The debate continues about whether Neandertals could speak like humans. A group of letter writers defends the U.S. National Park Service against a critic of its decision to let Yellowstone National Park burn in 1988. The effect of orcas killing sea otters in the North Pacific Ocean is explored. A reader writes that "as few as four whales, eating only otters, could have been responsible for the loss of some 40,000 sea otters in the Aleutians." Recommendations of the New York State Task Force on Life and the Law are clarified. And a 1975 prediction about climate change appears to be correct.

Silver-Tongued Neandertals?

Neandertal speech capability appears to have become one of the central issues in determining whether they are a distinct branch from the human tree. Milford Wolpoff (Letters, *Science*'s Compass, 11 Dec., p. 1991) writes that Neandertals "seem human-like" because of the "speech-related details of the hypoglossal canal [and the] hyoid bone anatomy." Other advocates of Neandertal "equality" cited by Constance Holden (Special Section, Archaeology, 20 Nov., p. 1456) make the same argument, that Neandertal speech capability did not differ in any way from that of modern humans because of their hyoid bones and hypoglossal canals. However, the studies on which they base this argument run counter to the known anatomy and physiology of human speech.

Independent studies show that non-human primates and human newborn infants, whose tongues rest almost completely within their mouths, can not produce the full range of human speech sounds. In the course of normal maturation, the hyoid bone and larynx descend and the tongue reshapes, extending well below the lower jaw. This configuration yields the human "vocal tract" that can form sounds, such as the vowel in "me," which has properties that enhance speech perception (*1*). An isolated Neandertal hyoid bone (*2*) can't tell you whether the Neandertal had a human vocal tract, because the hyoid bone and larynx descend as children mature, without any systematic change in shape. Therefore, the larynx could be anywhere between its newborn and adult human positions (*3*). A study of the hypoglossal canal opening, through which nerves that enervate the tongue run, found that the opening was proportionately greater in modern humans and Neandertals than in chimpanzees (*4*). However, the tongues that were fitted in this study to both humans and to the Neandertal fossil were ape-like. The hypothetical human and Neandertal tongues were confined to the mandible and inherently could not have produced fully human speech. When the canal opening is compared with actual human tongues, there is no difference in relative hypoglossal canal size between chimpanzees and humans. Because chimpanzees can't talk, the conclusion must be that hypoglossal canal size "tells" nothing about the speech capabilities of Neandertals.

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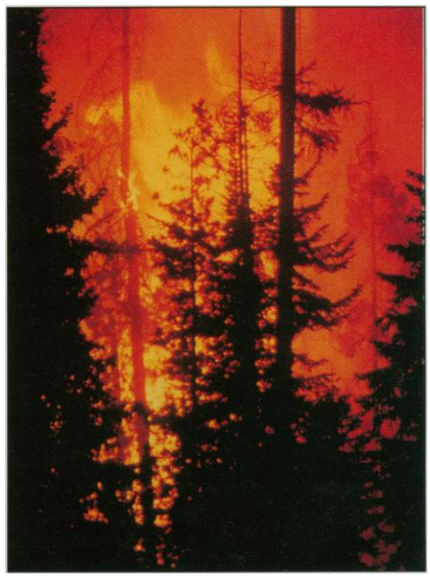
References and Notes

1. Studies since Darwin's time of the anatomy, physiology, and development of speech are reviewed by P. Lieberman in *Eve Spoke: Human Language and Human Evolution* (Norton, New York, 1998). In brief, the "tube" formed by the posterior margin of the tongue in the pharynx must be equal in length to the "tube" formed by the mouth. The initial study of Neandertal speech by P. Lieberman and E. S. Crelin [*Linguist. Inquir.* **2**, 203 (1971)] noted that Neandertals had speech, but it was not as efficient as fully human speech because it lacked the full range of sounds that humans can produce.
2. B. Arensburg *et al.*, *Am. J. Phys. Anthropol.* **83**, 137 (1990).
3. P. Lieberman, *ibid.* **94**, 275 (1994).
4. R. F. Kay, M. Cartmill, M. Balow, *Proc. Nat. Acad. Sci. U.S.A.* **95**, 5417 (1998).

Yellowstone Fires

Bill Wattenburg (Letters, *Science*'s Compass, 6 Nov., p. 1051) accuses the U.S. National Park Service and ecologists quoted by Richard Stone (Research News, 5 June, p. 1527) of struggling "to rationalize the official burning of the forests of Yellowstone in 1988," and he cites unnamed "[i]ndependent observers who know the status of the park today" to support his claim that the "rosy picture of renewal" presented in Stone's article is inaccurate. We wish to call attention to numerous scientific publications that refute Wattenburg's assertions.

Wattenburg states that a photograph in the original article "does not typify 90% of the previously forested areas devastated by the all-consuming fires." The photo was never intended to represent the entire range of successional trajectories occurring after the fires, but it is typical of many lodgepole pine stands. Most of the previously forested areas are now stocked with sufficient densities of tree saplings to re-establish closed forests within several decades (the normal time required for reforestation in this kind of ecosystem); other areas typically developed a dense cover of herbaceous plants (*1*).



Yellowstone ablaze, 1988

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Wattenburg refers to a "vast cemetery of burned, rotting, and bug-infested tree stumps that is all that remains of 320,000 hectares of once-beautiful Yellowstone forests...." The burned forests do contain great quantities of dead wood, but that is a natural part of forests characterized by large, infrequent fires. Explorers in the mid-1800s commented on the great abundance of dead wood in Rocky Mountain forests. These forests provide habitat for numerous native animals and plants specialized to use postfire environments (*2*).

Wattenburg asserts that the Park Service could have used "controlled" burning to "clean up the forest and make it fire tolerant...." Although such a strategy has been effective in other kinds of forest ecosystems, for example, ponderosa pine, it is unworkable in an ecosystem like Yellowstone. The prehistoric fire regime in most of Yellowstone Park was characterized by infrequent, high-intensity, stand-replacing fires, not by frequent, low-intensity, non-lethal fires (*3*). Prescribed burning is difficult in lodgepole pine forests, because of the narrow range of weather conditions within which burning can be conducted and the ever-present danger of the fire escaping. J. K. Brown, a fire behavior specialist with the U.S. Forest Service, concluded that the extent and severity of the 1988 Yellowstone fires could not have been prevented by a pre-1988 program of prescribed burning (*4*).

The statement by Wattenberg that thousands of tons of topsoil washed into streams after the 1988 fires is true (*5*), but similar erosion has occurred after fires in Yellowstone repeatedly in the past. The geological record is clear: radiocarbon dating shows that debris flows and flash floods, which carry the great majority of sediment into streams after major fires, have recurred at intervals of about 300 to 450 years over the last several 1000 years (*6*). It is also clear that major fires and erosion are much more prevalent in periods of warming climate, and instrumental records in Yellowstone show a significant trend of increasing temperatures and summer drought severity over the last 100 years (*7*).

Fire-related erosion and sedimentation have both positive and negative aspects (*8*). In addition to siltation, debris flows and floods are a major source of spawning gravel, boulders, and woody debris to streams, clearly important functional components of aquatic habitats. Erosion is a transient response after fire and is greatly reduced even by relatively sparse growth of herbaceous plant cover in Yellowstone, where deep-seated soil slips are rare (*9*). Fire-related debris flows and floods became uncommon after 1991 and have continued only in limited areas, such as from dry south-facing slopes that are slower to revegetate. Fine sediment input is therefore greatly reduced within a few years after fire in Yellowstone. Also, much fire-related sediment is deposited locally along valley sides and on floodplains (*9*), where this organic- and nutrient-rich material contributes to the productivity of those environments.

Clearly the potential remains for future large, intense fires in the greater Yellowstone area. If climate warming continues, as appears likely (*10*), then we may anticipate more drought years like 1988, when fires probably will be impossible to control even if managers decide that complete suppression is desirable.

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References

1. J. E. Anderson and W. H. Romme, *Int. J. Wildl. Fire* **1**, 119 (1991); M. G. Turner, W. H. Romme, R. H. Gardner, W. W. Hargrove, *Ecol. Monogr.* **67**, 411 (1997).
2. D. L. Taylor, *Ecology* **54**,1394 (1973); M. E. Harmon *et al., Adv. Ecol. Res.* **15**,133 (1986); A. J. Hansen, T. A. Spies, F. J. Swanson, J. L. Ohmann. *BioScience* **41**, 382 (1991).
3. W. H. Romme, *Ecol. Monogr.* **52**, 199 (1982).
4. J. K. Brown, in *The Greater Yellowstone Ecosystem: Redefining America's Wilderness Heritage*, R. B. Keiter and M. S. Boyce, Eds. (Yale Univ. Press, New Haven, CT, 1991). pp. 137–148.
5. R. Ewing, *Water Resour. Bull.* **32**, 605 (1996).
6. G. A. Meyer, S. G. Wells, R. C. Balling Jr., A. J. T. Jull, *Nature* **357**, 147 (1992); G. A. Meyer, S. G. Wells, A. J. T. Jull, *Geol. Soc. Am. Bull.* **107**, 1211 (1995).
7. R. C. Balling Jr., G. A. Meyer, S. G. Wells, *Clim. Change* **22**, 34 (1992); *Agric. For. Meteor.* **60**, 285 (1992).
8. L. E. Benda, D. J. Miller, T. Dunne, G. H. Reeves, J. K. Agee, in *River Ecology and Management: Lessons From the Pacific Coastal Region*, R. J. Naiman, and R. E. Bilby, Eds. (Springer, New York, 1998), pp. 261–288.
9. G. A. Meyer and S. G. Wells, *J. Sediment. Res.* **A67**, 776 (1997).
10. M. Mann, R. S. Bradley, M. K. Hughes, *Nature* **392**, 779 (1998).

Otter-Eating Orcas

The report "Killer whale predation on sea otters: Linking oceanic and nearshore systems" by James A. Estes *et al.* (16 Oct., p. 473) poses an intriguing explanation for the recent precipitous decline of sea otters in the Aleutian Islands. This crash began in the early 1990s, in the same year as one

Sea otter, a victim of orca predation

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of the first confirmed sightings of a killer whale attacking a sea otter. The proposition that orca predation is decimating otter populations is not conclusive, but it is supported by a collection of evidence, including continued sightings of killer whale attacks.

The analysis in the report was limited to the Aleutian chain, but the report has implications elsewhere: killer whale predation on sea otters has also been witnessed in Prince William Sound, Alaska. In fact, of the nine sightings in the 1990s, three were in Prince William Sound (*1*), the site of the largest oil spill in North America and the focus of continuing scientific and legal disputes regarding recovery. Nearly a decade after that March 1989 spill, some researchers believe that sea otters are among the handful of species that still have not recovered (*2*).