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Aristotle's Ghost

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I am white. I am male. The closest I come to prejudice every day is to suffer the baldness jokes of friends and comedians. I don't mind. Really. But I wonder—if most people were bald, would there be jokes about hairy scalps? Who is ridiculed and why? I watch a television documentary one night. It is the story of a group of physically disabled people attempting a difficult hike to the top of a mountain. Wheelchairs are muscled over boulders. One man pulls himself over logs and stones, powerful arms straining, immobile legs dragging behind. Another walks on his hands across a mountain stream. I am stunned by these scenes, awed by the spiritual and physical strength I see. I watch as an oncoming hiker passes by. "Why don't you get off the trail?" he sneers. I think I must have heard it wrong, but the narrator confirms it—not everyone is happy about the group being there. This offhand comment shocks and depresses me. How could someone feel anything but joy and admiration in the face of such determination and physical prowess? I have just witnessed one small, vile act of prejudice.

I am not naive. I know that prejudice is everywhere, all around us. It is as much a part of the human condition as language and upright stance. It issues from the human mixture, a noxious byproduct of diversity. Images of the Holocaust, ethnic cleansings, race riots are fresh in my mind. But like so much one learns or observes at a distance, these things are intellectualized. The small incident I have watched is so raw and unexpected it reaches from the screen and slaps me. I brood about it. There is no target for my outrage. The sneering tone of the man's voice—there was hate there, disgust, arrogance and superiority, all of it. What could provoke it? Hikers pass on a trail. They

share the same enthusiasm. But one walks; the others do not. A small difference between them. A difference measured in chance.

Why do the differences among us lead to ridicule, to sneering, even to hate? Is prejudice inevitable? There seems to be a kind of terrible logic operating here, a hateful syllogism: People are different; differences create prejudice; people are prejudiced. As a scientist, an evolutionary biologist, I worry that it could be the way we are made, a hard-wired trap. At the same time, I am only too aware of how culture and the history of ideas shape our thoughts even before they are consciously manifested. Patterns of thought and therefore attitudes seem to develop in the mind along paths of least resistance. The paths become rutted with constant use and increasingly hard to escape. They may be more learned than evolved, and so I wonder about the history of ideas about diversity. Could the way we think about the diversity of life in the broadest sense provide clues to the nature of human prejudice? Is Aristotle to blame?

More than 300 years before the birth of Christ, Aristotle was busy establishing the roots of Western science. A keen observer of nature, he wrote voluminously about the animal life known to him. Like all biologists since, Aristotle needed a systematic way to arrange the creatures he described, a logical way to organize them for description and study. He recognized that certain groups of animals could be placed together on the basis of similarities in structure and that these were separated from other such groups by gaps or discontinuities in form or internal organization. To Aristotle the groups exhibited different levels of complexity that could be ordered from simplest to most complex. Aristotle thus organized all animal life into an ascending, linear sequence, or "scale of beings." Not surprisingly we humans were at the top of the heap (exalted by virtue of our "rational soul" and "high degree of life"). Diversity, Aristotle seemed to say, can be rank-ordered—and there's only room for one at the top.

The scale of beings, or *scala naturae* (ladder of nature), as it came to be called, became a mainstay of biological and religious thought. It permeated scientific thinking and our view of the world for more than 2,000 years after Aristotle's death. Christian theologians readily incorporated it into their doctrine, offering the harmony of nature as evidence of God's design. Species were viewed as fixed, each playing its essential role in the hierarchy. Indeed the very continuity of the

chain of life was itself held as proof of divine perfection. Created in God's image and manifesting both the physical and the spiritual, human beings bridged the ethereal gap between animals and angels. German transcendentalists of the 19th century even invoked a parallel scale of beings in human development, seeing in the growth and transformation of embryos a sequential progression from "lower" to "higher" animal forms. Biologists of the time scrambled to describe the myriad new species then coming to light, working hard to fit them into the order of things, to place each one on the appropriate rung of the ladder.

The essential quality of the *scala naturae* was its equation of difference with rank, the conflation of diversity and sequence. Its consequence was vertical thinking—the notion that differences among types betrayed position in a vertical hierarchy. Different forms of life could be ordered, one above, one below, with all that this implies: lower-higher, imperfect-perfect, inferior-superior. As it was humans who created the order in the first place, it is hardly a surprise that they were placed at the top of this pecking order. From our 21st-century vantage point, we might further surmise that Aristotle and those who followed him did not have in mind just any humans for the coveted top position. The pinnacle was reserved for the leaders of the Western scientific and religious establishment—that is to say, white males like them.

Darwin, of course, should have ended it. Although not the first evolutionist, he was the first to propose a logical mechanism (natural selection) whereby one species could, over time, be transformed into another. He supported his theory with an overwhelming body of evidence. In one fell swoop, Darwin's 1859 "Origin of Species" dealt a decisive intellectual blow to vertical thinking. Implicit in his work was a new view of diversity—a richer, subtler, three-dimensional picture that emphasized historical equivalence, connection and kinship among all living forms rather than rank order. Instead of a straight line or an ascending series, Darwin's metaphor was a branching tree—the tree of life. In convincing the world of his views, Darwin confronted not only religious dogma but also the apparently innate resistance of people to truths of subtlety and complexity when a simpler preconception would seem to suffice. That Darwin won the battle but lost the war may be the point of this essay.

To understand the Darwinian view of diversity, we can turn to his metaphor of the tree. Imagine a fine, healthy specimen, dense with branches and twigs. At the point where the tree is widest, use virtual clippers to make an even cut all the way across so that everything above this point is removed, leaving a level plane. Lay a sheet of glass across the flat top of the truncated tree, and our model of diversity is complete. The glass plate is the present time, and the tree beneath the plate is the genealogical history of life on earth. At the base of the tree is a single trunk representing the origin of life more than three and a half billion years ago. Moving up from the base, branches diverge as ancestral species split into descendant daughter species, creating new, separately evolving lineages. Through geological time, countless branches split off, and new forms ceaselessly evolve. Tracing upward along any random path of connected branches, we discover that ultimately most branches end before reaching as high as the glass plate. These are the extinct lineages of life, a smattering known to us through their fossil remains. The extinct forms are legion, vastly outnumbering the few branches that make it all the way to the glass, the present time.

Scanning across the plate at the top of the tree, we see the yellow tips of each freshly shorn branch where it contacts the glass. These are the species of our present time, the lucky few to make it, the lineages that avoided extinction. They encompass the diversity of life on earth as we know it. Here is a parasitic worm, there a sponge. Farther along are frogs, and not too far from them, fishes, crocodiles and lizards. There are antelope, yeasts, bacteria, giant squids, oak trees, cormorants, algae, paramecia, locusts, moray eels, deer ticks and centipedes—diversity almost beyond imagining. Some of these life forms are simple, microscopic specks, hardly more than a strand of DNA surrounded by a membrane. Others are indescribably complex, vast conglomerations of specialized cells, pulsating organs, jointed legs, moving fluids and bulging brains packed with millions of sparking neurons. A few of them are human beings.

Now look again at the species disposed across the plane of glass. There is no vertical here. No higher, no lower, no rank order. There is no ladder. Only the horizontal now. Every form of life now extant has exactly the same amount of evolutionary history beneath it. Every species is equally evolved since the origin of life. Diversity is

arrayed across a single plane of equivalence. From simple to complex, from *E. coli* to the leader of the Free World, each species—each individual—is at precisely the same level.

The tree shows more, however. It reveals the shared history of all life and the illusion of our separateness. For in the past, beneath the glass, the twigs of the present coalesce into common, ancestral stems, and these join still others farther back. Progressing downward, back through time, more and more branches merge until finally there is just the one trunk, symbol of that astonishing moment when inanimate became animate and the saga of genetic continuity began. Viewed from the present, the history of life is a story of confluence and connection, a fractal pattern of nested relationships. From this perspective we see that the question is not *if* we are related but only how closely.

Today, evolution is established fact—as well established as the rotation of the earth around the sun, the atomic nature of matter or the many other scientific certainties that can be proven, if not easily observed. Although technically still a "theory," natural selection has been demonstrated in nature and in the laboratory. All that remains is minor professional quibbling over mechanistic details and the relative importance of selection as the engine of evolutionary change in particular cases. In other words the Darwinian view of diversity has been fully vindicated. Aristotle's ladder has been replaced by the horizontal plane of evolutionary equivalence. Disparity, fixity of type and rank-order linearity are superceded by underlying similarity, historical confluence and the branching tree of life. Currently observed similarities and differences among species reflect only degrees of evolutionary relatedness, not absolutes—great similarity implies a relatively recent divergence from a common ancestral form, with increasing difference roughly proportional to the time since a historical, genealogical split between lineages. Thus it is that our kinship to a chimpanzee is readily apparent, separated as we are by only a few million years (a geological instant), but our connection to the oyster slurped at dinner or the grass trod underfoot is hidden to the casual eye by the eons passed since our genetic lines shook hands and parted ways.

The Darwinian view of diversity applies equally to humans and other species. As for all life existing in the present, human differences reflect equivalences, not positions in a hierarchy. Prejudice is not possible in a society enlightened by Darwinian thinking because there is

no basis for rank-ordering, no way to place one type—one race, one ethnicity, one religion, one culture, one sex—above another. Prejudice is spawned by vertical thinking, the scientifically vitiated practice of turning diversity on end, rending the connections among us, and stacking the differences in arbitrary order, only one at the top. What could be more unnatural, more irrational or more hateful? What could be more common?

OK, perhaps I am naive, after all. Who ever said prejudice is rational? But I can't help wondering. I'm a scientist, after all, a professional rationalist. I naturally seek patterns and the causal processes underlying them. Prejudice follows a well-worn and unusually persistent path in the history of scientific thought on diversity. Vertical, linear thinking has the advantage of more than 2,000 years over the principles of Darwinism. Perhaps its expression in modern human behavior reflects nothing more than the disjunction between scientific and everyday thinking, the typical lag between the origin of new knowledge and its assimilation into the general population. This implies that time and education are the remedies to the scourge of prejudice. In my optimistic periods, I almost believe this.

Optimists can find succor in evolutionary theory. Everything we know says that diversity in humans, as in other species, is good. It is the best possible hedge against extinction. From diversity emerges the highly desirable trait of "evolvability"—literally, the ability to evolve, to adapt to new conditions. If life is a game, there is only one measure of success: persistence. Losers go extinct. Those species at risk of extinction are usually those that are least diverse. Genetic and behavioral mechanisms exist in most species, including humans, to promote diversity. The evolution of sex itself is likely to have persisted in the face of severe competition from rapidly reproducing asexual forms, by virtue of the boost it gives to the creation of diversity and therefore evolvability. Genetically homogenized human populations are more likely to express undesirable recessive traits and genetic diseases. "Outcrossing" among divergent populations creates healthier offspring. Humans, for example, usually select mates that differ immunologically, an unconscious preference mediated by smell that leads to healthier, more disease-resistant children. Our experience with commercially bred agricultural monocultures teaches us the extreme danger of uniformity—whole crops are wiped out by single pathogens