(Univac 1108). Calculations of the terminal velocities of spherical particles from 1 to 10,000 μ in diameter were made for each pair of temperature-density values (Table 1) for the Mariner V and Venera 4 atmospheric models. The difference between the velocities of dust particles for both the Mariner V and Venera 4 model atmospheres increases both with size (starting from 10 μ) and altitude. The velocities of dust particles for the Venera 4 model atmosphere are 1.38 (10 μ, 0 km) to 3.29 (10,000 μ, 25 km) times those of the Mariner V model atmosphere. The difference occurs principally because the Mariner V model atmosphere is more dense at a given altitude than that of Venera 4. Figure 1 shows three curves of terminal velocity v plotted against particle diameter d. The falling rates near the surface on Earth are at least twice as high as those on Venus, primarily because the density of Earth's atmosphere is much lower. For particle sizes between 1 and 10,000 μ, the vertical winds required to maintain particles aloft in the denser, lower atmosphere of Venus are less than one-half the magnitude of those needed on Earth. Therefore, for the same degree of convective activity, one would expect more dust in the lower atmosphere of Venus than on Earth. Studies of dust storms and volcanic ash indicate that particles as great as 50 μ in diameter can persist over relatively great distances in the atmosphere of Earth (*11*). Persistent particles in the atmosphere of Venus (Fig. 1), with the same terminal velocity as a 50-μ particle near the surface in Earth's atmosphere, could be as large as 130 μ. If convective activity on Venus is the same as on Earth, the dust on Venus could contain larger particles than that on Earth, ranging up to over 100 μ in diameter. If the convective activity on Venus is much greater than on Earth, as is probable, then it is likely that Venus has a great deal more atmospheric dust than Earth, with dust particles on Venus ranging in size to perhaps 500 μ in diameter. Support for strong convective activity is given by calculations (*12*) which indicate that the lower atmosphere of Venus contains a thick (5 to 10 km) superadiabatic atmospheric layer on its surface. The presence of such a marked convective layer and the influence of its accompanying vertical velocities on dust particles may have profound effects on the dynamics of the lower atmosphere of Venus (*13*).

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22 October 1968

Archeological Evidence for Utilization of Wild Rice

Abstract. *The use of wild rice during the late prehistoric period is suggested by charred wild rice grains associated with fire hearths and threshing pits in historically known, specialized harvesting sites. Similar wild rice grains imbedded in the clay lining of specialized threshing pits called "jig pots" confirms the prehistoric use.*

The question of the prehistoric use of wild rice (*Zizania aquatica*) as a foodstuff by the native populations of the western Great Lakes region was raised many years ago by Jenks (*1*), who felt that the intensive use of this aquatic grass depleted stands rapidly, leading him to speculate that the historic intensive use of wild rice was very recent in origin. Kroeber subsequently discussed the high population density of this region in the early historic period, noted the lack of any unique natural food source other than wild rice, and attributed to wild rice a causal role in regional population growth (*2*).

Kroeber also suggested the possible prehistoric utilization of wild rice in this region in noting the overlap of prehistoric burial mound concentration and the distribution of productive wild rice lakes. While there is extensive literature on *Zizania*, there has been little published on the time of its utilization. Dickinson records two statements that suggest a prehistoric use of wild rice (*3*), and Wilford also infers prehistoric use based on site location (*4*). One reason for the lack of data on use of wild rice in prehistoric periods may be the lack of evidence of the plant in previous excavations. I now describe the evidence that does exist, based on field excavations in the Mississippi River headwaters of Minnesota.

Indirect evidence comes from the location and nature of certain sites of wild rice harvesting. Such sites are located adjacent to contemporary shallow lakes that produce wild rice, and until recent Minnesota harvesting regulations forced a change in the Indian pattern of harvesting, many of these sites were occupied seasonally in late August and early September by Minnesota Chippewa Indians. These people in the modern period, as in the earlier historic period, not only harvested the wild rice but did much of the preparation of the grains for storage at the same location. The latter involves an initial period of sun drying on mats, parching the grains in a kettle or steel drum over an open fire, threshing the parched wild rice to remove the husk, and winnowing the grains to remove the chaff (*1, 5*).

One of several such harvesting sites is located on the east edge of Lower Rice Lake in Clearwater County; another is the Mitchell Dam site located at the outlet of Rice Lake, Becker County. Where permanent Chippewa villages are located very close to the rice beds, special harvesting and preparation localities are found adjacent to the village. Harvest sites of this nature are those at Nett Lake, near the contemporary Chippewa village of Nett Lake in St. Louis County, and at Petaga Point on Lake Ogechie, located near the Chippewa community of Vinland in Mille Lacs County (Fig. 1). These latter sites were not used as camping areas but the activities associated with wild rice harvesting and preparation were carried on here during the harvest season.

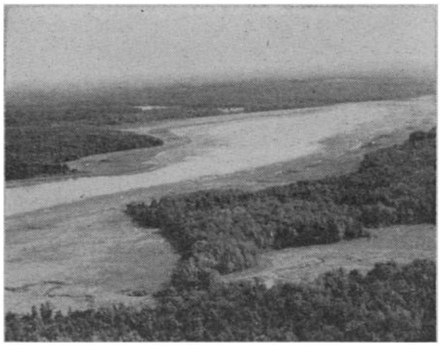

Fig. 1. Lake Ogechie, Minnesota, showing a typical small wild rice lake with emerging rice. The Petaga Point archeological site is at the upper left (southeast) section of the lake. Evidence of rice harvesting is found on all of the points projecting into the lake.

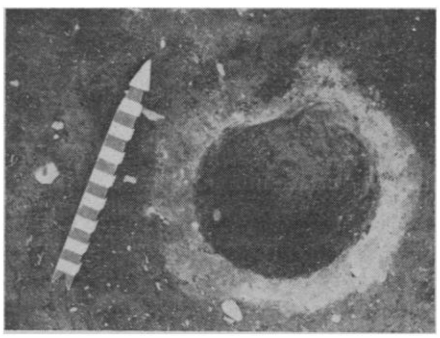

Fig. 2. Thick clay lining of the base of a jig pot excavated at the Lower Rice Lake site. Scale intervals are 2 cm.

Both types of sites are characterized by their location on recently used Chippewa harvest sites, they are on high ground with easy access to the rice lake, and each site on excavation produced quantities of heavy utilitarian pottery and numerous shallow basin-shaped pits excavated into the subsoil.

Direct evidence for wild rice utilization during the prehistoric period comes from preserved rice grains, which are usually charred from the parching activity, and which are recovered from the excavations by means of flotation (*6*). Excavated earth is filtered through a very fine mesh screen in running water allowing the lighter vegetable matter to float to the surface. Wild rice grains obtained in this manner, of course, substantiate a prehistoric origin only when they can be attributed to that era and not to recent Chippewa activity. While the tools and paraphernalia of wild rice harvesting and preparation are not preserved in archeological sites, with the exception of parching vessels, two of the activities associated with the preservation of the grain do leave soil modifications that can be seen by the excavator and provide the necessary context.

At several of the rice-harvesting sites excavated, fire pits have been located, and in three instances, large thick-walled utilitarian pottery vessels have been found crushed in place at the edge of the fire pits. Considerable numbers of charred wild rice grains were found by flotation.

At the same time, shallow basin-shaped depressions excavated into the subsoil were used as threshing pits. Historically, pits like these were dug and lined with a tanned animal hide. The parched rice was placed in the pit, and one individual stood in the pit and by moving his feet over the parched rice, separated the husks from the grain. By means of flotation, quantities of charred rice grains have been recovered from pit fill.

While both the parching fire-pits and threshing pits contribute to the probability that the sites in question were sites of wild rice harvesting, alternative explanations are possible for their presence. Conclusive evidence is present at some of the sites mentioned where the shallow threshing pits have their basal section lined with a thick, unfired clay, apparently placed at the base of the pit to provide a stable surface against which to thresh the rice grains (Fig. 2). A long-time resident of the village immediately identified those at the Nett Lake ricing site as "jig pots" or "dance pots." Other Chippewa informants confirmed this identification. The phrase "jig pot" refers to the movement of the feet of the thresher who appeared to be dancing as he moved his feet over the rice grains.

That the jig pots are prehistoric in origin in many cases is again demonstrated by flotation where the clay lining or plug itself was carefully screened. In addition to wild rice grains, numerous small sherds of late prehistoric pottery were found in the screen after the clay had washed through the mesh. Examples of such clay lined pits have been located at Nett Lake, Lower Rice Lake, and at Petaga Point (*7*).

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Eolian Origin of Quartz in Soils of Hawaiian Islands and in Pacific Pelagic Sediments

Abstract. *The particle-size distribution and oxygen-isotopic composition of quartz isolated from Hawaiian soils, east-central Pacific sediments, and tropospheric dusts are remarkably uniform. A common origin and tropospheric transport from continental land masses is suggested.*

Soils of the Hawaiian Islands frequently contain quartz in spite of the fact that this mineral has not been detected in unaltered Hawaiian rocks (*1*). Local hydrothermal activity in rocks of the Kailua Volcanic Series in southeastern Oahu has given rise to hydrothermal quartz (*2*), but this is of very limited areal significance. Several workers concluded that the quartz in Hawaiian soils is pedogenic (*1*, *3*). We studied the particle-size distribution and oxygen-isotopic composition of quartz isolated from soils of the Hawaiian Islands and found that the isotopic results were remarkably similar to those obtained for pelagic sediments from the east-central Pacific (*4*) and for tropospheric dusts.

Monomineralic quartz was isolated from all samples by a procedure (*5*) involving fusion with $Na_2S_2O_7$ and treatment with H_2SiF_6 and yields quartz with oxygen isotopes unchanged. Results from x-ray study showed that this procedure effectively removed mica, feldspar, and small amounts of other minerals from a sample of tropospheric dust (*6*).

Particle-size distribution was determined by sedimentation and decantation (*7*). Oxygen was liberated from the quartz by reaction with bromine pentafluoride (*8*), and isotopic analyses were carried out with a 6-inch (15-cm) radius, 60°-sector, double-collecting mass spectrometer. Manometric determination of oxygen yields with an accuracy of ± 1 percent provides a test of purity of the quartz isolate.