Upping the chances of finding planets

A new generation of telescopes and the upgrading of existing instruments will soon enable astronomers to peer deeper into space and further back into time. But the improved optics have another payoff: boosting the odds of finding planets that lie outside the solar system but within our own galaxy.

In the May 25 NATURE, Adam S. Burrows and Jonathan I. Lunine of the University of Arizona in Tucson and their colleagues consider the feasibility of looking for young, giant planets—brighter and therefore more visible than older, smaller planets—at various distances from their parent stars.

They conclude that planets more massive than Jupiter and younger than 1 billion years have the best chance of showing up in telescope searches—especially if they lie farther from their stars than Jupiter does from the sun.

"That a young 'Jupiter' or 'Saturn' may be bright has been known for some time, but ours are the first detailed calculations for objects [with masses greater than Jupiter's] and ages greater than 10 million years," the team writes.

But brightness isn't the only consideration. To hunt planets, a telescope must detect faint objects and have high spatial resolution. Resolution allows the instrument to distinguish a planet from the star it orbits. The planned Large Binocular Telescope, the Near Infrared Camera and Multi-Object Spectrometer (NICMOS) due for installation on the Hubble Space Telescope in 1997, and the proposed Space Infrared Telescope Facility have the capacity to discover a variety of massive planets, the scientists note.

In particular, NICMOS can detect a planet 400 light-years away—as distant as the Pleiades star cluster—if the body has at least six times Jupiter's mass and travels in a sufficiently wide orbit.

More generally, the team says that none of the new or upgraded telescopes will have the resolution to find a massive planet in the Pleiades unless the object lies at least as far from its parent as Neptune's separation from the sun. Infrared telescopes can more easily detect very massive planets because these objects generate enough heat to emit a copious amount of infrared light.

Scientists have noted that giant planets like Jupiter may be rare (SN: 4/22/95, p.251). But it still pays to look, Lunine says, because knowing the population of big planets "cuts to the heart of whether we will find inhabitable planets." At least in our solar system, large outer planets protect smaller ones, such as Earth, from bombardment by comets. —*R. Cowen*

Lineage of Y chromosome boosts Eve theory

Men all over the world have an identical stretch of DNA on their Y chromosomes, researchers have discovered. The finding provides further evidence for the controversial theory that modern humans may originate from a single, recent population, they assert.

Other researchers argue that humans originated about 1 million years ago in different regions of the world. In 1987, however, molecular biologists began publishing analyses of mitochondrial DNA, which only women pass on to their offspring. These results suggest that all humans evolved from one woman, dubbed Eve, or more likely from a small group of women, living about 200,000 years ago in Africa (SN: 9/25/93, p.96).

"There's something tantalizing about the fact that two completely different parts of the genome are beginning to tell the same story," says Robert L. Dorit of Yale University. Dorit coauthored the new study, which appears in the May 26 SCIENCE.

"Everyone has eagerly awaited dates for the diversity of other regions of the genome that could support or contradict the mitochondrial evidence," notes Svante Pääbo of the University of Munich in Germany, in an accompanying commentary.

The equivalence of the Y chromosome DNA in different people suggests that all human Y chromosomes share a recent ancestor and that not enough time has elapsed for differences to develop, Dorit asserts. He and his colleagues looked for variations in part of the ZFY, or zinc finger y, gene in 38 men from around the world. They also compared ZFY in three species: chimpanzee, gorilla, and orangutan.

ZFY, handed down exclusively from father to son, appears to help with sperm or testes maturation. The gene sits on a segment of the Y chromosome that doesn't recombine, a process that involves the exchange of genetic information with a partner chromosome and that tends to muddy evolutionary history, Dorit notes.

To calculate the rate at which mutations accumulate in the segment of ZFY that they examined, Dorit and his group compared the DNA sequences of the four species—chimps, humans, orangutans, and gorillas—that they studied.

For each pair of species, such as chimps and humans, they then divided the number of DNA sequence differences by the number of years since the two shared a common ancestor. Humans diverged from chimps and gorillas about 5 million years ago, for example. The scientists calculated that 0.135 percent of the DNA changes every 1 million years. Humans had to have originated roughly 270,000 years ago to have such similar Y chromosomes.

Dorit and his coauthors acknowledge that factors other than a recent common ancestor could explain their findings, but none of these holds up as well, they say. Nonetheless, researchers need to do more work on the rate of ZFY variation among nonhuman primates, Pääbo notes.

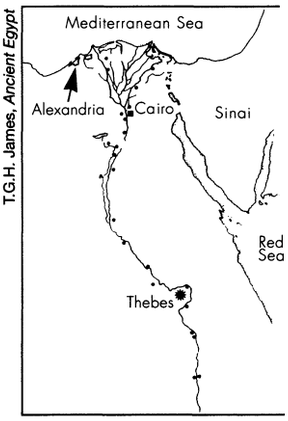
— T. Adler

Ancient Egyptian tomb held royal sons

Ramses II, one of ancient Egypt's most powerful rulers, continues to wield his influence from beneath the desert sands he once trod. An archaeological team announced last week its discovery of the largest and most complex tomb known in Egypt's Valley of the Kings. Ramses II (or Ramesses II, according to some researchers) apparently built this sprawling set of at least 67 chambers as a mausoleum for many of his 52 sons.

Further excavation and study of the massive burial site will shed light on the chronology, artwork, and royal family life during a critical period in Egypt's history, the 67 years from 1279 B.C. to 1212 B.C. when Ramses II was pharaoh. Ramses II is traditionally thought to have reigned at the time of the Israelites' exodus from Egypt.

"We've found a new type of tomb from ancient Egypt, a family mausoleum," Kent R. Weeks told SCIENCE NEWS. "This is the first major discovery in the Valley of the Kings since 1922, when Tutankhamen's tomb was found." Weeks, an archaeologist at the American University in Cairo, directs the ongoing excavation.



T.G.H. James, *Ancient Egypt*

Star denotes the Valley of the Kings.

Nearly all pharaohs from 1550 B.C. to 1070 B.C. were buried in the Valley of the Kings, located about 300 miles south of Cairo on the western side of the Nile River.

An English traveler first exposed the entry area to the new find in 1820, after digging through flood debris that clogged the passage. English archaeologist Howard Carter reopened the tomb about 100 years later but soon abandoned the site and heaped dirt from the excavation of Tut's tomb on top of it.

Weeks' team knew from a previously found piece of ancient papyrus scroll

Weeks

Main corridor of the new Egyptian tomb and statue of the god Osiris.

that a captured thief had tried in 1150 B.C. to rob the tomb of Ramses II and an adjacent burial, which they assumed was the site covered over by Carter.

They established the location of the tomb's entrance in 1988 and have conducted annual fieldwork since then. Last February, Weeks and his coworkers finished clearing debris from the entry area and two chambers just beyond it. Beyond the back door of the second chamber lay dozens of rooms along three corridors arrayed in a T shape.

Stairs and sloping passages at the end of two corridors apparently lead to rooms on a lower level, probably the actual burial chambers, Weeks says.

The team has identified the names of four sons of Ramses II, including his first-born son, on walls or artifacts in the tomb. Objects found so far include pottery, inscribed stone vessels, pieces of wooden furniture, statue and stone-coffin fragments, offerings of cooked meats, and pieces of mummified human bodies.

Rooms on the mausoleum's upper level may have served as chapels where priests performed rituals for the dead, Weeks says. More than a dozen walls in these chambers display painted scenes of Ramses II presenting various of his sons to Egyptian gods and goddesses, accompanied by written descriptions of the scene and religious texts.

Burials probably occurred on the lower, still unexplored level, Weeks asserts. Ancient grave robbers probably dragged bodies out of the tomb, he says, and left behind the mummified pieces found on the upper level.

Investigators assume that as many as 50 of Ramses II's sons were buried in the tomb; separate graves for two of his sons have already been found.

The date of the mausoleum's construction remains unknown, although Weeks suspects it occurred late in Ramses II's reign. Curiously, artistic styles in the tomb resemble those from his early years of power, Weeks says.

Researchers have noted that Ramses II mentioned his more than 100 children in numerous pieces of art and inscriptions. Other pharaohs left records mainly of their first-born sons and built much smaller tombs than the one authorized by Ramses II.

"Ramses II was a unique Egyptian king in that he had so many sons and daughters and was so devoted to them," says Abdel Halim Nour ed-Din, head of Egypt's Supreme Council for Antiquities in Cairo. "But the size of this new tomb still surprises me."

Work at the site will resume in July. Further excavations may take 6 years or more, Weeks says. "This tomb is so weird, all bets are off on what or who we'll end up finding," he remarks. — *B. Bower*

Taking chlorine out of tough pollutants

The crisp white paper that readers and writers enjoy bears more than a monetary price. The unseen cost comes in the form of pollution, since many of the chemicals generated in paper manufacturing resist natural degradation and instead tend to linger, unwanted, in the environment.

In the process of bleaching wood pulp to press out pearly reams, paper mills may create up to 250 different types of chlorinated contaminants (SN: 5/12/90, p.303). The most tenacious include a class of halogenated aromatic compounds called trichlorophenols (TCPs). At the heart of a TCP molecule lies a tightly bound ring of atoms that includes three chlorines.

The structure of TCPs allows them to stand up to nature's degradative forces, presenting soil-borne microorganisms with an indigestible meal. Their resistance to decomposition causes trouble for the paper industry, which must safely dispose of the long-lasting waste.

Offering a potential solution to this problem, chemists Alexander Sorokin and Bernard Meunier at the National Scientific Research Center (CNRS) in Toulouse Cedex, France, and Jean-Louis Séris of GRL-Biotechnology in Artix describe a new type of catalytic system for breaking up TCPs.

Using hydrogen peroxide, a relatively safe and environmentally benign agent, coupled with a readily available iron-based catalyst, the new system oxidizes TCP molecules by breaking open the chlorinated rings at their cores. The chemical compounds resulting from the reaction can then undergo natural degradation, the team reports in the May 26 SCIENCE.

"Many of these pollutants can be converted into less dangerous organic products and can be eventually degraded by different microorganisms," the researchers point out. "Systems that can remove halogen substitutents from [TCPs] may produce compounds that can be more easily biodegraded.

"In this case," they add, "the use of chemical catalysts to convert recalcitrant pollutants to more degradable molecules by microorganisms would be beneficial."

The iron-based catalyst crucial to the new dechlorination technique bears the unwieldy name 2,9,16,23-tetrasulfophthalocyanine. Its power lies in its ability to "cleave" the aromatic chlorine-containing rings of the otherwise impenetrable TCPs, Meunier says.

Upon mixing the difficult-to-destroy trichlorophenols with hydrogen peroxide, then adding the iron-containing catalyst, the chemists found that the chlorine atoms freed by TCP breakup linked with other molecules to form four relatively benign products.

Moreover, they found that it took only a little catalyst to trigger the desired reactions. And the process goes speedily: In several tests of the catalytic system, the chemists converted all of the toxic compounds into tolerable ones in less than 5 minutes, they report.

This system offers several potential advantages to industry, Meunier says. Both hydrogen peroxide and the catalyst are relatively "clean," easy to make, and inexpensive.

"The chemical industry has been worrying about the accumulation of these compounds that don't break down," he says. "But if you make them biodegradable, then microorganisms will take care of them."

"This catalytic process is quite general," Meunier adds. "You could use it to treat many chemicals. We use trichlorophenol mainly to show that the method works."

The new technique could prove useful for processing contaminants at toxic waste sites, the researchers say. "Now we have to try other molecules and demonstrate that the system works on a large scale."

"We've had a good start," observes Meunier, who adds that he and his colleagues are exploring potential applications with industry. — *R. Lipkin*