universe, which—as attested in the microwave background—was accurate to a part in ten thousand in the early history of the universe. Yet the homogeneity is not perfect, as the recent observations have revealed; indeed, the early universe must have contained the seeds that later, by gravitational accretion, grew into galaxies and other large-scale structures. Inflationary models offer a very promising way of getting insight into these inhomogeneities, by relating them to (inflated) quantum fluctuations.

On the other hand, it has to be admitted that the phenomena so far explained by the inflationary scenario are both few in number and not entirely characteristic: the flatness of the universe had been a working assumption of many cosmologists earlier, and the simplest (scale-invariant, or Harrison-Zeldovich) spectrum of inhomogeneities, which inflation models tend to give as a first approximation, was also hypothesized well before, by its namesakes. Also, the existing models of particle physics that give inflation are only metaphorically related to concrete world-models and contain some disturbingly "unnatural" features, in the form of unexplained small parameters. Most troubling of all, perhaps, is that the fundamental mechanism that drives inflation, the negative pressure associated with the energy density of empty space, is closely related to perhaps the weakest point in current physical theory, the problem of the cosmological constant. Roughly speaking, the issue is as follows. We know by observation that space devoid of matter, in the present state of the universe, does not weigh very much. Strange though it sounds, this familiar fact is baffling to modern physicists, because according to our theories apparently empty space is actually highly intricate and structured. At any rate, we do not understand why empty space weighs so little now, and in order to have inflation we must believe that it was not so—in a big way—in the early universe. Thus there remain challenges to derive and test more distinctive consequences of inflation and to root it more firmly in physical theory.

All this is just to caution, as Guth himself does repeatedly, that there continue to be lively debates on the fundamentals of scientific cosmology. It is undeniable, and truly remarkable, that the terms of these debates are increasingly set by Guth's extremely bold, yet coherent and not implausible, extrapolation of known physical laws to produce an epoch of cosmic inflation. Anyone interested in ideas, or the history of ideas, should read his book.

Frank Wilczek
Institute for Advanced Study, Princeton, NJ 08540, USA

Nonhuman Kindness

Good Natured. The Origins of Right and Wrong in Humans and Other Animals. FRANS DE WAAL. Harvard University Press, Cambridge, MA, 1996. viii, 296 pp., illus., + plates. $24.95 or £16.50. ISBN 0-674-35660-8.

Is morality unique to humans or does it have an evolutionary history? In this well-written, provocative book, de Waal argues that moral behavior can be found in nonhuman species, most clearly in great apes, but also in monkeys and nonprimate species.

Three conditions lead to the evolution of morality: an individual's dependence on a social group to find food or defend against enemies or predators; mechanisms for cooperation and reciprocal exchanges within a group; and individuals having disparate interests that must be resolved in order to preserve the benefits of living in a social group. Conflicts of interest between individuals over access to resources arise constantly, but organisms must develop mechanisms for resolving conflict to maintain social stability. The drawbacks to competition can be bodily harm, disruption of a social relationship, or harm to group unity. The defense of community or group occurs when each individual or its kin will benefit from the maintenance of the group. Thus, de Waal argues, social animals have evolved to inhibit actions that disrupt group harmony and to balance private interests with peaceful coexistence. In his view the evolution of morality can be explained in terms of individual and kin selection.

This framework coupled with clear operational definitions allows the scientific study of moral behavior. Reconciliation, the increased likelihood of positive or affiliative behavior between two actors closely following an aggressive interaction, compared with control rates of affiliation between the same actors, was first documented in chimpanzees but has now been reported in a wide variety of animals. The importance of reconciliation and the likelihood of its occurrence are related to species differences in dominance structure. However, important aspects of reconciliation are learned. Rhesus macaques were cross-fostered with stump-tail macaques, which have a higher rate of reconciliation than rhesus. The rhesus reconciled with increasing rates until they reached the same rate as the stump-tails, although they still used rhesus-typical behaviors. The high rate of reconciliation was maintained after the stump-tails were removed, suggesting that learning of reconciliation is not only possible but long-lasting.

Nonhuman primates adjust submissive and reconciliation behaviors in response to population density. Chimpanzees housed in small indoor cages in the winter have higher rates of submission and lower rates of aggression than they do in a much larger outside facility where they live in the summer. Rhesus macaque populations studied in densities varying over 646:1 ratios showed very small differences in aggression rates but increased the frequency of grooming, submissive, and appeasement gestures as population density increased. The commonly held view that aggression is a by-product of increased density is not supported. Rather, primates appeared to be sensitive to potential problems of greater density and increased the rate of friendly and reconciliation behaviors.

Reciprocal behavior is found in the sharing of food. Wild chimpanzees share meat from hunting in a strategic way to support male allies and females, and captive chimpanzees show reciprocal food-sharing behavior, giving to those who have given to them in the past. Capuchin monkeys do not show active donation of food to others but tolerate food scrounging by those they are close to socially. Nonhuman primates do not share resources as extensively as humans do, but the foundation for sharing and reciprocity exists.

Monkeys adjust their behavior with mentally retarded or physically handicapped individuals, suggesting a rudimentary sympathy, and chimpanzees show consolation toward victims of aggression. Evidence is provided for active enforcement of social rules on young primates by adults. All these well-documented examples suggest that morality is not unique to human beings but has origins in nonhuman animals.

The book is written for a lay audience, but the scientific underpinnings of the research are presented in extensive notes that describe many of the empirical data on which the book is based. Four photo essays on Closeness, Cognition and Empathy, Help for a Friend, and War and Peace support the book's main points and are much more powerful than mere words. The central idea of this book, that interindividual conflict is fundamental but that mechanisms for restraining conflict and maintaining a community are equally important for social organisms, is an important message for scientists and nonscientists alike. *Good Natured*, written for a general audience but with strong scientific foundation, communicates this message in a clear and responsible way.

Charles T. Snowdon
Department of Psychology, University of Wisconsin, Madison, WI 53706, USA