

**Alfred Crosby, "Pangaea Revisited," from *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*.**

**I.**

IT IS NECESSARY TO BEGIN at the beginning in considering the Neo-Europes (areas such as North America, which have climates like that of Europe). We must begin in fact, not in 1492 or 1788, but about 200 million years ago, when a series of geological events began that brought these lands to their present locations.\* Two hundred million years ago, when dinosaurs were still lolling about, all the continents were jammed together in one great supercontinent that the geologists call **Pangaea**. It stretched over scores of degrees of latitude, and so we can assume that it had some variations in climate; but with only one land mass, there would not have been much variety among its life forms. One continent meant one arena for competition, and so only one set of winners in the Darwinian struggle for survival and reproduction. Reptiles, including all the dinosaurs, were the dominant kinds of land animals in Pangaea - and, therefore, the world - for three times as long as mammals have held that position since, and yet reptiles diversified into only two-thirds as many orders.

About 180 million years ago Pangaea began to break up like some immense tabular iceberg rotting in the heat of the Gulf Stream. First it split into two supercontinents, and then into smaller units that became, in time, the continents we know. The process was more complicated than we can describe here (indeed, more complicated than geologists completely understand as yet), but, in broad terms, Pangaea broke up along lines of intense seismic activity that later became undersea ridges. The most thoroughly examined of these is the Mid-Atlantic Ridge that boils and bubbles from the Greenland Sea to Spiess Seamount, twenty degrees of latitude and twenty of longitude southwest of Cape Town, South Africa. From this and other ancient drowned cordillera, lava poured (and in many cases still pours), generating new ocean floor and carrying continents on either side of a given ridge farther and farther from each other. Where these floors, moving away from the ridges that spawned them, back into each other, they curl downward into the earth's mantle, grinding and grating, sometimes scuffing continental mountain ranges up to the skies, sometimes creating underwater trenches, the deepest features on the surface of the planet. Geologists, who sometimes have a stony insensitivity to nuances, call this awesomely vast and eon-consuming activity "continental drift."

When mammals succeeded dinosaurs as the globe's dominant land animals and began to diversify into their myriad orders over the past few score million years, the separations of the continents seem to have been at their extremes, certainly more so than today, and there were large inland seas partitioning South America and Eurasia into two subcontinents each. On these fragments of Pangaea, life forms developed independently, and in many cases uniquely. This helps to account for the remarkable degrees to which mammals diversified and the speed at which they did so.

Continental drift largely accounts for the differences, often extreme, between the flora and fauna of Europe and those of the Neo-Europes. A European traveler sailing to any of the Neo-Europes must cross one or more of these undersea ridges and trenches. Europe and the Neo-Europes have not been part of the same continental mass for many millions of years (except for ephemeral Arctic connections between North America and Eurasia), years during which the ancestors of American buffalos, Eurasian cattle, and Australian kangaroos shambled and hopped down diverging paths of evolution. To cross these undersea seams is to step from one of those paths to another, almost to step into another world. (There are seams that are not under water and do not separate continents, but let us ignore them for brevity's sake.)

When Pangaea first split into northern and southern supercontinents, only North America of all the Neo-Europes was in the same supercontinent with Europe, and so the two have shared the same latitude and have had anciently similar histories. The floral and faunal differences between Europe and North America are less striking than the differences between either of them and the other Neo-Europes. Even so, their differences were enough to take the breath away from the Finnish naturalist, Peter Kalm, in Philadelphia and fresh off the boat from Europe in 1748: "I found that I was now come into a new world. Whenever I looked to the ground I found

everywhere such plants as I had never seen before. When I saw a tree, I was forced to stop and ask those who accompanied me, how it was called ... I was seized with terror at the thought of ranging to many new and unknown parts of natural history."

Biogeographers have properly designated North America and Eurasia, including Europe, as different biological provinces or subregions. After all, Nero threw Christians to the lions, not to the cougars. As for the other Neo-Europes, there is no doubt about their deserving biogeographical categories separate from that of Europe. All three, for instance, have large - some of them man-sized - flightless birds.

The breakup of Pangaea and the decentralization of the processes of evolution began 180 or 200 million years ago. For almost all the time since, except for a few instances counter to the dominant trend (e.g., the periodic rejoining of North America and Eurasia by reappearances of the Bering land connection, and consequent intermixing of biota), centrifugal forces have prevailed in the evolution of life forms. This trend, prevalent since some of our distant mammalian ancestors made a living by stealing dinosaur eggs, halted about half a millennium ago (a tiny fraction of a single tick on the geological clock), and centripetal forces have dominated since. The breakup of Pangaea was a matter of geology and the stately tempo of continental drift. Our current reconstitution of Pangaea by means of ships and aircraft is a matter of human culture and the careening, accelerating, breakneck beat of technology. To tell that tale, we have to go back not 200 million years, fortunately, by only a million or three.

## II.

The most adaptable and therefore most widely distributed of today's large land animals are human beings, and this has been true of the members of the species *Homo sapiens* and their hominid predecessors for a very long time - long from their point of view. Other creatures had to wait for specific genetic changes to enable them to migrate into areas radically different from those of their ancestors - had to wait for incisors to lengthen into daggers before they could compete successfully with hyenas on the veldt, or had to wait for hair to thicken into fur before they could live in the north - but not humans nor hominids. They made not a specific but rather a generalized genetic change: They developed bigger and better brains wired for the use of language and for manipulation of tools.

That growth of nerve tissue crammed into the treasure box of the skull began several million years ago, and as it did, the hominid became increasingly capable of "culture." **Culture** is a system of storing and altering patterns of behavior not in the molecules of the genetic code but in the cells of the brain. That change made the members of the genus *Homo* nature's foremost specialists in adaptability. It was as if the fisherman in the fairy tale to whom the princely flounder granted three wishes had asked first of all for all the wishes he would ever want.

These plump-brained apes made use of their new skills of adaptability to migrate out of their ancestral home (probably Africa) and across dry Pangaeian seams into Eurasia. Ever since, hominids and humans have migrated; they seemingly have tried to occupy every crack, cranny, and niche above the low-tide line. Our ancestors (*Homo erectus*), with brains, on average, hundreds of cubic centimeters smaller than ours, increased in numbers, migrated through out the Old World tropics, and, by 750,000 years ago, moved into the northern temperate zone, taking up residence in Europe and China. By about 100,000 years ago, the human brain was as large as it is today, which is probably as large as it ever will be. We may or may not have folded in a few convolutions since, but there is no doubt that the actual physical development of the brain in our species was completed by 40,000 years ago, when *Homo sapiens* (the wise man!) appeared, face daubed with whatever raw pigments nature provided in the neighborhood, and a sharpened or stone-tipped stick clenched in his fist.

Humans were in occupation of the Old World from Europe and Siberia to the southern tip of Africa and the islands of the East Indies. Yet there were whole continents and myriads of islands we had

not explored or settled. We had not yet passed over one of the expanding, deep-water seams of Pangaea.

### III.

These early humans were about to do something of the same magnitude as moving from earth to another planet. They were about to leave a world - the riven core of Pangaea, Eurasia plus Africa - of life forms with which their ancestors had lived for millions of years and **go to worlds where neither humans nor hominids nor apes of any kind had ever existed**, worlds dominated by plants, animals, and microlife whose forms had often diverged sharply from the patterns of life in the Old World.

The new worlds were North and South America and Australia. (To get to New Zealand, a land mammal had to be a bat or an excellent sailor, and Homo sapiens arrived there tardily.) Members of the genus Homo had been in the East Indies for most of the time that the genus had existed; the waters between those islands were warm and the straits narrow, and the shallow strait between New Guinea and Australia becomes dry land during an ice age. Members of our species turned south and walked into Australia some 40,000 years ago, giving that continent its first large placental mammal. The second, the dog called the dingo, arrived some 8,000 years ago or even more recently. (These dates and others cited in this chapter are matters of controversy in which we need not involve ourselves. We are interested in sequences, not absolute dates.)

There is evidence that a number of species and even genera of Australian marsupials and reptiles, creatures considerably larger than those of historical times, disappeared at roughly the same time that humans spread through that continent. The temptation is to promote chronological coincidence to the level of proof and to blame those extinctions on the invaders, though it strains credulity to claim that Stone Age human hunters alone killed off Australia's giants. They may have had assistance from diseases that came south with them from the East Indies. They did have fire, which Aborigines in historical times have used to burn over vast areas of the continent annually, and in ancient times this practice conceivably could have altered the habitats of the giants sufficiently to make life and reproduction impossible.

Getting from the East Indies to Australia was a matter of crossing a few warm, narrow straits; getting to the Americas was something more difficult. The problem was not the cold, foggy, dangerous waters of the Bering Strait; indeed, that strait has been a broad highway of tundra for much of the time since the arrival of members of the genus Homo in Siberia. The problem was the hostility of the climate in the high latitudes. There were few human beings in Siberia to follow the herds of caribou and such across Beringia to Alaska, and once in Alaska the early migrant human fetched up against a continental ice cap that occupied much of America north of Mexico. There were warm periods that opened a corridor south from Alaska to Alberta and beyond, but all in all the pedestrian's passage from Asia to the lush grasslands and forests of North America was a miserably difficult one.

Humans probably did not arrive south of the North American ice cap until long after they set foot in Australia, but in the New World, as in Australia, there seems to have been a coincidence between the arrival of human big-game hunters and the extinction of many species of large mammals: mammoths, mastodons, giant ground sloths, giant buffalos, and horses, for example. Some individuals of these giant species were incontestably killed by humans - we have found stone spear points between the ribs of fossil mammoths - but most experts are reluctant to attribute the extinction of whole species to these human hunters. Again, humans may have been only part of a wave of invading species, including parasites and pathogens, that attacked the native fauna. But why would the latter concentrate on the larger mammals? Why and how would anything but humans kill mostly those animals representing the largest meals? Homo sapiens found a hunter's paradise in Australia and the Americas. All three continents were chock-full of toothsome herbivores utterly inexperienced in defending themselves against human aggressors, providing the newcomers with seemingly inexhaustible quantities of protein, fat, hide, and bone. Expansion of Homo sapiens into Australia and the Americas must have led to a very large increase in the total number of humans on the earth. The Americas and Australia were Edens to

which God added Adam and Eve very tardily. "There can be no repetition of this," wrote Francois Bordes in *The Old Stone Age*, "until man lands on a hospitable planet belonging to another star."

#### IV.

**Some 10,000 years ago all the larger ice caps melted**, excepting those in Antarctica and Greenland, and the oceans rose to approximately their present levels, inundating the plains that had connected Australia with New Guinea, and Alaska with Siberia, and isolating the avantgarde of humanity in their new homelands. From that time until the Europeans made a common practice of sailing across the seams of Pangaea, these peoples lived and developed in complete or nearly complete isolation. One of the momentary respites from divergent evolution since the breakup of Pangaea had come to an end, and for the next few millennia genetic drift and, for the first time, cultural drift were in perfect consonance with continental drift.

#### V.

Then humanity made its next giant lunge, not a matter of geographical migration but of cultural mutation: the **Neolithic Revolution** or, more accurately, *Revolutions*. According to classic definition, the Neolithic Revolution began when humans started to grind and polish rather than chip their stone tools into final form, and it ended as they learned to smelt metal in quantity and work it into tools that stayed sharp longer and were more durable than their stone equivalents. In between, the story goes, humans invented agriculture, domesticated all the animals of our barnyard and meadow, learned to write, built cities, and created civilization. The complete story would be a great deal more complicated, but this definition will serve for our purposes.

The technological avant-garde of humanity, the peoples of the crossroads of the Old World, the Middle East, moved down the road toward becoming what we are today more rapidly than any others. The geographical avant-garde of humanity, the pioneers isolated in Australia and the Americas, had different histories. The Australian Aborigines kept to their Paleolithic ways; they did not smelt metals or build cities. When Captain Cook and the Australians of Botany Bay looked at each other in the eighteenth century, they did so from opposite sides of the Neolithic Revolution.

The peoples of the New World had their own Neolithic Revolution or *Revolutions*, most spectacularly in MesoAmerica and Andean America, but theirs, relative to that in the Old World, began slowly, accelerated tardily, and spread as though the Western Hemisphere were somehow less hospitable to the techniques and arts of civilization than the Eastern. When the *conquistadores* arrived with iron and steel, the peoples of the high Amerindian cultures were still in the early stages of metallurgy. They used metals for ornaments and idols, not for tools.

Why was the New World so tardily civilized? Perhaps because the long axis of the Americas runs north and south, and so the Amerindian food plants on which all New World civilizations depended had to spread through sharply differing climates, unlike the staple crops of the Old World, which by and large spread east and west through regions of roughly similar climates. Perhaps because American farmers required a very long time to transform their most important staple, maize, from what was at first a niggardly sort of plant into the richly productive food source that Europeans first encountered in the 1490s. In contrast, wheat, initially the most important Old World cultivar, was already highly productive when it was first exploited. The first maize could not support large urban populations; the first wheat could, and so Old World civilization bounded a thousand years ahead of that in the New World.

This kind of speculation, even if correct, does not explain why the American Neolithic Revolution was so inferior to that in the Old World in the matter of domesticating animals. Amerindians were better at this than Aborigines, who domesticated only the dog, but they were amateurs compared with peoples of the Eastern Hemisphere. Compare the American assemblage of livestock (dogs, llamas, guinea pigs, and some fowl) with that in the Old World: dogs, cats, cattle, horses, pigs,

sheep, goats, reindeer, water buffalo, chickens, geese, ducks, honeybees, and more. Why such a contrast? It is not likely that the Eastern Hemisphere's wild animals were intrinsically more tamable than those in the Western Hemisphere. Indeed, the ancestor of our cattle, the Old World aurochs, seems to have been as unlikely a candidate for domestication as the North American buffalo. Some scholars believe that Amerindians placed a prohibitively high valuation on animals, considering them fellow creatures equal to or even superior to humans, not as potential servants. New World gods, in contrast to Old World gods (at least, one of the more widely publicized of them), did not give humans "dominion over the fish of the sea and over the fowl of the air, and over every living thing that moveth upon the earth."

Or perhaps the contrast between the Old World and New World Neolithic Revolutions was simply a matter of timing. Mark Nathan Cohen, in his book *The Food Crisis in Prehistory, Overpopulation and the Origins of Agriculture*, posits population pressure as the true driving force behind the migration of Paleolithic humanity out of Africa and to the rest of the habitable continents. He also credits the pressure of numbers for the beginnings of agriculture. His thesis, brutally abbreviated and simplified, is this: When the Australian and American pioneers reached their final frontiers and looked out on waters that led only to Antarctica, the world behind them was filling up with hunters and gatherers. There was nowhere else for the surplus population to go, and there were about as many people on the earth as could be supported by means of Paleolithic technology. *Homo sapiens* needed, not for the only time in the history of the species, to become either celibate or clever. Predictably, the species chose the later course.

All over the globe, east and west, people began to shift from dependence on the herds of large animals (many of which were in sharp decline) to exploitation of smaller animals and of plants. Gatherers became more important and hunters less so, and of necessity humanity produced its greatest practical botanists and zoologists of all time. Where conditions were particularly suitable - where, for instance, wild wheat grew in solid stands and included strains with ears that did not shatter and scatter wastefully when harvested with flint sickles - the jigsaw pieces of domestication came together, and gatherers became farmers. It would seem probable that the sense of population pressure, the *primum mobile*, was greater in the more ancient centers of human occupation (i.e., those of the Old World) than on the frontiers and that this may account for the faster acceleration of the Neolithic Revolution in the Old World relative to the New World.

## VI.

But enough time spent on footless or, at least, unconfirmable speculation. The Amerindians and Aborigines came late to the full Neolithic Revolution, for whatever reasons, and suffered for it. Traditionally, the keepers of domesticated fowl have taught their birds to hurry when called by using a stick to hit the last to arrive. History has similarly chastised latecomers to the Old World's style of Neolithic Revolution.

The triumph of the European invaders in the Americas and Australasia, we shall see, owed as much, or more, to the Old World Neolithic Revolution as to the developments in Europe between the age when Abraham tended his sheep in the Fertile Crescent and when Columbus, Magellan, and Cook crossed the seams of Pangaea. Therefore, if we seek the roots of the success of European imperialism, we must be off to the Middle East, to Abraham, to Gilgamesh and the cultural ancestors of all of us who eat wheaten bread, smelt iron, or record our thoughts alphabetically.

**The Old World Neolithic Revolution, for all its dazzling advances in metallurgy, the arts, writing, politics, and city life, was at its base a matter of the direct control and exploitation of many species for the sake of one: *Homo sapiens*.** The opposable thumb had enabled hominids to grasp and manipulate tools; in the Neolithic, these humans would reach out to grasp and manipulate whole divisions of the biota around them. Old World peoples conscripted wheat, barley, peas, lentils, donkeys, sheep, pigs, and goats about 9,000 years ago. (The dog was domesticated much earlier; in fact, it was the only Paleolithic domestication.) Cattle

maintained their independence for a few more millennia, and camels and horses for even longer, but by 4,000 or 5,000 years ago the humans of southwestern Asia and environs had completed the domestication of all but a few of the crop plants and livestock most crucially important to Old World civilization, then and now.

Sumeria, humanity's first real civilization, appeared about 5,000 years ago in southern Mesopotamia in the flat lands around the lower reaches of the Tigris and Euphrates rivers. There the written chronicle of humanity begins, a manifestation first on clay and later on papyrus, vellum, cloth, and paper of the awesome continuity of Old World civilization. We - you who read and I who write this sentence - are part of that continuity; these words are in an alphabetical form of writing, a very clever Middle Eastern invention produced by peoples even more directly influenced by the Sumerian example than we are. The Sumerians and the inventors of the alphabet, and you and I, no matter what our genetic heritage, are in one category: heirs of post-Neolithic Old World cultures. All Stone Age peoples, including the few still living, and all pre-Columbian Amerindians, however sophisticated, are in another. The indigenous populations of the Neo-Europes were in the second category until Europeans arrived from beyond the seams of Pangaea. The transition from one category to another was a harrowing one, and many individuals and even peoples faltered and failed.

If we, whoever we are, compare the Sumerians with the hunters and gatherers that preceded them or have lived since, we see that the contrast between these dawn people of civilization and any Stone Age people is greater than the contrast between the Sumerians and ourselves. In examining hunters and gatherers we are looking at people who are profoundly "other." In looking at Sumerians and other early civilized peoples of the Middle East (Akkadians, Egyptians, Israelites, Babylonians, etc.) we are looking into a very old, very dusty mirror. Let us begin by seeking their knowledge of who Columbus was and who we are.

The Sumerians were great and powerful, and **they knew wherein lay their greatness and power: in their crops of barley, peas, and lentils, and in their herds of cattle, sheep, pigs, and goats.** The Sumerians, more humbly conscious of the importance of their servant species than we tend to be, did not have the gall to take credit for their existence themselves. They thanked the gods and demigods for them: to Ehlis, Enki, Lahar, Ashnan, and their peers went all praise for bringing abundance to the houses of humans, who previously had lived "hugging the dust." When these gods bestowed their blessings on the Middle Easterners, hunters and gatherers everywhere became obsolete, and the agriculturalists of the New World became obsolescent.

In sum - all articles added together - the Sumerians had food, fiber, leather, bone, fertilizer, and draft animals in greater and more dependable quantity than any other people in the world. Hunters and gatherers often had more nourishing food in greater variety than the farmers of the Middle East, but their supplies were less abundant, except for the lucky few living in such paradises as the Pacific Northwest of North America. Surpluses that exceeded the immediate requirements of the hunters and gatherers and their families were often difficult to come by and very difficult to preserve. The farmers of the New World had crops as dependable and nourishing as those of Sumeria, crops such as maize and potatoes, but they were far inferior in terms of the quality and quantity of their livestock.

The most important contrast between the Sumerians and their heirs, on the one hand, and the rest of humanity, on the other, involves the matter of livestock. There was, for instance, nothing in the Neo-Europes (or, for that matter, in tropical America or Africa south of the Sudan) that could so enhance the mobility, power, military might, and general majesty of humans as did the horse. The poet or poets who wrote the book of Job were very impressed with the horse: "Trembling with eagerness, he devours the ground; And cannot be held in when he hears the horn; At the blast of the horn he cries 'Aha!' And from afar he scents the battle."

Jehovah claimed full credit for the horse for himself, asking poor job, "Did you give the horse his strength? Did you clothe his neck with a mane?" Job did not answer, knowing a rhetorical question when he heard one, but he might have offered the thought that humanity had done something that, practically speaking, was almost as impressive as creating the horse. Humanity

had tamed it. A millennium later, Sophocles, who did not have to live with a single omnipotent god and was freer in his praise of humanity, did declare that one of man's greatest accomplishments was the taming of "the wild horse windymaned."

**Domestication of horses, oxen, and other Old World livestock** gave the Sumerians and their heirs from Europe to China an immense advantage over the peoples who had little more than the strength of their own bodies to draw on. Job, for instance, was a billionaire by the standards of the New World Neolithic revolutionaries. Before misery descended on him, swept away his worldly possessions, and blistered his poor hide, he owned 7,000 sheep, 3,000 camels, 500 yoke of oxen, and 500 asses. In comparison, Montezuma, for all his legions, was in poverty in terms of protein, fat, fiber, leather, and especially power and mobility; and the indigenes of the Neo-Europes were all still "hugging the dust."

The true strength of a society, however, lies not in its billionaires but in its common folk and their strength; and here again the heirs of Sumeria had the edge over the heirs of other cultures. They had as allies their livestock, which, somewhat like benign cousins in an extended family, provided the means for staying alive when the labor and luck of the nuclear family did not suffice. And by and large, these cousins - pigs and lambs and cows - provided for themselves while waiting to be called on to provide for their masters. Modern livestock may stand by the feeding trough and starve if it is not filled, but for most of the thousands of years since their ancestors were first domesticated, livestock scavenged for food, huddled together for shelter, and much of the time depended on their own tusks, horns, and speed for defense, with no more than skimpy guidance from their owners.

The examples of the importance of domesticated animals to the heirs of Sumeria that we could cite are thousands in number, ranging from the cozy to the bizarre. How many youngsters, meek and mild, driven from the breast by newborn siblings, survived on goat's milk or cow's milk until they could manage on a solid diet? (The name of the dreaded nutritional disease kwashiorkor, literally meaning "the sickness of the deposed baby when the next one is born," comes from the Ga language of Ghana, where the tsetse fly and trypanosomiasis exclude dairy animals.) How many Mongol horsemen, fierce and terrible, persevered through the hungriest times of the great khan's campaigns by drinking measured amounts of their horses' blood, enough to keep themselves alive and yet not so much as to enfeeble their mounts?

The farmers of western Europe north of the Pyrenees and Alps have often been praised for their skill in maintaining, even enhancing, the fertility of their land. At their most admirable, they actually create loam by carefully rotating crops, by cultivating and plowing under compost and plants especially rich in soil nutrients ("green manure"), and, above all, by folding into the soil the excrement of their animals. The livestock that provide these farmers with meat, milk, leather, and power also provide them with the means to raise grains and vegetables and fiber in plenty on the same plots of ground that their fathers' fathers' fathers cultivated. The farmers of western Europe are the priests, and their animals the acolytes, in the ancient rituals of sowing, harvesting, and replenishing.

The successful farmer of Sumerian or European or any other society has usually had a spouse - nearly always if he or she has been able to sustain success. He has depended on her, she on him, and both on the servant organisms around them. If this extended family of species lost a major member - the sow, an oat crop, or the patriarch himself - the survival of the other family members was in jeopardy. In the preindustrial world, in which muscle was often more important than mind, a widow needed more than her traditional pittance. If she had dependent children she needed a good deal more than a pittance, even if it included a bit of land, unless, of course, the lamented husband had left her animals. Land she might or might not be able to work herself, but livestock, her cousins in the extended family mentioned earlier, could manage largely on their own on the commons and wastes.

The husband of the widow in Geoffrey Chaucer's "The Nun's Priest's Tale" died and left his poor wife but a patch of land, a meager income, and two daughters - surely a recipe for misery, even tragedy. But the three women did well enough, having also inherited a rooster ("His voys was

murrier than the murie organ), some hens, three sows, three cows, and a sheep named Molly. The animals provided the humans with a diet not likely to produce a Chaucerian friar's jowls, but one nourishing and sufficient in quantity. What the mother and daughters needed in addition, they could obtain by bartering the extra food and wool. They had no wine, of course, "neither whit ne reed," but did well on bread, bacon, sometimes an egg or two, and plenty of milk. These, along with easily acquired grains and vegetables, made up a diet containing all the essential nutrients, a luxury often beyond the means of people who performe are vegetarians.

The ability of domesticated animals, a renewable resource, to create foods for humans out of what humans cannot eat has served Europeans in sectors of the globe of which neither Sumerians nor Chaucer ever dreamed. In 1771, a survivor of Captain Cook's first voyage to the Pacific offered up thanks to a milch goat who had served Europeans well for three years in the West Indies, had traveled round the world once on H.M.S. Dolphin with Captain John Byron and again on the Endeavour with Cook, "and never went dry the whole time." Those whom she benefited (and the benefit may have been life itself, because malnutrition killed many on such voyages) pledged "to reward her services in a good English pasture for life."

The metaphor of humans and domesticated animals as members of the same extended family is especially appropriate for northwest Europeans. The three women of "The Nun's Priest's Tale" and the Britons who crewed the Dolphin and Endeavour were among that minority of the human species and of the class Mammalia in general who maintain through maturity the infantile ability to digest quantities of milk. Few adult black Africans or East Asians and fewer yet of the adult indigenes of Australasia or the Americas, can tolerate milk in any but small amounts after infancy. In fact, it makes them quite sick, and they must go to the trouble of changing it into cheese or yogurt before they can digest it. This must have discouraged at least some of them from taking up the pastoral life. The advantage of being able to digest milk may seem slight today, but it may have been considerable in the past, when so many peoples so often skirted the edge of starvation. Domesticated milk producers can be especially valuable in a land before it is tamed by cultivators. For instance, when Julius Caesar invaded England, he found the interior inhabited by people - perhaps ancestors of Chaucer's characters and the sailors on the Dolphin and Endeavour - who did not hunt or farm, but depended on their herds, "flesh and milk forming the principal diet."

Of all the admirable characteristics of the widow in "The Nun's Priest's Tale," none is more important than her fecundity and her knack for bringing children to maturity. Rearing two healthy daughters in Chaucer's time, the age of the Black Death, was an accomplishment worth praising. Success at procreation has been particularly characteristic of most of the heirs of Sumeria. God promised Abraham, one of the prominent figures among the early heirs, to "abundantly and greatly multiply your descendants until they are as numerous as the stars in the sky and the grains of sand on the sea-shore. Your descendants shall possess the cities of their enemies." Abraham, as a herdsman, had access to all the amino acids essential to make a strong beginning on such a future. Job, one of his descendants, had, prior to his troubles, not only his herds as evidence of his prosperity but also his children: seven sons and three daughters.

## VII.

The peoples who inherited the crop plants and domesticated animals of the advanced cultures of southwestern Asia (the Europeans, the Indians, the Chinese, etc.) prospered and multiplied, but they did so despite as well as because of the organisms, institutions, and ways of civilization. Farmers and pastoralists found that their new way of exploiting nature was a sword that cut both ways. They, though not necessarily the first on earth to cultivate plants, were the first to practice extensive agriculture. Tapping the strength of their animals by such means as the plow, they probably raised more food per human laborer (not per unit of land) than other early farmers. They cultivated the small grains, which are best raised in solid stands, not intermixed with other plants, as maize, beans, and squash were and are so often in Amerindian America. This Middle Eastern technique produced a great deal of barley and wheat, but it laid the earth bare twice a year, once before planting and once after harvesting, because all the seeds were sown at once

and came to maturity at once. Any system of cultivation, but particularly this one, produces inadvertently domesticated plants: weeds, as much the farmer's creation as his crop plants.

**"Weeds" is not a scientific word.** It refers not to plants of any specific species or genus or any category recognized by scientific taxonomy, but to whatever plants spring up where humans do not want them. More often than not they are plants that evolved originally to fill the minor role of colonizing bare ground after fires, landslides, floods, and such and that found themselves wonderfully preadapted to spread across the expanses stripped clean by the Neolithic farmer's plow or sickle. Already tolerant of direct sunlight and disturbed soil, they added tolerance of sandal, boot, and hoof. Always ready to spring up fast in the wake of disasters, they easily evolved to survive and sprout again in the wake of the tug, tear, and chomp of grazing livestock. The farmer calls them the bane of his life, and they are, but they also provide livestock with feed and help combat erosion.

The Neolithic farmer simplified his ecosystem to produce quantities of plants that would grow rapidly on bare ground and would survive grazing animals, and he got exactly what he tried for, but some of them he cursed: tufted vetch, ryegrass, cleavers, thistles, coriander, and others.

The Middle East's farmers and village dwellers also unintentionally cultivated villains of the animal world, creatures who utilized human garbage and trash for food and shelter and entered into direct competition with humans for the food that humans raised and stored. Hunters and gatherers had their personal vermin - **lice, fleas, and internal parasites** - but few of the nomad humans remained long enough in one spot in sufficient numbers to accumulate filth enough to enable mice, rats, roaches, houseflies, and worms to multiply into armies. The farmer, however, did just that, and in doing so invented the animal equivalent to weeds: varmints. The Sumerians, trying to adjust to the new world they were willy-nilly creating, prayed to Ninkilim, goddess of field rodents and varmints in general, for the safety of their sprouting grain.

The vermin were more than just burglars; they carried diseases. For example, we know today that rats are carriers of plague, typhus, relapsing fever, and other infections, and we can be sure that they, and the other varmints as well, played similar roles in the past. The first book of Samuel in the Old Testament tells us of an epidemic associated with swarms of mice or rats that swept the Philistines and the Hebrews, a disease that caused "tumors," or so say the scholars of ancient Semitic tongues. Today's epidemiologists might suggest "buboes," the swollen lymph nodes of bubonic plague, as a better translation.

The vermin of civilization were not all visible; in fact, the worst were invisible. The Middle Eastern farmers and herdsmen were the first to raise large numbers of plants and animals of a very few species. They were experts at producing solid stands of plants and animals, and because they were able to create surpluses of food, they were able to raise solid stands of their own species. Along with these concentrations they produced large populations of predators, some visible, like worms and mosquitoes, and many micropredators: **fungi, bacteria, and viruses**. Farmers and herdsmen were able to drive off wolves and pull up weeds, but nearly helpless to stop infections raging through the packed crowds of their fields, flocks, and cities.

There are some human infections that are specifically called crowd diseases. For instance, maladies like smallpox and measles that either kill or produce lasting immunity and have no carriers except humans cannot exist for long among small groups of people for the same reason that forest fires cannot last long in scattered copses of trees. Both use all the available fuel quickly and gutter out. As for diseases of filth, like typhoid, hunters and gatherers usually moved too often to seriously foul their own homes, and therefore were seldom troubled with such. The first really large accumulations of humans and of human garbage were in the Middle East, where archeologists dig our first cities out of hills that were the middens of scores of generations of inhabitants.

Hunters and gatherers had, at most, only one kind of domesticated animal: the dog. New World farmers and herdsmen domesticated no more than three or four species. The Old World's civilized peoples had herds of cattle, sheep, goats, pigs, horses, and so forth. They lived with their

creatures, sharing with them the same water, air, and general environment, and therefore many of the same diseases. The synergistic effect of all these different species living cheek by jowl - humans, quadrupeds, fowl, and the parasites of each - produced new diseases and variants of old ones. Pox viruses oscillated back and forth between humans and cattle to produce smallpox and cowpox. Dogs, cattle, and humans exchanged viruses or combined different viruses to produce three new maladies for each other: distemper, rinderpest, and measles. Humans, pigs, horses, and domesticated fowl in contact with wild birds- shared and still share influenza, periodically and perpetually producing new virulent strains for each other. When humans domesticated animals and gathered them to the human bosom - sometimes literally, as human mothers wet-nursed motherless animals - they created maladies their hunter and gatherer ancestors had rarely or never known.

And when the Sumerians and their successors invented such concomitants of civilization as long-range commerce and invasions - in general, the ebb and flow of peoples across deserts, mountain ranges, seas, and distances daunting to hunters and gatherers - they placed themselves in jeopardy from unfamiliar microlife and exposed immunologically innocent peoples to the bacterial flora peculiar to dense populations of humans and their animals. Ever since, the common individual's immune system, adjusted and tuned by heredity and experience to a particular environment, has been chronically obsolescent. One's immune system is tuned to one's part of the world, but human greed, aggression, curiosity, and technology chronically thrust one into contact with the rest of the world.

In the literatures of the ancient Middle East are many references to pestilence. The first book of Samuel, for instance, tells us of the disease that afflicted the Philistines and Hebrews cited earlier, and it seems likely that some of the Mosaic plagues that scourged Egypt were caused by microorganisms. There are in the Pentateuch intimations of the beginnings of epidemiology, that is, an empirical knowledge of the circumstances that encourage the spread of infections. At the foot of Mount Sinai after the flight of the Hebrews from the pharaoh, God told Moses, "When you number the Israelites for the purpose of registration, each man shall give a ransom to the Lord, to avert plague among them during the registration." It seems that God, or at least the author, knew that the coming together of the Israelites or of any large number of people who have been living in separate groups (in this case, separate groups scavenging in the wilderness for water and food) multiplies the chance of epidemics and that measures to deal with the problem must be taken.

Later, when Jehovah informed the Israelites of the many advantages he would bestow on them when they reached the land of milk and honey, provided they had obeyed his dictates, he vowed, "The Lord will take away all sickness from you; he will not bring upon you any of the foul diseases of Egypt which you know so well, but will bring them upon all your enemies." People migrating out of the Nile Valley, probably the most densely populated area in the world at the time, into the relatively dry, less densely populated surrounding country were moving into territory that was safer vis-a-vis communicable disease and were carrying with them infections often unknown and quite possibly deadly to the scattered local peoples. The Israelites began their journey with the advantage of their infections, an immense advantage that goes far to explain how "civilized" peoples have so often conquered less advanced peoples so easily. (This process has been most clearly elucidated by William H. McNeill, and as a predictable factor in human history has been called **McNeill's law**.)

## VIII.

**By 3,000 years ago, give or take a millennium or so, "superman," the human of Old World civilization, had appeared on earth.** He was not a figure with bulging muscles, nor necessarily with bulging forehead. He knew how to raise surpluses of food and fiber; he knew how to tame and exploit several species of animals; he knew how to use the wheel to spin out a thread or make a pot or move cumbersome weights; his fields were plagued with thistles and his granaries with rodents; he had sinuses that throbbed in wet weather, a recurring problem with dysentery, an enervating burden of worms, an impressive assortment of genetic and acquired

adaptations to diseases anciently endemic to Old World civilizations, and an immune system of such experience and sophistication as to make him the template for all the humans who would be tempted or obliged to follow the path he pioneered some 8,000 to 10,000 years ago.

\* This essay has been edited for Prof. Littlejohn's class at Norfolk State University.

### Reading Quiz I

In his article "Pangaea Revisited," Alfred Crosby discusses the creation of two separate worlds on planet Earth. Although he begins with a short discussion of Pangaea, Crosby's focus is on the breakup of the super-continent, the resulting de-centralization of evolution, and the development, migration, and diversification of the human population.

Crosby's article will set the stage for our discussion of Contact in 1492. It was Columbus who (accidentally) brought the two worlds together, thus changing the course of human history. To prepare for our discussion of Contact, and to better understand Crosby's argument, please answer the questions below. No more than a few sentences should be necessary for each question.

**Question:** 1. What was Pangaea? When did it exist? What was special about it (in Crosby's story)?

When did it begin to break apart? Why should we care?

**Question:** 2. What does Crosby say about Human Evolution? Specifically, when did hominids first appear? When did our species first appear? What sets us humans apart from other animals (this has something to do with question three as well)?

**Question:** 3. What does the term "culture" mean to Crosby? Why is culture so significant?

**Question:** 4. When did people move into Europe and Asia? Australia? The Americas (in Crosby's view)?

**Question:** 5. How were the peoples in the Americas isolated?

**Question:** 6. What was the Neolithic Revolution – by definition? That is, when did it start, when did it end?

**Question:** 7. Why does Crosby spend so much time on the Neolithic Revolution? That is, what happened as part of the Neolithic Revolution?

**Question:** 8. What made the Eurasian (Old World) Neolithic Revolution different from the American (New World) Neolithic Revolution?

**Question:** 9. What reasons does Crosby posit for the differences between the two Revolutions?

**Question:** 10. What does Crosby mean when he says: "By 3,000 years ago, give or take a millennium or so, 'superman,' the human of Old World civilization, had appeared on earth"? This probably has something to do with "McNeill's law"?