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Hollis White
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The Lethal Gift of Livestock

It was several years ago while traveling through a German Airport that the PA system would announce on 5 minute intervals the following " the carrying of meat from England was forbidden and recent travelers to England should pass though a special gate for inspection". It had a science fiction feel to it.

When I came back to the states and had applied for life insurance the life insurance forms included questions on travel to England, as part of their review on my insurability.

All these precautions were due to Mad Cow disease.

My paper tonight will be on the Lethal Gift of Livestock a chapter from the Pulitzer Prize winning book, Guns, Germs and Steel written by Jared Diamond.

This book was written to answer an age-old question,
Why did some societies flourish and develop and others never did?

One of the keys for having a successful society was to be effective in food production. This efficiency led to the increase of literacy, technology, centralized government and deadly germs.

These germs were the major killers of humanity though out history. The diseases of small pox, flu, tuberculosis, malaria, measles and cholera afflicts are the culprits. All of these diseases evolved from an animal form.

Not only have these diseases been major killers but also they have decisively shaped the history of our world. Indeed more wars were won on the basis of the spread of germs than any great strategy or weaponry.

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The diseases that the Spanish brought with them aided the European conquest of the Americas; however the European conquest of the Tropics was hindered. The question is raised, why the germs from America did not similarly strike back at the Europeans and why the tropical diseases struck the Europeans so hard.

The animal origins of human disease are behind some of the most pressing health issues of the day. Over the past years we have seen Aids, Anthrax as well as the West Nile virus elevate to our conscious. Tonight we will review what makes a disease, and why some microbes make us sick. We will also review the reason we have epidemics. We will see how the diseases leapt from animals to humans and why there was such a one-way exchange of germs between Europeans and Native Americans.

First, I am a germ; I am a lot like your fraternity brother from college.

Let us be that germ-producing microbe, eager to reproduce and spread ourselves to other victims. A priority for us is to keep our victim alive so we can continue the spread of our germ. Having infected our victim we wish to enlist them in the spread of our germs.

The easiest way for us to infect would be to lie around and wait to be ingested by our host. Salmonella from under cooked eggs, trichinosis from undercooked ham or Anisakis from sushi all work in this way.

Or, we can wait in our animal host, hoping the host gets bitten by a mosquito, flea, or Tsetse fly and spreads the malaria, plague, typhus or sleeping sickness diseases.

Or, I can develop open sores on my host, so that by contact with another my germs are spread.

I might force my host to cough, so that I can spread the cold or flu. As Cholera I would induce chronic diarrhea so that the drinking water gets contaminated. I might drive my dog host mad with rabies and ensure that he bites others and spreads my disease.

I am only concerned about my host's welfare as long as he infects another host, thus I have met my objective and his death will have little consequence.

In the defense against these germs the body has several tricks up its sleeve to kill them.

Our bodies' defenses against germs may show up as the symptoms of the disease. One sure fire way to kill germs is to expose them to heat. The body has an internal thermostat that is normally set at 98.6 degrees Fahrenheit. When we are under the onslaught for disease the body raises the temperature to kill off those microbes sensitive to increased temperatures.

A second response to the onslaught of microbes is the anti body response. White blood cells and other cells seek and destroy the invaders. The cells grant us immunity for life after one episode. The Vaccination shot takes advantage of this by exposing us to weakened strain of the disease. We then build up a response to the invader's more virulent form. This is the reason for MMR shots.

Again some germs adapt by countering the antibody response and alter their make up. They change their antigens and the antibodies become clueless. Malaria, Sleeping Sickness and Aids all fall in to this category.

Finally the slow plodding of evolutionary change is also the survival of the fittest or most resistant to the disease onslaught. Small differences in human genetics offer protection against malaria, tuberculosis and bacterial diarrheas amongst various peoples.

The microbes continue to attack because they need us. We provide the nutrients and a place for their offspring. We use countermeasures and they develop counter counter measures. They use the symptoms of the disease to spread themselves to others. Let us consider the battle with germs, is it a blitzkrieg or a guerilla war?

Some disease occurs every month such as malaria. The flu comes every year, at times more severe than others. Cholera may not show itself for decades. Before the advent of modern medicine there was much more to fear from these diseases. The greatest single epidemic was the flu that killed 21 million people at the end of World War I. The plague wiped out half of Europe's population between 1346 and 1352.

The four attributes of the epidemic diseases are the following 1. They spread easily, 2. They kill you or you get better, 3. If you are lucky enough to survive you develop antibodies that leave you immune and 4. The diseases are restricted to humans. The epidemic diseases are familiar to us as the childhood diseases of measles, mumps, rubella, pertussis and small pox.

The cycle of an epidemic disease works as follow: The disease spreads easily amongst the population from an outside source, a lot of people get sick, some die, and those that survive develop antibodies. The human population grows and now only the newly arrived babies are susceptible, safe until the disease comes again from the outside.

For diseases to sustain themselves they need populations that are large enough to be self-sustaining, in that there are always babies to infect other wise the disease dies. Hence measles and others are known as the crowd diseases. It is estimated that measles will die out in any population of less than 500,000.

The remote society would find it difficult to sustain these so-called crowd diseases. The hunter-gatherers and the slash and burn farmers simply had no way to build up antibodies over time. For example a dysentery epidemic in 1902 that was brought by a sailor on a whaling vessel killed 51 of the 56 Eskimos living on the remote Southampton Island in Canada. The childhood diseases are more lethal in adults than if encountered as a child. The remoteness or lack of a crowd leads to two facts, one that epidemics can't be sustained in their population and two they never develop epidemic disease of their own to give back to visitors.

Some diseases do not require the crowd such as yellow fever, which relies on monkeys, or leprosy, which acts over a long time on its host.

Crowd diseases rely on large concentrations of populations, which rely on productive agriculture. Agriculture sustains a higher population density than the hunter-gatherer lifestyle. These farmers put down roots so to speak stayed in one place, this allowed feces to collect, which allowed microbes to collect and contaminate water. In addition human waste was utilized as fertilizer. The irrigation that was used to grow the crops enticed snails that carried disease and flukes that bury though our skin in feces laced water. The forest clearings also created an ideal habitat for the malarial mosquito.

Sanitation in the cities was worse, as densely packed humans were easy targets for the microbes. A constant influx of peasants to the cities was necessary to sustain the cities' population due to the high mortality rates. World trade routes provided ample opportunity for the microbes to travel from Europe, Asia and North Africa. Small pox reached Rome as the plague of Antoninus and killed millions of Romans between A.D. 165 and 180.

Now here is the paradox, if the diseases of the crowd requires a crowd to self sustain. Where does the disease come from? Evidence from molecular studies of theses diseases can identify the close relatives. From these studies it is concluded that most of these crowd diseases are closely related to the diseases associated with social animals. Social animals are ones that like to hang out in herds. Then as history progressed, these animals became domesticated and the microbes that they carried were ready to be transferred from them to us.

The Measles virus is most closely related to Rinderpest. Rinderpest is a disease effecting cud chewing animals but not humans. Because Measles does not affect cows, this suggests that cattle transferred the disease to humans. It is not surprising that the microbes made the jump to humans because of the close proximity of peasant farmers and their herd. With over the 9,000 years of domestication there was plenty of time for the disease to pass through.

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The deadly gifts form livestock our as follows.

Measles, TB, Small pox	from	Cattle
Flu from	Pigs and Ducks	
Pertussis from	Pigs and Dogs	
And Falciparum malaria from	Birds	

Given our close proximity to animals we are constantly bombarded by these microbes. A few of them succeeded and became human diseases. A survey of the diseases lets us trace four stages of evolution of human disease that starts from animals.

In the first stage our disease that make the leap from animals to human these include cat scratch fever from cats, psittacosis from chickens and parrots, and brucellosis from cattle. We can get tularemia from wild rabbits while skinning them. These diseases are not passed form one person to another and their ability to be passed from the animal to us is low.

The second evolutionary stage is where the diseases can be passed between humans and cause epidemics and then the disease quickly dies out as the infected become immune or die. Fort Bragg fever was an epidemic in 1942;it was a leptospiral disease that broke out and soon thereafter disappeared.

The third stage of evolution for major disease is that of those diseases that have not yet died out. Lassa fever is a disease that probably came from rodents. Its' fatal illness was so contagious that a hospital had to be closed if even a single case appears. Here in the US, Lyme diseases carried by ticks and deer is a spirochete that has reached epidemic proportions. Aids also falls in this category.

The final stage of evolution for the microbe is the long established diseases that are confined to humans. What transforms an animal disease into one exclusively human? On transformation can be a change of

vector. For example the typhus microbe was originally transmitted between rats by rat fleas, which then was transferred, by rats to humans. The microbes adapted and found that human body lice offered a better means to travel between humans. Then proper delousing was used and the microbe has resorted to the North American Flying squirrel who infects those whose attics it lives in.

Disease represents an evolution in progress as the microbes adapt to new vectors and host. In several cases veterinarians and doctors have been able to observe the microbe evolve.

One such case is the Myxo virus. The Myxo virus was a virus native to Brazilian rabbit, which causes a lethal epidemic to European rabbits. The virus was introduced to Australia in hopes of ridding it of the European rabbit that had been introduced in the nineteenth century. In 1950 the transplanted rabbits were infected with the virus. In the first year the program was a success, death rates for the rabbits was 99.8%. The second year death rate dropped to 90% then down to 25%. Over time the virus changed to kill fewer rabbits and to permit them to live longer. Thus the virus could sustain it self without losing its host to death.

An example similar to this in humans is syphilis. Today it is a slowly developing disease, but it was not always so. When syphilis was first recorded in Europe in 1495 it's pustules covered the body from head to the knees, cause flesh to fall off peoples face and led to death in a few months. By 1546 it became more of the disease that we know today. Apparently the Mxyo virus and the syphilis spirochetes evolved to keep their victims alive long enough to transmit new diseases.

The importance of the microbe in human history can be shown by the European's conquest and depopulation of the New World. More Native Americans died in bed from Eurasian germs than on the battlefield to guns and swords. The germs undermined resistance by killing most of the Indians and their leaders and sapping the survivor's morale.

In 1519 Cortez landed in Mexico with 600 troops to conquer the fiercely militaristic Aztec Empire with a population of millions. Cortez reached the capital of Tenochtitlan; he escaped with only the loss of 2/3 of his force and managed to fight his way back to the coast. This demonstrates the Spanish Military advantage and Aztec naiveté. When Cortez next onslaught came the Aztecs fought street by street with tenacity. What gave the Spaniards the upper hand was that small pox had arrived in 1520 with a slave from Spanish Cuba. The resulting epidemic killed ½ of the Aztecs including the emperor Cuitlahuac. A disease that spared the Spaniards and killed Indians, as if proclaiming the Spaniard invincibility, demoralized the survivors. By 1618 Mexico's population of about 20 million had plummeted to 1.6 million.

The Mississippi Valley had been a populous Indian center prior to the Europeans arrival. In this case the decimation of the population was in advance of the conquistadores arrival. When De Soto marched through the South Eastern United States in 1540 he came across numerous abandoned towns that had been struck by epidemics passed on to the interior from the coastal Indians contact with the Spanish.

Desoto did see some of the towns still in existent on the lower half of the Mississippi. By the end of his expedition it was a long time before Europeans again reached the Mississippi Valley. The microbes were there and kept spreading, by the time the French settlers came in 1600 all the big Indian towns on the Lower half of the Mississippi had vanished. Their only relics today are the great mound sites. For the new world as a whole, the decline of Indian population was 95% in the century following Columbus' arrival.

The main killers were old world germs of which the Indians had neither an immune nor genetic resistance. Small pox, Measles, Influenza and Typhus were the top killers. If these were not enough diptheria, malaria, mumps, pertussis, plague, TB and yellow fever were close behind. In 1837 the Mandan Indian tribe with one of the most elaborate cultures contracted small pox from a steamboat traveler coming up the Missouri from St. Louis, The population of one Mandan village went from 2000 to 40 within a few weeks.

The Europeans had over a dozen diseases they were bringing with them wherever they went. The sole possible exception of the one way transfer of germs is syphilis, but the origins of this disease remains

controversial. Why didn't the new world cities that had booming population have diseases that awaited the Europeans? A contributing fact could be that the cites started later or were not connected by trade routes like Europe, Africa, India, China. Still there are no lethal crowd epidemics coming from the new world at all.

The main reason that there are none of the crowd diseases in the Americas becomes clear when we ask, "from where could these diseases originated from?" In Europe crowd diseases evolved out of the Eurasian herd animals that become domesticated. Where in the Americas only the Turkey, Llama, Guinea Pig, Muscovey duck the dog had been domesticated.

This shortage of domesticated animals in the new world is due to the shortage of animals to be domesticated, 80 % of the big wild animals became extinct at the end of the Ice Age 13,000 years ago. Against cow and pigs what did get domesticated just doesn't compare. The Muscovey duck and turkey don't live in large flocks. Guinea pigs may contribute trypanosome disease. There does not seem to be any disease that emanates from the llama.

The historical importance of animal derived diseases extends beyond the old and New World conflicts. The Eurasian germs played a key role in decimation the populations of native peoples around the world including Pacific Islanders, Aboriginal Australians, and the Khosian people. Mortality rates of previously unexposed peoples ranged from 50 to 100% The Indian populations of Hispaniola declined from 8 million when Columbus arrived in1492 to 0 by 1535.Measles reached Fiji in 1875 and killed ¼ of the Fijians still alive after the previous European visit. In Hawaii Captain cook brought Syphilis, Gonorrhea, Typhus and the flu in 1779, followed by the Typhus epidemic in 1804 reduced Hawaii's populations from a ½ million in 1779 to 84,000 in 1853 when finally small pox reached Hawaii an killed of an additional 10,000.

The Germs did not solely act on the Europeans behalf. Tropical Asia, Africa, Indonesia, and New Guinea have a disease or two to give back. Malaria was throughout the Tropical Old world, Cholera in tropical

South East Asia and Yellow fever in tropical Africa were and still are the most notorious killers. The European partitioning of Africa happened 400 years after that of North America.

Let us step back and reconsider. Why did some societies flourished and developed and others never did? Europeans had big advantages is weapons, technology and political organization over the non-Europeans. But that alone does not explain how so few Europeans came to supplant son much of the native populations of the world. None of that would have happened without Europe's sinister gift to the other continents- the germs that evolved from Europe's long intimacy with domestic animals.