, the terrible situation that resulted. The French were particularly concerned with the factories because they considered them to be the main source of the deterioration in health status. Villermé stated this in his major treatise, *A Description of the Physical and Moral State of Workers Employed in Cotton, Wool, and Silk Mills*. It was the Industrial Revolution that brought about public health in a very real sense.

NAJERA: Well, Villermé was concerned with the workers' conditions because nobody cared about them. A century had elapsed since industrialization started before steps were taken to improve the health of the population. The Industrial Revolution started during the second half of the eighteenth century, but it went very slowly and its effects were not really seen for quite some time. By the beginning of the nineteenth century, industry had developed so much that they needed more people, more workers.

For example, in England, where there was a very special social environment, the New Poor Law was enacted so that poor people would receive medical relief at the working place rather than at the parishes. The classes in power abolished the Old Poor Law so the poor would be forced to come to the towns to work in the factories. This was a very important social change, and it is so interesting to read how Chadwick, who has been considered one of the big names in public health, was responsible for abolishing the Old Poor Law. The situation was completely schizophrenic: on the one hand he was trying to make things better for the people with public health, but on the other he was putting people to work under horrible conditions.

TERRIS: It was not schizophrenic, it was Benthamite. It's hard to believe, but if you read Chadwick's *Report on the Sanitary Conditions of the Laboring Population of Great Britain*, you discover that his rationale for sanitary reform was to mitigate the trouble caused by "young. . . passionate and dangerous" workers engaged in labor demonstrations. He proposed that working-class people should be allowed to become old enough to mature and acquire a sense of responsibility. That way they would not be supportive of trade unions, anarchism and so on—in his own words, "anarchical fallacies . . . trade unions . . . the violence of strike after strike." He also conceived and administered the Poor Law Amendment Act of 1834, which mandated that there would be no more home relief. People either had to go to the workhouse—the hated Bastille as the poor soon learned to call it—or get no medical relief at all. The poor were forced into the cities, and the industrialists got the labor they wanted. It was all of a piece. Chadwick a humanitarian? Not as far as I am concerned.

NAJERA: He was a man of his time. He knew exactly what he wanted and he served the establishment. He served those in power. Chadwick was the prime force behind England's public health movement, and since he lived to a very old age his influence was felt almost throughout the nineteenth century. He was born in 1800 and lived to the end of the century, 1890, in fact.

BUCK: I think he was a contemporary of Charles Dickens, who, by the way, although also concerned with the appalling conditions, probably did not like Chadwick very much. The story I have heard is that Chadwick became very much disliked and they really wanted to get rid of him, so they pensioned him off. They gave him quite a handsome pension for those days, and he got his revenge by living yet another 30 years.

TERRIS: He was called "the most hated man in England."

NAJERA: I think we also need to consider the shift between the eighteenth and the nineteenth centuries, especially in the latter part of the nineteenth, from people like Baker and Casal to people like Finlay, Chagas, and Carrión. With the industrial revolution, infectious diseases became the big problem. They resulted from poor living and working conditions, from overcrowding, and from lack of sanitation in the slums created for poor laborers in industrialized towns. From the middle to the end of the nineteenth century, everything became infectious diseases and microorganisms. These diseases were prominent, while malnutrition, low

salaries, and other social factors were forgotten. Panum, Snow, Finlay, Chagas, Carrión, Takaki, Haffkine all looked at infectious diseases. The other diseases practically disappeared from the focus of research and attention, although certainly not from reality. Villermé had shown that there was a strong relationship between poverty and disease, but only a few decades later a shift had occurred. Suddenly no one thought of this link anymore; everyone was trying to discover those new, “socially neutral,” biologic agents—the microbes.

TERRIS: I am not sure I accept what you are saying. I think the time when infectious disease became all important was after Pasteur and Koch, because then they could do something about it. Then the whole field became infectious disease. It was the success that created the interest, not the existence of the problem. The reason that the Latin Americans today think only in terms of infectious diseases is that they can do something about them.

Let me put it another way. Noninfectious diseases existed long before 1940, but there was no noninfectious disease epidemiology of any great significance until after some successes were achieved—until, for example, the relation of cigarette smoking to lung cancer was discovered and the risk factors for coronary heart disease were demonstrated. Once there was some success, everyone jumped on the bandwagon.

I don't accept the thesis that it was the Industrial Revolution which caused an emphasis on infectious diseases. They were the most important diseases long before the Industrial Revolution. Look at plague. Look at all the great epidemics of the Middle Ages. They dominated the field. As a matter of fact, look at the early books like *Epidemiología Española*, they are all about *pestes*, plagues. It's all infectious disease; it never was anything else. The only time they get into occupational disease and toxicology is with the Industrial Revolution.

NAJERA: Well, we could talk a lot about this. But what you said about the focus shifting to noninfectious diseases in the 1940s is more complicated. And the reason being success? Not necessarily. Take cancer and smoking. It's been 40 years since the epidemiological discoveries, and we still are about the same. It's not that we have had actual success, but, rather, we have the *possibility* of success.

And as far as infectious diseases not becoming important until Koch and Pasteur, it's not that clear cut. Snow's work was with infectious diseases, and that was 30 years before

Koch. So, by the time of Koch and Pasteur the shift had already occurred.

TERRIS: Was it really a shift?

NAJERA: Except for the work of Panum, Budd, and Snow, we don't have examples of good epidemiology in other diseases in the mid nineteenth century, and yet there had been quite a few a century before. In any case, in the 1840s or 1850s, the attention focused on infectious diseases because they had become really predominant. Before the epidemics of cholera, typhoid, or respiratory diseases such as tuberculosis or scarlet fever, infectious diseases were not such a terrible problem. This is why I think that the social conditions of the industrial revolution made infectious diseases so predominant that attention was shifted to them. Why was Snow studying cholera? Not because of the possibility of success, but because cholera was important. And why was cholera important? Because of the overcrowding in London, as a result of the process of industrialization.

Long before Pasteur, infectious diseases were so important that they even generated international health measures at the first International Sanitary Conference held in Paris in 1851. The participants debated whether diseases like cholera were miasmatic or contagious; even political considerations entered into the positions adopted by some of the countries. It was to England's advantage for these diseases to be miasmatic, whereas Spain wanted them to be infectious so it could set trade barriers against England. All of this was between 1850 and 1890. The controversy ended when it was demonstrated that these diseases were infectious, that the germs were there. Then the approach shifted from changing the social conditions to the development of vaccines as a means of prevention.

TERRIS: I couldn't disagree with you more. If you read Hecker's *The Epidemics of the Middle Ages*, the main diseases before the Industrial Revolution were infectious diseases. They didn't know about any other diseases, all they knew about was infectious diseases. Only the fact that the Industrial Revolution intensified some of them is true.

NAJERA: I am talking of the shift in the late eighteenth and nineteenth centuries.

TERRIS: But there was little or no interest in noninfectious diseases before then. Look at the plague, the "Black Death" which wiped out a quarter of the population of Europe in the

fourteenth century. Look at syphilis, an enormous problem long before the Industrial Revolution. But I do think you are right about the intensification of some infectious diseases in the big cities after the Industrial Revolution.

NAJERA: Well, if you take plague, for instance, it is very interesting to discuss why it intensified during the Middle Ages. This wasn't a new disease, and yet it became the great epidemic from the fourteenth to the seventeenth centuries. Then, long before anything could be done about it, plague disappeared. All of a sudden there were no more plague epidemics. I believe this was because the process of urbanization affected the rats, and the Norwegian rat replaced the black rat.

TERRIS: I could also argue that another big factor, long before the Industrial Revolution, was the commercial revolution. The extension of trade on a world scale brought disease from all over the world. This was a major factor.

NAJERA: There were no new diseases, or very few new diseases. Some said syphilis came from America, but that has never been proven.

TERRIS: It isn't a question of new diseases. Disease spread because of the development of international trade which we associate with the commercial revolution. And the commercial revolution preceded the Industrial Revolution by at least 200 years.

NAJERA: Not that much.

TERRIS: Well, 1492 started an era of worldwide discovery and trade.

NAJERA: But long distance trade began long before, for example trade with China. Trade grew with the incorporation of America, it was another big door opened to knowledge, but what can be considered important is the social change that was brought about by the Industrial Revolution. The people who came from the villages into the towns to become laborers. I think this is what created the extraordinary overcrowding of the big towns like London, Manchester, Paris, or Berlin.

TERRIS: I agree with that, it is true they didn't have sanitation in the big cities.

NAJERA: And they were absolutely overcrowded. Take cholera, for example, and all the discussion about whether cholera was

really a new and imported disease or if it was an exacerbation of "cholera nostras."

TERRIS: The difference in our positions is that you claim there was a shift toward infectious diseases as a result of the Industrial Revolution, whereas I say that all that really happened was that infectious diseases, which were the main causes of disease, were intensified by the Industrial Revolution.

NAJERA: No, the shift that I refer to is a shift in attention, not a shift in the diseases. Both types of disease existed before. Chronic diseases were there and epidemic, or infectious, diseases were there, but attention was not focused on the infectious diseases until the Industrial Revolution. What happened then was that they were intensified.

Why did Snow study cholera? Because it was something that was obvious, it was there, people were dying like flies in London, in Soho. This was something that had not occurred before, because the living and working conditions of the people were worse than ever.

TERRIS: They were dying like flies from infectious diseases all through the Middle Ages. The difference is that they weren't able to deal with them. Science hadn't developed, technology hadn't developed. It was during the Industrial Revolution that it was possible to develop a totally new approach.

NAJERA: In any case, the fact that Snow was able to deal with cholera through sanitation because he discovered the key role of the contaminated water pump, is good. But sanitation was known to be the fundamental thing to avoid epidemics by the Greeks in the fifth century B.C. and even by the Indus Valley civilizations of Mohenjo-daro, Harappa, or Taxila some five or six centuries before that. Yet sanitation had only been applied to the very rich. But since overcrowding was not a problem, they could manage—epidemics came and went. But the overcrowding of the nineteenth century was terrible.

Why did Dickens write his stories? Because the conditions of the people were different. They were living worse than ever in these industrial-town slums. There are descriptions of families of 12 living in one room. This had not happened before. True, there had always been poor people, but most of them lived in rural areas where there was more space.

TERRIS: Well, I must tell you that the plagues of the Middle Ages were much more devastating than the plagues of the Indus-

trial Revolution. If you look at the Great Plague, whole cities were practically wiped out in Asia and Europe. I've read the accounts and it was much worse than what happened during the Industrial Revolution.

NAJERA: This may be, but the descriptions of the Middle Ages and even of some later periods were narrative accounts without any data, and most probably were quite exaggerated.

LLOPIS: I don't think I agree that these were only stories, since these narratives gave all the historical and economic contexts of the plague epidemics of the fourteenth century. And, as Terris has said, whole cities were wiped out. The economic impact of these epidemics was major. So many people died that goods and properties, the entire community's wealth, were left for far fewer people. The standard of living rose after each one of these great outbreaks.

NAJERA: All I'm saying is that there was much better data in the nineteenth century than before. Besides, the fact that plague was an important infectious disease from the fourteenth to the seventeenth centuries isn't relevant in the context of the effects of the Industrial Revolution. The plague epidemics of the Middle Ages were a consequence of a different kind of revolution, one that happened when overcrowding started in the medieval towns. These burghs were different than the Roman towns. The houses in the Roman towns had separate living and storage sections. But the houses in the medieval towns had no sanitation and had a loft where the grain for the whole year was stored. This loft made an ideal dwelling for the black rat. The black rats lived in the house and so it was possible for plague to spread from rat to rat and, therefore, from house to house. So, these epidemics really resulted from the urban revolution. And I agree that there was also a correlation with economics. The price of wheat, for instance, went down after a very good harvest. When the price went down, people stored more grain in order to have an ample supply or to speculate while they waited for prices to go up. Since they kept more grain in the houses, the rats thrived and multiplied—and with them the intensity of plague. Plague epidemics followed good harvests, which is opposite from what one would think.

TERRIS: I would still want to emphasize that there was no shift of concern from noninfectious disease to infectious disease because of the Industrial Revolution. People were always concerned with infectious diseases; this was the major area of concern. Infectious diseases increased as a result of the

Industrial Revolution and that is why they tried to do something about them, but there was no shift. There was no change. No one was working on noninfectious diseases and then shifted to infectious diseases.

- LLOPIS:** These men were not talking about infectious disease or chronic disease. In some cases they did not know what they were dealing with. Some of these diseases were studied in order to establish their modes of transmission, because investigators felt they might be communicable diseases. In other cases they were just trying to find out anything they could. Actually, their work was more in the line of research. They could be classified as researchers, investigators, etiological researchers, really.
- NAJERA:** Perhaps it would be useful, at this point, to review some of the important, early works. Take Lind, for example. After he did his work on scurvy in the first half of the eighteenth century, nothing happened. Nobody paid attention to him, and for the next 50 years people continued to die of scurvy. It was only after the work of Gilbert Blane and the publication of his "Observation on the Diseases of Seamen" in 1789, that the English Navy would take action. Blane based his work on Lind's and Cook's experience because he believed strongly in prevention.
- TERRIS:** Kamahero Takaki was the James Lind of beriberi. By 1882, Takaki's observations as director of the Tokyo Naval Hospital led him to attribute beriberi to poor diet. He persuaded the skeptical Japanese admiralty to initiate massive dietary reforms. Crews were given more fresh meat and vegetables and at some meals they were given barley instead of rice. The effects were incredible. In 1882, there were over 400 cases of beriberi for each 1000 men. In five years the disease was completely eliminated.
- LLOPIS:** Another important investigator was Panum, who addressed the question of incubation periods in his "Observations made during the Epidemic of Measles in the Faroe Islands". He discovered that the age distribution of the disease in those islands where the virus had not circulated for a long time was different than in those where it had. In the former it was the adults who had the measles, which, under normal conditions they didn't have.
- NAJERA:** Think, too, how interesting it is to compare, for example, Snow and Farr, how formative. If one analyzes Farr today, it is possible to conclude that he was also right. Snow had the success, he dealt with the disease, but theoretically and

methodologically it was Farr who was right. Farr was much more logical, much more of an epidemiologist. Snow, by luck or chance, found out that the pump was the key to the spread of cholera, and, therefore, had the success. But it was Farr who was really closer to the sociological roots of the disease. By looking at people according to income he came closer to the problem, without, of course, the possibility of coming up with a solution.

TERRIS: I do not agree. What Farr did was to publish a paper showing that as altitude above the Thames increased, cholera decreased. That was based on the miasma theory, and the paper was published to buttress this theory. If you read Snow's book carefully, you'll find that it is a profound sociological document. He showed that cholera was the disease of the poor because it flourished among people who were crowded together. The eating room and the sleeping room were the same. He showed that the rich did not have that problem, since they had separate rooms for eating and sleeping. He even included occupational epidemiology because he pointed out that the miners had so much cholera because they had to defecate and eat in the same space and it was impossible for them to escape this. Yes, it was a profound sociological document. Farr was too busy with altitude because he held to the miasma theory. The real pioneer of "social" epidemiology was Snow, not Farr.

BUCK: I believe that Najera was thinking of another work of Farr, one where he showed the difference in mortality between the country and the city and developed the idea of the minimum mortality which might be obtained in every segment of the country.

NAJERA: If one looks at the way that Baker studied lead poisoning in Devon in the first half of the eighteenth century, that was also very impressive. He undertook this study after the problem was considered solved. Someone else, Huxham, had attributed the disease to cider, but Baker knew that in France they had had a similar colic and there was no cider there, only wine. So he deduced that it couldn't be the cider. It was neither the cider nor the wine, but the lead that was present in both. Acute poisoning in the case of the Devon colic and chronic in the gout in France.

We could also mention the famine in Ireland in 1845, where practically half the population died and a third emigrated to the United States—the Kennedys and most of the Irish families came to the United States at this time. Ireland was a British colony that grew potatoes as a monoculture. Heavy rains promoted an extraordinary growth of

a fungus—the potato blight—that practically destroyed the year's crops. As a result of this, a famine ensued, and people, millions of poor people, died of hunger. This was analyzed very well by René Dubos.

BUCK: There also was a beautiful etiological mistake in that. When it was suggested that the typhus fever which broke out among the Irish coming in ships to the New World was a communicable disease, people laughed; they were certain that the disease was caused by malnutrition.

NAJERA: Another good example was Jenner's work with smallpox vaccination. In the eighteenth century people were becoming more and more variolated through the technique of using direct inoculation. This technique was imported from China and was becoming more and more common, especially for the rich, for the nobility. When he was practicing in Devonshire, Jenner apparently saw that many variolated people had the same type of lesions as some milkmaids, and people confirmed that these milkmaids never had smallpox. So he thought that this must be a similar, but not exactly the same, thing. His line of thought was that smallpox was one thing, variolation a second, and the milkmaid's immunization a third similar thing. So it occurred to him that he could experiment, and he set up an experiment with only one subject, a boy. You see, it was still an experiment. After all, Lind's experiment on scurvy had only 12 subjects. Lind took 12 sailors and put six groups of two people in six different treatments. So it was not much of an experiment with two subjects in each group.

BUCK: Jenner avoided the problem of random allocation.

TERRIS: He didn't go beyond that one experiment?

NAJERA: Well, from the experiment with the boy he concluded that the results were good, and everybody accepted them. So he introduced a new method, vaccination, as it was later called. Immediately people were opposed to him, especially the church, because it could not accept the idea of introducing an animal substance into the human body. A big battle began. The big problem was, and this is the most interesting thing, that after the first experiment with the boy, most of the people that were vaccinated died from the inoculation. It was described in detail by several people in England, from the late 1790s up to 1820 or so. It was a big mess. Some of the vaccines were very good and nobody died, but they still did not protect people against smallpox. Some people have concluded that what probably happened

was that when Jenner saw that people were dying from the vaccine, he went back to variolation without telling anyone. Two or three books have been published recently on this subject in England. They have copied comments made at the time about people who died and ones who did not; what was happening and why; whether the method was good or not, etc. It was a very, very complicated beginning for this method. Perhaps Spain backed it more than most countries, and organized the expedition of Dr. Francisco Balmis that carried the vaccine around the world. This expedition should be designated as the first international health program.

TERRIS: So there was reason for the opposition.

NAJERA: Sure there was reason for the opposition; people were being killed by the inoculation. But what is interesting is that Jenner developed the vaccine.

BUCK: If we use Jenner in this book, I think the only part we want to include would be the passage that describes the rarity of the disease in the milkmaids. That's the epidemiological part isn't it?

NAJERA: That's a good point. After that they had technical problems.

TERRIS: I think we should also include Carlos Finlay and yellow fever.

NAJERA: Yes, sure, and we should also mention Daniel Carrión, the Peruvian who described a rare disease in Peru. It is a severe disease called *verruca peruana*, Peruvian wart, transmitted by *Phlebotomus*, sandflies. While he was still a medical student, Carrión set out to prove that the disease was infectious and that the systemic manifestations, which had been considered to be another disease, were part of the same disease. He set up an experiment where he had himself inoculated with material from a wart. He subsequently developed the systemic manifestations, made the clinical description of the disease as he became sicker, and proved that it was infectious—then he died.

TERRIS: He died?!

NAJERA: Yes, I think it's important to emphasize in closing this section that the motivation in all the people we have mentioned was to question what was known, to question the established truth. This is what makes them real investiga-

tors. Baker, for instance, was not happy with an explanation that didn't fit his observations of colic in England, so he started to investigate. Casal did the same thing. All of them, I think, except Villermé. Villermé is something different from the others in the sense that his work was more of an observation of the social and political context.

BUCK: By the way, I suddenly realized we have overlooked Semmelweis, haven't we?

LLOPIS: His investigations of childbed fever made in a Vienna maternity clinic in 1846 constitute a solid piece of epidemiological research.

BUCK: Yes, his study of the harmfulness of interventions is the first epidemiological study of iatrogenic illness. It also has a sort of lesson indicating how difficult epidemiological investigations of health services are. He was literally driven to his death, I think, by the reception of that paper.

TERRIS: In the old days, epidemiologists were willing to take serious risks in order to answer questions. Take Lazear of the Walter Reed Commission. There is a fairly widespread opinion that he experimented on himself, that his death wasn't accidental. Self-experimentation was a real tradition. For example, when Goldberger and Anderson of the United States Public Health Service were studying typhus fever in Mexico, Anderson slept in a bed in which a person with typhus fever had died, to see if the disease could be transmitted in that way. The United States Public Health Service had a number of martyrs to various diseases, either through self-experimentation or because they caught the disease inadvertently and died. For all these early investigators there was a tradition of real heroism, a willingness to put their lives on the line.