Appendix: *Triodia* resin manufacturing techniques

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Introduction

Aboriginal methods of collecting and preparing *Triodia* resin as a hafting adhesive have sometimes been misunderstood and various accounts lack detail, particularly with respect to alternative sources of resin and techniques. Accounts of processing *Triodia* resin are reviewed here, beginning with the work of Binford (1984, pp.173–177), who compared his observations of resin preparation by a group of Alyawara men with two accounts of resin preparation by Pitjantjatjara speaking people. The manufacturing techniques are broadly similar (see Appendix Table 1) but highlighting the differences and consulting other evidence contribute to understanding particular processes and preferred techniques. I also include my own observations on resin manufacturing, while working with Kimberley and Western Desert communities from 1972 to 1998 to shed light on the use of ant-derived resin, heating methods and the historical context of *Triodia* production.

Binford's Account

Binford (1984, pp.173–177) described the preparation of *Triodia* spinifex resin by a group of Alyawara men and compared their techniques with those of Pitjantjatjara speaking people, recorded by Greenway (1972, pp.201–204) and Brokensha (1975, pp.64–66). The Alyawarra heated the dust in a bark tray placed over a small fire, and supported by two cobbles (Binford, 1984, p.166). The fire 'grew up around the green bark trays' and melted the upper surface of the resinous dust pile that ran into small balls or pellets. The pellets were gathered by the men, pressed together and moulded into larger balls. These were then ironed with hot stones, flattening them into small cakes, while folding them to drive out air pockets and further compressing the softened material into a homogenous mass (like potters wedging clay).

Brokensha (Appendix Table 1) noted that the resinous dust was heated by passing firebrands or flaming strips of bark over the mass to melt the outer surface and cause it to run together to form liquid pellets that were then compressed— in Greenway's example, moulded while soft onto a stick 'handle', and, in Brokensha's case, compacted into a ball.

Binford recorded the most detail, even mapping the processing site. Greenway and Brokensha were very brief, although Brokensha included eight captioned photographs. Binford did not consider that the identification and procurement of the *Triodia* grass were steps in the manufacturing procedure. Only Greenway described procuring of the grass tussocks, stating that the men tore the 'spinifex out of the sand' (Greenway, 1972, p.202). Binford suggested wind-caused abrasion of the leaves on rocks caused exudation and disagreed with Greenway's claim that resin exudates were caused by a parasite. In my own experience, exudates of pure resin may be found on undamaged *Triodia* leaves on plants growing both on sand plains and on rocky areas, suggesting they are not the result of abrasion (See Appendix Fig 1).

1967 **Pitjantjatjara (Greenway 1972)**	**1972-75** **Pitjantjatjara (Brokensha 1975)**	**1974** **Alyawara (Binford 1984)**
Cause of resin deposits		
Grass infested by parasites	No data	Grass abraded on rocks
Initial procedures		
(1) Threshing grass on natural rock floor	Threshing grass over cloth	Threshing grass on natural rock floor
(2) Sweeping up dust with expedient grass broom	Dust collected in cloth.	Sweeping up dust with expedient grass broom
(3) Transfer of dust to manufactured and curated wooden bowls	No transfer to other container noted.	Transfer of dust to expediently produced bark winnowing trays
Cleaning of resin dust		
(1) Winnowing and cleaning *by women*, using curated wooden bowls	Passing dust through fly screen *by men*, to remove large grass stems. ***Binford missed Brokensha's photograph of winnowing with a curated wooden bowl.***	Winnowing and cleaning *by men*, using expediently produced bark trays
(2) Cleaned dust heated, placed on/in unknown surface ***Greenway notes the dust was winnowed in wooden bowls and it may be inferred that the heating process took place in these bowls.***	Cleaned dust transferred to table rock for further processing	Cleaned dust collected in bark containers
Methods of heating resin		
(1) Heating of surface using fire brands	Passing fire brands over dust exposed on table rock	Placing bark trays directly on fire and stirring
(2) Resin moulded into a ball mounted on a stick	Resin compacted into a hand-compressed ball	Resin compacted into a hand-compressed ball ***Resin ball transferred to unheated flat table stone***
(3) No data	(3) No data	Gray ball ironed with heated flat rocks ***On a flat unheated table stone***
(4) No data	(4) No data	Melted resin dust, transformed into black gum so that gray ball is transformed and shaped into a tablet

Appendix Table 1. *Triodia* resin manufacturing procedures as presented by Binford (1984:175) with Akerman comments added in bold italics.

Binford suggested that Greenway did not get the idea that the exudate derived from insects from his informants but from a caption provided by respected entomologist and anthropologist Norman Tindale (1974, Plate 37). In 1896, Baldwin Spencer had written on the 'porcupine grass ant' (then known as *Hypoclinea flavipes*), and noted the presence of two or more Coccidae (soft-scale insects) in sand and resin chambers constructed by the ants, that may be found on the leaves of spinifex (Spencer, 1896, pp.69–72). The Coccidae are tended by ants, which in return are assumed to receive nourishment in the form of fluids exuded by them (*ibid.,* 70). These tunnels and nests are constructed of grit-filled resin. As well as the ant-constructed structures, exudates of virtually pure resin appear to seep naturally, particularly in hot weather. This relatively grit free resin oxidises or weathers to a light grey colour (See Appendix Fig 1).

Appendix Fig 1. Resinous exudations on *Triodia* leaves that indicate that the plant is a good source of resin. Balgo WA. 1998. [Akerman photo]

Other Evidence

Stirling (1896, p.63) provided a concise description of *Triodia* harvesting and resin manufacture in central Australia, for cementing and mending artefacts. Roth's (1897, pp.101–102) brief description (in Queensland) included the use of hot stones to pound the melting resinous dust, to compress and consolidate it. Mathews (1964, p.96) described a process in the Warburton Ranges area, Western Australia, whereby the tussocks of *Triodia* were fired and then globules of resin were gleaned from the burnt debris and cleaned by yandying. The clean pellets of resin were then melted and run together by holding glowing sticks over them. In a footnote to Mathews, the editor of the *Western Australian Naturalist* noted remarks of Cleland: "I have not heard of this way of obtaining 'Spinifex" gum before. The way I have seen is beating the *Triodia* basal stems on a rock surface and so dislodging the 'gum'. The native women could easily separate the 'gum' particles by yandying in a pitchi [wooden bowl]" (Mathews 1964, p.96)

Cleland also described how heated stones were used to melt the resinous dust that was extracted by beating and cleaning (Cleland, 1966, pp.121–122, 146–147). Cleland noted that a piece of bitter bark is chewed to create a flow of saliva, which is allowed to fall on the melting resinous matter (Cleland, p.147, Fig. 21). Later, Latz (1995, p.290) identified the bark as that of *Acacia pruinocarpa* and probably *A. estrophiliata*. According to Clark (2012, p.145) mulga, presumably *Acacia aneura*, foliage was also used.

A more detailed description also from the Warburton Ranges, WA, is provided by de Graaf (1967, pp.117–119). The area of manufacture described by de Graaf, was a preferred resin-manufacturing site, featuring a large flat-topped rock, approximately one metre in diameter and about 60cm above the ground surface, and the smooth surface 'showed signs of having been utilised often' (de Graaf, p.117). Tussocks of *Triodia* were collected by the gatherer group, who pushed them sideways out of the ground with a foot. The tussocks were then placed on the flat-topped boulder. A length (60cm) of mulga wood was used to beat the grass and release the resin. He noted that a mat of emu feathers could also be used to beat the grass if no suitable rock surface was available. The resinous residue was cleaned by sifting through the fingers to remove the coarser chaff, although the indigenous people also noted that the dust could be sifted through twigs from a mulga tree. The clean material was then heated by passing over a burning strip of dry mulga bark. If the resin or the bits of chaff still remained alight, the fire was extinguished or the burning dross removed. The mass was then pounded with smaller stones, possibly old hand stones once used for grinding seeds or other foodstuffs. The process of heating and pounding was repeated several times and de Graaf noted a colour change from yellow to black.

Gould (1970) did fieldwork in the Warburton Range area examining the material culture, ethnoarchaeology and archaeology of peoples between the years 1966 and 1970. His account of resin manufacture is detailed (Gould, pp.38–40). Gould noted that women usually prepared the resin. The sequence of activities recorded by Gould include locating the appropriate tussocks of *Triodia*, collecting clumps of the grass and taking them to a suitable place (either cleared hard ground or a flat rock) and then beating the collected plants. The resultant pile of resinous dust and chaff was then winnowed in a coolamon. Gould also noted that the dust could be further refined by being passed through the fingers, while held above a coolamon, so that a light breeze would blow away the finer chaff whilst the heavier resin dust fell into the bowl. The collected dust was then taken back to the camp for further processing.

At camp, a strip of burning bark was moved back and forth over the resin dust in the coolamon. Gould noted that the surface of the resin melted initially and then a stick was rolled back and forth in the melted resin. This action allows the melted mass to accumulate and, at the same time, pick up the dust material, which is then exposed to heat and melts. This process is continued until all the material is transformed from dust to a solid mass of resin. The resin is then removed from the processing stick and further moulded or compressed into a compact cake. It was then considered ready for use (Gould, 1970, pp.39–40).

More recent accounts of resin preparation are provided by Thomson (1975, pp.111–112) and Latz (1995, pp.66, 290–293), which is summarised in Appendix Table 2.

Latz (1995, p.66) stressed that the strength and quality of the resin depend on several factors including the particular plant, from which it is obtained, the age of the exudation and the amount of chaff incorporated in the final resin cake. Thomson (1975, pp.111–112) described how the indigenous groups used the soles of their feet to kick out the clumps of *Triodia* during collection. I have seen clumps kicked out, dug out using digging sticks of either wood and metal, cut from the ground surface with metal spades, and also gathered in the arms and pulled out of the ground (See Appendix Fig 2).

Appendix Fig 2. Woman carrying collected *Triodia* bush (*T. pungens*) to beating floor. Balgo 1991. Note the structure of the 'soft' spinifex plant. [Akerman photo]

Goddard and Kalotas (1988, pp.44–47) described a Yankunytjatjara narrative of the resin preparation from mulga leaves (*Acacia aneura*) and the preparation of an earthen floor, on which the leaves are beaten to release the resin. The floor preparation is the same as that used to prepare a surface on which to beat *Triodia* clumps, when a flat rock surface is not available. The process involves locating the flattened site of an old eroded termite mound that is cleaned with a tuft of grass to sweep off any loose dirt and expose the hard pavement (ibid., p.46). I have also seen small quantities of resin prepared for immediate use by first beating the collected *Triodia* grass in tin coolamons.

Appendix Fig 3. Women threshing collected *Triodia* bush (*T. pungens*) over a groundsheet. Balgo 1991. [Akerman photo]

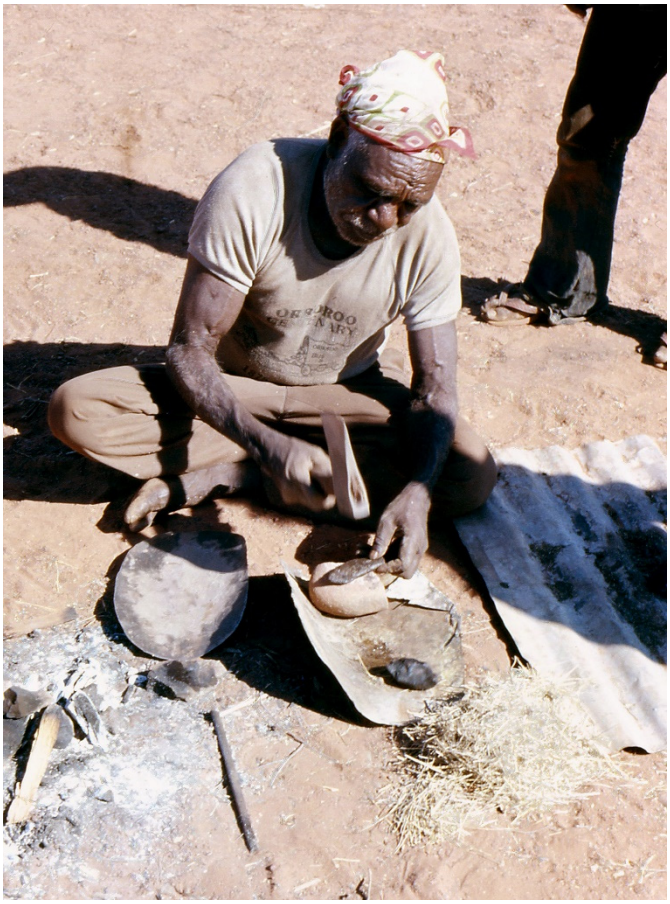
Appendix Fig 4. Women using wooden bowls to winnow concentrated resin dust. Balgo 1991. [Akerman photo]

1957 **Pitjantjatjara** **(Thomson 1975)**	**1995** **Pitjantjatjara** **(Latz 1995)**
Cause of resin deposits	
No data	No data
Initial procedures	
(1) Collect *Triodia* tussocks using feet to kick them free.	No data
(2) Threshing grass on flat rock pavement, or on a cleared area of hard ground, using a woman's digging stick or a man's spearthrower	Threshing grass on hard surface with sticks
(3) Sweeping up dust with expedient grass broom	Sweeping up dust
(4) No transfer	Dust placed in coolamon (material unspecified).
Cleaning of resin dust	
(1) Remove coarse material by hand	Dust winnowed
(2) Winnow chaff from concentrate through the fingers	Resin concentrate *yandied* using an undescribed vessel presumably a coolamon
Methods of heating resin	
(1) Heating of concentrate using hot rocks	Concentrate is heated
(2) Resin moulded into a ball while using saliva or sweat to wet the fingers to prevent sticking	Resin compacted with hot rock into a cake or with saliva-wetted fingers

Appendix Table 2. Brief summary of two *Triodia*-resin manufacturing accounts, provided by Thomson (1975) and Latz (1995)

Appendix Fig 5. Woman using heated rocks to melt concentrated resin dust on an expedient tin tray. She is squirting water from her mouth over stones and resin to control the temperature of the resin. Balgo 1976. [Akerman photo]

Appendix Fig 6. Woman using a smouldering brand to shape a consolidated resin mass in a wooden tray. Balgo 1991. [Akerman photo]



Appendix Fig 7. A man using a metal hatchet to pound and consolidate softened cake of prepared resin on an anvil stone placed on an expedient tin tray. The curated tin bowl used to winnow the resin dust is before the man's right foot. Balgo 1976. [Akerman photo]

Kimberley and Western Desert Communities

My own experience with the manufacture of *Triodia* resin includes observations made at Warburton Ranges in 1972; at Balgo and other south Kimberley communities in the 1970s and 1980s; and participating in the actual manufacture at Balgo in 1991 and 1998 (See Appendix Table 3). I have also recorded *Triodia* resin being used by peoples from the north-central Kimberley, the south Kimberley and in the Western Desert communities resident at Warburton Ranges, Cundeelee, Wiluna, Jigalong and La Grange. Although all the people demonstrating these activities were living in contemporary communities at the time, all had been raised in a more or less traditional environment, where the manufacture and use of indigenous manufacturing, hunting and gathering equipment was the norm.

On another occasion in 1976, I observed a Pintubi man processing a small amount of *Triodia* grass that had been collected and brought into the community at Balgo. The grass was broken up over a tray made from a scrap of tin, and then beaten while in the tray with the back of a metal hatchet. The coarse fibres were then removed by hand and discarded. The resinous dust left in the tray was then further cleansed by yandying in a curated tin bowl, then returned to the expedient tin tray. Hot rocks were moved through the refined material using short sticks. The heated mass was then manipulated using the sticks to form a cake of resin that was then beaten using the back of the hatchet as a hammer and the tray as a base (See Appendix Fig 7). The cake of resin was then moulded by hand against a small rounded cobble into a regular rod-like form, which was then painted with red ochre. In the north and central Kimberley men would also beat softened resin (acquired via trade, prior to using it, from the Fitzroy River Basin), while attaching the spur to a spearthrower, joining sections of composite spears, or attaching Kimberley points to them.

It has been my experience that while men may process small quantities of resin to fill immediate requirements, women, who are generally much more proficient at winnowing or yandying large quantities of material, are responsible for resin production when a greater mass of material is required for stockpiling or gift exchange.

1976 **Pintubi (Balgo)**	**1991** **Kukaja/Walmajarri (Balgo)**	**1998** **Kukaja/Walmajarri (Balgo)**
Cause of resin deposits		
Occur naturally	Occur naturally	Occur naturally
Initial procedures		
(1) Woman collect *Triodia* tussocks that show exudations of resin	A man and several women collect *Triodia* tussocks that show exudations of resin. Tussocks uprooted by kicking with the heels while sitting down or by using wooden and metal digging sticks	A man and several women collect *Triodia* tussocks that show exudations of resin. Tussocks uprooted by kicking with the heels while sitting down or by using wooden and metal digging sticks
(2) No data	Threshing grass over plastic groundsheet using metal and wooden digging sticks (Appendix Fig 3)	Threshing grass over tarpaulin using metal and wooden digging sticks
(3) Dust collected in flat cardboard carton	Dust collected on groundsheet	Dust collected on tarpaulin
Cleaning of resin dust		
(1) Winnowing and cleaning *by women*, using curated tin bowl	The bulk of *Triodia* leaves and larger chaff removed by hand from the beating surface Winnowing and cleaning by women, using curated wooden bowls (Appendix Fig 4)	The bulk of *Triodia* leaves and larger chaff removed by hand from the beating surface Winnowing and cleaning by women, using curated wooden bowls
(2) Cleaned dust placed on an expediently made tin tray	Cleaned resin dust transferred to aluminium pot. Further refining carried out in camp by winnowing in curated wooden bowls.	Cleaned dust collected in milk powder tin
Methods of heating resin		
(1) Hot stones pushed through mass of dust to melt it together. Water squirted from the mouth to quench any areas of resin that ignited or seemed to get too hot and on to the hot stones to reduce resin adhering to it (Appendix Fig 5)	Hot stones pushed through mass of dust to melt it together.	Resin dust placed in iron frypan greased with margarine and placed directly over the fire
(2) Resin moulded into a ball by hand	Resin compacted into a hand-compressed ball	Melted resin moulded into small flat cakes
(3) Resin ball folded and beaten with a rock while resting on anvil stone, to consolidate and compress it	Resin ball folded and beaten with a rock while resting on anvil stone, to consolidate and compress it. Heat maintained using a burning stick to keep the surface fluid (Appendix Fig 6)	
(4) Resin ready for use	Resin ready for use	Resin deemed ready for sale!

Appendix Table 3. Brief summary of three, *Triodia*-resin manufacturing events, witnessed by Akerman in 1976, 1991 and 1998

Binford (1984) emphasised that the Alyawara men used the expediently produced bark trays, earlier used for winnowing the resin dust from the *Triodia* chaff as vessels, were placed directly over a fire to heat and stir the resin dust (See Appendix Table 1). I would contend that the trays were likely rested above the fire on two stones rather than placed directly on the fire. It is lateral heat from the flames, rising around the green bark trays that melted the surface of the resin dust to form globules of resin. The stirring moved the now sticky globules around the unmelted material, picking it up and exposing it further to lateral heat and transforming it. I doubt that green bark would transfer heat through the base of the tray in the manner of a hotplate to melt the lower surface of the resin dust, and would expect resin residues to be seen adhering to the bottom of the tray,which was not observed.

I have observed women using frypans and other metal hotplates (See Appendix Table 3) to heat and consolidate *Triodia* resin dust, and the use of a bark tray placed over a fire (reported by Binford), is probably a direct influence of this practice. In all the cases I have seen, bar one, water was used to control the heat and prevent the resin burning or rising to such a high temperature that the adhesive qualities suffered although extensive areas of resin were always found sticking on the hotplate. When using hot rocks to melt the dust, the use of water or saliva to control the temperature of the resin and prevent burning, reduces the chances of the melted material adhering to the stones. Hotplates or frypans are used for heating resin primarily when demonstrating resin manufacture in a quick and dirty manner or when producing resin for sale to craft centres. In 1998, the use of margarine to prevent the resin sticking to the frypan worked wonderfully but rendered the resin virtually useless as an adhesive (See Appendix Table 3). There had been a misunderstanding that the final product would actually be used for sale rather than as an adhesive—if the resin looked right and could be sold as the real thing, there were no other functional considerations required.

Binford attempted to differentiate the behaviour of the Alyawara men and women in the use of specific tools—expedient bark bowls used by men in contrast with curated wooden vessels used by women. However, from my own observations and experience, men can use grindstones, wooden coolamons, digging sticks and spindles; and women can use hafted stone tools (Akerman, 1979; Love, 1942, pp.215–217).

It is easy to promulgate modern myths about technology. For example, novices believe that dry kangaroo dung is a necessary ingredient but I have yet to see a reliable reference to this and have never witnessed it myself. Another myth is that the spinifex ant, *Ochetellus flavipes* (Kirby) played an important role in concentrating and providing a ready supply of resin. Spencer (1896) noted that the indigenous peoples “do not make use of the resin already massed together by the ants to form their nests, but always get it by burning the leaves of the porcupine grass for themselves.’ He also observed that examination of many hafted artefacts incorporating *Triodia* resin do not reveal the quantities of sand in the mix that would indicate that ant nest resin had been used in their manufacture (Spencer, p.72). Moreover, the ant collected material is hard, brittle and of little adhesive value. Latz (1995, p.291) noted that kangaroo dung or plant fibres may be used as a strengthening agent but, because of the amount of sand incorporated naturally into the mix, it is inferior to that derived directly from the plant. This is particularly so in my own experience if the area in which the ants live has been subjected to firing. Lowe with Pike (1990, pp.67–68) described how the Walmajarri in the northern Great Sandy Desert, pound the ant nests and then use a coolamon, expedient bark tray or, more recently, a metal pot or pan, to yandy out the excess grass and dirt. The concentrate is then heated and formed into large lumps.

My argument suggests that the use of ant-derived *Triodia* resin is a relatively recent practice in the south Kimberley (Akerman, 1980, p.246; see also Lowe with Pike, 1990, p.68. With the introduction of metal tools, particularly those that replaced the traditional hafted flaked-stone adze, the need for good resin declined greatly. Being very brittle and not as malleable as plant-derived resin, the ant bed material was probably primarily used to repair holes in wooden bowls and other vessels, although it still played an important role in the exchange networks that linked the desert and adjacent north Kimberley regions (See Appendix Fig 8; Akerman, Fullagar and van Gijn, 2002).

Appendix Fig 8. Hafted cakes and plug of prepared fine quality *Triodia* resin from Western Australia. Akerman Collection. High-grade resin was important in the construction of the composite Kimberley spear and the hafting of the stone, and later glass or metal spear, point. [Akerman photo]

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