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Prehistoric Giant Swamp Taro (*Cyrtosperma chamissonis*) from Henderson Island, Southeast Polynesia[1]

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ABSTRACT: Subfossil leaf fragments of giant swamp taro (*Cyrtosperma chamissonis*) were recovered from archaeological contexts dating as early as A.D. 1451 (mean date) on Henderson Island (24° 22′ S, 128° 19′ W), Pitcairn group—a raised limestone (*makatea*) island isolated at the extreme margin of southeastern Polynesia and the Indo–West Pacific biotic province. Comparison of subfossil specimens and modern reference material from a range of known cultigens under scanning electron microscopy confirms the identification. A period of active interarchipelago voyaging between A.D. 1000 and A.D. 1500 is known from recent summaries of the geochemical analysis of exotic fine-grained basalt artifacts from archaeological sites throughout Polynesia. If not an initial colonization, it is during this time that *Cyrtosperma* should have been introduced prehistorically to most, if not all, of the inhabitable islands of the region, especially those island groups lying to the west of Henderson. Investigation of subfossil plant remains adds another dimension to understanding plant distributions, prehistoric crop use, and subsistence practices in the Indo-Pacific region.

INVESTIGATION OF THE plants associated with past diet and subsistence economy in the Pacific by the direct analysis of the archaeological remains of plant tissues is limited compared with that in other parts of the Tropics (for example, Central and South America and northern Africa). This is largely the result of the importance of perishable root and tuber foods in Pacific subsistence over that of seeds that often preserve well. Methodologies for the archaeobotanical analysis of partially or wholly seed-based economies are well established and have met with considerable success. Comparable analysis of tropical archaeological root and tuber–based economies has, until relatively recently, lacked a well-defined methodology and so, apart from a few isolated important identifications (see Hather 1992 for a general review), has received less attention. Consequently, the plant remains associated with past root and tuber–based economies have also been left unanalyzed. In this paper we report the identification of the leaf remains of an important Pacific cultigen, *Cyrtosperma chamissonis* (Schott) Merr, from a prehistoric context and discuss the significance of this identification in terms of its past and present distribution and its contribution to Pacific archaeobotany.

Cyrtosperma chamissonis, the giant swamp taro, is an aroid of considerable dimensions, cultivated for its starchy corm (Figure 1). Petioles are often spiny and arise directly from the corm at ground level and may reach over 2 m long. The leaf blades, up to 1 m long, are sagittate with pointed inferior lobes, with the midrib on a continuous line with the petiole. In this character they are similar to *Alocasia* but differ from *Colocasia.* Varieties

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FIGURE 1. Giant swamp taro, *Cyrtosperma chamissonis,* growing in a large excavated pit on Ebon Atoll, southern Marshall Islands. (Photo by M. I. Weisler)

differ in overall size as well as leaf shape and the spininess of the petiole. Corms commonly mature after 2 to 4 yr, when they may weigh up to 15 or 20 kg. If left for 10 or more years, corms may reach 80 kg in weight (Barrau 1961:43, Small 1972:66).

The nomenclature of the domesticated *Cyrtosperma* is a little confused. *Arisaconthis* *chamissonis* Schott and *Cyrtosperma edule* Schott are now both considered to be synonymous with *C. chamissonis. Cyrtosperma merkusii* is considered by some also to be synonymous with *C. chamissonis* but by others to be a separate and nondomesticated possible ancestor of the domesticate (Thompson 1982). Others view *C. merkusii* as a domesticate itself and a variety of *C. chamissonis* in the western Indo-Pacific (Purseglove 1972). It has been considered that *C. chamissonis* was domesticated in Indonesia (Massal and Barrau 1955), and so the two possibilities of *C. merkusii* being either an ancestor or an early variety of *C. chamissonis* are not far apart. In this paper, the plant remains identified as *Cyrtosperma* sp. are considered to be *C. chamissonis.*

Cyrtosperma chamissonis is generally cultivated on the low Pacific atolls in conjunction with coconut, breadfruit, arrowroot, and pandanus. On such islands *C. chamissonis* is favored for its ability to tolerate both occasional drought and the swampy saline conditions that characterize the only fertile regions of such islands. The herbaceous and relatively low habitat of aroids is also favored on islands with frequent high winds. The most important product of *C. chamissonis* is the starchy corm, which on some islands holds a position of considerable prominence in the diet. A secondary use of the crop is, however, the leaves, important in wrapping food for cooking in the earth oven and for covering the earth oven during cooking (Massal and Barrau 1955).

Thompson (1982) described the modern distribution of *C. chamissonis* in a paper that relates the economic importance of the aroids in the Pacific to both cultural preference and ecology. Thompson reported that by far the main concentration of *C. chamissonis* as a major crop is in Micronesia, whereas in both Melanesia and Polynesia, where *C. chamissonis* is reported, it is of minor or only occasional use. This, Thompson suggested, is culturally significant, citing Luomala's work in Kiribati (1953, 1974) as an important example, but is largely determined by environmental conditions. The identification of *Cyrtosperma,* reported here, suggests that the distribution of this domesticate in the Pacific deserves reexamination. Brief review of the evidence for prehistoric long-distance inter-archipelago interaction (so-called trade and exchange) within Polynesia strongly suggests that *Cyrtosperma* should have been an aboriginal introduction throughout the region. This additional archaeological information is especially important because Whistler (1991), in his recent summary of Polynesian plant introductions, reported *Cyrtosperma* as aboriginally introduced only as far east as the Cook Islands (see also Peters 1994) and that it was a modern introduction to the Marquesas and the Society Islands (Whistler 1991 : 45, 59).

Archaeological Context

The subfossil plant remains were collected from the raised limestone (*makatea*) island of Henderson, Pitcairn group (24° 22′ S, 128° 19′ W), isolated near the southeastern margin of Polynesia and the Indo–West Pacific biotic province (Kay 1984, Benton and Spencer 1995). A 5-month archaeological program during 1991–1992 was designed to investigate how small human groups survived on isolated landfalls with impoverished marine and terrestrial biota, nutrient-poor soils, unpredictable rainfall, and, perhaps most important, isolation from high volcanic islands with correspondingly richer and more diverse resources (Weisler 1994, 1997*a*, Waldren et al. 1999). Twenty-eight sites were recorded, consisting mostly of rockshelters and caves, with a few gardening areas (marked by remnant stands of *Cordyline fruticosa,* level soil pockets, and stone mounds) and a large coastal midden (Weisler 1998*a*). Measuring up to 225 m^2 in floor area, all caves and rockshelters were situated within 50 m of the high-tide mark. The deep recesses of the shelters and the dry, calcareous sandy deposits provided ideal conditions for the preservation of plant macrofossils. Thirty-one radiocarbon age determinations from 12 sites suggest an occupation sequence spanning about 600 yr beginning A.D. 1000 (Weisler 1995). All sites from which plant macrofossils were recovered are clearly prehistoric.

The archaeological deposits were excavated by trowel and sediments sieved through 6.4-mm mesh (other samples were processed with 3.2- and 1.6-mm screens). Both leaf samples were found in situ. The sample from site HEN-6 was found 19 cm below the surface, just above an earth oven (in a layer with dense combustion features) and associated with abundant prehistoric artifacts, shellfish, and faunal remains including bones of turtle, fish, bird, and rat. Wood charcoal from deposits immediately below were dated to 380 ± 50 B.P. (before present [laboratory sample number Beta-59009]) and calibrated to A.D. 1451–1650 (conventional age −40 yr for Southern Hemispheric samples, then calibrated at 2 σ after Stuiver and Reimer 1993). From HEN-7, the leaf sample (11 cm below the surface) was associated with an earth oven in a layer with prehistoric artifacts, shellfish, and bone midden. A wood charcoal sample (Beta-62941) provided a conventional age of 270 ± 50 B.P. calibrated to A.D. 1522–1955. Although the latter end of the calibration is modern, the archaeological context is clearly prehistoric where, on Henderson, this predates the early seventeenth century.

MATERIALS AND METHODS

Plant remains were systematically collected for archaeobotanical analysis from the Henderson excavations. Leaf fragments from a variety of contexts were collected by hand and carefully packed for detailed laboratory analysis. The leaf fragments were examined under low-power incident light microscopy, and small fragments of both the abaxial and adaxial surfaces were mounted for examination by scanning electron microscopy. Standard botanical texts were used to complement data gathered from modern reference material in identifying the archaeological remains. The modern reference material comprised the following taxa: *Alocasia macrorrhiza, Artocarpus altilis, Asplenium nidus, Cocos nucifera, Colocasia esculenta, Cordyline fruticosa, Cucuma longa, Cyrtosperma chamissonis, Hibiscus tiliaceus, Morinda citrifolia, Musa paradisiaca, Pandanus tectorius,* and *Zingiber officinalis,* collected from a variety of locations in the Pacific. Leaves of modern material were air dried and then placed in a drying oven at 100°C.

RESULTS

Much of the archaeological leaf material seemed well preserved under low-power incident light microscopy. Several individual fragments were up to 6 cm across and, though thin and fragile, were pliable. Few fragments had the original leaf margin, and the important character of the marginal vein, used to differentiate some taxa, was not available. Under scanning electron microscopy the leaf surfaces appeared considerably abraded, and trichomes (hairs), where present, were visible only as disrupted basal cells. Stomata, however, were well preserved and provided an important character upon which to identify the taxa present. *Cyrtosperma chamissonis* was identified from two samples. Figure 2 shows the similarities in leaf texture and stomata between the modern reference specimen and the archaeological sample.

DISCUSSION

The distribution of any plant has a temporal dimension that may be of considerable importance to anyone studying the evolution of a specific plant or flora. To those studying the origin and dispersal of plants used by people, the temporal dimension is of particular importance and forms the basis of many theoretical discussions of archaeological topics such as economy, migration, sedentism, and agricultural origins. *Cyrtosperma* is not considered to be a crop of widespread importance; indeed, it tends to be grown as a major staple only in regions where there is environmental discrimination against other crops, with perhaps cultural preference a factor of varying significance. The importance of the archaeological remains of *Cyrtosperma* is in indicating a marginal agrarian environment where conditions were such that

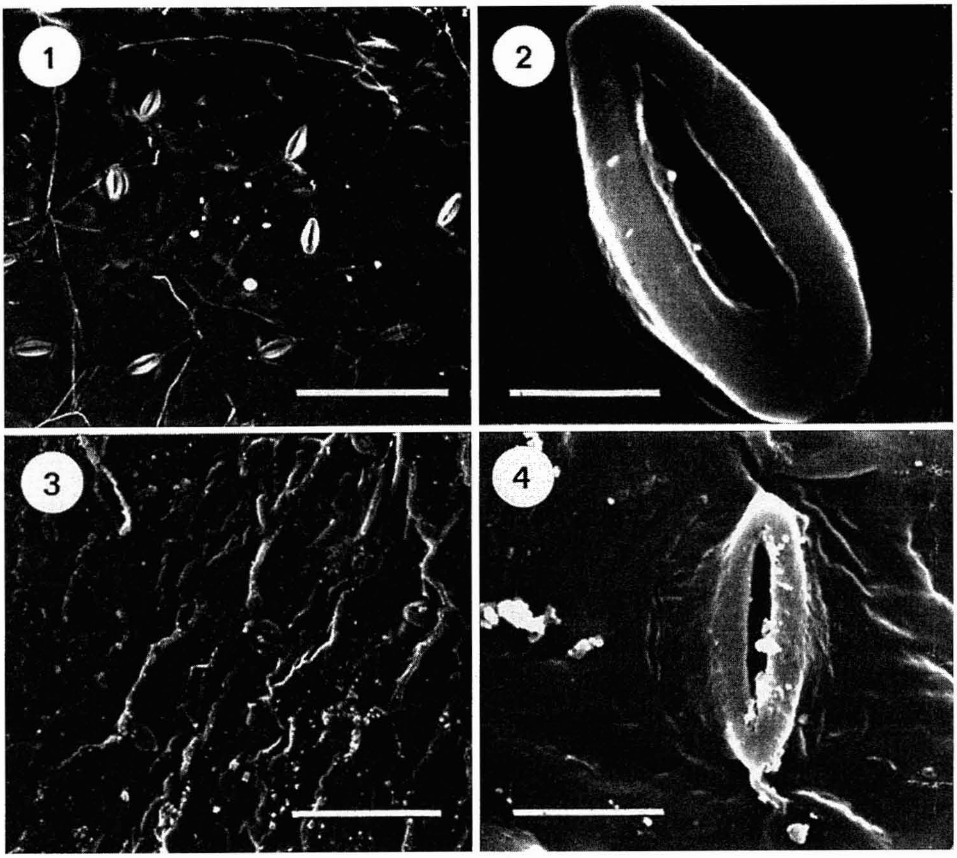

FIGURE 2. Scanning electron micrographs of *Cyrtosperma chamissonis.* (1) Surface of modern leaf (scale bar = 75 μm); (2) detail of stomata of modern leaf (scale bar = 10 μm); (3) surface of archaeological leaf (scale bar = 75 μm); (4) detail of stomata of archaeological leaf (scale bar = 10 μm). (Photos by J. G. Hather)

other crops could not be grown. The practice of using *Cyrtosperma* as a crop in such conditions, so as to make productive otherwise marginal islands, is uncommon in Polynesia, although well known in Micronesia (Weisler 1999). As reported by Thompson (1982 : 193), the modern distribution of *Cyrtosperma* places its farthest east occurrence about 2000 km northwest of Henderson (128° 18′ W, 24° 22′ S) on Makatea Island, Tuamotu Archipelago (148° 15′ W, 15° 50′ S). As such, the presence of *Cyrtosperma* on Henderson gives, perhaps, an indication of agrarian practices in the Pacific that may now be only locally isolated, but may have been of considerable importance in the past.

Archaeological evidence for long-distance, postcolonization voyaging within Polynesia has been summarized recently (Weisler 1997*b*, 1998*b*) and adds an important independent line of data for interpreting aboriginal plant dispersals in the region. Figure 3 presents the prehistoric interaction spheres as inferred from the distribution of exotic fine-grained basalt adze material. The largest solid line delimits the area with artifacts originating from Tutuila, Samoa—an interaction sphere operating perhaps as early as 2000 yr ago (Best et al. 1992, Clark et al. 1997 : 79). East of the Cook Islands, all interaction spheres date to between A.D. 1000 and A.D. 1500 and suggest a time of prolonged long-distance

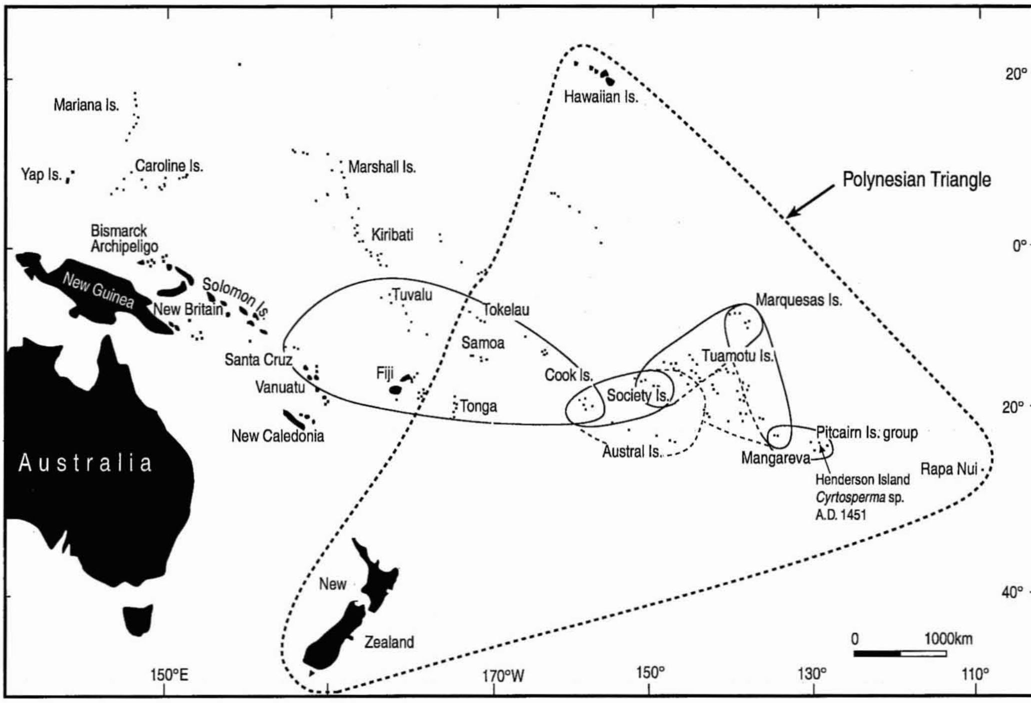

FIGURE 3. The Polynesian triangle and prehistoric interaction spheres delimited by the spatial and temporal distribution of exotic, fine-grained basalt adze material (after Weisler 1998*b*). The Australs and Tuamotus undoubtedly played a vital part in interisland contacts in central Polynesia, but detailed data are currently lacking. If not introduced at initial colonization, it is most likely that most, if not all, cultigens were distributed throughout Polynesia during the period of postsettlement voyaging, A.D. 1000–1500. Consequently, the modern distribution of *Cyrtosperma* does not reflect its prehistoric occurrence.

voyaging. For example, we know that adze rock from a source on Eiao, Marquesas, was transferred to the Societies and from Eiao to Mangareva during the late twelfth to early fifteenth centuries (Weisler 1998*b*). Along with stone tools it is highly likely that cultigens and other commodities were carried as well. Although Brown, in his botanical survey of the Marquesas in the 1920s, found that *Cyrtosperma* was rare, it was "well known to the old inhabitants ... [and] it would seem that in ancient times it was cultivated" (1931 : 131). From the archaeological evidence for prehistoric interaction, it seems likely that *Cyrtosperma* was an aboriginal introduction across Polynesia, except New Zealand and Easter Island, where climate and/or cultural preference may have discouraged its growth. Having identified *Cyrtosperma* from two prehistoric contexts on Henderson Island—arguably one of the most isolated landfalls—we believe that there is little reason to accept that *Cyrtosperma* was a modern introduction on any inhabitable island within tropical Polynesia.

Archaeobotanical investigation in the Pacific is in its infancy and it is only by continued, often-isolated analyses that the range and type of archaeological plant remains may be identified and evaluated (Hather 1991, Hather and Kirch 1991, Hather and Ellison 1995). The use of large leaves in the subsistence economy of the Indo-Pacific makes them invaluable as archaeological remains in interpreting the spread of crop plants and agrarian practices in the region.

Their particular use in cooking—to wrap food for placing in an earth oven or for storage, to line or cover an earth oven, or for serving cooked food—positions leaf material in a broad range of preservational contexts. Both leaf remains described here were found associated with earth ovens, lending weight to this argument. The types of remains present in the agrarian past of Europe, Southwest Asia, North Africa, and Mesoamerica are so considerably different from those in the Indo-Pacific region that many of the tried and tested techniques and methods of interpretation are not applicable. We should not let this fact delay our pursuit of understanding past plant uses in the Indo-Pacific region.

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