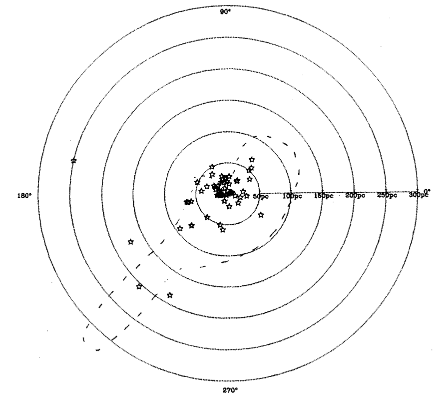
Revisionists' view of solar system environs

Astronomers are zeroing in on the nature of the gaseous environment in which the sun and nearby stars make their home. In addition to precisely measuring such properties as the distribution of gas in and around the solar system, a trio of new studies provide supporting evidence that the solar neighborhood consists of diffuse clouds embedded in a hot, virtually gas-free region. However, the origin of this void may differ from what astronomers had proposed.

Examining reflected sunlight near Mars, a French-U.S. research team has confirmed that hydrogen atoms slow down as they enter the solar system. Using the Hubble Space Telescope's Goddard High Resolution Spectrograph, the team found that in the solar system these atoms move at a speed of about 20 kilometers per second. Previous Hubble measurements, reported by a separate research group headed by Jeffrey L. Linsky of the Joint Institute for Laboratory Astrophysics in Boulder, Colo., are consistent with hydrogen atoms moving at a faster speed outside the solar system, about 25 km/sec. The slowdown confirms an earlier finding, using a ground-based telescope, reported by Rosine Lallement of the French research agency CNRS, in Verrieres-le-Buisson, and P. Bertin, a CNRS colleague.

In contrast to hydrogen, helium atoms don't change their speed as they cross into the solar system, notes John T. Clarke of the University of Michigan in Ann Arbor, a coauthor of the new study. Clarke and his colleagues suggest that the hydrogen slowdown occurs near the edge of the solar system, where the solar wind – a swiftly moving stream of charged particles – slams into the slower moving interstellar wind. At this boundary, protons grab electrons from the hydrogen atoms. In the process, the hydrogen atoms decelerate. According to the researchers, helium atoms keep up their speed since the solar wind protons can't steal their electrons as efficiently.



Barry Welsh/ROSAT/EUVE

Elongated region (dashed line) indicates misshapen void in which our sun is immersed.

Using estimates of the density of solar wind protons, Clarke and his colleagues calculate that the edge of the solar system lies about 100 astronomical units from the sun, or 100 times the distance from the Earth to the sun. If their calculation proves correct, the Voyager 1 spacecraft should pass the solar system's edge by 2010, the researchers note. Clarke, Lallement, and Jean-Loup Bertaux of CNRS report their work in the May 21 SCIENCE.

In another Hubble study, Linsky and his colleagues measured the local ratio of deuterium (a heavy isotope of hydrogen) to hydrogen in two directions: toward the nearby star Capella and another neighbor of the sun, Procyon. Results of a preliminary analysis indicate that the interstellar gas along the Procyon line of sight may have a smaller deuterium-to-hydrogen ratio than that in the direction of Capella. Future Hubble observations along other lines of sight should reveal if the local ratio truly varies. Linsky notes that because hydrogen and deuterium have not been produced since the Big Bang, the present-day ratio can be used to determine the amount of ordinary matter in the universe a few hundred seconds after the birth of the universe.

Examining a bigger piece of interstellar space, Barry Y. Welsh of NASA headquarters and his colleagues have used ultraviolet data from two orbiting observatories, ROSAT and the Extreme Ultraviolet Explorer, to map the contours of a huge void in space that extends about 600 light-years across, well beyond the solar system. Researchers had previously speculated that this giant void represents a low-density bubble blasted out by a supernova explosion (SN: 4/17/93, p.244).

But the new data, presented last week by Welsh at an astrophysics meeting in Noordwijk, the Netherlands, indicate the void has a highly misshapen contour and bears little resemblance to a single bubble. At the meeting, Fred Bruhweiler of Catholic University in Washington, D.C., proposed that the void marks the intersection of several bubbles, each sculpted by a separate supernova explosion or strong stellar wind. *– R. Cowen*

Middle Eastern hominids keep an early date

Age estimates based on a new analysis of fossil teeth found in three Israeli caves confirm reports that Neandertals and anatomically modern humans lived virtually side by side in the Middle East around 100,000 years ago, a team of scientists asserts in the May 20 NATURE.

The role played by Middle Eastern hominids (members of the human evolutionary family) in the emergence of modern humans remains controversial, however.

Modern humans inhabited the region first and lived near later-arriving Neandertals for at least 40,000 years, argue Frank McDermott, a geologist at University College in Dublin, Ireland, and his coworkers, who obtained the new dates from animal teeth found near the hominid remains. Neandertals died out after little or no interbreeding with modern humans, who originated about 250,000 years ago in Africa and spread throughout the world, the group contends.

Other anthropologists, including David W. Frayer at the University of Kansas in Lawrence, assign all Middle Eastern hominid remains to an early form of *Homo sapiens* (SN: 6/8/91, p.360), which they also believe encompasses European fossils usually classed as Neandertals (SN: 6/20/92, p.408). *H. sapiens* emerged as many as 2 million years ago and evolved simultaneously in several parts of the world, according to these researchers. Dates provided in the new report and in other recent studies help establish the antiquity of "archaic" *H. sapiens* in the Middle East, in their view.

Frayer and four colleagues defend this "multiregional" theory of evolution in the March AMERICAN ANTHROPOLOGIST.

McDermott and his associates analyzed tooth fragments of ancestral cows or oxen found in the same sediment as hominids at three Israeli caves: Skhul and Tabun on Mount Carmel, south of Haifa, and Qafzeh near Nazareth. The investigators classified the heavier bones at Tabun as Neandertals and the slighter skeletons at Qafzeh and Skhul as modern humans.

Prior studies of animal teeth at the three sites, based on measurements of electrons that accumulate in bone as a result of environmental radiation after burial, yielded age estimates of about 100,000 years old (SN: 4/29/89, p.263).

The new dates, derived from chemical analysis of tooth scrapings in a mass spectrometer, reflect the time elapsed since the bones began to acquire uranium through exposure to groundwater after burial.

Of two teeth taken from hominid-bearing sediment at Skhul, one dates to around 106,000 years ago and the other to 89,000 years ago, the researchers hold.

Three teeth from fossil layers at Tabun date to between 98,000 and 105,000 years ago, they contend.

One tooth at Skhul yields a date of about 80,000 years old, but several others cluster around 40,000 to 45,000 years old, McDermott and his colleagues note. Skhul hominids may segregate into earlier and later populations, they suggest.

Of the 15 dates generated in the new experiment, 11 closely match dates for the same sites already calculated through other techniques. *– B. Bower*