Emerging Infectious Diseases: A Brief Biographical Heritage

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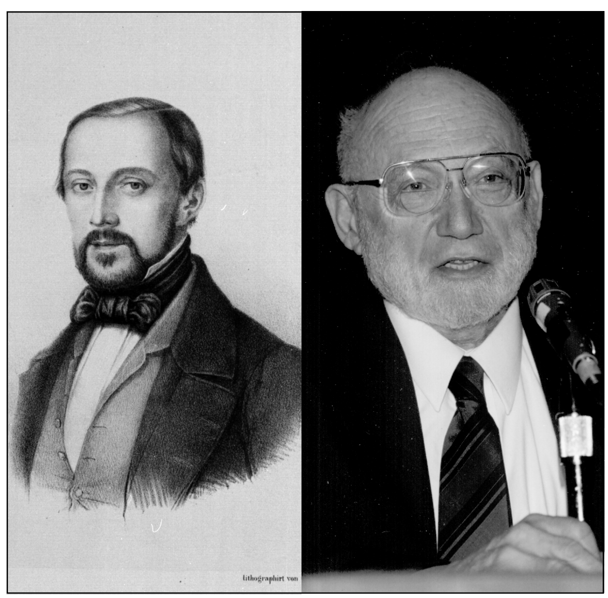
The concept that infectious (and other) diseases emerge and reemerge is not new, and neither is the search for causes of disease emergence. However, societies frequently overlook or forget that microbes evolve, adapt, and emerge in response to nonmicrobial and even nonbiologic changes in the physical and social environment. Sometimes we need to be rudely reminded of this lesson. Two scientists who have delivered such reminders, both in the form of landmark reports, are Rudolf Virchow, a 19th century German pathologist, statesman, and anthropologist, and Joshua Lederberg, the American microbiologist who coined the phrase "emerging infectious diseases" within the last decade (Photo). We owe much to the pioneering vision of these scientists.

Infectious diseases have been emerging for at least as long as humans have inhabited the earth. Every student of microbiology, medicine, and public health learns about the triangle of host, environment, and agent; what is not clear is how the three change over time, often in response to changes in another side of the triangle. Factors that influence such changes do evolve, but many are surprisingly constant. How easily and often some of these factors are overlooked is often both consequential and tragic; a historical example illustrates this point.

Rudolf Virchow, the founder of cellular pathology, wrote the first textbook in that field and established the principle that disease results from disturbed cellular function. As a young physician and anatomic pathologist in Berlin, he was assigned by the central government to investigate an epidemic in Upper Silesia, a sector of the Prussian Empire populated by a Polish-speaking minority. He completed the field portion of his investigation on March 10, 1848 (exactly 150 years before the International Conference on Emerging Infectious Diseases). The report he wrote was remarkable.

Even though Virchow was working before the germ theory of disease was accepted, at a time when disease causation was highly debated and microbes were not well described, he seems to have correctly diagnosed typhus (or possibly relapsing fever) as the cause of the Silesian epidemic (1). Even though Virchow's diagnosis cannot be confirmed, it is consistent with clinical descriptions and epidemiologic inference. He clearly demonstrated that the conditions and vectors for typhus and relapsing fever (famine and malnutrition, humid climate, poor housing, poverty) were present in Upper Silesia in 1847 to 1848. The agents that cause epidemic louse-borne typhus fever *(Rickettsia prowazekii)* and relapsing fever *(Borrelia recurrentis)* were not described until many years later.

Virchow's report was a scathing criticism of the Prussian government, which he squarely blamed for the epidemic. Virchow considered the Silesian outbreak investigation a defining



Rudolf Virchow and Joshua Lederberg.

episode in his life and career, so when the government largely ignored the report and his recommendations (Table 1), he became a passionate voice in politics, albeit in a minority role. He died in 1902, a revered scientist with a lifetime of magnificent achievements, but also with desires to have done more to improve public health and social conditions. We still have a lot to learn from Virchow's life and work.

Joshua Lederberg was awarded the Nobel Prize for medicine in 1958 for his discoveries concerning genetic recombination and the organization of the genetic material of bacteria. He is President Emeritus of The Rockefeller University in New York, a member of the Institute of Medicine, an advisor to presidents, and a 20th century Rudolf Virchow. Like Virchow, Lederberg recognized that microscopic changes make much larger differences, particularly when viewed in the context of global changes. Like Virchow, he coauthored a prescient report that associated a pressing health emergency with larger social, political, and environmental changes. The similarities between the two reports are striking (Tables 1, 2). Each regarded control of diseases as primarily social, political, and environmental. We overlook this common theme at our collective peril.

Unlike Virchow's report, the words of Joshua Lederberg are being translated into actions. Those actions can be spurred by disseminating information and building partnerships to effectively address the ongoing threat of emerging infectious diseases.

Table 1. Virchow's recommendations to the Prussian government regarding the typhus epidemic in Upper Silesia, 1848 (2)

Political reform and local self-government, including local coordination of relief efforts
"Education, with its daughters, liberty and prosperity" (3)
Economic reform
Agricultural reforms, including development of cooperatives
Building of roads
Acceptance of Polish as an official language (while most Silesians spoke Polish, nearly all the physicians and school teachers assigned by the central government spoke only German)
Separation of church and state (he criticized the Catholic hierarchy) (4)

Table 2. Factors in disease emergence—The Institute of Medicine's 1992 report on emerging infections (5)

Human demographics and behavior
Technology and industry
Economic development and land use
International travel and commerce
Microbial adaptation and change
Breakdown of public health measures

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