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For Whom the Bell Tolls

Illegal entry, sting operations, deception, aggression, bloodsucking, and territorial greed are what the articles in this issue of *Science* are about. They are also about cost-effectiveness, altruism, fertility, resource allocation, and adaptive behavior. The ecology world is one in which there is only one standard of ethics: survival. Species that can put together the smartest programs are going to survive, often at the expense of others. Ivory-tower critics may talk about animal rights or plant rights, but the mosquito is not worried about infiltrating across a border, nor does the malaria parasite have fits of conscience because it may be a stowaway in the illegal action. Nor is the swatter of the mosquito particularly distressed by intruding on the reproductive cycle of this interesting species.

Understanding the behavior of species and the survival strategies that they have developed is essential for understanding the survival of all species including humans. For evolution has finally succeeded in producing a species, *Homo sapiens*, whose physical features are not that impressive but whose brain has made its proliferation incredibly more efficient than it is in other species. As a result, the population of the globe has lost proportion, and the number of human beings is threatening all other species. Estimates of global species numbers range from 5 million to 50 million in the world today (May, page 1441), but their numbers appear to be dwindling rapidly. Efforts to protect a few endangered species such as the red-cockaded woodpecker or the northern spotted owl can only succeed at great expense and with knowledge of their habitat needs (Lande, page 1455). Specialized programs do not solve the problem of the relentless expansion of man, with his consequent destruction of tropical forests, his defiling of wilderness areas, and his pollution of the oceans. Ecology, the study of the delicate balance between species in the environment (Partridge and Harvey, page 1449, and Roughgarden *et al.*, page 1460), shows that evolution has developed clever strategies, not all of them following the Marquis of Queensberry rules, to use resources to maximum effectiveness. Those strategies sometimes involve symbiosis, sometimes tacit agreements on territory, and sometimes murderous aggression, but all are based on the assumption that resources are limited so that the clever and the parsimonious will gain relative to the inefficient and wasteful.

Our ability to speak and write has tilted that equation so that we humans are reproducing profligately while other species die. Are we likely to stop in deference to other species? Curiously the animal rightists and anti-evolutionists think in parallel in regard to the exalted status of man. Animal rightists suggest that we have no right to attack other species. Anti-evolutionists say that we are so different that we cannot learn from the behavior of lower species. Both are partly wrong and partly right. Evolution makes no case for gifts of rights to other species, and we have learned much about human behavior from studies of less complex species. But ecological studies also reveal that species adapt to threats to their own survival, and symbiosis is one of nature's prize stratagems.

Our great brains have allowed us to reproduce somewhat unchecked, but they should also allow us to modify behavior more than other species. The relentless extinction of species by destruction of their habitats is no longer a triumph for our species but a decisive warning to change our ways. Whether the greenhouse warming has really begun or is still hundreds of years in the future is almost irrelevant. It is bound to come, as has the destruction of arable soil by pollutants, and the drop in the quality of the air we breathe; these will worsen if we do not learn more respect for the ecosystem.

This issue of *Science* has a few articles, assembled with the help of Martha Coleman and Roger Lewin, on the forefront of one aspect of the vast subject of ecology. They emphasize the importance of understanding the value of species diversity, species interdependence, and species reproductive efficiency. Most species struggle to overcome poverty of resources and occupy niches that allow a critical number to survive in competition with other species. Modern civilization has upset that process so that many (although certainly not all) humans are living far beyond a survival level. The brain that allowed that situation needs now to curb a primordial instinct to increased replication of our own species at the expense of others because the global ecology is threatened. So ask not whether the bell tolls for the owl or the whale or the rhinoceros; it tolls for us.—DANIEL E. KOSHLAND, JR.