the University of California, Santa Cruz, notes that the seismic images from below 1700 kilometers may be muddy simply because seismic data are poor at those depths. And there are seismic signs, he says, that the deepest mantle could be more dynamic than allowed by the layers in the lava lamp model. He also notes that the proposed structure will be "very difficult to detect seismically."

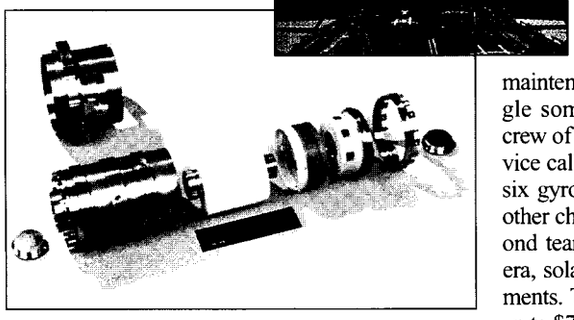
Van der Hilst agrees that testing the model will be a challenge, but "it's certainly more promising than any of the end-member models presented so far." If the model does pan out, lava lamps are one '70s craze that may have a lasting effect. **–RICHARD A. KERR**

ASTRONOMY

NASA Plans Earlier Hubble Rescue

WASHINGTON, D.C.—For months, NASA has been weighing the possibility of losing its most productive science instrument, the Hubble Space Telescope, against the certainty of disrupting a carefully choreographed launch schedule involving its most important engineering mission, the international space station. Hubble won. NASA announced last week that it will mount a special space shuttle mission in October to replace failing gyroscopes that threaten to cripple the telescope's ability to do science.

Since its launch in 1990, the $2 billion telescope has delivered a steady stream of spectacular images of the universe. But it has had to overcome its share of problems, including a now-corrected flaw in an expensive mirror that initially rendered its images nearly useless to scientists. The Hubble's current predicament involves its six gyroscopes—small, rapidly spinning wheels enclosed in liquid-filled containers that act like compasses. The navigational aids make it possible for the telescope to lock onto targets and maintain a rock-steady focus on small patches of space for long periods. In 1995 and 1998, for instance, the Hubble stared at two patches of sky for 10 consecutive days each, revealing thousands of previously unseen galaxies believed to be at the edges of the universe.



Hubble trouble. Corrosion may have disabled three of six gyroscopes (*above*) that stabilize the telescope (*inset*).

CREDIT: NASA

Concerns about the Hubble's gyroscopes surfaced last October, after two of the devices—which were installed in 1993 and checked in 1997—failed within 18 months. The losses, which a NASA official termed "disquieting," left the Hubble with four working gyroscopes. Three are needed to keep the spacecraft from entering a self-protective safe mode, in which its scientific instruments are shut down. When a third gyroscope showed signs of breaking down in late January, NASA activated an emergency response plan. "When Hubble reached the point of being one failure away from doing science, our flight rules said we must look at a mission to correct the situation," explains John Campbell, Hubble project director at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

NASA officials faced several obstacles, however. After a series of delays, the next Hubble maintenance mission was scheduled for June 2000, and some key instruments would not be ready for an earlier launch. Moreover, three of the agency's four shuttles have been reconfigured to carry construction payloads for the space station, and their launch schedules were booked. That left Columbia as the favored vehicle for Hubble repairs. But NASA had a long-scheduled overhaul of Columbia planned for this fall—just when engineers feared the telescope might be forced out of action.

To forestall that disaster, NASA officials decided to jury-rig the shuttle Atlantis, stretch out the planned Hubble maintenance over two missions, and juggle some space station launches. One crew of astronauts will make a 9-day service call to Hubble this fall to replace all six gyros and a computer and do a few other chores. Next year or in 2001, a second team will install an improved camera, solar panel, and new science instruments. The two visits could cost NASA up to $75 million extra over the next couple of years, officials say.

Although putting off the installation of new instruments may delay some science, researchers support the plan. Indeed, "splitting the mission may make things easier, since the servicing mission was getting very crowded," says astrophysicist Rodger Johnson of the University of Arizona, Tucson, lead scientist for the Hubble's Near-Infrared Camera and Multiobject Spectrometer. The instrument, which has been out of action since January due to a lack of nitrogen coolant, will now have to wait at least 6 months longer for a new supply. But, says Johnson, "it gives us more time to analyze the data we've already got."

The October mission will also give NASA an early opportunity to do autopsies on the dead gyros and get its first look at the performance of a new design. Engineers believe the existing gyroscopes—which cost $3 million each and are built by Allied Signal Corp. of Teterborough, New Jersey—fail when their copper electrical cables become corroded. The corrosion occurs, they believe, because compressed air was used to pack the thick fluid surrounding the spinning wheels into the devices. Oxygen from the air mixes with bromine in the fluid, catalyzing the corrosive reaction.

To defuse that threat, the company is now using compressed nitrogen to pack the gyroscopes. But building the devices is "like crafting a fine watch: It can take years," says Campbell. As a result, just three of the new units may be ready to be installed on the October flight; the other replacements will probably be of the older type. But Campbell is confident that the arrangement can keep Hubble pointing in the right direction until its planned demise in 2010. **–DAVID MALAKOFF**

EUROPEAN UNION

Cresson Resigns in Wake of Fraud Report

The European Union's (EU's) embattled research commissioner, Edith Cresson, submitted her resignation this week along with the other 19 EU commissioners in the wake of a scathing report by a European Parliament investigative panel that alleged cronyism and mismanagement in the EU's executive body. The panel singled out Cresson for the harshest criticism. As *Science* went to press, it was not yet clear whether some commissioners—all of whom are political appointees—would be renamed to their positions by their respective governments, to serve out terms that had been scheduled to expire at the end of this year. However, two sources in Brussels said it was "highly unlikely" that the French government would restore Cresson to her post, and officials are beginning to speculate about her successor.

The commission's mass resignation—roughly equivalent to the entire U.S. federal Cabinet stepping down at the same time—comes just a month after the EU's science directorate, known as DGXII, formally launched its new 4-year, $17.6 billion research program, Framework 5. DGXII officials say it is still unclear exactly what impact, if any, the resignation of the unpopular Cresson will have on the nascent program.

The European Parliament's 140-page report, issued on 15 March by a five-person panel of independent experts, was scathing about aspects of Cresson's management of DGXII and the education directorate, DGXXII. The report said that Cresson, a former French prime minister who has headed the directorates since early 1995, "failed to act in response to known, serious, and continuing irregularities over several years" in the 5-year, $700 million Leonardo da Vinci program to help fund vocational and professional training. Audits have accused an outside contractor of defrauding the program of millions of dollars.

Cresson also was criticized in the report, and in earlier inquiries, for helping a French friend with dubious qualifications gain contracts to work for DGXII and, later, the EU's Joint Research Centre. However, this week's report said that no commissioner "was directly and personally involved" in fraud or received money personally. Cresson did not comment on Tuesday. Earlier, she had denied being aware of any fraud.

In the wake of the resignations, officials in Brussels are speculating that an interim commissioner might be named to head DGXII until the new commission is chosen later this year. One Brussels insider says Swedish officials had expressed an interest in the science directorate. Another source says that Portugal's research minister, José Mariano Gago, might be considered for the permanent position. But, says another source, "it's too early to even speculate."

–ROBERT KOENIG

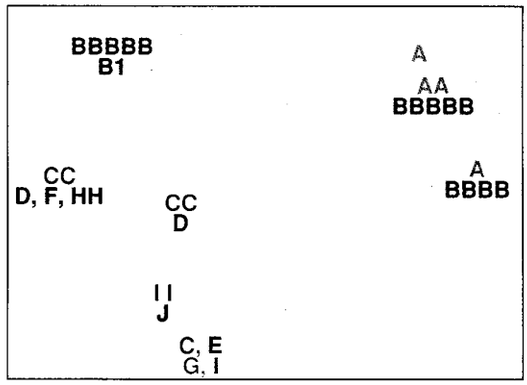
HUMAN EVOLUTION

Genetic Study Shakes Up Out of Africa Theory

A new DNA analysis is casting doubt on the popular notion that all modern humans descended from one small population of ancient Africans. This "Out of Africa" theory had gained support in recent years, as a string of genetic studies suggested that a single group of ancient, sub-Saharan people left traces of their genes in modern people—implying that only this group succeeded in taking the final evolutionary leap to becoming modern humans. This new human species then migrated throughout world, replacing populations of "archaic" humans, such as Neandertals. Or so the story goes.

But a few anthropologists have always questioned this tale, and this week the skeptics added new data to their cause, as population geneticist Jody Hey and anthropologist Eugene Harris of Rutgers University in Piscataway, New Jersey, presented evidence that two human populations dating to at least 200,000 years ago left their genetic legacy in modern people. One group gave rise to modern Africans and the other to all non-Africans, Hey and Harris report in the 16 March *Proceedings of the National Academy of Sciences*.

To remain distinct, the two ancestral populations presumably lived in different places, which fits with a competing theory of human origins, called multiregionalism, in which modern human traits evolved in various populations and then were spread around the world by small groups of migrants who interbred with other populations. "It's important evidence," Henry Harpending, an anthropologist at the University of Utah, Salt Lake City, says of the new study. "A lot of us thought [the question] was answered." And although Harpending, who has done genetic work supporting the Out of Africa scenario, doesn't support multiregionalism, he agrees that "if we follow the implications of [this work], then the Out of Africa hypothesis is wrong."



Genetic divide. Non-Africans have versions A and B of the *PDHA1* gene, while Africans have a different set of variants.

Multiple analyses of mitochondrial DNA and Y chromosome variations have bolstered the Out of Africa hypothesis. But Hey and Harris found a different pattern when they compared different versions, or haplotypes, of a gene on the X chromosome called *PDHA1*, which codes for a key enzyme in sugar metabolism. They gathered DNA from six French, seven Chinese, five Vietnamese, one Mongolian, six Senegalese, three African Pygmies, three members of the Khosian tribe near Angola, and four South Africa Bantus.

By assuming that the number of sequence differences between two haplotypes corresponds to the time since populations carrying them split apart, Harris and Hey built an evolutionary tree for the gene. To turn the sequence differences into an absolute measure of time, they calculated the gene's mutation rate, based on the number of differences between chimp and human *PDHA1* genes, which are assumed to have split 5 million years ago. Such molecular clocks have come under fire lately (*Science*, 5 March, p. 1435), but the team notes that other analyses show that *PDHA1*'s clock appears to keep steady time.

The tree showed that modern variants of the gene go back to two ancestral haplotypes. One gave rise to several modern haplotypes found only among Africans. The other ancient haplotype eventually gave rise to one variant seen today in some Africans, and another variant that—some 200,000 years ago—evolved into the two haplotypes seen today in non-Africans. What's more, the team found a so-called "fixed difference" between Africans and non-Africans: At one spot in the sequence, all the Africans had one base, while all the non-Africans had a different base. This is the first time such a fixed regional difference has been found in human genes, and it "is a strong indication of an historical division" in the population, says Hey.

All this offers a serious challenge to the Out of Africa hypothesis, says Rosalind Harding, a population geneticist at the Institute of Molecular Medicine in Oxford, United Kingdom. Although the previous studies may have accurately traced particular genes, a given gene may not accurately reflect a population's movement. Moreover, the new work isn't the only one questioning Out of Africa. Harding's previous work revealed ancient, non-African haplotypes in the beta globin gene. And work by Michael Hammer of the University of Arizona, Tucson, showed that a haplotype on the Y chromosome apparently arose in Asia and then moved back to Africa in an early migration (*Science*, 25 April 1997, p. 535). But the new study, with its finding of a fixed difference, offers more clear-cut evidence of multiple ancient populations. "It's the best study of the lot," says anthropologist Milford Wolpoff, a longtime multiregional defender at the University of Michigan, Ann Arbor.

But both Hey and Harding say Out of Africa isn't yet obsolete. For one, "[our study] is just a one-gene view of human history," Hey cautions. For another, he thinks that the two ancestral populations both could have lived in Africa, close enough for some interbreeding, so that the traits that distinguish modern humans emerged in both groups. Then, perhaps 100,000 years ago, one group left Africa. Thus humans "could still be out of Africa," Harding says.

What's needed now, Harding and Hey say, are more studies of more genes, particularly nuclear genes, to see which scenario they match. If future work supports the tale told by the *PDHA1* gene, says Harding, then in 5 years, "we could be looking back and saying this [report] was the key paper."

–ELIZABETH PENNISI

SOURCE: JODY HEY