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REPORTS

Notes on Creosote Lac Scale Insect Resin as a Mastic and Sealant in the Southwestern Great Basin

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A variety of products were used by the Indians of the southwestern Great Basin as mastics and sealants. These included the pitch (sap) from various pines (*Pinus* spp.), junipers (*Juniperus* spp.), brittle bush (*Encelia farinosa*), and the glue obtained from simmering the horns, hide scrapings, and tendons of bighorn sheep (*Ovis canadensis*) and other animals. Another mastic was derived from the resin of the creosote lac scale insect (*Tachardiella larrae*) found on the branches of the creosote bush (*Larrea tridentata*). This insect resin sometimes has been improperly identified as a plant product, being labeled as "gum from the creosote bush." Although the use of resin from lac insects is known from much of southwestern North America (cf. Standley 1926:641; Bennett and Zingg 1935:147, 158; Casterter and Underhill 1935:21; Crosswhite 1981:47; Felger and Moser 1985; Ebeling 1986:126, 400), for purposes of brevity, the discussion of its use is limited herein to groups residing in the southwestern Great Basin.

Lac scale insects (Homoptera: Tachardiidae) comprise a fairly small family (some 65 species [Arnett 1985:239]), with several species being economically important. These insects exude a resinous substance known as lac, from which a number of products are made. For example, shellac is made from the exudation of the Old World lac insect (*Laccifer lacca*; Arnett 1985:239) while other

species are used to produce medicines and dyes (Arnett 1985:239; also see Colton 1944:1).

Ethnographic data on the use of the products of lac insects in California and the Great Basin are sporadic and often unspecific (cf. Coville 1892:361; Sparkman 1908:209; Kroeber 1925:651; Essig 1926:287, 1934:182-183; Zigmund 1980:89). Among the species available in California was the oak wax scale (*Cerococcus quercus*), that inhabits oak (*Quercus* spp.) in the semi-arid mountains of California and Arizona (Essig 1931:20), and the irregular wax scale (*Ceroplastes irregularis*), that inhabits various species of saltbush (*Atriplex* spp.) in California, Arizona, and New Mexico (Essig 1931:20). The wax and gum from these insects reportedly was used for a variety of purposes including chewing gum, basketry sealant and mastic, ceramic sealant, mastic on bows (Essig 1931:19-20), and tool handles (Zigmund 1980:89).

DISTRIBUTION AND BIOLOGY

Of particular note here is the by-product of the creosote lac scale, *Tachardiella larrae* (formerly *Carteria larrae*) that infests creosote bush (*Larrea tridentata*). The distribution of the creosote lac scale follows that of the creosote bush; both occur in the Mojave and Colorado deserts of California, and the Sonoran and Chihuahuan deserts of Arizona, New Mexico, Baja California, and northern Mexico (Hunziker et al. 1977:14) (Fig. 1).

Colton (1943) discussed the distribution of the scale insect and investigated its concentrations in the Creosote Bush Scrub plant community in western Arizona. He found that infestation varied from zero (no infestation) to 54% of bushes being infested, with

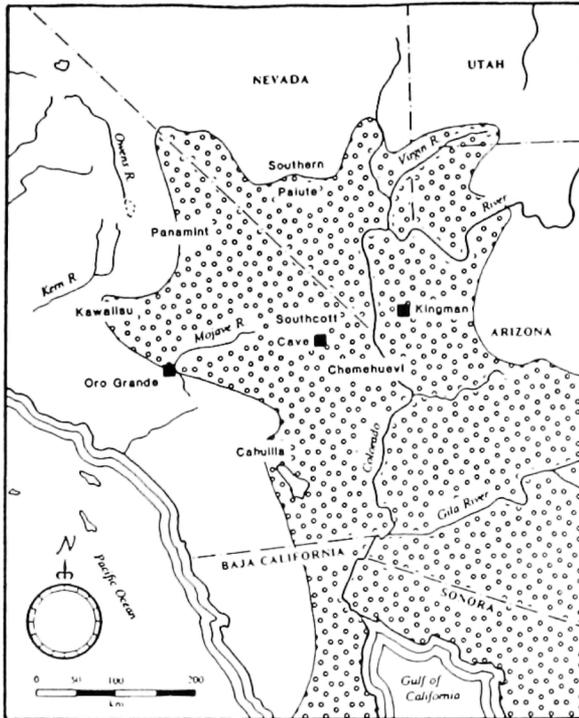


Fig. 1. Distribution of the creosote bush, *Larrea tridentata*, in the southwest Great Basin, western Arizona, and northern Mexico (after Hunziker et al. 1977, Fig. 2-4), and native groups and archaeological sites noted in text.

between 11.9% and 13.6% being the average (Colton 1943:23).

Only one generation of scale insects is produced per year. The adult female lives on the branches of the creosote, completely encased in a resin cell. The young hatch during February and March, after which the female dies. The young leave the cells and begin producing and covering themselves with lac. The male larva undergoes a fairly rapid metamorphosis, emerging as a small red "fly" (Colton 1943:27). The winged adult male then copulates with the still immature female (in effect creating a "sperm bank") and dies within a few days (Colton 1943:27). Once the female reaches maturity, the stored sperm is then used to fertilize the eggs.

The female produces large quantities of a reddish-colored lac that eventually encases her (Essig 1958:286). Individuals occur either singly or in groups, are globular-shaped, and are about 2 mm. in diameter (Essig 1958:286). Large numbers of insects can aggregate on individual bushes and the ensuing colonies can result in a considerable concentration of lac (Fig. 2). Because females are continually encased in lac, the material is available for collection and use throughout the year.

TECHNOLOGICAL NOTES

The resin is present in small clumps on the outside of creosote branches (Fig. 2) and can be removed by hand by twisting it from the branch. This action generally would result in serious, even lethal, damage to the branch. In the process of removal, fragments of bark and other plant materials, live and dead lac scale insects, and possibly some ants, are included. The resulting "raw lac resin" consists of a combination of these materials.

The quantity of resin present on any single creosote bush varies from infestations on many of the branches to just a few. Given a good concentration, a considerable quantity of the resin can be collected in a short time. In one collecting episode by the author (in 1986), several ounces were obtained in just a few minutes (the specific collection times and recovered quantities were not recorded and, due to a fortunate encounter, no search time was involved).

Westgate (1943:198) reported that the lac consisted of approximately 23.5% shellac and 51.9% wax, with the remainder consisting of other materials (e.g., bark, insect bodies, etc.).

Experimental Data

Raw lac scale resin is rather hard and brittle. The resin softens at approximately 250° F. (as measured in an electric convection oven), turns dark red, becomes malleable

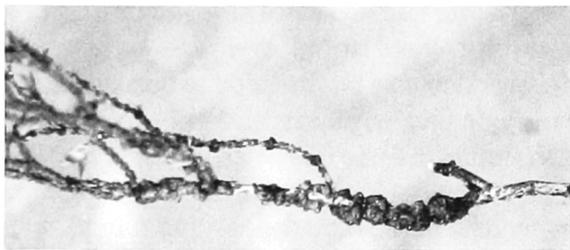


Fig. 2. A colony of lac insects on the branch of a creosote bush (length of branch is 20.0 cm.).

and very sticky but does not “melt,” at least not below 450° F., where it begins to produce smoke. Removed from the heat, it cools very rapidly, regaining its hardness and brittleness. This rapid cooling makes it difficult to apply and might interfere with its utility. The resin must have been applied hot (ceramic vessel No. 4 from Southcott Cave in the Providence Mountains [Sutton et al. 1987] exhibits such evidence).

The Panamint are reported to have ground the resin along with “pulverized rock” (Coville 1892:361). It is thought that in doing so, several advantages may have been gained. The first possible advantage was that the resin would be made into smaller fragments, reducing their individual surface area to volume ratio, and resulting in more even heating. Second, the presence of the sand within the mixture could serve to conserve the heat, thereby delaying the cooling and making the material more useful.

To test the merit of these notions, a small amount (1.0 g.) of raw resin was ground with a ceramic mortar and pestle and added to a small amount (1.0 g.) of sand (also ground in the ceramic mortar). Although the two ingredients weighed the same, the sand had only about one-third the volume of the resin. The combination was then placed in a convection oven at 200° F., increasing 25° F. every 15 minutes to 450° F. As a control, ground raw resin with no ground sand was subjected to the same conditions.

Neither combination melted, although the resin mixed with sand did seem to retain greater malleability than the raw resin alone. Clearly, the sole addition of sand did not improve the usefulness of the resin, at least under the conditions applied here.

It is also possible that the resin was combined with another mastic material (e.g., pine pitch) to improve its performance, although there is no ethnographic evidence that this was done. The gas chromatograph (GC) profiles obtained from raw lac and from the archaeological samples from Southcott Cave (Sutton et al. 1987) are very similar and do not reveal the presence of any additive. It should be noted, however, that these GC results are not particularly sensitive. The experimental work is continuing.

ETHNOGRAPHIC DATA FROM THE SOUTHWESTERN GREAT BASIN

Lac was utilized by at least several native groups in the southwestern Great Basin. Coville (1892) noted the use of several adhesives by the Panamint Shoshoni of the Death Valley region. These included pine (*Pinus monophylla*) pitch, a glue made from boiling the horns of mountain sheep (*Ovis canadensis*), and a gum found on the creosote bush. He wrote:

This last product is an interesting one. In its crude form the larrea gum occurs in the form of small, reddish, amber-colored masses on the twigs of the shrub, and is deposited there by a minute scale insect, *Carteria larreae* [*Tachardiella larreae*]. The crude gum is mixed with pulverized rock and thoroughly pounded. The product, heated before applying, was once used to fasten stone arrow-heads in their shafts, and is at the present time employed for other similar purposes. At Ash Meadows, Nevada, I was shown a broken sugar-bowl cover that had been neatly and firmly mended with this cement by an Indian [Coville 1892:361].

Over 40 years later, Driver recorded the use of a pitch among the Panamint to seal

water bottles (1937:78) and to glue feathers to arrows (1937:71), but the type of pitch was not identified. Based on the description by Coville (1892:361), it is reasonable to assume that at least some of the "pitch" related by Driver (1937) may have been lac resin.

Steward (1933:262) noted that the Owens Valley Paiute used a glue made from "a kind of shellac from sage infested by insects." Although the Owens Valley is to the north of the normal range of creosote, small populations of creosote do occur there (DeDecker 1984:125) and it is possible that the "sage" is creosote. It is more likely, however, that the plant referred to by Steward was a species of *Atriplex* that is infested by the irregular wax scale (*Ceroplastes irregularis*). It is not known which species actually was utilized by the Owens Valley Paiute.

Palmer (1878:654) reported the Paiute use of the "gum" from the creosote but recorded the material as "pitch" rather than the by-product of an insect. He did note, however, that the Paiute used the material to cement projectile points to foreshafts.

Both the Ute and Southern Paiute made glue from horn (as Coville noted for the Panamint), but "larrea gum" was not mentioned by Stewart (1942:266). The use of a pitch was recorded among the Ute and Southern Paiute (Stewart 1942:271) and the Chemehuevi (Drucker 1937:20) for waterproofing baskets and for gluing feathers to arrows, but the pitch is not identified. Zigmond (1980:89) reported that a red pitch found on creosote bushes (undoubtedly lac) was used by the Kawaiisu to fashion handles for awls and knives.

Laird (1976:6) noted that the Chemehuevi routinely stored seeds "in storage baskets capped with suitably shaped potsherds and sealed with greasewood (creosote) gum." Van Valkenburgh (1976:12) recorded the use of "greasewood pitch" to repair (ceramic?) bowls

by the Chemehuevi. Lac resin also is noted in Chemehuevi oral tradition to repair a knife (Laird 1976:189).

Barrows (1900:48) noted that, among the Cahuilla, glue was obtained from several plants, including the creosote.

Glue, *san-ot* [a generic term for vegetable gum (Barrows 1900:48)], is also obtained from the "creosote bush" (*Larrea Mexicana*), on the bark of which an amber colored gum is deposited by a small scale-insect.

Drucker (1937:17) further noted that the Cahuilla used "greasewood" gum to produce a black pigment (also see Ebeling 1986:400), and Rogers (1936:33) noted the use of pitch among Yuman language groups.

ARCHAEOLOGICAL DATA

Although several archaeological examples of the use of lac scale insect products are known from the Southwest (e.g., McGregor 1943:292; Felger and Moser 1985:92), such examples are very rare in the Great Basin. Euler and Jones (1956) identified lac scale resin as a sealant on a hermetically sealed olla containing processed mescal. The vessel was found near Kingman, Arizona (Fig. 1), and was dated to approximately A.D. 1300 (Euler and Jones 1956:88).

A stone bowl fragment containing an unknown material was recovered during excavations at the Oro Grande site located on the Mojave River (Fig. 1). Most of the archaeological remains at the site date to the last 1,000 years (Rector et al. 1983). A sample of the material was removed from the bowl and subjected to chromatographic analysis. The preliminary results (van Balgooy 1983:178) suggested that the substance within the bowl was a wax:

A conservative guess is that the bowl was used to store, grind, or collect wax-containing material. This could have been beeswax, other insect wax, or wax-containing plant parts.

The high wax content of creosote lac scale lac (Westgate 1943) also supports this possibility. Since the Panamint ground creosote lac scale resin prior to its use (Coville 1892:361), it is possible that the material from Oro Grande also was ground, or that the bowl was used to process or handle lac.

A reddish-colored material was found adhering to the rims of several ceramic vessels recovered from Southcott Cave (Sutton et al. 1987), in the eastern Mojave Desert (Fig. 1). It was determined, using voucher specimens and gas chromatography, that the material was creosote lac scale resin. A radiocarbon date of 2100 ± 230 radiocarbon years B.P. (UCR-2034/AA-2467) was obtained on the material (Sutton et al. 1987), which seems entirely too old. At nearby Mitchell Caverns, Pinto (1989:51) tentatively identified lac resin as the adhesive on several hooked poles (apparently) used to capture chuckwallas (*Sauromalus obesus*) and from a knife.

CONCLUSIONS

The majority of the ethnographic references to greasewood gum or creosote gum probably refer to the resin of the creosote lac scale. This conclusion is based on the fairly consistent color (red) of the reported material, that the creosote bush itself does not produce usable (i.e., flowing) sap, and the lack of evidence that a creosote plant product (sap) was ever used. Examples in the archaeological record are rare, but it is possible that many such examples remain unrecognized. The identification of such resin and information on its distribution would be of great value in the delineation of trade patterns and technology (cf. Euler and Jones 1956).

Examination of museum specimens and a more careful scrutiny of newly discovered archaeological materials, rather than reliance on the assumption that extant pitch is some other type of gum, probably would result in

the identification of additional examples of the use of lac scale resin.

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The Population of the Santa Barbara Channel Missions (Alta California), 1813-1832

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THE demographic collapse of the native populations in the Americas in the four centuries following sustained contact with Eurasia has been a major topic of discussion among scholars for decades. Much of the debate has been based on the assumption that epidemics of contagious diseases such as smallpox and measles were the primary causes for the rapid decline of the Indian populations. Yet, few detailed studies have examined Indian demographic collapse using parish registers, censuses, and reports that record vital statistics for Indian populations. One notable exception is the case of the frontier Indian mission communities of Alta California established by Franciscans between 1769 and 1823. The rich data available on the missions, including complete lists of baptisms and burials, and detailed annual and biennial reports, provide the basis for local demographic studies that can test the basic explanations for the causes of Indian demographic collapse.

Sherburne F. Cook pioneered the study of the causes of Indian demographic collapse in the Alta California missions in a series of

monographs (Cook 1976a, 1976b; Cook and Borah 1971-1979). Cook's studies not only initiated the discussion of the topic for the Alta California missions, but more importantly, provided an empirical and theoretical framework for subsequent research. Despite Cook's positive contributions to the field of historical demography and California Indian and mission history, his works have increasingly come under attack, especially within the context of the current and controversial campaign to promote the canonization of Franciscan missionary Junipero Serra, O. F. M., architect of the Alta California mission system. Scholars who favor Serra's canonization have systematically attacked those elements of Cook's interpretations, even if substantiated by empirical evidence, that do not reflect well on their own colored view of mission history, the Franciscans, or Serra the man (Lothrop 1989; Hornbeck 1990).

One scholar in particular, who can be considered a strong advocate of Serra's canonization and a sanitized version of Alta California mission history, went so far as to attack the reliability of the sources for the study of the historical demography of the California missions. He did so despite the fact that these sources are the most complete and among the most reliable for colonial Spanish America. Historian Harry Kelsey, who has no practical expertise in the field of historical demography and brings a decidedly Eurocentric view to his interpretation of the history of the California missions, wrote in a footnote in a recent article that discussed the development of the building complex of San Juan Capistrano mission:

There are no accurate population statistics for the missions. The figures listed in annual reports and mission registers need to be approached with a great deal of caution. There is no modern mission population study based on careful and critical research in the original sources [Kelsey 1987:30 nt. 22].