tion, giving a greater age for humic acid than for peat.

These radiocarbon ages, along with others, appear in Fig. 3. The ages reported by other investigators are for four similar salt-marsh deposits along the northeast coast of the United States. Our youngest age, given by a sample from about 2.9 m below mean high water, indicates that the salt-marsh intertidal peat, which has a maximum thickness of 1.8 m over most of the project area, evidently began to form extensively at some time after 2500 years ago. This conclusion is confirmed by the fact that pollen associated with Caucasian settlement (after about 1600 A.D.) occurs only in the upper meter of the cores (*6*). These data support earlier conclusions (*7, 8*) that the rate of submergence decelerated appreciably at some time between 2500 and 350 years ago and that this deceleration permitted the extensive development of salt marshes in the Wachapreague area.

The Virginia and New Jersey plots are similar except for the oldest date (ML-192) from Virginia. These coastal segments have had similar submergence histories since about 4500 years ago, and the upper layers of salt-marsh sediment containing *Spartina* sp. rhizomes are of similar thickness. Ages and salt-marsh sediment thicknesses reported for Barnstable marsh, Cape Cod (*9*), are comparable with the data from Virginia and New Jersey. The submergence histories of these three localities (the VNC sites) have been similar, and extensive salt-marsh development has occurred only within the past 2500 years, concurrently with deceleration in submergence.

The submergence curves constructed from sets of ages obtained from the coasts of Connecticut (*2, 8*) and northeast Massachusetts (*10*) (the CM sites) differ markedly from the equivalent curves for the VNC sites. The rate of submergence at the latter sites has been approximately twice that at the former. The greater thickness of the *Spartina* sp. rhizome layer at the CM sites (2.8 m in Connecticut and 3.7 m in Massachusetts) also indicates that submergence at these sites has been slower than at the VNC sites. Finally, the radiocarbon ages indicate that the CM-site marshes are several thousand years older than marshes at the VNC sites.

All these curves cannot represent a purely eustatic rise in sea level because they differ by a meter or more at several points in time. It appears likely that, in addition to eustatic rise of sea level, differential crustal warping has occurred along this length of coast. Warping seems clearly indicated by sample ML-192. The exact nature of the warping is difficult to discern. It may be that the crust at the VNC sites has been essentially stable for the past 4500 years and that the CM sites are still undergoing postglacial isostatic rebound or some other kind of upwarp. The rate of uplift is apparently being exceeded by eustatic rise of sea level at the CM sites because there are no features indicating a later Holocene shoreline of emergence. It is also possible that the five localities are subsiding differentially, or that the crust at Virginia, New Jersey, and Cape Cod is subsiding while the CM sites are rising at rates less than the eustatic rise. There is evidence of local structural uplift at the mouth of Chesapeake Bay (*11*) and in the Wachapreague locality more than 4500 years ago. Still another possibility is differential depression of the edge of the continental block by water loading during postglacial submergence (*12*).

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5. These ages apparently confirm a prediction of Kay and Barghoorn (*3*) concerning the effect of root contamination.
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Radiocarbon Age of a Nevada Mummy

Abstract. *Skin tissue, bone collagen, and vegetal clothing from a well-preserved Indian mummy from a dry cave in Nevada have been analyzed radiochemically. The age is about 2500 years; the ages obtained for the various samples were in close agreement.*

A well-preserved mummy, commonly referred to as Whiskey Lil (Fig. 1), was discovered in 1955 in Chimney Cave, Lake Winnemucca, Nevada. Chimney Cave is one of the shallow sea caves formed along the shore of Pleistocene Lake Lahontan that became habitable by man when the lake level fell 11,400 years ago (*1*). It was used intermittently until about 1500 years ago. The area is now inhabited by the Northern Paiutes, whose exact time of arrival is unknown. The good preservation of skin, basketry, matting, cordage, and other perishables associated with the mummy is due to the extremely dry desert air.

The mummy is that of an adult female, cranial index 76.1, buried in a tightly flexed position; the face is to the side and the head pointed NNE. Apart from the face, most of the skin is intact, though withered. The hair has been devoured by dermestid beetles, but preservation of nails and "finger prints" is excellent. Around the waist of the body are twisted strips of rabbit skin and a fringed apron made of cord. A small bag or "compact" of mountain sheepskin was x-rayed, but contained no dense objects. The body was wrapped in a poorly tanned mountain-sheep hide with no decorations and was covered with a loosely woven blanket or mat of cedar bark.

Burial was accomplished by digging a shallow hole in the floor of the cave, which disturbed another burial beneath. The wrapped body was then left on the surface, and during the next 2500 years windblown dust and rat debris covered it to a depth of a

few centimeters. Remains of four more bodies were found, only one of which was male. A variety of basketry, cordage, wooden artifacts, shell beads and ornaments, and bone and stone tools accompanied them. Other human mummies, bones, and perishables found in nearby caves of the Lake Winnemucca group have been radiocarbon dated at 11,200 ± 250 years (sample L-245) (*2*), 5970 ± 150 years (sample L-289-FF) (*3*), and 1510 ± 200 years (sample M-436) (*4*).

Whiskey Lil was first dated by Crane and Griffin (*4*) at 2040 ± 250 years (M-437) by analysis of a portion of the cedar-bark matting. She was selected as a control for collagen dating of the bones because of the 2000-year age and the uncontaminated state of preservation. The mummy, obtained by one of us (P.C.O.), is now preserved in the Western Speleological Institute's collections at the Santa Barbara Museum of Natural History. No preservatives had been used on the body itself, and the likelihood of natural contamination with carbon of different radioactive age, such as humic acid, was remote. In order to estimate the amount of bone to be sacrificed for collagen-based radiocarbon assay, a few hundred milligrams were removed from a rib. A Kjeldahl nitrogen determination indicated 3.3 percent organically bound nitrogen. Multiplying this percentage by six gave the amount of collagen in the bone: 20 g of collagen containing 10 g of carbon in 100 g of bone.

The CO_2 proportional counter of the radiocarbon laboratory at the University of California, Los Angeles, needs about 8 liters of CO_2 for a full filling, which gives the best results, so that about 4 g of carbon is required for optimum conditions for analysis. A section of rib weighing 50 g was removed from the upper thorax, near the spine, freed of dust and connective tissue, and treated with 1*N* HCl to destroy the mineral matrix (*5*). The collagen isolated by the acid treatment was washed in distilled water and dried. It was then burned to CO_2 in a stream of oxygen in a combination combustion-purification, high-vacuum line. The CO_2 was purified by absorption in ammonium hydroxide and hot precipitation as calcium carbonate by addition of calcium chloride. The calcium carbonate was washed with distilled water, and the CO_2 was liberated with HCl. After passage through traps filled with 0.1*N* $AgNO_3$, CuO (500°C), chromic acid, and Cu (500°C), the CO_2 was sufficiently pure for admission to the proportional counter. In repeated counting for 1000-minute intervals, it yielded a radiocarbon age of 2500 ± 80 years (UCLA-689) (*6*).

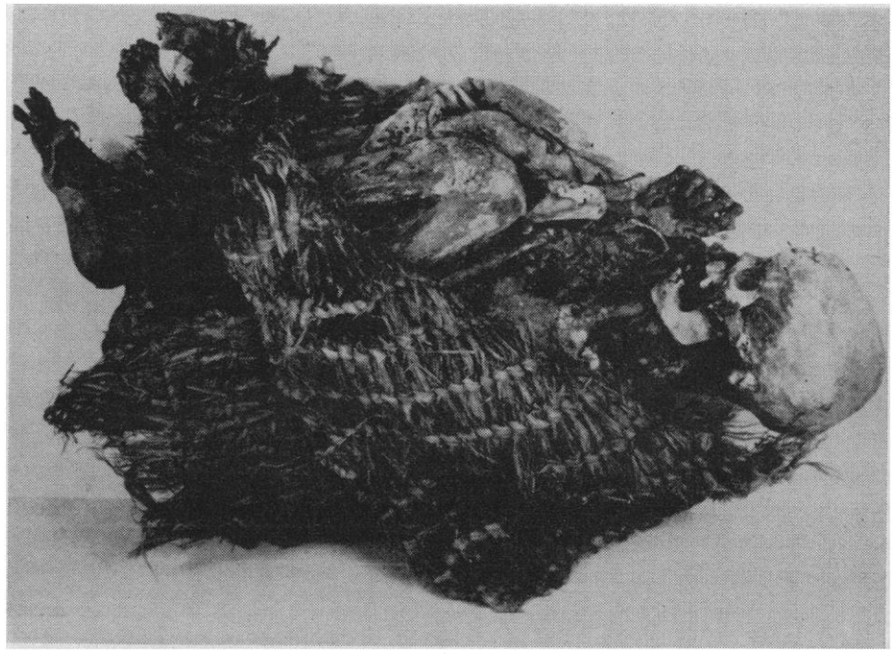

Fig. 1. Indian mummy from Chimney Cave, Lake Winnemucca, Nevada. Age about 2500 years.

Since age appeared to be too great in the light of M-437 at 2040 ± 250 years, a second measurement was made from skin tissue. Twelve grams of skin, similarly cleaned and converted to CO_2, yielded an average age of 2510 ± 80 years (UCLA-690) from several counts, in complete agreement with the collagen date.

A sample of the cedar-bark mat was also analyzed. After treatment with hot, dilute HCl to remove calcium carbonate dust and rat excrement, about 15 g of mat was burned to CO_2, which was purified with omission of the precipitation step. The sample yielded an age of 2590 ± 80 years (UCLA-692), compatible with the collagen and skin ages, bearing in mind that cedars are long-lived and that only very old bark is suitable for weaving. The discrepancy in age between M-437 and UCLA-692 may be due to differences in pretreatments of samples and to the fact that the Michigan counter was only partially filled.

In some instances the size of samples necessary for such destructive analysis can be reduced, as when mummies are not more than several thousand years old and long counting periods are possible. This is of considerable importance when comparing historical and radiocarbon chronologies directly on mummies of early pharaonic times or for rare specimens for which no absolute historical chronology exists.

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