Astronomy

Heralding Hale-Bopp

As it heads toward an April 1 rendezvous with the sun, Comet Hale-Bopp continues to blossom. Over the coming weeks, skywatchers will see for themselves whether this icy relic of the solar system's birth merits the title Comet of the Century.

Now visible with the naked eye in the northeastern sky before sunrise, the comet by March 20 should appear low in the northwestern sky soon after dusk. It's likely to delight after-dinner viewers through most of April and may be at its brightest during the first 2 weeks of that month. Moonlight should not interfere with observations between March 26 and April 12.

Astronomers chart a comet's journey from the fringes of the solar system using a planetary yardstick—the separation between the Earth and sun, defined as 1 astronomical unit (AU). Even at its closest approach to Earth, on March 22, Hale-Bopp will stay a respectful 197 million kilometers, or 1.3 AU, from our planet. That's 13 times farther away than Comet Hyakutake ventured last spring, when it put on a memorable show for observers away from city lights (SN: 6/1/96, p. 346).

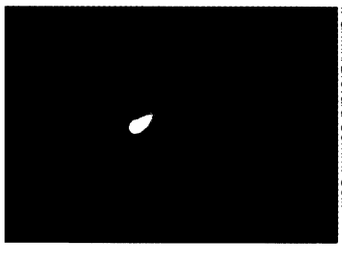
Nonetheless, Hale-Bopp may surpass that performance, according to comet mavens Michael F. A'Hearn of the University of Maryland in College Park and Brian G. Marsden of the Harvard-Smithsonian Astrophysical Observatory in Cambridge, Mass. Hale-Bopp's nucleus, they note, may be a whopping 40 km in diameter—more than 10 times Hyakutake's—if a rough estimate made with the Hubble Space Telescope is correct. The comet also has a far more mercurial nature, which may portend the expulsion of larger amounts of dust. Dust particles, which form a comet's signature tail and its huge shroud, or coma, reflect sunlight extremely well and make for a brilliant apparition.

Because of its distance from Earth, Hale-Bopp will appear smaller than last year's visitor. However, its very compactness concentrates Hale-Bopp's light. As a result, viewers are likely to see a small, sharply defined dust tail rather than the elongated, wispy gas tail exhibited by Hyakutake, says Marsden. Especially near cities, where the night sky never gets completely dark, Hale-Bopp "is definitely going to be more spectacular," adds A'Hearn.

Marsden and A'Hearn predict that the comet will be at its brightest shortly after April 1, when it comes closest to the sun. Solar heating of the comet turns some of the water-ice on or just beneath its surface into jets of vapor that fling out dust, brightening the body. If Hale-Bopp is indeed large, it may take a little time for jets of water vapor and the dust they carry to percolate through the comet's outer layers, Marsden speculates.

A'Hearn compares Hale-Bopp to Comet Bennett, a small, bright comet that graced terrestrial skies in 1970, and says it may become as memorable as Comet West in 1976. Marsden hasn't budged from his original prediction that the comet, discovered in July 1995 when it was well beyond Jupiter's orbit, could become as bright as the star Sirius and even rival the appearance of the Great Comet of 1811 (SN: 8/12/95, p. 103).

Harold A. Weaver of Johns Hopkins University in Baltimore offers one caveat. Analyzing data from Hubble and other telescopes, he and his colleagues, including A'Hearn, find that the amount of dust spewed by the comet during 1996 did not keep pace with the increase in expelled water vapor. Weaver theorizes that if the trend continues, Hale-Bopp will not brighten quite as much as Marsden hopes. — *R.C.*



L. Griffin/Brevard Comm. Coll.

Comet Hale-Bopp as seen before dawn on Feb. 27.

Earth Science

Earth's pole is a pushover for quakes

As Asian nations gain economic clout, they are shifting the world's political center of balance from the Atlantic region to the Pacific. Less conspicuously, earthquakes are changing Earth's physical balance by gently nudging the North Pole in the direction of the Pacific at a rate of about 10 centimeters per century. Earthquakes exert such a weighty effect because the globe's largest shocks occur mostly along the Pacific Rim, reports Giorgio Spada of the University of Bologna in Italy.

Spada studied the influence of earthquakes by using a computer to simulate random quakes and then calculating their effect on the planet's rotational axis. Quakes can shift the orientation of Earth's axis because they move large sections of the crust and subtly unbalance the planet.

In previous studies, Benjamin Chao of NASA's Goddard Space Flight Center in Greenbelt, Md., and his colleagues showed that quakes since 1977 have exerted a force that would push the pole in the direction of Tokyo. Chao's analysis did not address why quakes have such an effect.

In the March 1 GEOPHYSICAL RESEARCH LETTERS, Spada reports studying many aspects of simulated quakes, including their longitude, latitude, depth, and fault orientation. Of these factors, the longitude of quakes influenced Earth's rotation most. Because most large quakes occur along the Pacific Rim, they combine to force the pole toward Tokyo.

Actual measurements since 1900, however, show the pole edging in the opposite direction at the rate of about 10 cm per year. Geophysicists explain this motion as a legacy of the ice age. Continents once weighted by ice have been rising for the last 10,000 years, overwhelming the quakes' influence.

By geologic standards, the glacial effect is short-lived. Over extremely long periods of time, more deep-seated processes come into play. In the Jan. 17 SCIENCE, Spada and his coworkers show that the process of subduction—which sends surface plates sinking into the mantle—has controlled the pole's position over the last 100 million years. — *R.M.*

Pacific puts the brake on warming

Parts of the tropical Pacific Ocean have cooled over the last century, slowing the rate of global warming, according to a team of climate researchers. This reluctant section of the Pacific may explain why Earth has not warmed as quickly as expected, says Mark A. Cane of the Lamont-Doherty Earth Observatory in Palisades, N.Y.

Many computer simulations of Earth's climate have forecast a temperature rise twice as great as the current one. In the Feb. 14 SCIENCE, Cane and his colleagues look to the Pacific for answers. Using a computer model of the tropical ocean, they artificially warmed the climate and found that winds and ocean currents work to cool the eastern Pacific.

Even under natural conditions, the eastern equatorial Pacific tends to be cooler than the west because trade winds push warm surface water toward Indonesia and cause deeper, cool water to rise near Ecuador. The computer studies by Cane's team show that human-induced warming would enhance this natural cycle by strengthening the trade winds and the upwelling of cold water in the east. The much larger models used to study global climate lack enough resolution to simulate the ocean properly and thus do not show this process.

As evidence in support of their theory, the scientists point to records of sea surface temperatures over the last century. These show slight cooling in the eastern equatorial Pacific, while the global mean temperature has climbed about 0.4°C.

Although this process may delay global warming, it can cause its own problems. Pacific cooling can disrupt global weather. Such cooling, say the researchers, "would likely have substantial social and economic consequences." — *R.M.*

Science Service, Inc. is collaborating with JSTOR to digitize, preserve, and extend access to *Science News*. www.jstor.org