erected some 245 stone platforms, carved more than 800 giant statues and destroyed the forest so completely that its tree species are now extinct[7]. Deforestation had three harmful consequences: soil erosion, hence lower crop yields; no trees to build canoes, hence lower yields of fish, the main protein source on Easter Island other than chickens; and inability to erect statues (weighing up to 85 tons), which had probably been raised to an upright position with the help of logs used as levers. The human population now exceeded the carrying capacity of the island. Warfare, cannibalism and slavery became chronic, a warrior class took over, spear-points were manufactured in enormous quantities and people reverted to living in caves for defence. By the time that Europeans discovered Easter Island, they found a panorama of destruction: the population may have crashed, many of the statues had been toppled and intentionally decapitated during battles between rival factions, and the island had been converted to barren treeless grassland.

A second example is the collapse of the Anasazi, one of the most advanced pre-Columbian civilizations in the United States. When European explorers reached the deserts of the American south-west, they found gigantic, uninhabited, multi-storied communal houses or pueblos. The dwellings in Chaco Canyon, for example, contained up to 5 stories and 650 rooms, were constructed with more than 200,000 roof beams weighing an average of 275 kg and were the largest and highest buildings in the United States until the advent of skyscrapers in the late nineteenth century. Archaeologists have shown that the dwellings were built about 1,000 years ago and abandoned in the twelfth century. The prevalent view, based on tree-ring evidence for a period of low summer rainfall, is that abandonment was forced by drought. But although drought may have contributed, the Anasazi themselves also inflicted fatal blows on the fragile desert environment.

Betancourt and Van Devender[8-11] used plant remains in radiocarbon-dated pack-rat middens to establish Chaco's vegetational history. When construction of the dwellings began in the early tenth century, the cliffs were covered with pinyon/juniper woodland, which was then cleared for firewood over a radius of 20 km during the next 200 years. The logs to construct the dwellings were mainly ponderosa pine, hauled in via roads from sites mostly more than 40 km away. As pines became depleted, the Anasazi began in AD 1030 to haul spruce, fir and Douglas fir logs from distances exceeding 75 km. In addition, Anasazi desert agriculture depended on gravity-flow irrigation without pumps, so that irrigation would have become impossible if channel erosion eventually lowered the water level below the field level. With the need to scour over a growing radius for construction timber and fuel, as well as the possible collapse of the irrigation system, the Chaco dwellings had to be abandoned. At Chaco Canyon, as on Easter Island, the environmental damage was irreversible.

Other cases deserve brief mention. It has long been debated whether overgrazing, removal of plant cover and soil erosion contributed to the decline of the ancient civilizations of Greece and the Middle East. A recent study[1] of the Peloponnisos suggests an answer in the affirmative by documenting at least four cycles of settlement, erosion and abandonment between 2000 BC and the Middle Ages. Abandonment was caused by slope erosion and valley siltation, resulting from shortened fallow cycles, clearing of steep slopes, domestic grazing animals and neglect of terracing and check dams. In Polynesia there was massive forest destruction in New Zealand[12] and Hawaii; degradation of forest to extensive fern savanna useless for agriculture in the Cook, Society, Marquesas and Mangaréva islands; and destruction of the xeric vegetation of Kahoolawe Island, causing a steep population decline and abandoment of all but a few coastal settlements after the sixteenth century[5]. Many other possible cases, such as the collapse of Mayan civilization and the desertification of the Sahara, cannot be evaluated without detailed evidence.

Although the lack of such evidence until recently surely helped the myth of an environmental golden age to persist, there may be another reason for the myth. It used to be common for industrial societies to treat pre-industrial peoples as savage brutes, meriting extermination or at least disposession of their lands. In reaction to this appalling history, others have idealized pre-industrial peoples as gentle conservationists. Both views are equally false. Ever since humans acquired the capacity to affect their environment, all societies have faced similar problems of managing fragile natural resources and have risked self-inflicted tragedies. □

1. Van Andel, T.H. *et al. Hesperia* **55**, 103 (1986).
2. Martin, P. S. & Klein, R. G. (eds) *Quaternary Extinctions* (University of Arizona Press, Tucson, 1984).
3. Diamond, J. M. *Nature News and Views* **298**, 787 (1982).
4. Steadman, D. W. & Olson, S. L. *Proc. natn. Acad. Sci. U.S.A.* **82**, 6191 (1985).
5. Kirch, P. V. *The Evolution of the Polynesian Chiefdoms* (Cambridge University Press, 1984).
6. Flenley, J. R. & King, S. M. *Nature* **307**, 47 (1984).
7. Van Tilburg, J. thesis, Univ. Calif. Los Angeles (1986).
8. Betancourt, J. L. & Van Devender, T. R. *Science* **214**, 656 (1981).
9. Samuels, N. L. & Betancourt, J. L. *Envir. Manag.* **6**, 505 (1982).
10. Betancourt, J. L. *et al.* in *Chaco Canyon Country, a Field Guide* (eds Wells, S. G. *et al.*) 207 (Geomorphological Field Group, 1983).
11. Betancourt, J. L. *et al. Am. Antiquity* **51**, 370 (1986).
12. McGlone, M. S. *Archaeol. Oceania* **18**, 11 (1983).

Jared M. Diamond is Professor of Physiology at the University of California School of Medicine, Los Angeles, California 90024, USA.

100 years ago

Observations on heredity in cats with an abnormal number of toes

THIS observation is concerned with a family of four male tabby kittens, all of which possessed the abnormality to a very market extent. This was the first family produced by a female tabby cat which, when born, was the most abnormal form which had come under my notice, possessing two extra toes on all the paws, i.e. seven on each fore-paw and six on each hind-paw. The extra toes (in the fore-feet) are those labelled A and B (in Figs. 1 and 2), and they confer the extraordinary breadth upon the foot. The most recently added is B, which is still partially coalesced with A, and has but one pad in common with it (Fig. 2)...There is seen to be an extra pad behind the additional toes, of which there is no trace in the normal foot." In the hind-paws (Figs. 5 and 6) "there is little doubt that the innermost toe I is the hallux lost in the normal foot...The second extra toe is that labelled A...On the under side (Fig. 6) all the toes have seperate pads, and there is an additional pad behind the extra toes," which is sometimes fused with that behind the normal toes.

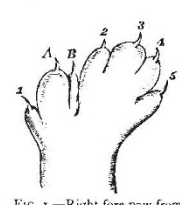

FIG. 1.—Right fore-paw from above, with extra toes.

FIG. 2.—Right fore-paw from below, with extra toes.

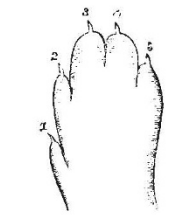

FIG. 3.—Right fore-paw from above, normal.

FIG. 4.—Right fore-paw from below, normal.

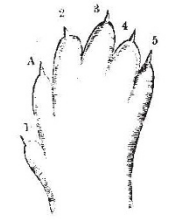

FIG. 5.—Right hind-paw from above, with extra toes.

FIG. 6.—Right hind-paw from below, with extra toes.

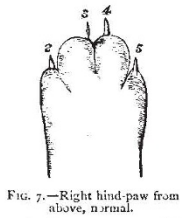

FIG. 7.—Right hind-paw from above, normal.

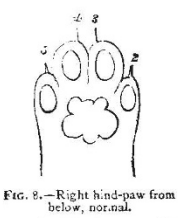

FIG. 8.—Right hind-paw from below, normal.

From *Nature* **35**, 38; 11 November 1886.