

## THE GEOGRAPHY AND MORTALITY OF THE 1918 INFLUENZA PANDEMIC

*K. David Patterson and Gerald F. Pyle*

The 1918 influenza pandemic spread over the entire world in less than six months and killed tens of millions of people, many times more than have been killed in any other outbreak of infectious disease thus far in the twentieth century. This pandemic probably took more lives than the plague that swept much of Asia and Europe in the mid-fourteenth century. Influenza spread in three distinct waves that, had they occurred even two or three years apart, would have been seen as distinct pandemics. In March 1918 a "spring" wave of flu began in the midwestern United States. It spread to Europe, and had reached North Africa, India, China, and Australia by July. The deadly second, or "fall," wave began in late August, apparently in France, and quickly diffused around the world. In many places there was a third, less well defined wave in the winter and spring of 1918-19. It is generally assumed that the third wave was really just a normal series of "trailer" outbreaks similar to those observed after the 1889-90 pandemic.<sup>1</sup>

The viral etiology of the disease was not known at the time, so there were no contemporary serological studies, but it seems probable that the strain prevalent in the spring was closely related to the virus that circulated in the fall and winter. Those persons and regions attacked in the spring generally suffered less severely in the fall, suggesting that, despite obvious differences between the viral strains, exposure provided some protection against the more virulent fall virus. This, however, cannot be proven, and the antigenic composition of the 1918 viruses, while believed to fall in the H1N1 group, is not certain. The extreme virulence of the fall wave has never been explained. Both the nature of the virus itself and accompanying bacterial pneumonias may be involved.<sup>2</sup>

This article deals with the first two waves and does not consider the more episodic and scattered winter outbreaks. It addresses two problems that have not been given serious scholarly attention on a global basis in

<sup>1</sup> K. David Patterson, *Pandemic Influenza 1700-1900: A Study in Historical Epidemiology* (Totowa, N.J.: Rowman & Littlefield, 1986), pp. 67-69.

<sup>2</sup> Edwin D. Kilbourne, "Epidemiology of Influenza," in *The Influenza Viruses and Influenza*, ed. Edwin D. Kilbourne (New York: Academic Press, 1975), pp. 506-7; Kingsley M. Stevens, "The pathophysiology of influenzal pneumonia in 1918," *Perspect. Biol. Med.*, 1981, 25: 115-25.

recent years. First, what were the major geographical pathways of spread of the spring and fall waves? Second, what were the demographic consequences of the lethal fall wave? We hope that our attempt to provide an overview of these questions will encourage others to present material we may have missed and to conduct further research, especially in regions where our data base is thin or nonexistent.

In the wake of the events of 1918–19, important surveys were published by Jordan, Vaughan, and the British Ministry of Health.<sup>3</sup> These accounts have been extensively cited by later writers, and Jordan's estimate of 21.6 million deaths has been widely quoted. Detailed studies for a number of regions, including the United States,<sup>4</sup> Africa,<sup>5</sup> India,<sup>6</sup> and Indonesia,<sup>7</sup> have been published in recent years, but there is a need for a modern global synthesis. This paper draws upon a wide range of contemporary sources and recent studies to give the best reconstruction of the pandemic which can be made at the present stage of research. Further local studies will be necessary to plug important gaps in our knowledge, especially of events in Eastern Europe, China, the Middle East, and Southeast Asia.

#### THE DIFFUSION OF THE SPRING WAVE

The diffusion of the first, or spring, wave is shown for the world in figure 1; figure 2 presents more detail on Europe. While the time and place of the first appearance of the new virus cannot be pinpointed, the earliest recorded outbreak seems to have been among army recruits at Camp Funston, Kansas, where an epidemic began on 5 March.<sup>8</sup> Flu spread to military training installations in several midwestern and southeastern states by the end of the month. During April the virus became widely diffused across the United States and was affecting civilian as well as military populations. Flu apparently

<sup>3</sup> Edwin Oakes Jordan, *Epidemic Influenza: A Survey* (Chicago: American Medical Association, 1927); Warren Taylor Vaughan, *Influenza: An Epidemiologic Study*, American Journal of Hygiene Monograph (Baltimore: American Journal of Hygiene, 1921); Great Britain, Ministry of Health, *Report on the Pandemic of Influenza, 1918–1919* (London: His Majesty's Stationery Office, 1920).

<sup>4</sup> Alfred W. Crosby, *Epidemic and Peace, 1918* (Westport, Conn.: Greenwood Press, 1976), reprinted with a new introduction as *America's Forgotten Pandemic: The Influenza of 1918* (Cambridge: Cambridge University Press, 1989); Gerald F. Pyle, *The Diffusion of Influenza: Patterns and Paradigms* (Totowa, N.J.: Rowman & Littlefield, 1986); Gerald F. Pyle and K. David Patterson, "The geography of influenza," *Focus*, 1987, 37: 16–23.

<sup>5</sup> K. David Patterson, "The influenza epidemic of 1918–19 in the Gold Coast," *J. African Hist.*, 1983, 24: 485–502; *idem*, "The Demographic Impact of the 1918–19 Influenza Pandemic in Sub-Saharan Africa: A Preliminary Assessment," in *African Historical Demography*, vol. 2, ed. Christopher Fyfe and David McMaster (Edinburgh, Scotland: University of Edinburgh, Centre for African Studies, 1981), pp. 401–31; *idem* and Gerald F. Pyle, "The diffusion of influenza in sub-saharan Africa during the 1918–1919 pandemic," *Soc. Sci. Med.*, 1983, 17: 1299–1307.

<sup>6</sup> I. D. Mills, "The 1918–1919 influenza pandemic: the Indian experience," *Indian Econ. Soc. Hist. Rev.*, 1986, 23: 1–40.

<sup>7</sup> Colin Brown, "The Influenza Pandemic of 1918 in Indonesia," in *Death and Disease in Southeast Asia: Explorations in Social, Medical, and Demographic History*, ed. Norman G. Owen (Singapore: Oxford University Press, 1987), pp. 235–56.

<sup>8</sup> Vaughan, *Influenza*, p. 70.

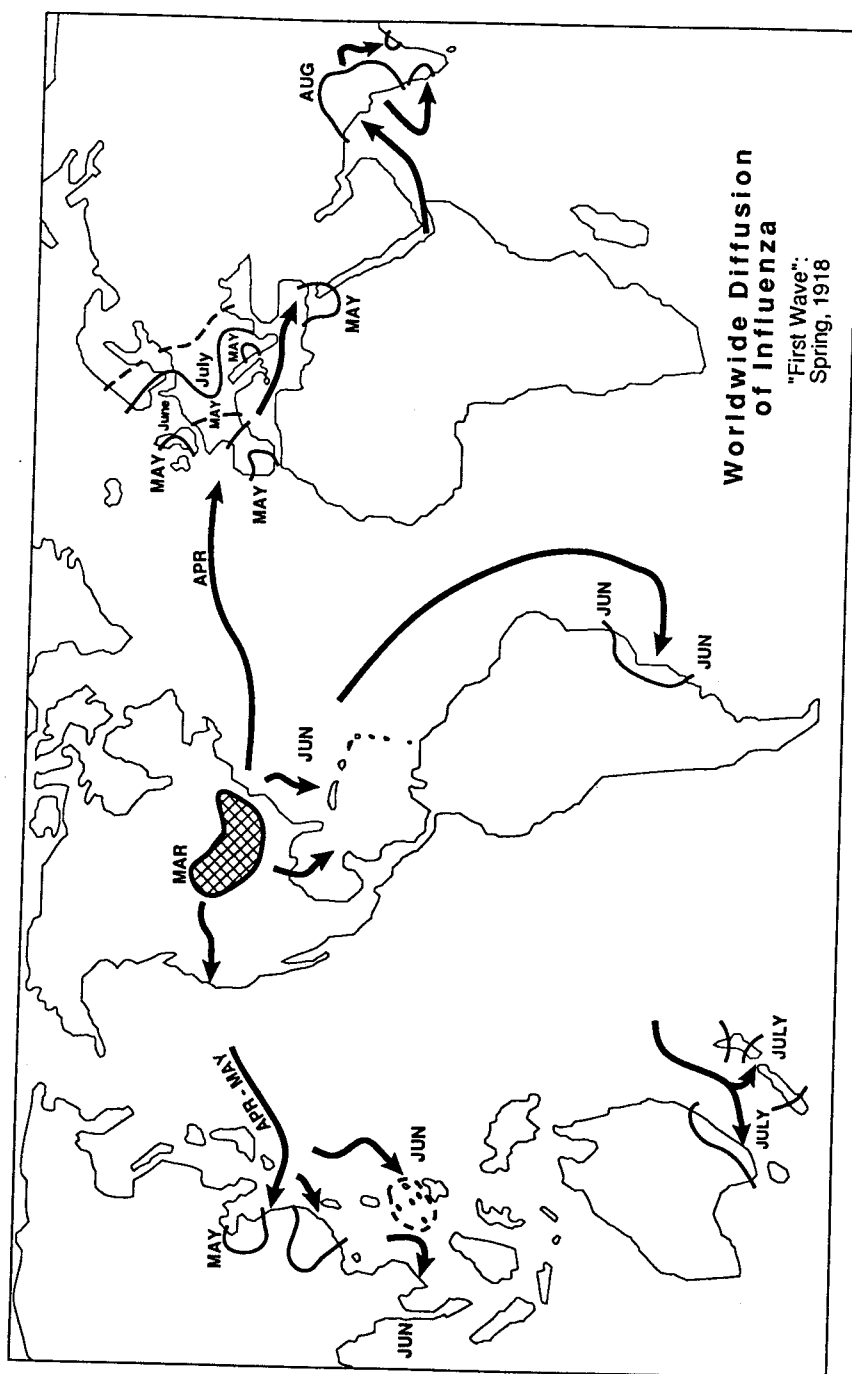


Fig. 1.

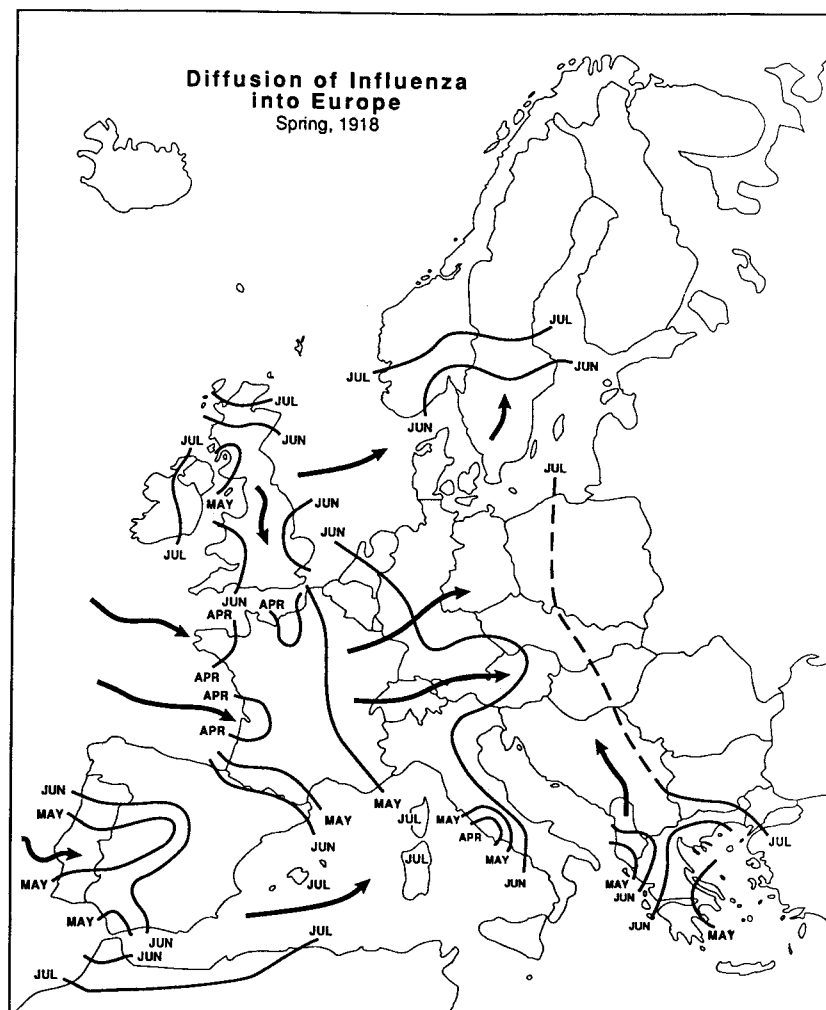


Fig. 2.

reached France aboard American troop ships in early April, and the disease spread quickly in that wartorn country. Portugal and neutral Spain were affected in May. Since Spain did not censor news, the epidemic there was widely publicized, giving rise to the common but totally misleading term *Spanish flu*.<sup>9</sup> Influenza reached Germany, Scandinavia, and Britain in June. The spring wave moved as far east as Poland and Rumania, but it did not

<sup>9</sup> "The Spanish influenza," *The Times* (London), 25 June 1918, p. 9, col. d. Contemporary observers were aware that the term was inappropriate. See, for example, M. Péhu and E. Ledoux, "Influenza in France in 1918," *Annales de Médecine*, 1918, 5: 580-81; Arnold Netter, "L'Epidémie d'influenza de 1918," *Paris Médical*, 1918, 8: 382.

reach Russia.<sup>10</sup> Sub-Saharan Africa was also spared. Ships did, however, transport the virus in the lungs of passengers to Bombay in May, whence it advanced over the railroad network to much of the rest of the Indian subcontinent. Australia, New Zealand, and the western islands of the Dutch East Indies (modern Indonesia) were infected in June.

The surprisingly early reports from China<sup>11</sup> probably indicate rapid trans-Pacific transport from the United States, and possibly one or more local, independent outbreaks of another virus. There is no evidence to support theories that the spring wave began in China and was brought to North America and then to France by Chinese laborers on their way to the Western Front. This notion seems to have originated in wartime German propaganda and from an erroneous association between influenza and bubonic plague, which was then active in parts of China.<sup>12</sup>

The spring wave waned in July and August, probably owing to seasonal factors. It had, however, covered much of the earth and had persisted longer into the summer months than most influenza pandemics. In retrospect, the rapid spread and persistence of the spring wave appear to portend the events of the fall.

Overall mortality rates were low in the spring wave, as in previous influenza pandemics, but in some places there seemed to have been disproportionately high mortality rates among young adults, even in civilian populations.<sup>13</sup> This suggests that there was indeed a close relationship between the spring virus and the deadly strain that covered the globe later in the year.

#### THE DIFFUSION OF THE FALL WAVE

The exact origins of the fall virus, which was more lethal alone and more likely to be accompanied by bacterial pneumonias, are also unclear, but the most likely hypothesis is that the new strain arose in early August by genetic mutation or recombination in western France. The first reports were from Brest, a major Atlantic port and landing point for American troops, on 22 August. Ships rapidly carried the virus to new foci in North America and Africa. Indeed, the virulent new strain showed up almost simultaneously in Boston, Massachusetts, and Freetown, Sierra Leone, an important West African harbor. Freetown was infected by sailors from a British ship, the SS *Mantua*,

<sup>10</sup> Dimitri Mikhailovich Rossi'ski'i, *Gripp* (Moscow: Medgiz, 1949), p. 14.

<sup>11</sup> "Epidemic of influenza," *China Med. J.*, 1918, 32: 399; J. W. H. Chun, "Influenza, including its infection among pigs," *Nat. Med. J. China*, 1919, 5: 34; "Flu in China," *New York Times*, 1 June 1918, p. 3, col. 3. The disease was considered mild.

<sup>12</sup> James Joseph King, "The origin of the so-called Spanish influenza," *Med. Rec.*, 1918, 94: 632-33; Great Britain, *Report*, p. 267; Frank Macfarlane Burnet and Ellen Clarke, *Influenza: A Survey of the Last Fifty Years in the Light of Modern Work on the Virus of Epidemic Influenza* (Melbourne and London: Macmillan & Co., 1942), p. 71.

<sup>13</sup> See, for example, Crosby, *America's Forgotten Pandemic*, pp. 21-27, and the literature he cites.

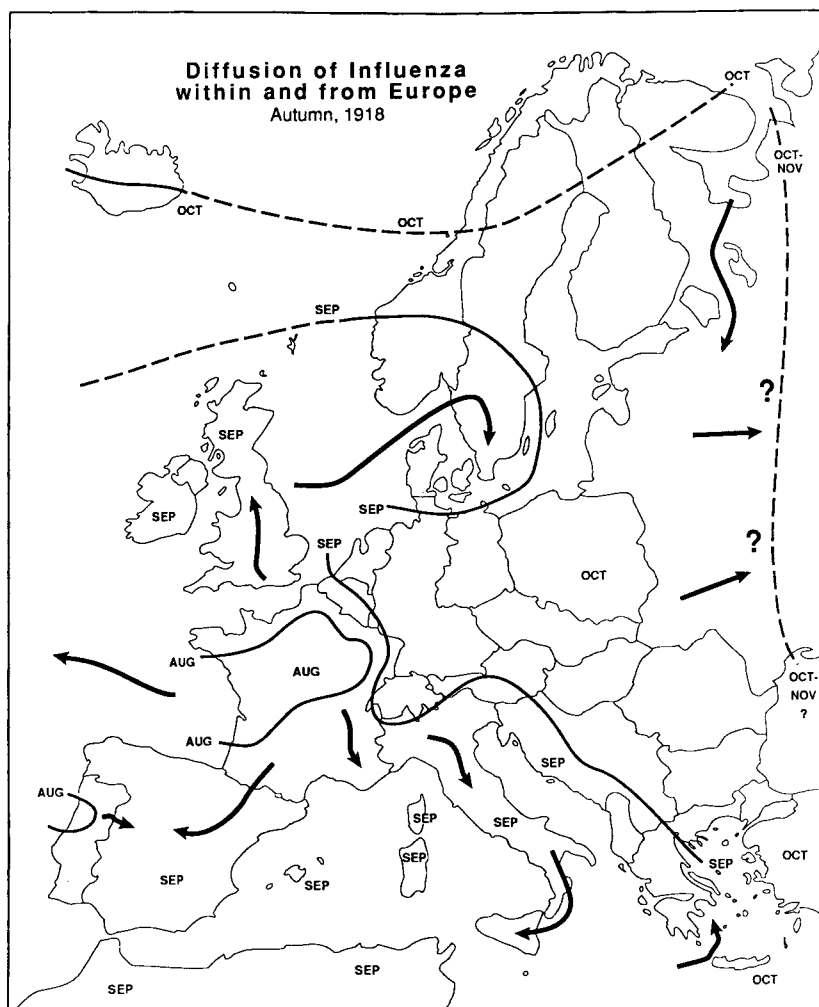


Fig. 3.

who must have encountered the new strain in England.<sup>14</sup> Influenza spread explosively from all three of these maritime foci.<sup>15</sup>

The major diffusion pathways for Europe are shown in figure 3. From England the virus moved north to Scotland and to neutral Scandinavia. Flu appears to have spread south in France, down the Italian boot to Sicily, and

<sup>14</sup> Sheldon F. Dudley, "The biology of epidemic influenza, illustrated by naval experience," *Proc. Roy. Soc. Med., War Section*, 1921, 14 (9 May): 45.

<sup>15</sup> Diffusion data have been compiled from a wide range of sources cited elsewhere in connection with specific places, and from Great Britain, *Report*; Jordan, *Epidemic Influenza*; Vaughan, *Influenza*; Crosby, *America's Forgotten Pandemic*; and W. H. Frost and E. Sydenstricker, "Epidemic influenza in foreign countries," *Pub. Health Rep.*, 1919, 34: 1361-76.

on to the Greek islands. Mediterranean shipping doubtless abetted transmission. Spain was attacked both from Portugal in the west and across the Pyrenees in the north. Influenza's advance into Germany and central Europe was only slightly delayed by the mine fields and trenches that separated the Allies and the Central Powers. The disease covered much of Europe in a matter of weeks, and most cities in western and central Europe had epidemics in October. Remote Iceland was infected by vessels from America and Europe in mid-October.<sup>16</sup> The diffusion routes are not clear in Eastern Europe. Budapest was struck in late October,<sup>17</sup> and the disease advanced eastward overland along with returning war prisoners and refugees. The White Sea area of northwestern Russia was infected in September by Allied troops arriving to support local anti-Bolshevik forces; Archangel was in the grip of a severe epidemic in early October.<sup>18</sup> Russia was in revolutionary chaos by this time; influenza, like typhus, was almost certainly transported along the rail system by troops and refugees.

Transmission in many places was greatly facilitated by wartime disruption and troop movements, and its pace was quickened by the vastly improved railroad networks that spanned the continents, and by the steamships that connected them with unprecedented efficiency. The rapid progress of influenza in North America is illustrated in figure 4. Starting in the northeastern United States, the disease moved rapidly overland, and was introduced by sea to the Gulf and Pacific coasts. Important pathways included northward movement up the Mississippi Valley, and movement from an early focus in Chicago into the Great Plains.<sup>19</sup> Canada was attacked along the Atlantic coast, by shipping down the Saint Lawrence, along the route of the Trans-Canada railway, and overland from the United States, especially in the west.<sup>20</sup>

Multiple coastal introductions were also characteristic of the spatial diffusion of influenza in Africa and Latin America, as indicated in figure 5. The new rail system in southern and central Africa and steamers on the rivers of the Congo basin provided especially efficient means of dispersal for the virus.<sup>21</sup> China and India were also attacked by sea, with penetration up the Chinese rivers and along India's railroads. The Trans-Siberian railroad was a major diffusion route in northern Asia, but it did not, as one observer

<sup>16</sup> A. D. Cliff, Peter Haggett, and J. K. Ord, *Spatial Aspects of Influenza Epidemics* (London: Pion, 1986), pp. 147-48.

<sup>17</sup> Great Britain, *Report*, p. 265. There are weekly data tables and graphs for cases and/or deaths for many European cities on pp. 206-74.

<sup>18</sup> Crosby, *America's Forgotten Pandemic*, p. 145-50; Leonid I. Van Strakhovsky, *Intervention at Archangel: The Story of Allied Intervention and Russian Counter-revolution in North Russia, 1918-1920* (New York: Howard Fertig, 1971), p. 97.

<sup>19</sup> For greater detail, see Pyle, *Diffusion of Influenza*; Pyle and Patterson, "Geography of influenza."

<sup>20</sup> Janice P. McGinnis, "The impact of epidemic influenza: Canada, 1918-1919," *Hist. Pap. Canadian Hist. Assoc.*, 1977, 19: 122-24.

<sup>21</sup> Patterson and Pyle, "Diffusion of influenza in sub-saharan Africa."

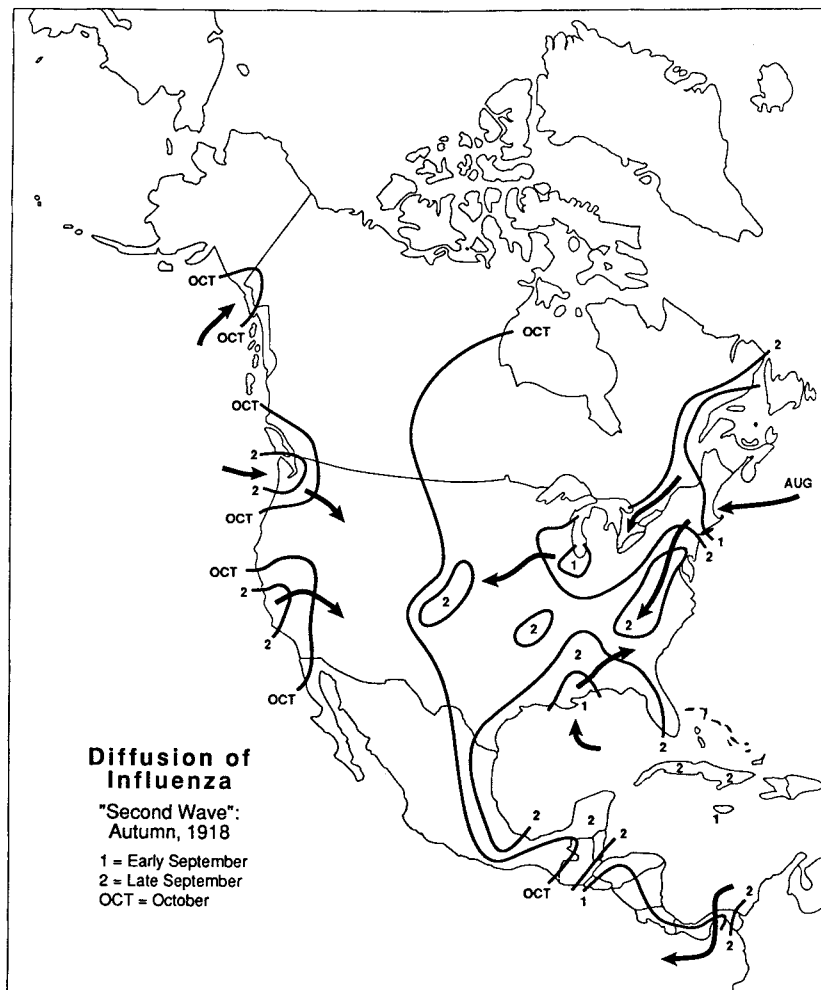


Fig. 4.

suggested, provide the path for the virus to reach Seoul, Korea.<sup>22</sup> New Zealand was infected in October by ships from the United States. A vigorous quarantine protected Australia until January 1919, when the island continent was finally struck, probably from New Zealand.

By the end of January 1919, the fall virus had reached virtually every inhabited place on earth, sparing only a few islands and very remote regions. Relative isolation and strong quarantines protected northern and eastern

<sup>22</sup> Frank W. Schofield and H. C. Cynn, "Pandemic influenza in Korea, with special reference to its etiology," *JAMA*, 1919, 72: 981.



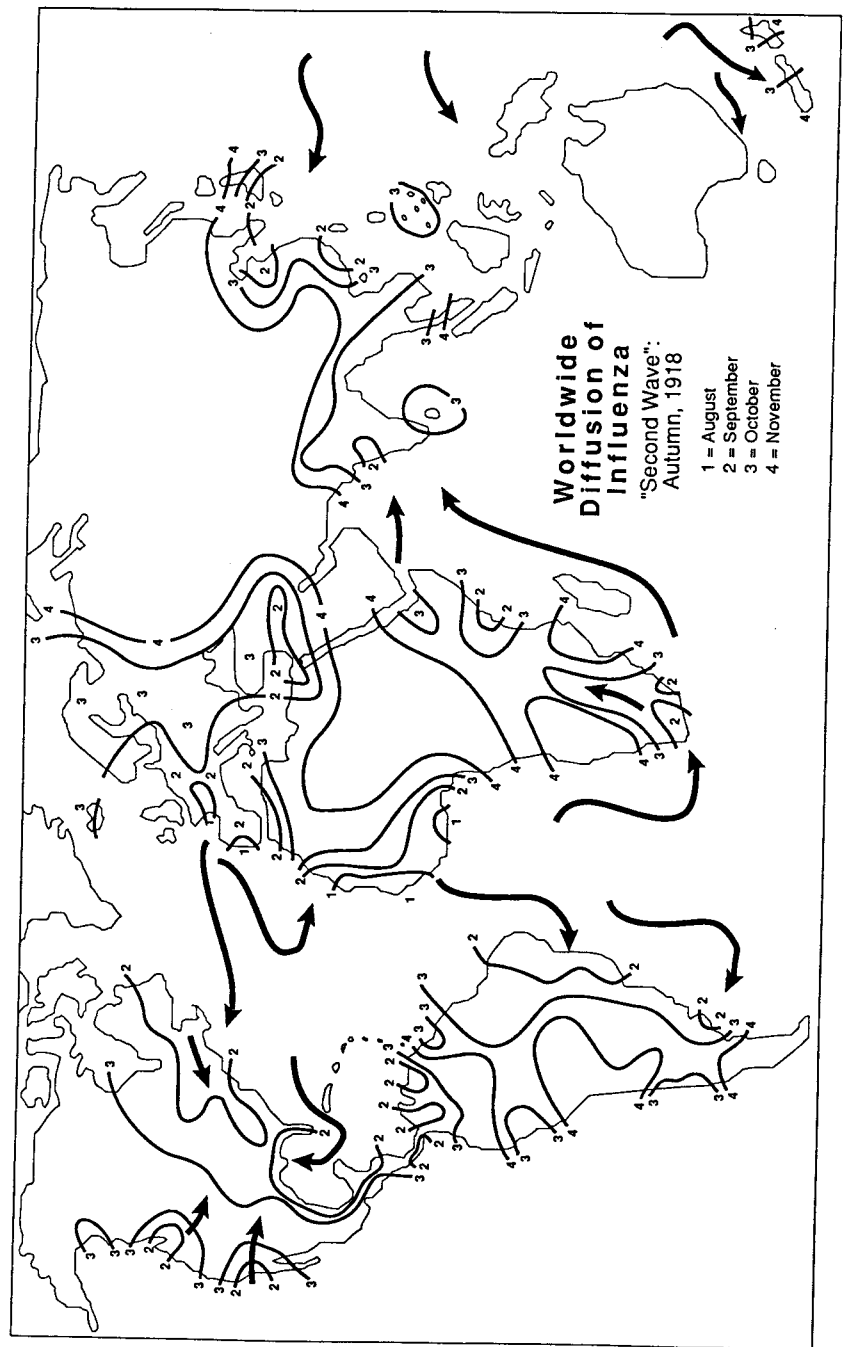


Fig. 5.

Iceland and American Samoa; quarantines proved useless almost everywhere else. This wave of influenza was probably the most truly pandemic disease in the history of world at that time; since then, other influenza strains and the AIDS virus have also spanned the globe.

#### DEMOGRAPHIC CONSEQUENCES OF THE FALL WAVE

The death toll from the fall wave was enormous, and the precise total can never be known. Incompleteness of reporting, lack of accurate diagnosis, and difficulties in assigning the cause of death when, as is common in fatal cases, influenza is accompanied by pneumonia were problems in 1918 and remain problems today. Deaths attributed to pneumonia, cardiovascular disease, diabetes, or renal disease sometimes had influenza as the immediate cause.

Reporting was always incomplete. Official registration systems were disrupted by war in many European countries, especially Germany, Austria-Hungary, and Russia. Data from China, the Latin American states, and the colonial areas of Africa and Asia are generally woefully inadequate, as one would expect from poor countries even today. In much of the world, officials had no information on the numbers of deaths even in normal times, and certainly had only the most general notions about causes. Estimates of influenza mortality were often simply guesses by scattered, overworked doctors and administrators. Modern censuses had still not been taken in many places, so even if flu deaths had been reported accurately, mortality rates could have been only approximated. Some of the mortality data discussed here is probably reasonably good, especially for some of the advanced countries. For many other territories, there are good data for some controlled groups, such as soldiers or prisoners, and guesses of varying degrees of plausibility for the general population. Finally, as will be discussed below, there is no information at all for several populous countries.

Estimates of total influenza mortality and cause-specific mortality rates are summarized in table 1. Question marks indicate especially unreliable numbers. Rates are calculated on the basis of population figures from census returns, estimates in standard reference works, or United Nations estimates. Populations are generally reported for 1920, not 1918, but this source of error is certainly smaller than others.

The highest death rates are generally from Africa and Asia, and the lowest from North America, Australia, and Europe. Not surprisingly, poor populations suffered more than wealthier ones with better food and shelter. Differential access to health care probably also had some impact; there was no specific therapy for influenza or its complications, but supportive care was useful.

Sub-Saharan Africa suffered severely.<sup>23</sup> Detailed archival studies of two

<sup>23</sup> Patterson, "Demographic Impact."

Table 1. Fall Wave Mortality Estimates for Selected Places

Place	Deaths	Deaths per 1,000
<i>Africa</i>		
Belgian Congo	300,000(?)	50(?)
Botswana	7,000	40-50
Ghana	100,000	45
North Africa	124,000-248,000	5-10(?)
South Africa	124,000-248,000	36-43
All sub-saharan Africa	1.7-2 million	18.1-21.3
Whole continent	1.9-2.3 million	14.2-17.7
<i>Asia</i>		
Afghanistan	32,000(?)	(?)
China	4.0-9.5 million	10.0-22.5
India	12.5-20.0 million	42-67
Indonesia	1.5 million	30.6
Japan	350,000	6.4
Philippines	70,000-95,000	6.8-9.2
Southwest Asia	215,000-430,000(?)	5-10(?)
Other East and Southeast Asia	220,000-1.3 million(?)	5-30.6
Whole continent	19-33 million	19.7-34.2
<i>Europe</i>		
Austria	24,000	3.4
Denmark	11,400	3.7
England and Wales	c. 200,000	4.9
France	240,000	3.9
Germany	250,000-300,000	4.2-5
Hungary*	c. 100,000	—
Iceland	440	4.6
Ireland	18,400	4.2
Italy	325,000-350,000	8.8-9.5
Netherlands	23,000-29,000	3.3-4.2
Norway	13,000	4.9
Portugal	59,000	9.7
Russia/U.S.S.R.	450,000(?)	2.8(?)
Scotland	16,500	3.4
Southeast Europe**	462,800(?)	—
Spain	150,000	7.1
Sweden	30,000	5.1
Switzerland	23,000	5.9
Whole continent	c. 2.3 million	c. 4.8
<i>Latin America</i>		
Argentina	14,000	1.6
Brazil	180,000	6.8
Caribbean & Central America†	96,000(?)	—
Chile	30,000	8.1
Guatemala	44,000(?)	35.5(?)
Mexico	300,000-500,000	21.4-35.7
Uruguay	2,000	1.4
Other South America‡	100,000(?)	—
Total Latin America	766,000-966,000	8.4-10.6

\* 1914 borders, less Croatia and Slovakia.

\*\* Rumania, Yugoslavia, Turkey.

† Except Guatemala.

‡ All except Argentina, Brazil, Chile, Uruguay.

Table 1, continued

Place	Deaths	Deaths per 1,000
<i>North America</i>		
Canada	50,000	5.7
Alberta	4,300+	—
Ontario	9,000	—
Quebec	14,000	—
United States	550,000	5.2
Alaska	1,650–2,150	3.0–3.9
Hawaii	1,559	0.6
Total North America	603,000	5.3
<i>Pacific</i>		
Australia	12,000–13,000	2.2–2.4
Fiji	8,145	49.6
Guam	858	(?)
New Zealand	6,000	5.0
"South Sea Islands"	50,000	—
Western Samoa	8,500	(?)
Total Pacific	c. 85,000	—
<i>Grand Total</i>	24.7–39.3 million	13.6–21.7

SOURCES: Populations for calculating rates from *United Nations Demographic Yearbook* (New York: United Nations, 1962), 14: 124; Brian R. Mitchell, ed., *European Historical Statistics 1750–1975*, 2d rev. ed. (New York: Facts on File, 1980), pp. 29–34; *idem*, *International Historical Statistics: Africa and Asia* (New York: New York University Press, 1982), pp. 38–45; and James W. Wilkie and Adam Perkal, eds., *Statistical Abstract of Latin America* (Los Angeles: University of California at Los Angeles, Latin American Center Publications, 1984), 23: 104. Mortality estimates are our own or are taken from Crosby, *America's Forgotten Pandemic*; Great Britain, *Report*; Jordan, *Epidemic Influenza*; Patterson, *Demographic Impact*; Vaughan, *Influenza*; or specific works cited for different countries, except for the following: Belgian Congo—Bogumil Jew-siewicki, "Rural Society and the Belgian Colonial Economy," in *History of Central Africa*, ed. David Birmingham and Phyllis Martin (London: Longman, 1983), p. 104, n. 20, citing an official report to the Belgian government; Botswana—John V. Spears, "An epidemic among the Kgata: the influenza of 1918," *Botswana Notes Rec.*, 1979, 11: 76; Scotland—League of Nations Health Organisation, *Epidemiological Intelligence*, 1923, 8: 41.

important countries, the Gold Coast (modern Ghana) and South Africa, indicate that official estimates were as much as 50 percent below the actual toll.<sup>24</sup> The North African territories stretching from Egypt to Morocco had a total population of some 25 million; very conservative death rates of 5 or 10 per thousand would produce between 125,000 and 250,000 deaths. Data from other African colonies, much of which was not available in 1920, put our estimate for the African continent at almost twice the figure of 1.35 million proposed by Jordan.

The data for Latin America vary in quality from what appear to be serious estimates for countries such as Argentina and Chile to pure guesswork for Mexico. The high rates reported for the last-named country and for Guatemala may or may not reflect reality. The disease was said to have "taken a fearful

<sup>24</sup> Patterson, "Influenza epidemic in the Gold Coast"; Howard Phillips, "Black October: The Impact of the Spanish Influenza Epidemic of 1918 on South Africa" (Ph.D. diss., University of Cape Town, 1984).

toll" in British Guiana, especially among the poor.<sup>25</sup> The approximately one hundred thousand inhabitants of Caracas, Venezuela, experienced some seventy-five thousand cases, and 1,491 deaths from flu were counted, for a fairly high mortality rate of 15 per thousand.<sup>26</sup> The Brazilian state of São Paulo recorded 12,386 influenza deaths; flu caused one-third of all deaths while it was prevalent.<sup>27</sup> Other Brazilian states and some important cities also seem to have suffered severely.<sup>28</sup> More than 600 "excess deaths" were reported in Lima, Peru.<sup>29</sup> In general, however, Latin America seems to have escaped rather lightly, at least in comparison with Asia and Africa.

Europe suffered over 2 million influenza deaths; the real number might be 2.5 million or even higher. The overall death rate for the continent was about 5 per thousand. We have not been able to find data for Greece, but the toll in Athens and Piraeus was put at 1,727, and flu was described as "severe" in the country during October.<sup>30</sup> Figures from much of central and eastern Europe, especially the Balkans, are of doubtful quality because of military and administrative disruption near the end of the war. Finnish death reports, if collected, may exist in Russian archives.

Influenza deaths in Russia were not recorded, except for partial data from a few cities. Jordan's estimate of 450,000, accepted here in table 1, was, as he noted, "a shot in the dark."<sup>31</sup> His suggested influenza death rate, and hence his fatality total, is probably on the low side. Soviet writers shed little light on the problem, but flu struck almost the entire country and caused "many" deaths.<sup>32</sup> The disease was apparently quite severe in Archangel.<sup>33</sup> A standard Soviet reference work gives figures for mortality in many countries but is silent about the toll in the U.S.S.R.<sup>34</sup> The entry for influenza in the *Large Medical Encyclopedia* notes that there was no national registration of influenza cases from 1917 to 1921, which is hardly surprising given the extremely difficult conditions prevailing. However, extrapolating from imperfect data collected in Moscow and Leningrad, the author of the entry suggested a total of some 220,000 deaths.<sup>35</sup> Given a population of something like 140 million, this would imply a very low death rate: 1.6 per thousand. A rate similar to that of Western Europe, 5 per thousand, would have produced

<sup>25</sup> F. G. Rose, "The influenza epidemic in British Guiana," *Lancet*, 1919, 1 (15 March): 421.

<sup>26</sup> Francisco A. Ríquez, "La epidemia de 1918 en Caracas," *Gaceta Médica de Caracas*, 1919, 2 (31 January): 14-16.

<sup>27</sup> Carlos Luiz Meyer and Joaquim Rabello Teixeira, *A grippa epidêmica no Brasil e especialmente em São Paulo* (São Paulo: Estado do São Paulo, Directoria do Serviço Sanitário, 1920), p. 403.

<sup>28</sup> *Ibid.*, pp. 48-62, 529-607.

<sup>29</sup> C. E. Paz Soldán, "Influenza in Peru," *JAMA*, 29 March 1919, 72: 970.

<sup>30</sup> T. G. Filtzós, "Epidemic influenza in Greece," *Pub. Health Rep.*, 1919, 34: 507; P. J. Rondopoulos, "Influenza in Greece," *JAMA*, 28 June 1919, 72: 1947.

<sup>31</sup> Jordan, *Epidemic Influenza*, p. 222.

<sup>32</sup> Rossi'ski'i, *Gripp*, p. 15.

<sup>33</sup> Strakhovsky, *Intervention*, p. 97.

<sup>34</sup> *Bol'shaya Sovetskaya Entsiklopediya*, 2d ed. (Moscow: Gosudarstvennoe Nauchnoe Izdatel'stvo, 1952), 12: 620.

<sup>35</sup> *Bol'shaya Meditsinskaya Entsiklopediya*, 1st ed. (Moscow: Medgiz, 1928), 8: 108.

about 700,000 deaths. Another author notes that millions got flu and that the case-mortality rate was "very high."<sup>36</sup> Additional research in local archives should help reduce the uncertainties in the Soviet data.

The United States, Canada, Australia, and New Zealand suffered mortality rates on the order of 5 per thousand, comparable to those of Western Europe. The United States had about 550,000 flu deaths, roughly five times its total military losses in 1917-18 and a little more than its total military losses in World Wars I and II, Korea, and Vietnam combined.<sup>37</sup> Influenza attacked Australia late, which perhaps meant that the country faced an older, weaker virus than the one that struck New Zealand three months earlier. Vulnerable groups in these developed countries could, however, experience very high mortality rates. For example, the Maori of New Zealand had 1,130 deaths, for a rate of 22.6 per thousand, typical of a poor country rather than a prosperous one.<sup>38</sup> Australian Aborigines experienced higher rates than the white population,<sup>39</sup> and in the United States case-mortality rates for Indians were four times as high as those for general city populations.<sup>40</sup>

Asia, the most populous continent, suffered by far the highest number of deaths and had some of the highest death rates. Data from Turkey, Iran, and the Arab Middle East are very sparse, although the pandemic was severe in parts of Iran.<sup>41</sup> Turkey, Iran, and the Middle East had a population on the order of 43 million; modest death rates of 5-10 per thousand would indicate between 215,000 and 430,000 fatalities. Japan's rate, 6.4 per thousand, was comparable to those of Europe and North America. Our estimate of 1.5 million deaths in Indonesia, based on Brown's detailed study,<sup>42</sup> is almost twice the 800,000 suggested by Jordan. The reported tally for the Philippines seems low, but we have no basis for any other estimate. We have no specific information on Korea, Thailand, Indochina, or Malaya, countries with a total population of approximately 44 million at the time of the pandemic. The fall wave was reportedly severe in Saigon.<sup>43</sup> An average mortality rate of 5 per thousand in these four countries would imply some 220,000 fatalities; 10 per thousand would mean 440,000; and a rate equal to the 30.6 per thousand suggested by Brown's data for Indonesia would have produced over 1.3 million deaths in these countries. Further research should make it possible to narrow this wide range of uncertainty.

Little is known about the toll in China, but with some 400-475 million

<sup>36</sup> N. A. Vinogradov, E. D. Ashurkov, and S. V. Kurashov, "Osnovnye etapy razvitiya sovetskogo zdravookhraneniya," in *Sorok let sovetskogo zdravookhraneniia*, ed. M. D. Kovrigina (Moscow: Medgiz, 1957), p. 44.

<sup>37</sup> Crosby, *America's Forgotten Pandemic*, p. 207.

<sup>38</sup> D. I. Pool, "The effects of the 1918 pandemic of influenza on the Maori population of New Zealand," *Bull. Hist. Med.*, 1973, 47: 275-76.

<sup>39</sup> Humphrey McQueen, "'Spanish' flu 1919: political, medical and social aspects," *Med. J. Australia*, 1975, 1 (3 May): 568.

<sup>40</sup> Crosby, *America's Forgotten Pandemic*, p. 228.

<sup>41</sup> Charles Graves, *Invasion by Virus: Can It Happen Again?* (London: Icon Books, 1969), pp. 89-92.

<sup>42</sup> Brown, "Indonesia."

<sup>43</sup> M. L. R. Monteil, "La pandémie grippale de 1918 à Saigon," *La Presse Médicale*, 1919, 27: 770.

inhabitants the loss of life could have been enormous. The fall wave did spread over the entire country. In the Peking area there was a "serious epidemic with a high percentage of deaths."<sup>44</sup> Mortality in cities on the lower Yangtze was said to have been heavy enough to cause a shortage of coffins.<sup>45</sup> Rural areas around Wenchow were reported to have sustained 50 percent morbidity and 10 percent mortality; it is not clear whether the mortality rate was meant to apply to the entire population or, more probably, just to those who became ill.<sup>46</sup> "Extremely high" death rates were reported for Shanghai, Canton, and Hong Kong, but fatalities were more numerous in the hinterlands of these cities.<sup>47</sup> An observer thought that influenza was "moderately severe" in Shansi District.<sup>48</sup> It caused much mortality in Manchuria, where it apparently infected swine as well as people.<sup>49</sup> Such scattered, impressionistic data obviously do not support reliable estimates of the overall mortality. It seems likely that northern China suffered more than the south, but even this is not certain at the present stage of research. Flu death rates of 10–20 per thousand, quite reasonable for a poor country but well below estimates for Indonesia or India, would indicate a range of 4.0–9.5 million dead. Clearly, uncertainty about mortality in China has a major impact on any global casualty estimates, and further work on China is essential for a more complete evaluation of the demographic costs of the pandemic.

Death totals for British India, which included modern Pakistan and Bangladesh, are by far the highest for any single country and provide the largest single source of uncertainty for Asian and world mortality totals. The first British estimates were that about 6 million died, but the authorities later revised this to 12.5 million, the figure used by Jordan. This was about 4 percent of the population. An Indian doctor who studied the pandemic put morbidity at 50–80 percent and suggested a total of 15 million deaths.<sup>50</sup> A prominent demographer analyzing later census returns has persuasively argued that the pandemic caused at least a doubling of the normal crude death rate, and that the real total was at least 16 million and was probably 20 million or more.<sup>51</sup> A more recent study strongly suggests that the best estimate is about 17–18 million.<sup>52</sup> Although we accept this figure, table 1 shows a possible range of 12.5–20 million deaths in India. The actual number was probably toward the higher end of the range, but even the conservative official figure

<sup>44</sup> E. T. Hsieh, "The recent epidemic of influenza in Peking," *Nat. Med. J. China*, 1918, 22: 129.

<sup>45</sup> "Influenza (?) in China," *China Med. J.*, 1918, 22: 608.

<sup>46</sup> E. T. A. Stedeford, "Public health of Wenchow, 1918–1919," *China Med. J.*, 1919, 33: 392.

<sup>47</sup> William W. Cadbury, "The pandemic of influenza as it affected Canton, China," *Med. Rec.*, 1920, 97: 395.

<sup>48</sup> Percy T. Watson, "The epidemic in Shansi: pneumonic plague or influenza?" *China Med. J.*, 1919, 33: 171.

<sup>49</sup> Chun, "Influenza," p. 391.

<sup>50</sup> Rajendra Kumar Sen, *A Treatise on Influenza, with Special Reference to the Pandemic of 1918* (North Lakhimpur, India, 1923), pp. vii, 35–38.

<sup>51</sup> Kingsley Davis, *The Population of India and Pakistan* (Princeton, NJ: Princeton University Press, 1951), pp. 41, 237.

<sup>52</sup> Mills, "Indian Experience," p. 10.

Table 2. Other Estimates of Global Influenza Mortality

Author	Number	Implied Rate per 1,000
Jordan	21,642,283	12
Burnet	50-100 million	27.6-55.2
Beveridge	15-25 million	8.3-13.8
Webster and Laver	20-50 million	11-27.6
Schild	15-50 million	8.3-27.6

SOURCES: Jordan, *Epidemic Influenza*, pp. 229-30; F. M. Burnet, "Portraits of viruses: influenza virus A," *Interntology*, 1979, 11: 203; William Ian Beardmore Beveridge, *Influenza: The Last Great Plague, An Unfinished Story of Discovery*, rev. ed. (New York: Prodist, 1978), p. 32; Robert G. Webster and W. Graeme Laver, "Antigenic variation of influenza viruses," in Kilbourne, ed., *Influenza*, p. 273; G. G. Schild, "Influenza," in *A World Geography of Human Diseases*, ed. George Melvyn Howe (London and New York: Academic Press, 1977), p. 366.

is staggering. India had the greatest case-specific mortality rate of any large country, suffered roughly 40-50 percent of all deaths during the pandemic, and lost far more people than the approximately 8 million military casualties sustained by all of the belligerents in World War I. In India, as elsewhere, there was a remarkably high age-specific mortality rate among young adults.<sup>53</sup>

Assuming that 17-18 million people died on the Indian subcontinent, accepting a low estimate of 4 million dead in China, and using our lower estimates for Africa, North Africa, Latin America, the Middle East, and other parts of Asia for which data are lacking, our most conservative compilations indicate that influenza deaths in the fall wave amounted to some 25 million. However, results from the detailed studies of Ghana, South Africa, India, and Indonesia cited above make it highly probable that the real figures for many African, Asian, and perhaps also Latin American countries were much greater than contemporary official estimates, perhaps by as much as a factor of two. For example, the experiences of these territories make higher estimates for places such as China and Southeast Asia seem quite realistic. Acceptance of all of our higher figures in table 1 would mean there were some 40 million deaths. We think that this is too high, and suggest a conservative total of roughly 30 million victims.

Our estimate of 30 million deaths is compared with previous global estimates/guesses in table 2. Our figure is well above the 21.6 million suggested by Jordan and widely accepted since. It is, however, far below some very high figures proposed by some recent writers.

Figure 6 addresses this issue from another perspective. Approximate deaths for each continent and for the world are shown for three hypothetical mortality rates, with populations based on United Nations estimates. A world population of 1.811 million suffering 30 million deaths would have had a mortality rate of 16.6 per thousand, three times the rate for the richer countries

<sup>53</sup> Mills, "Indian Experience," p. 21-22. For more information on this unique feature of the 1918 pandemic, see Crosby, *America's Forgotten Pandemic*, and the sources cited there.



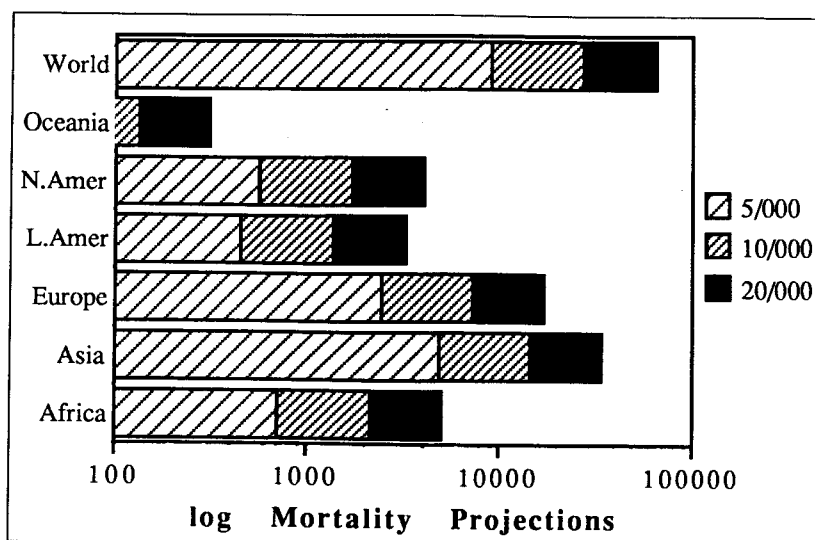


Fig. 6. Mortality projections by continent (in 1000s): three alternative rates.

but well within the range for poor ones. Guesses of 50–100 million flu deaths would put global rates at approximately 27.6–55.2 per thousand, comparable to the very high rates for Indonesia and India. These rates seem much too high for the entire world. Unless and until detailed local studies indicate that such rates are plausible for places such as China, the Soviet Union, Latin America, and Southeast Asia, we believe that approximately 30 million is the best estimate for the terrible demographic toll of the influenza pandemic of 1918.

Not all of the victims of influenza died quickly. It now seems probable that the wave of encephalitis lethargica, a mysterious brain disease observed from 1919 to 1928, was a late complication of influenza infection. If so, more than half a million additional deaths may be attributed to the pandemic.<sup>54</sup>

## CONCLUSIONS

Two basic conclusions emerge from our study. First, the spring and fall waves illustrated even more graphically than the 1889–91 pandemic that the world had become a single epidemiological unit. Aided by the greatly enhanced pace and volume of human movement, pandemic influenza spread with remarkable speed and affected almost every inhabited place on the planet. In many places it spread on a wide front, but it was always facilitated by railroads and by ocean and river shipping. In general, major cities did not

<sup>54</sup> R. T. Ravenholt and William H. Foegen, "1918 influenza, encephalitis lethargica, Parkinsonism," *Lancet*, 1982, 2 (16 October): 860.

play a crucial role as sources of infection for smaller cities and rural areas. Influenza advanced so quickly that the urban hierarchical effects common to many diffusion processes were not important. Second, the fall strain of the influenza A virus was responsible for an astonishing loss of life: a toll unprecedented in modern times for any disease. In six months the pandemic killed some 30 million people, more than three times the number of military casualties suffered by all of the belligerents during more than four years of fighting in what was then called the Great War.