ALLOCUTION DU PROFESSEUR PETER MARLER

LAURÉAT DU PRIX INTERNATIONAL 2001 DE LA FONDATION FYSSEN

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5 avril 2002

Monsieur le représentant du Ministre de la Recherche,

Madame la Présidente,

Mesdames et Messieurs les Membres du Conseil d'Administration et du Conseil Scientifique,

Mes Chers amis et collègues,

Mesdames et Messieurs,

If I give the impression of being unduly pleased at the honor bestowed on me by the International Prize for Comparative Ethology, the impression is correct. There are two reasons, one personal, the other more general. I am of course thrilled by the tribute to my work over the past fifty years in behavioral biology. If my career has been creative, my students must bear some of the responsibility for that. I have always strived to be alert to unusual talent and imagination in students. The worthy ones have had a good share of my time and attention. I have been richly

rewarded in turn, and if, as Professor Hauser has suggested, the strategy has sometimes succeeded, then I am gratified.

The other reason for taking such pleasure in the award is that it recognizes the contributions of comparative ethology to behavioral science. Ethology was the brainchild of two pioneers, Konrad Lorenz and Niko Tinbergen, whose revelations were becoming known to the world of science while I was a student, and for which, with Karl von Frisch, they were awarded the Nobel Prize in 1973. My mentors at Cambridge University, Professors William Thorpe and Robert Hinde, were among their disciples, and I was immersed in ethological doctrines from the start, beginning in earnest around 1950. This was a fascinating time in behavioral science. Little was known about communication in animals, the subject to which I was drawn. There was intense controversy over issues of nature and nurture. At that time, social scientists, with a predominately human focus, could not believe that nature played more than a subordinate role in the behavioral development of any higher organism. They were fiercely doctrinaire in resisting the invocation of anything more than trivial genetic contributions to human behavior, including language. But ethologists, versed as they were in the immense diversity of the behavior of animals, had no choice but to take a different view. The abundance of species differences in the behavior of otherwise closely related animals, surely implied that their genomes were crucial in shaping behavioral development. This

became the foundation of ethological theory. How else could animals whose lives were otherwise so similar, behave so differently? But to social scientists the ethological conception of innate behavior was like a red flag to the bull, and there were endless arguments. All of the classical confrontations were replayed between empiricists, who believed in the universal power of experience, and nativists, who believed in innateness. Any hint that experience might modify the form of so-called innate behaviors, even slightly, was seized upon by social scientists and magnified, in efforts to destroy the ethological argument. This was the state of the field when I entered it as a student.

The solution of the nature-nurture conundrum that emerged for me was a direct consequence of my personal history as a student of animal communication. As a schoolboy I was an enthusiastic birdwatcher and I became fascinated by the wonderful songs of birds, and their extraordinary variability were a source of endless pleasure for me. Although I was no musician, I developed a simple code for transcribing birdsongs by ear, revealing patterns that did not fit with the usual picture of innate, stereotyped behavior. It became clear that there are local dialects in birdsong, implying something striking and unusual about how birdsong develops. Gradually the evidence accumulated that the songs of some birds are in fact learned, and that is how local dialects arise. A bird raised out of hearing of its own kind develops a song, but the structure is abnormal. Provide it with

experience of a song, and it will learn eagerly. We found that one species could be taught the song of another. We had in fact discovered an unusually clear-cut case of behavior that is culturally transmitted, acquired in ways that are reminiscent of the dialects in our own speech behavior, even varying on a somewhat similar geographical scale. This apparent similarity evoked great interest among anthropologists and psychologists, who found their empiricist philosophy vindicated by the discovery of this elaborate behavior, that is learned, and is apparently largely independent of genomic influences. But then a paradox emerged.

If birdsong is so open to environmental influences, how is it that in nature, species differences are maintained? There could of course be a simple explanation. If a young bird only spends time with members of its own species and is only tutored by them, then the most likely outcome is the production of a species-typical song. But we found a different explanation. With the help of my wife Judith, who proved to be uniquely skilled in the art of raising young birds by hand, we addressed this question in the laboratory. Birds tutored with tape recordings, learned from them, and when we played a medley of songs, giving them a choice of what to learn, we found that they unerringly selected songs of their own species. They would indeed learn from another species but only if their own species song was withheld.

This was the time that the concept of an instinct to learn began to take shape in my mind. Songs are learned, but the learning process is shaped by the genome. There is no way to understand the details of song learning without acknowledging genetic contributions to the process. And of course once you begin to reflect on them, genomic contributions are ubiquitous. They give rise to the brain mechanisms that make learning possible, mechanisms which my students went on to describe and analyze in great detail with many important findings, including the discovery that new neurons are created in the mature brain. The genome shapes, not only learning preferences, but also the timing of song memorization, and the production of imitations. The genome dictates whether learning takes place just once in a bird's life, or whether it recurs seasonally, throughout life, as in some of the most accomplished songsters.

So we have behaviors that are a clear product of the interplay between genomic and environmental influences, providing us with a model that, in principle, is generalizable to other behaviors, including our own. With the advent of the genetic revolution, and the unprecedented accessibility of the genomic side of the developmental equation to analysis and manipulation, the issue of nature and nurture ceases to be intractable. There is no longer any need for it to cause such bitter controversy. We can begin experiments on the interplay of nature and nurture in behavioral development, instead of just arguing about it.

Nowadays, it is not behavioral scientists but some geneticists, who are tempted to overstate their case, as when they seem to equate a gene with a trait. Behavioral traits especially can never be fully immune to perturbation by the effects of experience. When a stereotyped behavior emerges in an animal, the path to stereotypy may be, not of one fixed, unwavering sequence of developmental changes, but much more devious, with many diversions, sensed as they occur, and corrected, setting the developing organism back on course each time it is deflected from its path. With a stereotyped behavior the result will be that environmental effects are countered. With a more plastic behavior, environmental effects will be supported and amplified, giving rise to a wide range of possible behavioral phenotypes, the choice depending on which environmental cues are encountered. And if we acknowledge, as classical ethology taught us, that responsiveness to the external world is often genetically programmed, we come full circle. The interdependence between nature and nurture in creating behavior is complete. If we had grasped this essential ethological insight sooner, much of the controversy about nature/nurture could have been avoided.

Ethological studies of animal communication have been the source of many insights into the interplay of nature and nurture. When I was a student the straitjacket of behaviorism inhibited everyone from even speculating about what was going on in an animal's head while it was communicating with others. I was

always skeptical of the view that animal vocalizations are simply involuntary, impulsive displays of emotion, devoid of any semantic, symbolic meaning. Looking for a new approach, a student working on an African monkey with an unusually large vocal repertoire described a remarkable set of alarm calls that appeared to serve as names for different predators, a special bark for leopards, a sibilant grunt for eagles. By playing tape recordings of the alarm calls to wild monkeys, when no predators were present, other students demonstrated that monkey calls do have their own inherent meanings, some much more rich in information content than a simple, emotional display.

This revolutionary finding caused quite a stir, and even made the front page of the New York Times. Other examples of the symbolic use of animal signals soon followed, in a range of different animals including not only monkeys and apes, but also birds including the humble chicken. The study of animal semantics became a legitimate pursuit. This is a field to which Professor Hauser has made many contributions. We find that animals not only behave symbolically, but like us, they are capable of deception. A rooster attracts a hen with a call for food. If she is especially desirable, he may be a little dishonest, and call her when he has, not food, but a twig. Of course, this is still a far cry from our language. So far as we know, no animal has ever created sentences in nature, bringing together

meaningful signals in new combinations, with new meanings. This seems to be a uniquely human ability.

Aside from language, the other aspect of human behavior with which animals can be compared, is music. Comparative ethology has hardly begun to address the question of whether birdsong or the songs of whales, that give us so much esthetic pleasure, share any common principles of composition and tonality with music. I am reminded of the composer Olivier Messiaen, for whom birdsongs were a truly inspirational resource. Messiaen believed that the relationship between birdsong and music is too profound and pervasive to be a matter of mere chance. He regarded birds as "probably the greatest musicians to inhabit our planet". But interestingly, his transcriptions of birdsongs are sometimes quite problematic for an ornithologist. He says that, because they sing in extremely quick tempi which are impossible for our instruments, he transcribed them to a slower tempo. Their excessively high registers also required him to transcribe them several octaves lower, suppressing very small pitch intervals. These changes often render the songs almost unrecognizable to an ornithologist. But other musicians are quite definite that they can still relate Messiaen's renditions to their avian counterparts.

So we have the unusual situation that musicians are more emphatic than scientists about the organic connections between birdsongs and music. Listening

to Messiaen's music, it becomes clear that he explored, not just the surface structure of birdsong, but also its deep temporal structure, something that ethologists have yet to study. For progress to be made, technical analyses of a quite novel kind would be required, of both songs and music. This would be difficult, but worth the effort if we could show that birds and humans have converged on similar esthetic rules of composition and tonality. Perhaps there is another frontier in comparative ethology emerging here, and another challenge for future students. In this case they will need to be, not just biologists, but also musicians and mathematicians as well. This is a more demanding job description than when I was a student. Then it was enough to be a birdwatcher.