exposure requires information that is not yet known in the scientific community: (i) the biological activity of short chrysotile fiber, (ii) the level of exposure to asbestos which is safe insofar as human cancers are concerned, if a safe level exists, and (iii) the biological activity of asbestiform silicates, not necessarily asbestos.

We urge that environmental analyses be made rapidly in areas where dusts may be anticipated from the use of quarried rock. Since public water supplies and crops may also be contaminated, they too should be monitored. In addition, a systematic inventory of quarry operations in the United States should be developed, with priority given to more heavily populated areas. Information should include the kind of rock worked, possible presence of asbestos, volume of production, types of uses, and levels of exposure.

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Meteorite Impact Crater Discovered in Central Alaska with Landsat Imagery

Abstract. *Several supporting observations indicate that Sithylemenkat Lake, Alaska, occupies a meteorite impact crater formed near the end of the Wisconsinan glaciation. The initial identification with Landsat imagery is attributed to the unique perspective provided by such imagery.*

Meteorite impact craters are important to geomorphology because they are produced by a process which occurs throughout the universe. The craters are unique on Earth, for they are created instantaneously. Most terrestrial landforms are slowly evolved by erosion or deposition from some preexisting situation. Therefore, meteorite impact craters provide a reference for local geologic chronologies and a representation of the intensity of geomorphic processes which have occurred since the time of impact.

A feature that appears to be an eroded meteorite impact crater has been discovered in central Alaska as a result of a systematic search for impact features of the entire state of Alaska using band 7 of available Landsat imagery. The crater is a bowl-shaped depression approximately 12.4 km across and 500 m deep. A lake about 3 km across occupies the center of the depression. The lake is named Sithylemenkat, which is a Koyukukian term for the "lake in the hills." Sithylemenkat Lake is located 90 km south of Bettles, Alaska, at latitude 66°07′N, and longitude 151°23′W, in the northern Ray Mountains.

The search was conducted by visually scanning complete orbital tracks of Landsat imagery that cross the state. One track from a single orbit was viewed at a time. The resolution of the imagery dictated that recognizable features would probably be greater than 1 km^2. The imagery was scanned for geologic features that might be indicative of impact events. The features included: (i) circular outlines of rock types, lakes, or structures, (ii) bowl-shaped depressions, with or without rims, and (iii) radial or concentric structures as evidence by geomorphic features such as valleys, ridges, or stream channels.

The major problem with locating and identifying a meteorite impact feature in Alaska is that there are numerous circular features of nonmeteorite impact origin. Periglacial lakes, volcanic vents, and the structural features of a tectonically active area are often represented by circular expressions. A circular feature was considered as a possible impact feature only if it is located in terrain unsuited for the formation of periglacial lakes and unlikely to contain volcanic vents.

In spite of these restraints, the search produced one feature which appears to be a meteorite impact crater. A circular lake in a depression located within the margins of a bedrock upland area can be seen on the Landsat imagery (Fig. 1). A system of radial features can also be observed. Because the rock-walled depression and the associated radial features are located in an area unlikely to contain volcanic vents, a closer investigation of the Sithylemenkat Lake area was warranted.

Sithylemenkat Lake is not accessible by surface vehicles except in deep winter when the ground is covered with snow, and observation conditions are limited by the arctic night. Because of this inaccessibility, aerial photographs and maps that covered the area were acquired from government sources. A search was also made for published reports about the area.

Stereo viewing of the aerial photography indicated that there were no features such as end moraines or ice-scoured bedrock knobs in the vicinity of the depression. The photographs did not reveal any nearby features which would indicate that glacial processes might have excavated the basin. Faults and fractures in the bedrock can be seen on the aerial photographs. The bedrock exposed in the walls of the depression has extremely serrated physical outlines and the exposures are crossed by numerous long notches. Because the outlines and notches show preferential alignment and form a definite pattern they indicate that the bedrock is intensely fractured. There is one set of fractures which is parallel to the regional structural trend of N45°E (*1*). A second set of fractures can be seen in the bedrock radiating in nearly all directions from the lake in the center of the depression. These radial fractures are not to be confused with the strings of alluvial material that are also radial to the lake and lie in a direction parallel to the slope of the walls. Also, a less obvious set of fractures is seen in the bedrock of the walls concentric to the lake. The radial and concentric fractures that can be seen on the aerial photographs are similar in pattern to those associated with

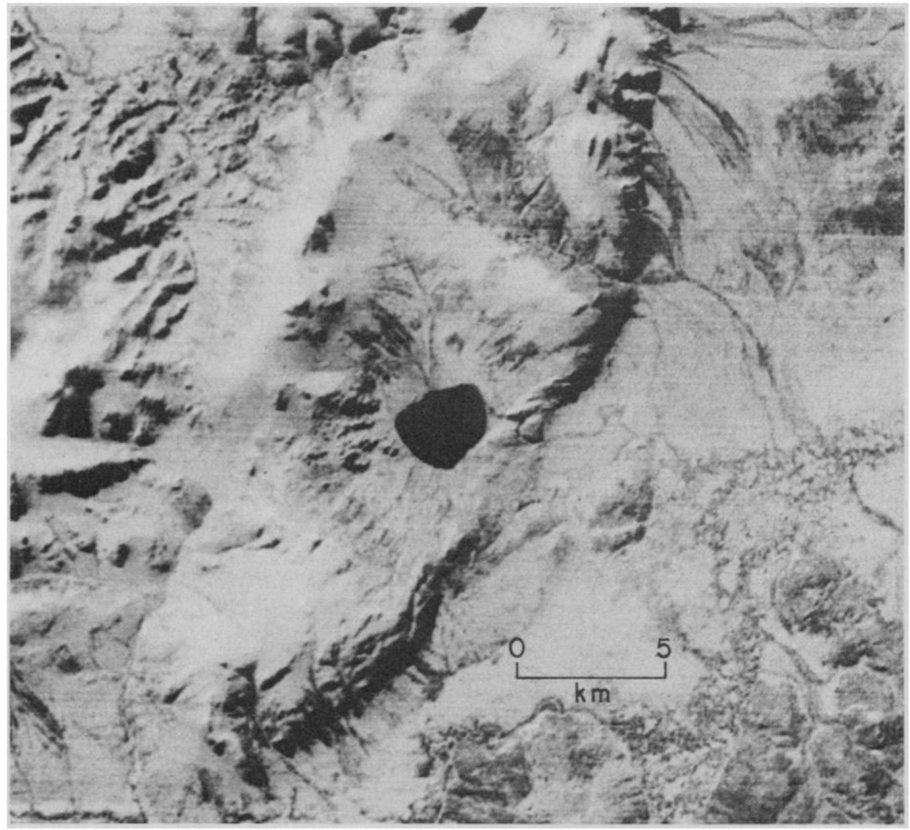

Fig. 1. Sithylemenkat Lake as seen on band 7 (spectral response of 0.8 to 1.1 μm) of Landsat frame 1072-21180. South is toward the upper left of the figure. This frame, taken on 3 October 1972, shows the radiating bedrock features of the walls.

such impact features as the Wells Creek Structure in Tennessee (*2*) or Meteor Crater, Arizona.

The original Sithylemenkat crater was probably about 10 km in diameter, but preferential erosion along mapped faults (*1*) has made the rim and diameter of the crater irregular. Meteor Crater, Arizona, has suffered a similar distortion of rim and diameter due to erosion along joints in the bedrock (*3*). I estimate that erosion of the walls of the Sithylemenkat crater has perhaps added 200 m of debris to the floor of the crater. This would give the original Sithylemenkat crater a depth of approximately 700 m.

Support for an impact origin for the depression comes from two previous mapping projects of the area. One of the mapping projects was a geologic and geochemical survey of the Sithylemenkat Lake area conducted by the State of Alaska (*4*). The survey was prompted by stream samples from the area which were anomalous in nickel, containing as much as 5000 parts per million (*4*, p. 1). This survey produced two major observations pertinent to this investigation. The first observation was that there are no glacial features of any sort (*4*, p. 3). Although Herreid (*4*) assumed that the basin was of glacial origin he indicated concern about the lack of glacial features. He also stated (*4*, p. 3) that the lack of glacial features indicated a pre-Wisconsin age for the assumed glaciation. This is a confusing statement because there are numerous glacial features in this part of the Ray Mountains of Wisconsin age (*5*). It appears to me that the lack of glacial features and the fact that the walls of the depression do not exhibit the subdued, smooth slopes common to the surrounding area indicate a late-Wisconsin or post-Wisconsin age for the crater. The second observation was that the high nickel concentrations occurred mainly in soil and float samples peripheral to the basin [figure 1 and table 4 in (*4*)], and no collaborating evidence could be found for the existence of a parent ore body for the nickel (*4*, p. 13). This second observation is important because a meteorite breaks up upon impact and the resulting fragments are distributed around the periphery of the crater (*3*). Impacting meteorites commonly contain substantial amounts of nickel, and this could explain the nickel anomalies and their distribution. However, the bedrock of the area consists of pre-Cenozoic granite, schist, and ultramafic rocks (*1*) which could comprise the source of the nickel.

The second mapping project was an aeromagnetic survey performed for the U.S. Geological Survey (*6*). This survey indicated that a substantial magnetic low is discretely associated with the depression. This supports a meteorite impact origin for the basin (*2*, *7*). The reason that a magnetic low could be associated with an impact crater comes from observations indicating intense fracturing of the bedrock immediately below the impact zone. The bedrock in this area is mainly composed of igneous and metamorphic rocks (*1*). It is possible that an intrusive feature located precisely below the lake could account for the magnetic low.

I made two low-altitude aerial-reconnaissance flights of the Sithylemenkat Lake area in August 1976. The aerial reconnaissance provided me with a realistic view of the terrain for morphological comparison with the previously visited meteorite impact features of Meteor Crater, Arizona, and the Howell Structure, Tennessee. The morphology of the depression as viewed from the air is consistent with that of an eroded meteorite impact feature. The low-altitude aerial-reconnaissance flights confirmed the presence of the fractures seen by stereo viewing of the aerial photographs. The low-altitude flights were extended over the surrounding region in order to compare the crater with the obvious glacial features of this part of the Ray Mountains. The morphology of the crater is unique to the region and bears no resemblance to the glacial valleys located in the region.

The Sithylemenkat crater is similar to the Lake Bosumtwi impact structure in Ghana. This depression is 10 km across and almost 500 m in depth (*8*). Hawkins (*9*) has calculated that the mass needed to create an impact feature 10 km in diameter would be somewhere near 50 million metric tons.

Such strong support as is presented in the preceding discussion for an impact origin to explain a suspected impact feature was unexpected. It is significant to note that the feature was initially located and identified through the exclusive use of Landsat imagery. Credit must be given to Landsat imagery because it provides useful contiguous coverage of large areas such as Alaska. The Landsat imagery also affords Alaskan scientists with an unique and important synoptic perspective which was previously unavailable.

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Pathogenic Amoebas from Brackish and Ocean Sediments, with a Description of *Acanthamoeba hatchetti*, n. sp.

Abstract. Acanthamoeba culbertsoni *was isolated from a sewage-spoil dump site near Ambrose Light, New York Bight. A second species,* Acanthamoeba hatchetti, *n. sp., was isolated from Brewerton Channel, Baltimore Harbor, Maryland. Both species killed laboratory mice after infection by the intranasal route.*

Small filose amoebas belonging to the family Acanthamoebidae Sawyer & Griffin, 1975 (*1*), have been studied extensively since the first species was discovered by Castellani in 1930. Culbertson *et al.* (*2*) found that at least one species of *Acanthamoeba* caused severe pathology and death in laboratory animals, and they clearly demonstrated the potentially pathogenic role of so-called free-living amoebas. Singh and Das (*3*) named the pathogenic species *Hartmannella culbertsoni* and, at the same time, described the pathogenicity of *Hartmannella rhysodes* in mice. Most investigators agree that the two species placed in the genus *Hartmannella* by Singh and Das (*3*) belong to the genus *Acanthamoeba* Volkonsky, 1931. Culbertson *et al.* (*4*) further reported than some less virulent strains of *Acanthamoeba* may produce chronic granulomatous responses of long duration in experimental animals. Subsequently, Jones *et al.* (*5*) described two cases of corneal ulceration in humans caused by *Acanthamoeba polyphaga* and one case of *Acanthamoeba* sp. uveitis, which resulted in the death of a patient. Nagington *et al.* (*6*) also described two cases of corneal involvement in England. Thus, *A. polyphaga*, and possibly other species of *Acanthamoeba* which do not cause death after nasal instillation into experimental animals, may be involved in chronic disease of the human eye. The ubiquitous distribution of *Acanthamoeba* in nature and the ability of certain species to survive and grow in oceanic seawater (*7, 8*) suggest that their role in diseases of humans and animals is just beginning to be understood and documented.

The study reported here concerns the isolation of *Acanthamoeba* from oceanic and brackish-water bottom sediments and the subsequent identification of two species that killed experimental mice after infection by the nasal route. Ocean sediment from a sewage-spoil dump site in the New York Bight apex near Ambrose Light was collected with a Smith-McIntyre grab, and additional samples were similarly taken from 50 stations which ranged from 10 to 90 miles offshore from Lewes, Delaware. Sediments from Baltimore Harbor were collected by scuba diving in the Brewerton and Craighead shipping channels. All sediment samples were placed in sterile plastic dishes and sealed with waterproof tape at the time of collection. Cultures were prepared by transferring small amounts of sediment on the tip of a bacteriological loop to the bottom of glass milk-dilution bottles previously coated on one surface with 8 ml of agar media streaked with *Aerobacter* (=*Klebsiella*) *aerogenes*. Culture media were made with 1 percent Bacto-agar containing 0.01 percent malt extract and 0.01 percent yeast extract dissolved in distilled water, brackish water [salinity, 5 parts per thousand (ppt)], or oceanic seawater (30 ppt). Initial cultures were prepared in bottles containing agar media prepared in low-salinity water (5 ppt) and incubated in an upright position at 40°C, as described by Griffin (*9*). When all experiments at 40°C were completed, a second series of cultures were prepared and incubated at room temperature (22° to 25°C) to test for amoebas which did not grow at the higher temperature. Pure cultures of amoebas were established by placing a single cyst of each isolate on agar medium and making subcultures at monthly intervals. Salinity tolerance by each strain was tested by maintaining cultures on media prepared with distilled water or with oceanic seawater of 30 ppt salinity. Mouse pathogenicity tests were conducted by inoculating approximately 10,000 amoebas intranasally into groups of white mice weighing either 10 to 12 g or 15 to 20 g (*10*). Mice were observed daily to record signs of disease and the day of death. Brain and lung tissues were taken from dead or dying mice for histological examination and for further culture studies on agar media. Living amoebas and cysts were measured with an ocular micrometer and photographed with phase contrast optics.

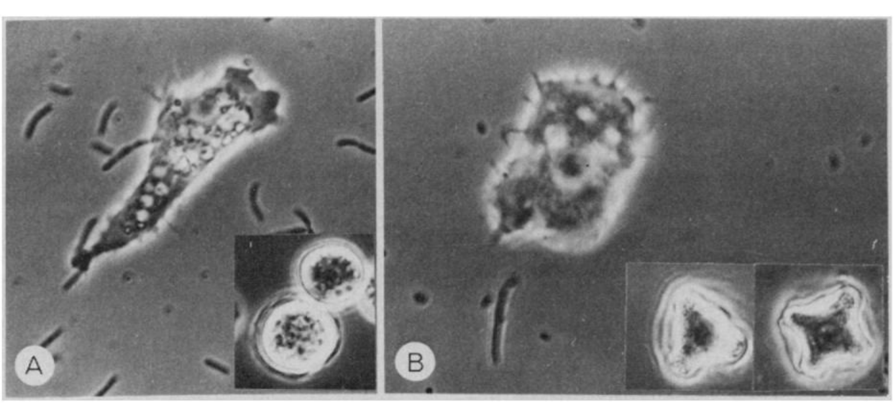

Fig. 1. Two species of *Acanthamoeba* that are pathogenic to white mice weighing 10 to 12 g (phase contrast photograph, × 1400). (A) *Acanthamoeba culbertsoni* trophozoite (insert: cysts with spherical endocyst). (B) *Acanthamoeba hatchetti*, n. sp., trophozoite (insert: cysts with three- to four-pointed endocysts).

Amoebas that grew at 40°C were isolated from one of two samples of sewage sediment collected in the New York Bight apex and from four of six samples of bottom sediment collected in Baltimore shipping channels. None of the 50 samples taken 10 to 90 miles offshore yielded amoebas after incubation at 40°C, but one *Acanthamoeba* species grew from sediment collected 20 miles offshore and incubated at room temperature. The New York Bight strain was identified as *Acanthamoeba culbertsoni*, a recognized pathogen of experimentally infected laboratory animals (Fig. 1A). The Baltimore isolates were identified as