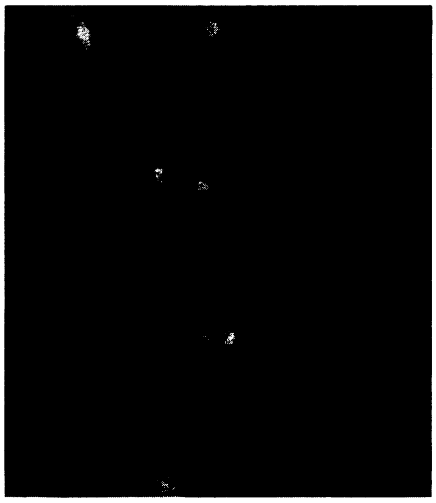
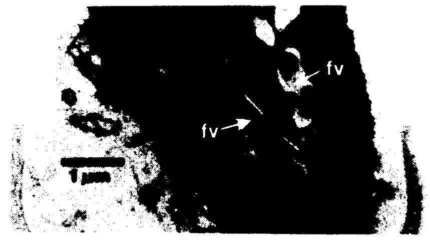
Lake algae dine on bacteria



Algal cells in branched lorica ingest fluorescent beads (brightest spots). The silhouette of the *Dinobryon* cells (medium-bright areas) is due to the fluorescence of chlorophyll.



Satiated alga: Several bacteria (b) are visible in food vacuoles (fv, light areas) of a Dinobryon.

Photos: Bird et al./SCIENCE

Sunlight has long been considered the major, if not sole, energy source for algae as for most other plants. But now scientists report that some common species of lake algae graze on bacteria as well. This finding adds a kink and another link to the aquatic food chain.

"It's the same sort of idea as the Venus's-flytrap," says David F. Bird of McGill University in Montreal. A clean, clear lake is low in nutrients, as is the boggy environment where most carnivorous plants grow. To supplement their photosynthetic production, the plants ingest other organisms. In the dim depths of the lake, algae obtain at least half their total carbon from ingested bacteria, rather than from photosynthesis, Bird and his colleague Jacob Kalff report.

In Lac Cromwell in Quebec, four species of the alga genus *Dinobryon* were found to be major consumers of bacteria. To demonstrate this appetite, the scientists mixed the algae with fluorescent latex beads just the size of bacteria. The algae ingested the beads, which are easy for the scientists to track, only a little less readily than they ingested bacteria.

Under their natural conditions, the algae each consume an average of 36 bacteria every hour, the scientists calculate. "This is equivalent to an individual *Dinobryon* removing bacteria [daily] from a volume equal to 1,500,000 times its cell volume and ingesting almost 30 percent of its weight in bacteria per day," Bird and Kalff say in the Jan. 31 SCIENCE. Algae of two species of another genus, *Uroglena,* also ingest bacteria, but at only about one-sixth that rate.

How do the relatively immobile *Dinobryon* scour the water for bacteria? Individual algal cells share a branching fibrous casing called a lorica. They use their flagella, which extend through the top of the lorica, to force water inside the casing. With its membrane, a cell then engulfs a passing bacterium. Using electron micrographs, the scientists have viewed bacteria entrapped in food vacuoles within algal cells.

"Our results show that [algal ingestion of bacteria] is quantitatively important in nature," Bird and Kalff say. Because large numbers of *Dinobryon* populate eastern North American lakes, averaging 150,000 to 650,000 cells per liter, they remove more bacteria from the water than do the crustacean, rotifer and ciliate communities combined — the animals long known to eat bacteria. Bird says the algal grazing rates are similar to those measured for marine microflagellates, abundant nonphotosynthetic microorganisms recently recognized as important in consuming algae.

"The algae and microflagellates provide a way of returning plant nutrients captured by bacteria back into plants and animals," Bird says. A conventional food chain would have plants manufacturing food photosynthetically; animals consuming both plants and bacteria; and bacteria living off both plants and animals. But the bacteria-eating algae and microflagellates, which are eaten by microscopic animals, some of which also eat bacteria, may be considered a new link in the food chain, and they introduce a new kink. — *J. A. Miller*

Wyoming fossils shake up views of early primate migration

Teeth and jaw fragments belonging to what may be the oldest known ancestor of modern primates, which include monkeys, apes and humans, have been uncovered in northwestern Wyoming, according to paleontologist Philip Gingerich of the University of Michigan in Ann Arbor. The discovery, he says, suggests that early primates migrated from Africa to Asia, then on to North America and finally to Europe.

Prior to this find, scientists assumed that while early primates originated in Africa, they came to North America via Europe.

The 53-million-year-old fossils combine features of two major primate groups from the Eocene epoch, which lasted from about 53 million to 37 million years ago. One type had shorter, broader teeth similar to those of modern tarsiers; the other had longer, narrower teeth similar to those of modern lemurs. But the remains lean more toward the lemur pattern, reports Gingerich in the Jan. 23 NATURE. He says the specimen represents the earliest known species of *Cantius,* a line of squirrel-sized primates that are extinct.

More complete remains of a 50-million-year-old species of *Cantius* indicate the creature had developed a grasping toe and forward vision, characteristics that cannot be identified with dental remains (SN: 6/5/82, p. 372).

Although the new find includes only teeth and pieces of jaw, the fossils are older than European *Cantius* remains, says Gingerich. Other animals represented at the Wyoming site, such as the "dawn horse" *Hyracotherium,* are smaller and more primitive than the same animals associated with European *Cantius* specimens, he adds.

"Based on present evidence," explains Gingerich, "it seems that the oldest ancestors of modern primates that have been found in Europe reached that continent by dispersal through North America."

Remains of early "true" primates have not been uncovered in Africa, he notes, because much of that continent's fossil deposits from around 50 million years ago have eroded and washed away. But there are several signs that modern primates originated in Africa, says Gingerich, such as the presence of lemurs on Madagascar today and the discovery last year of the jaw of a 33-million-year-old ancestor of the modern Asian tarsier in Egypt.

Gingerich speculates that early primates migrated from Africa to Asia and across the Bering Strait to North America. They then may have traveled to Europe over a land bridge that spans what is now the north Atlantic Ocean.

The new North American primate was discovered last summer by one of Gingerich's graduate students, Victor Torres. Gingerich dubbed the species *Cantius torresi* in honor of his student.

Other fossils at the deposit show that *C. torresi* lived in a subtropical forest that also contained primitive horses, early carnivores and alligators.

— *B. Bower*