Astronomy

An ocean for Callisto?

Of the four large moons of Jupiter, Callisto lies farthest from its mother planet and has always been regarded as the least interesting—a geologically dead chunk of ice and rock. New evidence from the Galileo spacecraft hints that, like its sister satellite Europa, Callisto may harbor an ocean beneath its icy crust.

During two recent passes by Callisto, Galileo found that the moon modified Jupiter's magnetic field by different amounts. The measurements suggest that Callisto does not possess a fixed magnetic field of its own. Instead, the Jovian field seems to induce a magnetic field within the moon, says Margaret G. Kivelson of the University of California, Los Angeles.

As Callisto orbits Jupiter, it moves through a Jovian magnetic field of varying intensity and direction. According to Kivelson, those variations set up electric currents within Callisto, which in turn generate a magnetic field. The currents could only be produced if Callisto possesses an electrically conducting medium, such as salt water, she notes.

To generate an appreciable field at Callisto's surface, the salt water can't be buried too deeply. Gravity maps of Callisto suggest that its icy shell is about 100 kilometers thick. If a layer of water lies within that shell and is as salty as the oceans on Earth, it would need to be 10 to 20 km deep, Kivelson says. She and her colleagues, including Krishan K. Khurana of UCLA, describe their findings in the Oct. 22 NATURE.

"We haven't proven that Callisto contains water, but now everything hangs together," says Kivelson.

Researchers had proposed such a model to explain magnetic measurements recorded near Europa (SN: 8/9/97, p. 90). Both the appearance of Europa's surface, scored with cracks and wedges, and its abundance of salt compounds suggest that it harbors a layer of salt water or slushy ice that seeps up from below. A gravitational tug-of-war between Europa, Jupiter, and two inner moons flexes Europa's surface and could generate enough heat to melt ice beneath its surface.

Callisto lies too far from Jupiter to experience the same type of heating. The heat could come instead from the slow release of energy from radioactive isotopes that helped form the moon, says Thomas B. McCord of the University of Hawaii in Honolulu. He also notes that carbon dioxide found on Callisto's surface could have bubbled up from a watery layer below.

Even if Callisto has an ocean, it probably lacks enough organic compounds for life, Kivelson says. *—R.C.*

A new, distant galaxy

Last spring, SCIENCE NEWS reported that astronomers had found the most distant known object in the universe—a galaxy some 12.2 billion light-years from Earth (SN: 5/2/98, p. 280). The team has now bested their own record. Their newly discovered galaxy lies 20 million light-years farther away, in the constellation Aquarius, says Richard G. McMahon of the University of Cambridge in England. Observed in August with the Keck II Telescope atop Hawaii's Mauna Kea, the galaxy is making stars at a rate equivalent to 10 suns per year. The light reaching Earth is from a time when the cosmos was only about 7 percent its current age.

In an expanding universe, the more distant the object, the more its light is shifted to longer, or redder, wavelengths. The newly found galaxy has a redshift of 5.74, meaning that its light observed at Earth is shifted by 5.74 times the original wavelength. The previous record holder had a redshift of 5.64.

"The galaxy is beautiful because it's very bright, and that makes it much easier to [measure its distance]," says Lennox L. Cowie of the University of Hawaii in Honolulu, who found the galaxy with McMahon and Esther M. Hu of Hawaii. "This makes it much more useful for all sorts of follow-up studies." Cowie reported the find at an annual October astrophysics meeting at the University of Maryland in College Park. *—R.C.*

Behavior

Monkey see, monkey count

Rhesus monkeys may not perform advanced calculus or even basic division, but a new study suggests that they can distinguish between varying numbers of items, from one to nine, and correctly order them from the smallest to the largest.

These results offer the strongest evidence to date that nonhuman primates wield numerical knowledge, say psychologist Herbert S. Terrace and psychology graduate student Elizabeth M. Brannon, both of Columbia University.

Since the monkeys make no obvious attempts to count on their fingers and maintain a humble silence in the face of researchers' questions, it remains difficult to pin down the mental tactics they use in determining that, for example, five diamonds represent a lesser quantity than six rectangles.

The animals apparently have learned some type of numerical rule for ordering amounts from one to nine, Brannon theorizes. "We don't have direct evidence yet, but it seems likely that these monkeys, and other nonhuman primates, can count," she says.

Terrace and Brannon presented two male rhesus monkeys with a series of 35 displays, each consisting of four images, on a touch-sensitive computer screen. Each image portrayed a different object in numbers ranging from one to four. Images were arranged randomly, from left to right. They might show, for example, two bananas, one triangle, four apples, and three hearts.

The size, surface area, shape, and color of objects were also changed randomly from one display to the next.

The monkeys rapidly learned to touch pictures in ascending numerical order when they received food pellets for correct answers. After errors, the screen turned blank, and a few seconds later, a new set of pictures appeared.

A subsequent series of displays presented arrays of four different objects shown in quantities ranging from five to nine. The monkeys ordered these novel amounts as accurately as they had learned to order the smaller numbers of items, the investigators report in the Oct. 23 SCIENCE. In a final trial, the rhesus duo usually distinguished smaller from larger amounts, ranging from one to nine, in pairs of images.

The Columbia scientists' findings bolster the view that people and many other animals possess a nonverbal brain system for reasoning about small quantities (SN: 7/11/98, p. 27). *—B.B.*

Glial deal in mood disorders

People who suffer from either major depression or manic depression and who also have family members with these mood disturbances display strikingly low numbers of glial cells—but not neurons—in a brain area implicated in emotional behavior and stress responses, a new study suggests.

Glia affect biological processes that aid neurons in this region, located just behind the eyes. Glial losses play a role in the emergence or expression of mood disorders that run in families, propose neurobiologist Dost Öngür of Washington University in St. Louis and his coworkers.

The scientists conducted microscopic analyses of a total of 73 brain specimens from human cadavers, representing nearly equal numbers of people with major depression, manic depression (also known as bipolar disorder), schizophrenia, or no history of psychiatric ailments. In the brain area called the subgenual prefrontal cortex, unusually low numbers of glia characterized those who had been diagnosed with one of the two mood disorders and who had at least one close relative with either of these conditions, the researchers report in the Oct. 27 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Psychiatric drug use didn't seem to have caused the glial losses. Participants who were the only members of their families with major depression or manic depression had taken the same medications as those who had familial mood disorders but who displayed no comparable glial reductions, the investigators say. *—B.B.*