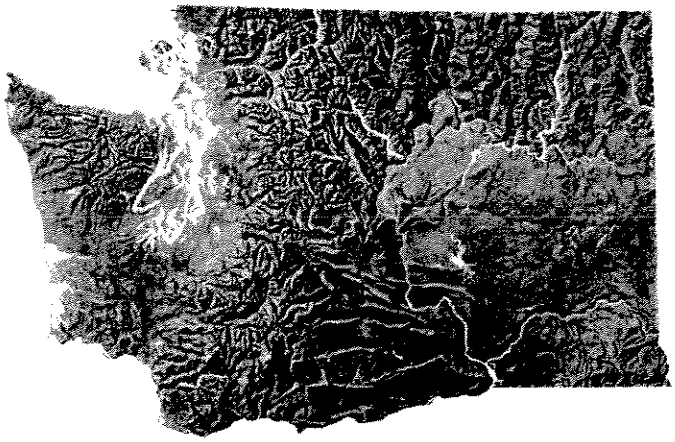

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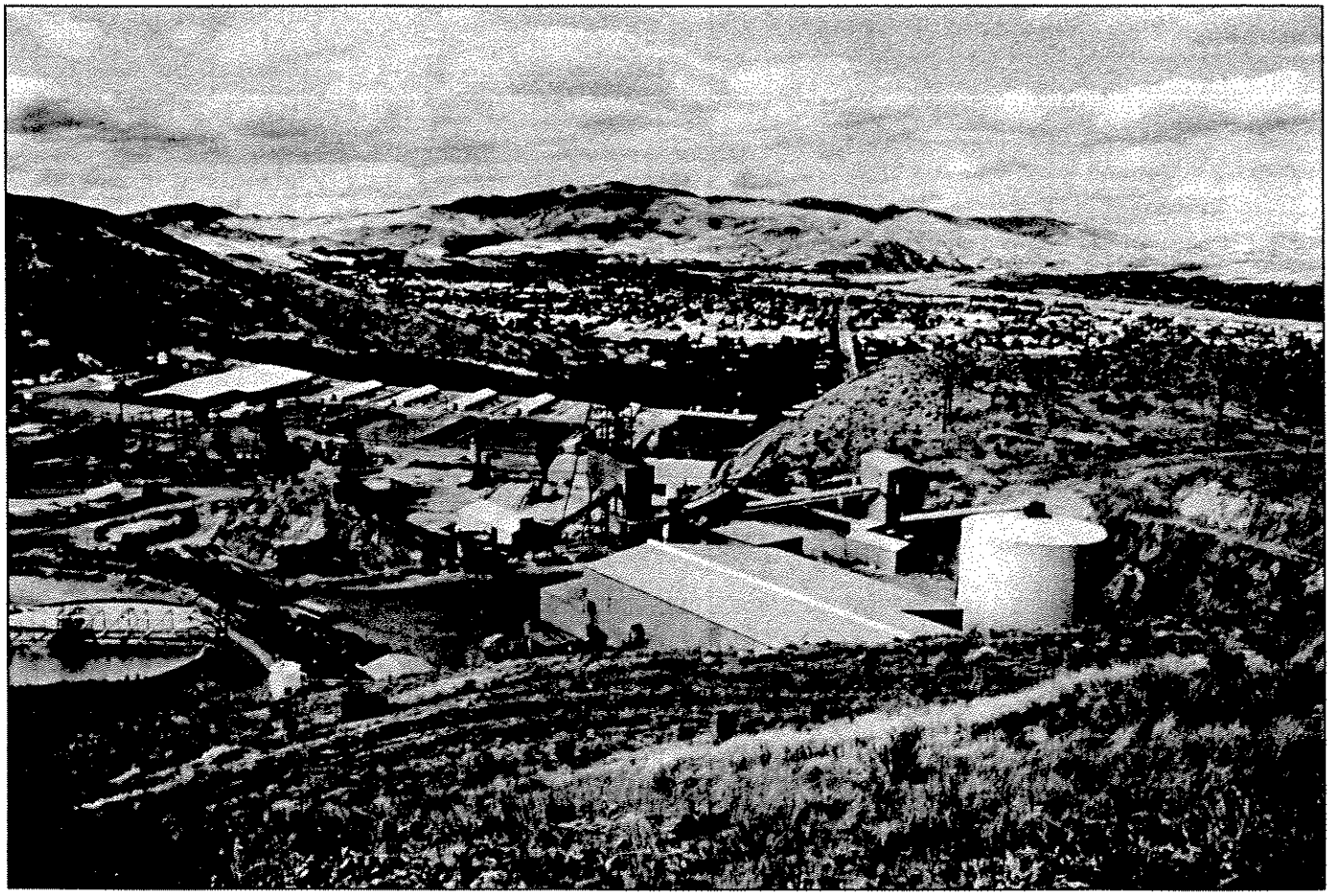

The Cannon mine surface plant at the edge of the city of Wenatchee. Ore is hoisted to the surface from the shaft (center of photo) and is processed in the mill (lower right). The mine has been the largest gold producer in Washington for the past few years, as well as one of the largest underground gold mines in the United States. Production decreased in 1992 due to dwindling ore reserves. If no new reserves are identified, the mine is expected to close in about 2 years.

# Fossil Mayflies from Republic, Washington

by

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Paleontologists continue to find "firsts" among the fossils at Republic. Collections made over the last 15 years have yielded the first representatives of the mayfly family Heptageniidae found in North America. These fossils are also the first Eocene mayflies to be recorded in North America since Scudder's finds of Ephemeridae (identification now questioned) more than century ago in the Eocene Green River Formation of Wyoming (Scudder, 1890). The four Washington specimens are impressions of three nymphs and a partial forewing. The fossils, from three sites in Republic (Fig. 1), were found in the lacustrine beds in the lower part of the Klondike Mountain Formation.

The order Ephemeroptera has a long history. It is known from the Carboniferous (Kulakova-Peck, 1985), the Permian (Hubbard and Kulakova-Peck, 1980), the Jurassic in Europe (Demoulin, 1970) and Asia (Sinitshenkova, 1985; Demoulin, 1954), lower Cretaceous rocks in the southern hemisphere (Grimaldi, 1990; McCafferty, 1990; Jell and Duncan, 1986), and in Eocene strata in Argentina (Rossi de Garcia, 1983), as well as in European amber (upper Eocene – Klyuge, 1986; Oligocene – Demoulin, 1974). The oldest mayfly in North America is a nymph in the Paleocene Paskapoo Formation of Alberta (Mitchell and Wighton, 1979, table 1). Mayflies have also been found in younger Tertiary deposits in North America: in the Oligocene beds in the Ruby River basin of southwestern Montana (Lewis, 1977a and b, 1989; Lewis and Swanson, 1992), and the upper Eocene or lower Oligocene Florissant beds of Colorado (Cockerell, 1923). They have also been recovered from numerous younger deposits on other continents.

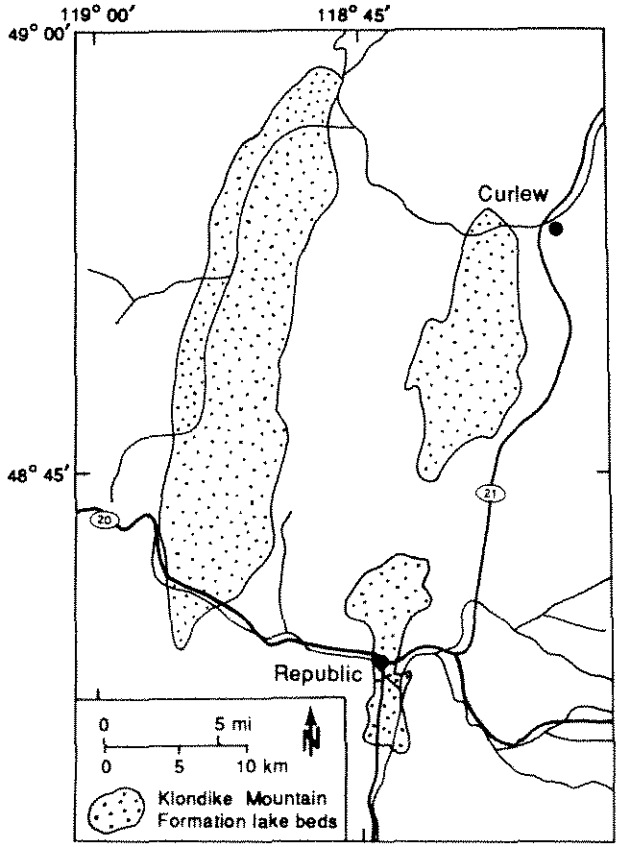


**Figure 1.** Location of Republic, Washington, and outcrops of middle Eocene lakebeds (modified from Wolfe and Wehr, 1987).

Today, there are about 190 genera and more than 2,000 species worldwide, and they are found on every landmass except Antarctica (Campbell, 1990). They inhabit both running water and ponds and lakes. More mayfly species live in warm or tropical areas than at high altitudes or in cold regions.

As the name of the order implies, winged mayflies live for a short time, about a day or long enough to mate in flight and lay eggs. Mature mayflies are normally found over water, usually in mating swarms. The swarms most often consist of males; females enter the swarm to locate a mate. Some species lay their eggs on the water surface, others lay eggs under water on logs, stones, or mud. The eggs of most mayflies hatch as nymphs within 10 to 20 days.

The pace of egg hatching is determined by water temperature. The aquatic nymphs may burrow into bottom sediments, attach themselves to rocks or logs, or cling to aquatic plants in fast-moving streams. Nymphs possess gills, and they molt several times (as many as 30 times in some species). Most nymphs mature in standing water as in a pond, but their survival depends on the water not drying up. The process of becoming an adult may take a year or more. The nymphs feed on algae, which are more abundant in warm waters, and other plant and animal microorganisms. Mayfly nymphs make up a large part of the freshwater fish diet.

Mayflies are unique in molting in their adult stage. After the mayfly nymph rises to the surface and molts, the winged form (subimago) flies a short distance to shore and lights on vegetation. These forms generally have dull colors and are covered with fine, short hairs. The next day the subimago molts to the last form, the imago. Imagoes are smooth and shiny, and they have a longer tail and longer legs than the subimago.

These mayfly fossils are significant for insect evolution, but they also may help us investigate the aquatic environment of the area at about 49 million years ago. We know from the flora that the climate at Republic was like that of the modern southern coastal area of Oregon (Wolfe and Wehr, 1991), with an annual mean temperature of about 10°C and an annual range of about 10°C. Since mayflies swarm and mate only in the warm months, the bed that contained the forewing must have been deposited at that time of year, probably summer. The nymph stages, however, could have been washed into the lake at other times.

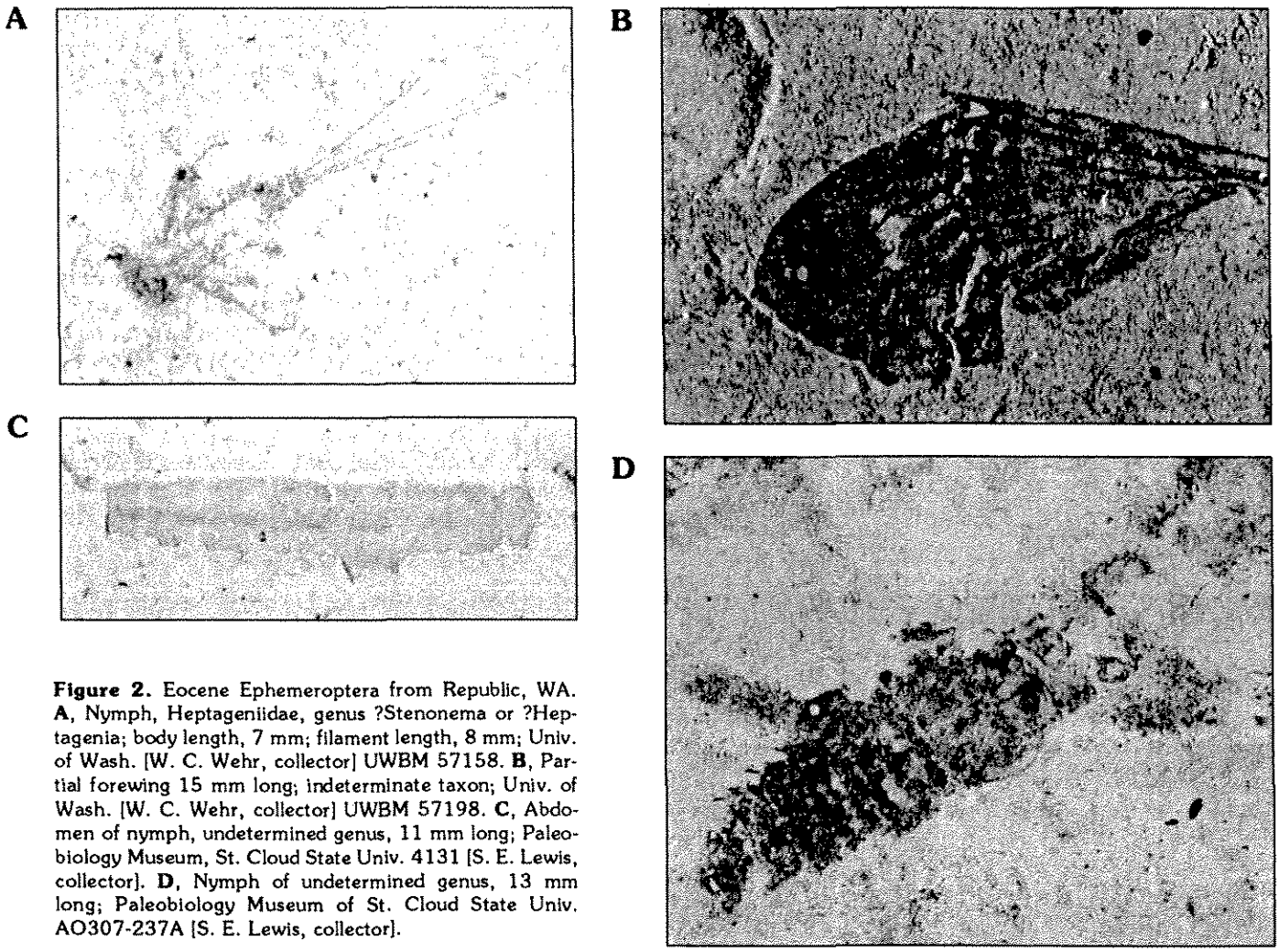


**Figure 2.** Eocene Ephemeroptera from Republic, WA. **A**, Nymph, Heptageniidae, genus ?Stenonema or ?Heptagenia; body length, 7 mm; filament length, 8 mm; Univ. of Wash. [W. C. Wehr, collector] UWBM 57158. **B**, Partial forewing 15 mm long; indeterminate taxon; Univ. of Wash. [W. C. Wehr, collector] UWBM 57198. **C**, Abdomen of nymph, undetermined genus, 11 mm long; Paleobiology Museum, St. Cloud State Univ. 4131 [S. E. Lewis, collector]. **D**, Nymph of undetermined genus, 13 mm long; Paleobiology Museum of St. Cloud State Univ. AO307-237A [S. E. Lewis, collector].

Some municipalities monitor mayfly populations as indicators of water quality because the sedentary burrowing nymphs cannot tolerate toxic materials or poorly oxygenated water (Fremling and Johnson, 1990). If we can assume Eocene mayflies of these taxa had similar tolerances, we can speculate about water chemistry where the nymphs were growing.

The four Republic specimens are illustrated in Figure 2. The remarkable preservation of these fragile insects underlines the importance of collections from the Klondike Mountain Formation as windows onto Eocene life.

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*Note: Fossils are a nonrenewable resource. Searching for fossils in Republic is permitted Tuesday through Saturday, 10:00 A.M. to 5:00 P.M., after May 1. Please register with the Stonerose Interpretive Center (next to the city park) before digging, and be sure to bring your specimens to the center. If you find a particularly fine or new fossil form, the center will ask you to leave it with them to assist scientists with their on-going research. Please do not dig in areas other than those open to the public.* ■

# Geomedia Computer System by USGS Teaches Children about Earth Science

A multimedia, interactive computer system called GeoMedia, designed to teach children (grades 4 to 6) about complex earth science processes, has been developed by the U.S. Geological Survey.

"The USGS is distributing GeoMedia digital compact disks to teachers who are willing to experiment with this new technology in the classroom," said Denise Wiltshire, chief of the project and a technical information specialist at the USGS National Center in Reston, VA.

"GeoMedia CD-ROMs contain a mix of information on earthquakes, the hydrologic cycle, topographic maps, and other earth science subjects," Wiltshire said. "Unlike traditional text books on these subjects, GeoMedia is in an interactive computerized format that allows children to plot their own personal path through the scientific information.

"The GeoMedia digital compact disk contains a wealth of facts on earth science topics, which are linked together to promote learning at the individual pace of each reader," Wiltshire said.

"For example, students may chose to learn about the forces that create earthquakes by viewing an animated sequence of images. In addition to animation, GeoMedia includes an audible narration to explain scientific concepts. The written descriptions also provide students with the opportunity to review glossary terms for unfamiliar vocabulary words.

"GeoMedia opens the doors to communicating earth science to some children who may not respond to traditional teaching methods," Wiltshire added.

Payson Steven, president of InterNetwork, Inc., a design consulting firm that collaborated with the USGS on producing GeoMedia, said "Children are more apt to comprehend a concept by interacting with the information that sparks their curiosity. Browsing through the information is dynamic and also allows many levels of focus."

GeoMedia is one of several educational products available from the USGS as part of its program to help teachers inform pre-college students about how geology, hydrology, and other earth sciences affect them, their communities, the nation, and the world. Other recent products include a series of colorful posters on water resources and a booklet on helping children learn geography.

To obtain a copy of GeoMedia, write to: Project Chief, GeoMedia; U.S. Geological Survey; 801 National Center; Reston, VA 22092. The GeoMedia CD-ROM is available at no cost to teachers and libraries while the supply lasts. ■

**RI 30 WINS AWARD**

Report of Investigations 30, **Paleontology and stratigraphy of Eocene rocks at Pulali Point, Jefferson County, eastern Olympic Peninsula, Washington**, received an Award of Merit in the Technical Reports category of the 1992 Art, Online, and Publications Competition sponsored by the Puget Sound Chapter of the Society of Technical Communications.

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Chairman: Dr. Tom Casadevall,
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