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THIS WEEK

RESEARCH NOTES

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DEPARTMENTS

COVER: Computers and calculators sometimes produce wrong answers because of flaws in the way they handle arithmetic. The Intel 8087 integrated-circuit chip shown is the first to implement a new proposed standard for microprocessor arithmetic that reduces the likelihood of such errors appearing. See p. 72. (Photo courtesy of Intel)

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LETTERS

Uranian reflections

I was pleased to read the recent SCIENCE NEWS article describing the preliminary results of measurements of the diameters and albedos of the Uranian satellites made by myself, Dale Cruikshank and David Morrison (SN: 6/19/82, p.404). Now that there has been time to reflect on our findings, we wish to expand upon some of the ideas in Jonathan Eberhart's excellent article.

We have recently arrived at our best values for the diameters of the Uranian satellites; Ariel's diameter is 1330 ± 130 km, Umbriel's is 1110 ± 100 km, Titania's is 1600 ± 120 km and Oberon's is 1630 ± 140 km. These values are slightly smaller than the ones reported to Jonathan Eberhart during a telephone interview with David Morrison, and result from the recent discovery by myself and Jay Goguen that the Uranian satellites have a very pronounced, non-linear, brightness increase as they approach full phase. The satellites of Uranus have phases vaguely similar to those of the moon, except that the great distance of the Uranian system from earth (2.6 billion km) causes the satellites to be seen always near full phase. As the Uranian satellites move from minimum phase to maximum phase as seen from earth, their visual and near-infrared brightnesses increase by as much as 75 percent; that is to say that the albedos (reflectivities) of the Uranian satellites change with viewing geometry. Therefore, the albedos one would measure at full phase can be as much as 75 percent higher than those measured at minimum phase. For that reason, the albedos reported earlier in SCIENCE NEWS apply only when the Uranian satellites are very near full phase.

A more representative set of albedos, those seen at somewhat less than full phase, are 0.30 ± 0.06 for Ariel, 0.19 ± 0.04 for Umbriel, 0.23 ± 0.04 for Titania and 0.18 ± 0.04 for Oberon. The albedos of Oberon, Titania and Umbriel are similar to that of Jupiter's satellite Callisto (0.17), the darkest of the Galilean satellites, and the albedo of Ariel is similar to that of Saturn's Hyperion (0.28), seen in the Voyager images to be a small, reddish, and irregularly shaped body. Pioneering work on the Uranian satellites by Dale Cruikshank has shown that the major constituent of the surfaces of the Uranian satellites is water ice. The new diameter and albedo measurements, combined with recent spectrophotometric observations by myself and Dale Cruikshank, suggest that there is significant contamination by darker material of the water ice on the satellite surfaces. Just what the dark material might be is the subject of part of my Ph.D. dissertation and I hope to be able to shed some light on the question in the near future.

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Opposable thumb evolution

I have found interesting the reports concerning *Cantius trigonodus* and the discovery that it had opposable thumbs on its rear feet (SN: 6/5/82, p.372).

Although the reports have emphasized that the thumbs were a major advantage to the animal in climbing, I am puzzled by that claim. It seems to me that in attempting to climb a tree whose trunk is larger than the grasp of such a foot, the adaptation becomes a liability. *Cantius trigonodus* would have been at an advantage only when climbing small trees or when in the upper branches of a large one.

It also seems odd to me that the rear feet should have evolved the ability to grasp first rather than the front. When climbing vertically the rear feet are forced against their support by the moment about the front feet caused by the animal's weight. In this position it is the front feet which must resist a force tending to pull them away from their support, so it is the front feet I would have expected to most benefit from the ability to grasp, at least in vertical climbing.

Further, the most unique climbing advantage afforded by an opposable thumb is the enhanced ability to hang from a branch. With its binocular vision and opposable thumbs on its front feet, *Cantius trigonodus* would have been able to swing from branch-to-branch like a monkey, and completely outclassed any predator in tree-top acrobatics. Such antics using its rear feet seem implausible.

I suspect the opposable thumbs of *Cantius trigonodus* evolved for other reasons than eluding pursuit. Two possible explanations come to mind. One, the animal may have developed a habit of hanging from a branch by its rear feet to gather and feed on fruit dangling below. This would not be beyond the ability of a clawed rear foot (witness a squirrel raiding a bird feeder), but the grasping rear foot would probably have afforded a competitive advantage.

Two, it is possible that *Cantius trigonodus* may have developed fighting behaviors, either for self-defense or competition. Fighting in the tree-tops requires sure-footing. I can see *Cantius* adopting an erect fighting stance, rear feet firmly locked around its support, clawed front feet and fanged jaws free to dodge and strike with agility denied its predators. *Cantius* would have been in an admirable position, able to outfight most predators, and able to outclimb those simply too big for it. A troop of these animals could have been simply too daunting for even a bold and hungry predator to attack. The danger of being out-flanked and attacked both front and rear by creatures more agile than itself would probably have been too great. This would have been an admirable means for *Cantius* to reduce predation pressure allowing it the luxury of the long nurturing period characteristic of primates.

And it may not be inconsequential that these most distant ancestors of ours, because of their opposable thumbs, could have been aggressive, territorial and cooperative in their own defense.

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