

'The Evolution of Germs'

Europe's sinister gift to other continents [is] the germs evolving from Eurasians long intimacy with domestic animals.

Extracts from Chapter 11 of

Guns, Germs and Steel

A Short History of Everybody for the Last 13,000 Years

By Jared Diamond, 1997, Vintage, Random House: 20 Vauxhall Bridge Road, London SW1V 2SA UK and Endulini, 5a Jubilee Road, Parktown 2193 South Africa

THE MAJOR KILLERS OF HUMANITY throughout our recent history—smallpox, flu, tuberculosis, malaria, plague, measles, and cholera—are infectious diseases that evolved from diseases of animals, even though most of the microbes responsible for our own epidemic illnesses are paradoxically now almost confined to humans.

Questions of the animal origins of human disease lie behind the broadest pattern of human history, and behind some of the most important issues in human health today. (Think of AIDS, an explosively spreading human disease that appears to have evolved from a virus resident in wild African monkeys.)

Microbes have evolved diverse ways of spreading from one person to another, and from animals to people. . . . Some microbes . . . hitchhike [a ride] in the saliva of an insect that bites the host and flies off to find a new host. The free ride may be provided by mosquitoes, fleas, lice, or tsetse flies [or ticks] that spread malaria, plague, typhus, or sleeping sickness [or Lyme disease], respectively.

To sustain themselves [acute infectious diseases] need a human population that is sufficiently numerous, and sufficiently densely packed, that a numerous new crop of susceptible children is available for infection by the time the disease would otherwise be waning. Hence measles and similar diseases are also known as crowd diseases.

Crowd diseases could not sustain themselves in small bands of hunter-gatherers and slash-and-burn farmers . . . [but] could have arisen only with the build-up of large, dense human populations. That build-up began with the rise of agriculture starting about 10,000 years ago and then accelerated with the rise of cities starting several thousand years ago.

Among animals, too, epidemic diseases require large, dense populations and don't afflict just any animal: they're confined mainly to social animals providing the necessary large populations. Hence when we domesticated social animals, such as cows and pigs, they were already afflicted by epidemic diseases just waiting to be transferred to us. . . . The close similarity of the measles virus to the rinderpest virus suggests that the latter transferred from cattle to humans and then evolved into the measles virus by changing its properties to adapt to us. . . . Our intimacy with cattle has been going on for the 9,000 years since we domesticated them—ample time for the rinderpest virus to discover us nearby. As the table below illustrates, others of our familiar infectious diseases can similarly be traced back to diseases of our animal friends.

Deadly Gifts from our Animal Friends

<i>Human disease</i>	<i>Animal with most closely related pathogen</i>
Measles	cattle (rinderpest)
Tuberculosis	cattle
Smallpox	cattle (cow pox) or other livestock with related pox viruses
Flu	pigs, ducks
Pertussis	pigs, dogs

Falciparum malaria birds (chickens and ducks?)

If the rise of farming was a bonanza for our microbes, the rise of cities was a greater one Not until the beginning of the 20th century did Europe's urban populations finally become self-sustaining: before then, constant immigration of healthy peasants from the countryside was necessary to make up for the constant deaths of city dwellers from crowd diseases. Another bonanza was the development of world trade routes, which by Roman times effectively joined the populations of Europe, Asia, and North Africa into one giant breeding ground for microbes. . . . Today, jet planes have made even the longest intercontinental flights briefer than the duration of any human infectious disease. . . . The explosive increase in world travel . . . is turning us into another melting pot . . . of microbes that [Americans] previously dismissed as just causing exotic diseases in far-off countries.

Diseases represent evolution in progress, and microbes adapt by natural selection to new hosts and vectors. But compared with cows' bodies, ours offer different immune defences, lice, feces, and chemistries. In that new environment, a microbe must evolve new ways to live and to propagate itself.

The importance of lethal microbes in human history is well illustrated by Europeans' conquest and depopulation of the New World. Far more Native Americans died in bed from Eurasian germs than on the battlefield from European guns and swords. . . . What gave the Spaniards a decisive advantage was smallpox, which reached Mexico in 1520 with one infected slave arrived from Spanish Cuba. The resulting epidemic proceeded to kill nearly half of the Aztecs . . . By 1618, Mexico's initial population of about 20 million had plummeted to about 1.6 million. . . . For the New World as a whole, the Indian population decline in the century or two following Columbus's arrival is estimated to have been as large as 95 percent. The main killers were Old World germs to which Indians had never been exposed, and against which they therefore had neither immune nor genetic resistance. Smallpox, measles, influenza, and typhus competed for top rank among the killers.

What must be the main reason for the failure of lethal crowd epidemics to arise in the Americas becomes clear when we pause to ask a simple question. From what microbes could they conceivably have evolved? We've seen that Eurasian crowd diseases evolved out of Eurasian herd animals that became domesticated. Whereas many such animals existed in Eurasia, only five animals of any sort became domesticated in the Americas: the turkey in Mexico and the U.S. Southwest, the llama/alpaca and the guinea pig in the Andes, the Muscovy duck in tropical South America, and the dog throughout the Americas.

. . . This extreme paucity of domestic animals in the New World reflects the paucity of wild starting material. About 80 percent of the big wild mammals of the Americas became extinct at the end of the last Ice Age, around 13,000 years ago. The few domesticates that remained to Native Americans were not likely the sources of crowd diseases, compared with cows and pigs. Muscovy ducks and turkeys don't live in enormous flocks, and they're not cuddly species (like young lambs) with which we have much physical contact. Guinea pigs may have contributed a trypanosome infection like Chagas' disease or leishmaniasis to our catalog of woes, but that's uncertain.

The historical importance of animal-derived diseases extends far beyond the collision of the Old and the New Worlds. Eurasian germs played a key role in decimating native peoples in many other parts of the world, including Pacific islanders, Aboriginal Australians, and the Khoisan peoples (Hottentots and Bushmen) of southern Africa. . . . While the New World and Australia did not harbor native epidemic diseases awaiting Europeans, tropical Asia, Africa, Indonesia, and New Guinea certainly did. Malaria throughout the tropical Old World, cholera in tropical Southeast Asia, and yellow fever in tropical Africa were (and still are) the most notorious of the tropical killers.

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