longer has much impact on our history. This crux in th
earth's history has been reached because Lamarckian pro
cesses have finally been unleashed upon it. Human cultur
evolution, in strong opposition to our biological history,
Lamarckian in character. What we learn in one generation
we transmit directly by teaching and writing. Acquired cha
racters are inherited in technology and culture. Lamarckian
evolution is rapid and accumulative. It explains the cardina
difference between our past, purely biological mode o
change, and our current, maddening acceleration toward
something new and liberating—or toward the abyss.

8

Caring Groups and Selfish Genes

THE WORLD OF objects can be ordered into a hierarchy of ascending levels, box within box. From atoms to molecules made of atoms, to crystals made of molecules, to minerals, rocks, the earth, the solar system, the galaxy made of stars, and the universe of galaxies. Different forces work at different levels. Rocks fall by gravity, but at the atomic and molecular level, gravity is so weak that standard calculations ignore it.

Life, too, operates at many levels, and each has its role in the evolutionary process. Consider three major levels: genes, organisms, and species. Genes are blueprints for organisms; organisms are the building blocks of species. Evolution requires variation, for natural selection cannot operate without a large set of choices. Mutation is the ultimate source of variation, and genes are the unit of variation. Individual organisms are the units of selection. But individuals do not evolve—they can only grow, reproduce, and die. Evolutionary change occurs in groups of interacting organisms; species are the unit of evolution. In short, as philosopher David Hull writes, genes mutate, individuals are selected, and species evolve. Or so the orthodox, Darwinian view proclaims.

The identification of individuals as the unit of selection is a central theme in Darwin's thought. Darwin contended that the exquisite balance of nature had no "higher" cause. Evolution does not recognize the "good of the ecosystem" or even the "good of the species." Any harmony or stabili is only an indirect result of individuals relentlessly pursui their own self-interest—in modern parlance, getting mo of their genes into future generations by greater reprodu tive success. Individuals are the unit of selection; the "stru gle for existence" is a matter among individuals.

During the past fifteen years, however, challenges to Da win's focus on individuals have sparked some lively debate among evolutionists. These challenges have come fro above and below. From above, Scottish biologist V.C Wynne-Edwards raised orthodox hackles fifteen years ag by arguing that groups, not individuals, are units of selec tion, at least for the evolution of social behavior. Fro below, English biologist Richard Dawkins has recentl raised my hackles with his claim that genes themselves ar units of selection, and individuals merely their temporar receptacles.

Wynne-Edwards presented his defense of "group selection" in a long book entitled *Animal Dispersion in Relation t Social Behavior.* He began with a dilemma: Why, if individuals only struggle to maximize their reproductive success, do so many species seem to maintain their populations at a fairly constant level, well matched to the resources available? The traditional Darwinian answer invoked external constraints of food, climate, and predation: only so many can be fed, so the rest starve (or freeze or get eaten), and numbers stabilize. Wynne-Edwards, on the other hand, argued that animals regulate their own populations by gauging the restrictions of their environment and regulating their own reproduction accordingly. He recognized right away that such a theory contravened Darwin's insistence on "individual selection" for it required that many individuals limit or forgo their own reproduction for the good of their group.

Wynne-Edwards postulated that most species are divided into many more-or-less discrete groups. Some groups never evolve a way to regulate their reproduction. Within these groups, individual selection reigns supreme. In good years, populations rise and the groups flourish; in bad years, the groups cannot regulate themselves and face severe crash and even extinction. Other groups develop systems of regulation in which many individuals sacrifice their reproduction for the group's benefit (an impossibility if selection can only favor individuals that seek their own advantage). These groups survive the good and the bad. Evolution is a struggle among groups, not individuals. And groups survive if they regulate their populations by the altruistic acts of individuals. "It is necessary," Wynne-Edwards wrote, "to postulate that social organizations are capable of progressive evolution and perfection as entities in their own right."

Wynne-Edwards reinterpreted most animal behavior in this light. The environment, if you will, prints only so many tickets for reproduction. Animals then compete for tickets through elaborate systems of conventionalized rivalry. In territorial species, each parcel of land contains a ticket and animals (usually males) posture for the parcels. Losers accept gracefully and retreat to peripheral celibacy for the good of all. (Wynne-Edwards, of course, does not impute conscious intent to winners and losers. He imagines that some unconscious hormonal mechanism underlies the good grace of losers.)

In species with dominance hierarchies, tickets are allotted to the appropriate number of places, and animals compete for rank. Competition is by bluff and posture, for animals must not destroy each other by fighting like gladiators. They are, after all, only competing for tickets to benefit the group. The contest is more of a lottery than a test of skills; a distribution of the right number of tickets is far more important than who wins. "The conventionalization of rivalry and the foundation of society are one and the same thing," Wynne-Edwards proclaimed.

But how do animals know the number of tickets? Clearly, they cannot, unless they can census their own populations. In his most striking hypothesis, Wynne-Edwards suggested that flocking, swarming, communal singing, and chorusing evolved through group selection as an effective device for censusing. He included "the singing of birds, the trilling of katydids, crickets and frogs, the underwater sounds of fish, and the flashing of fireflies."

Darwinians came down hard on Wynne-Edwards in the decade following his book. They pursued two strategies. First, they accepted most of Wynne-Edwards's observations, but reinterpreted them as examples of individual selection. They argued, for example, that *who* wins is what dominance hierarchies and territoriality are all about. If the sex ratio between males and females is near 50:50 and if successful males monopolize several females, then not all males can breed. Everyone competes for the Darwinian prize of passing more genes along. The losers don't walk away with grace, content that their sacrifices increase the common good. They have simply been beaten; with luck, they will win on their next try. The result may be a well-regulated population, but the mechanism is individual struggle.

Virtually all Wynne-Edwards's examples of apparent altruism can be rephrased as tales of individual selfishness. In many flocks of birds, for example, the first individual that spots a predator utters a warning cry. The flock scatters but, according to group selectionists, the crier has saved his flockmates by calling attention to himself—self-destruction (or at least danger) for the good of the flock. Groups with altruist criers prevailed in evolution over all selfish, silent groups, despite the danger to individual altruists. But the debates have brought forth at least a dozen alternatives that interpret crying as beneficial for the crier. The cry may put the flock in random motion, thus befuddling the predator and making it less likely that he will catch anyone, including the crier. Or the crier may wish to retreat to safety but dares not break rank to do it alone, lest the predator detect an individual out of step. So he cries to bring the flock along with him. As the crier, he may be disadvantaged relative to flockmates (or he may not, as the first to safety), but he may still be better off than if he had kept silent and allowed the predator to take someone (perhaps himself) at random.

The second strategy against group selection reinterprets apparent acts of disinterested altruism as selfish devices to propagate genes through surviving kin—the theory of kin selection. Siblings, on average, share half their genes. If you die to save three sibs, you pass on 150 percent of yourself through their reproduction. Again, you have acted for your own evolutionary benefit, if not for your corporeal continuity. Kin selection is a form of Darwinian individual selection.

These alternatives do not disprove group selection, for they merely retell its stories in the more conventional Darwinian mode of individual selection. The dust has yet to settle on this contentious issue but a consensus (perhaps incorrect) seems to be emerging. Most evolutionists would now admit that group selection can occur in certain special situations (species made of many very discrete, socially cohesive groups in direct competition with each other). But they regard such situations as uncommon if only because discrete groups are often kin groups, leading to a preference for kin selection as an explanation for altruism within the group.

Yet, just as individual selection emerged relatively unscarred after its battle with group selection from above, other evolutionists launched an attack from below. Genes, they argue, not individuals are the units of selection. They begin by recasting Butler's famous aphorism that a hen is merely the egg's way of making another egg. An animal, they argue, is only DNA's way of making more DNA. Richard Dawkins has put the case most forcefully in his recent book *The Selfish Gene.* "A body," he writes, "is the genes' way of preserving the genes unaltered."

For Dawkins, evolution is a battle among genes, each seeking to make more copies of itself. Bodies are merely the places where genes aggregate for a time. Bodies are temporary receptacles, survival machines manipulated by genes and tossed away on the geological scrap heap once genes have replicated and slaked their insatiable thirst for more copies of themselves in bodies of the next generation. He writes:

> We are survival machines—robot vehicles blindly programmed to preserve the selfish molecules known as genes. . . .
>
> They swarm in huge colonies, safe inside gigantic lumbering robots . . . they are in you and me; they

created us, body and mind; and their preservation is the ultimate rationale for our existence.

Dawkins explicitly abandons the Darwinian concept o individuals as units of selection: "I shall argue that th fundamental unit of selection, and therefore of self-interes is not the species, nor the group, nor even, strictly, th individual. It is the gene, the unit of heredity." Thus, w should not talk about kin selection and apparent altruism Bodies are not the appropriate units. Genes merely try t recognize copies of themselves wherever they occur. They act only to preserve copies and make more of them. They couldn't care less which body happens to be their temporary home.

I begin my criticism by stating that I am not bothered by what strikes most people as the most outrageous component of these statements—the imputation of conscious action to genes. Dawkins knows as well as you and I do that genes do not plan and scheme; they do not act as witting agents of their own preservation. He is only perpetuating, albeit more colorfully than most, a metaphorical shorthand used (perhaps unwisely) by all popular writers on evolution, including myself (although sparingly, I hope). When he says that genes strive to make more copies of themselves, he means: "selection has operated to favor genes that, by chance, varied in such a way that more copies survived in subsequent generations." The second is quite a mouthful; the first is direct and acceptable as metaphor although literally inaccurate.

Still, I find a fatal flaw in Dawkins's attack from below. No matter how much power Dawkins wishes to assign to genes, there is one thing that he cannot give them—direct visibility to natural selection. Selection simply cannot see genes and pick among them directly. It must use bodies as an intermediary. A gene is a bit of DNA hidden within a cell. Selection views bodies. It favors some bodies because they are stronger, better insulated, earlier in their sexual maturation, fiercer in combat, or more beautiful to behold.

If, in favoring a stronger body, selection acted directly

upon a gene for strength, then Dawkins might be vindicated. If bodies were unambiguous maps of their genes, then battling bits of DNA would display their colors externally and selection might act upon them directly. But bodies are no such thing.

There is no gene "for" such unambiguous bits of morphology as your left kneecap or your fingernail. Bodies cannot be atomized into parts, each constructed by an individual gene. Hundreds of genes contribute to the building of most body parts and their action is channeled through a kaleidoscopic series of environmental influences: embryonic and postnatal, internal and external. Parts are not translated genes, and selection doesn't even work directly on parts. It accepts or rejects entire organisms because suites of parts, interacting in complex ways, confer advantages. The image of individual genes, plotting the course of their own survival, bears little relationship to developmental genetics as we understand it. Dawkins will need another metaphor: genes caucusing, forming alliances, showing deference for a chance to join a pact, gauging probable environments. But when you amalgamate so many genes and tie them together in hierarchical chains of action mediated by environments, we call the resultant object a body.

Moreover, Dawkins's vision requires that genes have an influence upon bodies. Selection cannot see them unless they translate to bits of morphology, physiology, or behavior that make a difference to the success of an organism. Not only do we need a one-to-one mapping between gene and body (criticized in the last paragraph), we also need a one-to-one *adaptive* mapping. Ironically, Dawkins's theory arrived just at a time when more and more evolutionists are rejecting the panselectionist claim that all bits of the body are fashioned in the crucible of natural selection. It may be that many, if not most, genes work equally well (or at least well enough) in all their variants and that selection does not choose among them. If most genes do not present themselves for review, then they cannot be the unit of selection.

I think, in short, that the fascination generated by Dawkins's theory arises from some bad habits of Western scientific thought—from attitudes (pardon the jargon) that we call atomism, reductionism, and determinism. The idea that wholes should be understood by decomposition into "basic" units; that properties of microscopic units can generate and explain the behavior of macroscopic results; that all events and objects have definite, predictable, determined causes. These ideas have been successful in our study of simple objects, made of few components, and uninfluenced by prior history. I'm pretty sure that my stove will light when I turn it on (it did). The gas laws build up from molecules to predictable properties of larger volumes. But organisms are much more than amalgamations of genes. They have a history that matters; their parts interact in complex ways. Organisms are built by genes acting in concert, influenced by environments, translated into parts that selection sees and parts invisible to selection. Molecules that determine the properties of water are poor analogues for genes and bodies. I may not be the master of my fate, but my intuition of wholeness probably reflects a biological truth.

3

Human Evolution