The Excavation of the Mount Wood Woolscour, Tibooburra, New South Wales

MICHAEL PEARSON

In this paper the author, who is Historian in the New South Wales National Parks and Wildlife Service, reconstructs the little-known process of station-based woolscouring from documentary and archaeological evidence. It is argued that the relatively late survival of this form of scouring in western New South Wales resulted primarily from severely limited transport facilities. The considerable variation in scour design, evident in the literature and at Mount Wood, is attributed to individual adaptations to environmental constraints, primarily the availability of water and building materials. The economics of woolscouring in different environments is discussed and questions raised for further research.

1. INTRODUCTION

Mount Wood Station, now part of Sturt National Park, is located 23 kilometres east of Tibooburra, in the extreme north-western corner of New South Wales (Fig. 1). The property was first taken up in 1883 by Captain Dorward, and after several moves the homestead and woolshed were located in their present positions in 1892. The woolscour, the subject of this paper, was built in 1897, although a more primitive scour may have existed on the station before that date. The National Parks and Wildlife Service of New South Wales is currently involved in the development of displays in the homestead and woolshed area to explain to visitors the problems of water raising and use in the arid north-west. As part of this interpretation programme, the conservation and presentation of the woolscour is being planned. The first step in this project was the study and excavation of the area of the scour tanks to ascertain their construction, the condition of the materials used in them, and to give a more complete picture of the scour to enable the most appropriate conservation approach to be adopted.

As well as having this purely practical aim, the excavation was also motivated by research considerations. As will be seen from the discussion below, there is little in the historical literature regarding the technology and processes involved in this particular form of woolscouring, and it would appear that very few examples of similar scours have survived, perhaps none in as good a condition as that at Mount Wood. The excavation was therefore aimed at basic questions such as the nature of the process employed in scouring, the existence of evidence of modification of the process to cope with local conditions, and the existence of any water retention systems developed in this arid area.

The excavations were carried out in two seasons, a test excavation in March 1982, and a more complete excavation in May 1983, with the help of a total of nine volunteers.

2. HISTORICAL BACKGROUND TO WOOLSCOURING AND SCOURING TECHNIQUES

Throughout the second half of the nineteenth century a disagreement existed in the grazing fraternity regarding the effectiveness of sheep washing over woolscouring as a means of cleansing fleeces.

The aim of both processes was to remove grease and dirt which made up 50 per cent or more of the weight of most Australian fleeces.[1] This weight reduction was of great significance when wool bales had to be carried long distances by primitive transport. Mount Wood fleeces, for example, had to be transported on camel backs or in camel drays to the nearest river port, Wilcannia, over 300 kilometres to the south.

Sheep washing was the sole method used in the early days of the colony, and it still held sway in some areas until at least the 1880s.[2] Various methods of sheep washing were developed, ranging from simple cold-water washing, through to the use of hot soapy water baths followed by cold rinsing, using complicated troughs and overhead spout systems. However, as small-scale station-based woolwashing was pushed back to the more isolated areas towards the end of the nineteenth century, it often became hard to find sufficient water for sheep washing and sufficient areas of dust-free paddocks in which to dry wet sheep, and therefore woolscouring became more common. Woolscouring was also held by many to be more effective than sheepwashing.

Woolscouring, that is washing the fleece after it has been shorn from the sheep, was not a new process by any means. A method of scouring very similar to the most basic method used in New South Wales was illustrated by Diderot in 1751,[3] and various forms of woolwashing extend back into antiquity. The earliest reference I have found to woolscouring in Australia is to the establishment of a scour at Mount Clay near Portland, Victoria in 1846.[4] The process became more common in the 1860s,[5] and would appear to have completely replaced sheepwashing by the 1890s.

Woolscouring took two basic forms, station-based manual scouring, and large scale centralized mechanical scouring. The bulk of the descriptive literature available refers to mechanical scouring, a method developed in the 1850s.[6] Mechanical scours, in which the wool was passed by mechanized rakes through a series of tanks or bowls containing washing and rinsing liquids, became common in Australia in the 1870s.[7] Towards the end of the nineteenth century, wool manufacturers started to become more particular about the quality of the wool they accepted, and mechanical scouring became more common, as did the export of greasy wool not scoured at all. Some stations invested in small mechanical scours, but it is not certain how common this practice might have been.[8] By the 1920s what

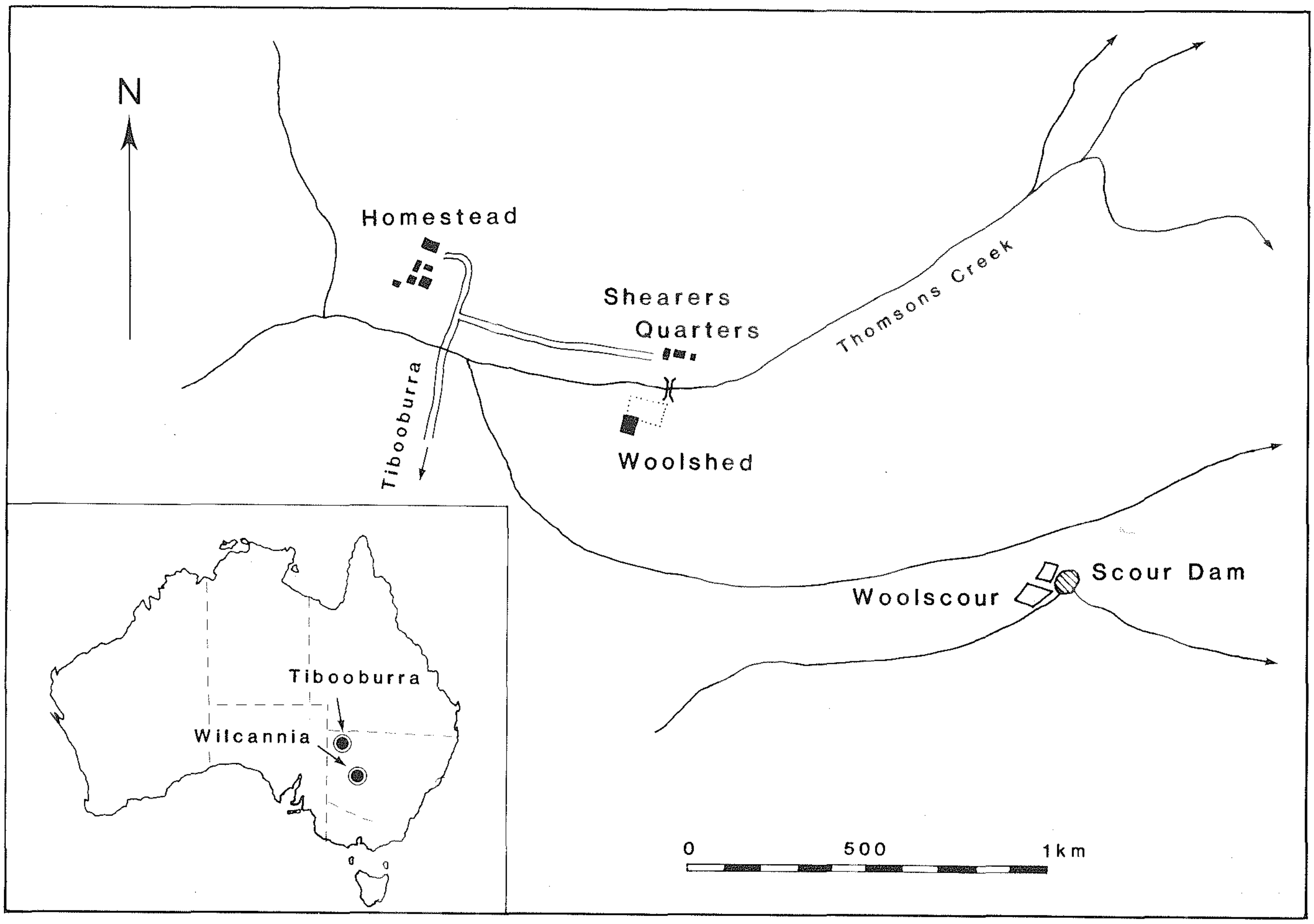

Fig. 1: Part of Mount Wood Station, showing the relationship between the homestead, woolshed and woolscour. The apparent confusion in the creek system is due to its being braided, as is common in this area.

little scouring was still being carried out in rural areas was done almost without exception by town-based mechanical scours, where quality control could be assured.

The Mount Wood scour is of the station-based manual type, and therefore greatest emphasis in what follows is devoted to this process. Station-based scouring, as I have termed it, can itself be divided into at least two main types, pot-stick scouring, and the box-washing system, which itself had several variations.

Pot-stick scouring was the simplest method, in which fleeces were washed with hot water and soap in a cauldron, being stirred with a stick, before being rinsed, drained, and dried in the sun. This method was in use into the first decade of this century in some areas.[9]

An advance on the basic pot-stick method was the hand box-washing system, which consisted of a series of square boxes arranged in a row, with drainage boards between them. Inside each timber box was a wire or perforated box or basket with a 2–3 inch (5.0 – 7.5 cm) space left between the basket and the box walls, to allow free circulation of water. Water was fed into each box from overhead tanks, the water being heated by steam injection in the soaking boxes, where soap was added. The wool was then transferred from the soaking boxes into rinsing boxes, and after the soap and dirt was rinsed out the wool was usually partly dried in a centrifuge spin dryer (hydro-extractor) before being spread out on sheets in the sun to dry completely.[10].

Variations on this system seem to have abounded. Two main variations were river-based tank and box-scouring, and dam-based tank and box-scouring using William's boxes (see description below).

In the river-based variety the rinsing of the fleeces, after the hot soapy washing, was carried out in perforated boxes (usually of zinc) suspended in a river or dam. Sometimes the rinsing was done from a platform, sometimes from a moored punt.[11] Given the amount of suspended silt in most Australian rivers, the fleeces produced by this process must have still retained a reddish tinge.

From the photographic evidence available it would appear that the hot washing phase was usually carried out in directly heated iron 'ship tanks', the ubiquitous 123cm-square nineteenth-century shipping containers, which were usually cut in half for the purpose, each thereby supplying two washing tanks of convenient size. These tanks were often benched into the steep river banks, and the washed fleeces were slid down iron troughs, or carted in barrows, to the rinsing platform or punt in the river. From there the fleeces were hauled back up the river bank by a variety of methods, to be spin-dried or simply spread out to dry before being baled.

Scouring at riverside locations, where river-steamer transport was often readily available, was usually restricted to the dirtier parts of the fleece, the finer wool being sent off greasy. The benefit of scouring the whole clip was reduced by the differential rates charged by river-boats for greasy and scoured wool. By 1876, for example, greasy wool was being carried from Bourke to Goolwa for five pounds five shillings per ton, while washed wool cost seven pounds fifteen shillings per ton.[12] The grazier was involved in a complex set of sums in calculating the relative costs of scouring and transport compared with the differing prices being paid for washed as opposed to greasy wool at any given time. Wool prices fluctuated widely, month by month, so a calculation made at the time of the clip might be out of date by the time the wool reached the market. The changes in price year by year were even more dramatic; for example at the Sydney market

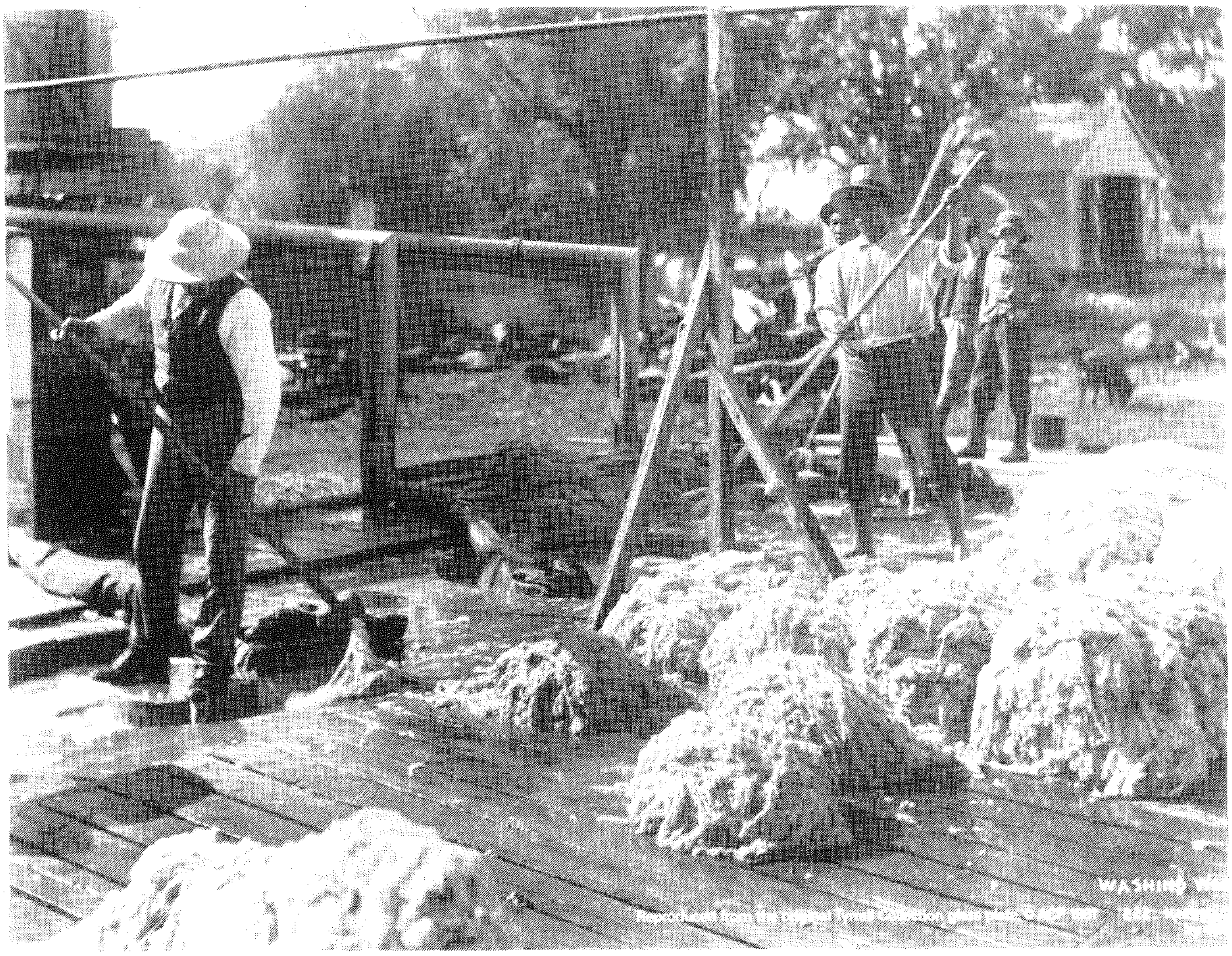

Fig. 2: *This Kerry photograph, taken in the last decades of the last century, shows Chinese workers operating an unidentified woolscour. Three William's boxes can be seen in the rinsing tank, with boarded work-platforms between them. Water is supplied from elevated tanks (upper left) through pipes to slotted nozzles in each William's box. The scoured wool lies in heaps on the draining floor to the right, the hydro-extractor being perhaps to the right of the photograph. The man to the left stands on the oval 'tub' in the middle of one of the boxes, removing rinsed wool with a fork. (Reproduced with the kind permission of Australian Consolidated Press.)*

in 1872 scoured wool reached 26½ pence per pound, and greasy wool reached 15½ pence per pound, while in 1876 scoured wool had fallen to 15½ pence and greasy to 8 pence per pound.[13]

This crude cost/benefit analysis applied also to the second main variety of box-washing, the dam-based tank and William's box system. There are almost no detailed descriptions of this technique in the historical sources so far located, and this description is based, as was that of the river-based system, on photographic evidence and a few scraps of documentary evidence.[14] It is the dam-based tank and William's box system which was more fully investigated and explained during the Mount Wood excavations, as discussed below. This technique employed hot tank washing (as in the river-based system), but the rinsing was carried out in a large tank built either of concrete or timber and iron, in which a number of circular perforated boxes were suspended. The washed fleeces were placed in these boxes while water was poured through them from overhead tanks, the dirt, grease and residual soap being washed out of the boxes, into the tank and away from the fleeces. It was really only an elaborate substitute for the perforated boxes submerged in the river, described in the previous technique. Water for the rinsing was pumped from a nearby dam, or occasionally from a river or creek.

The circular perforated boxes I have identified as 'William's boxes' based on four pieces of evidence. One book on the subject states that: 'there are several methods of scouring, such as pot-scouring, William's boxes, and by machine', and goes on to define William's boxes as: 'Apparatus for washing the dirt out of wool after it has been soaked in the hot scouring liquid'.[15] The second piece of evidence is in the Mount Wood Letterbooks, where an entry for July 1897 lists the equipment at the woolscour for stocktaking purposes.[16] This list includes '4 William boxes', valued at twenty pounds. The third piece of evidence is a Kerry photograph,[17] in which a series of circular metal boxes with an oval inverted tub-like object in the centre are shown sitting within a larger tank or trough (Fig. 2). A workman stands on top of the inverted oval 'tub' in order to move the fleeces about with a fork. Lastly, during the work at Mount Wood the remains of several of these circular boxes were found near the scour, complete with oval 'tub' and perforated sides, at a scour known from documentary evidence to have used William's boxes.

Putting these four pieces of evidence together, leads to the conclusion that William's boxes are these circular perforated metal boxes with a smaller oval inverted box or tub in the centre.

From photographic evidence it is obvious that the fleeces were taken from the William's boxes to a draining floor, put through a hydro-extractor, and then taken off to drying yards before baling. In one photograph[18] a very crude hydro-extractor is shown, clearly a locally made piece of machinery.

Often in the literature it is impossible to distinguish which type of scouring operation is being referred to, although it can be generally assumed that references to town scours are likely to be about mechanical scours, while station scours are likely to be either river-based or William's box types. Some of this evidence, though not specific as to the technology involved, is worth discussing here, as it throws light on several aspects of scouring in the nineteenth and early twentieth centuries.

Of particular interest on the Darling River is the relationship between professional scourers and the stations. The evidence suggests that in the Bourke area, at least, (lack of evidence prevents us saying what happened elsewhere) scourers travelled from station to station, either independently or in conjunction with the shearing contractors, and in some cases appear to have taken their own scouring equipment with them. The following quotes, from various 1870s sources, illustrate this:

'Topham's Plant arrived to begin the scouring, and at last the shearing finished, just 10 weeks after it began . . . Topham proceeding very slowly with the scouring, but finally loaded Davy with 56 bales on the two wagons.'[19]

'17 shearers and wool washers waited at Ouringperry for Topham to begin the shearing . . . Topham scouring wool.'[20] [This implies Topham was both shearing contractor and scourer.]

'Shearing began and Barton's plant arrived for the scouring, Mr Wilson noting that this was going along very slowly, Barton scouring at the rate of barely 5 bales a day.'[21]

'The successful woolscourer Topham was about to start at Hood and Torrance's, but they have decided to send away their wool in grease, and so now he goes down the Darling. He has a staff of 70, superintended by Mr Blakey.'[22]

'"Jandra" (Mr Guiness) is shearing 17,000 sheep. Mr Wall, scourer, has moved his plant there, and has scoured altogether 200,000 this season.'[23]

In other cases, it is clear that some stations built their own scours. For example, at 'Toorale' near Bourke in the mid 1880s, it was reported that:

'A new wool-scouring works, with every up-to-date equipment had been installed . . . Carney Creek supplied the wool-scouring works and shearing shed with water. The shearing shed and wool-scouring works were like a large factory. There were huge galvanized iron sheds where the shearing took place. The same where the wool was scoured, dried, and pressed into bales . . . As fast as the wool was scoured and pressed it was taken by bullock and horse teams to the railhead at Bourke.'[24]

Much discussion in the nineteenth-century literature was directed to the effectiveness or otherwise of different soap types and alkalies used in scouring. The traditional cleanser was stale urine, or 'ley', which as late as 1911 was still stated as being the best for mildly greasy wool, used in the proportion of one gallon of stale urine to five of water.[25] Sometimes urine was used as an addition to other cleansers. An example of this is referred to in a letter from a woolscourer, J.L. Corrigan of Hay, to J.B. Macleay Esq. of Booligal in 1897:

'Dear Sir,
I loaded yesterday, per carrier John Brannock, some magic soap, and 1 tin of ammonia, 14lbs, to treat the sandy wool with. This and plenty of hot water, I think it will come up tolerably well: of course it might show a reddish tinge. Use some of your ordinary soap with Magic, and some ammonia, as much urine as you can collect in old buckets. I prefer it to ammonia. In fact, when I scoured the "Paddington" clip I used as much urine as the men could make, and found it thoroughly cleaned the wool, making it nice and open. The ammonia and magic soap are also two very strong cleansers.'[26]

There was much experimentation with soaps and alkalies. Soda soap was said to make the wool brittle and yellow, and while soda ash was cheap and quick, it was also injurious to the wool.[27] Potash soaps or ammoniac soaps, with little free alkali, were generally accepted as being the best, these being used at the rate of one to one-and-a-half pounds (0.45 – 0.68 kilogramme) of soap per bale of wool, in water heated to between 100 – 130 degrees fahrenheit (37.4 – 53.9°C).[28] On some stations these soaps were manufactured on the property using tallow, while in other cases the soap was bought commercially. The scale of some of these operations is indicated in this extract from the 'Thurlagoona' Letterbooks (near Cunamulla, southern Queensland), dated 12 March 1897: 'Wool: noted you did not want any wool sent away in grease. Scour. Have not yet made any soft soap, but now have a man who understands the work so hope to be able to make some if your will order 6 tons we will make the rest.'[29]

The common problem of poor soap quality and the failure to control water temperature combined to give station-based scoured wool a poor reputation among wool buyers, and from the 1880s onwards the scouring of the entire clip before it left the station became less common. As has already been pointed out, this led to a growth in town-based mechanical scouring, where quality control was easier to ensure. Another factor contributing to this practice of scouring only the dirtier portions of the fleece was the scarcity of water on many stations. This was particularly critical in western New South Wales, as will be seen in the discussion of the Mount Wood Scour below. An example of the proportion of greasy to scoured wool leaving a station is given in the 'Thurlagoona' Letterbook for the period 1888–1891: 30 September 1888, produced 2000 bales greasy wool, 736 bales scoured wool; 1 November 1889, 259,793 sheep shorn, 2374 bales sent to market, 292 bales to the scour; 13 January 1891, of 4166 bales produced, 304 bales sent to scours.[30]

By 1907, a farmer's handbook was advising that it would only pay the small grower to scour the heavier lots of wool if a long trip to market was necessary, where transport costs would exceed one penny per pound weight of wool. The handbook pointed out that of recent years overseas buyers had been buying greasy lots, and that centrally located Australian scourers were buying up greasy small lots, suggesting that it might be more economical to consign the bulk of the clip to market in grease, and the heavy small lots to central scourers.[31] In other countries similar changes were occurring, for example in Canada by 1917 farm-washed wool was not being accepted, as it had been shown that mechanical scouring could remove dirt and grease equalling another 15 per cent of the weight of fleeces already scoured on the farm.[32] However, in Australia, scouring survived on the more isolated stations, such as Mount Wood, until the 1920s or 30s.

While many argued about which soap to use, few seem to have considered the retention of yolk (fat) from the scouring process to produce lanolin. Overseas scourers were in intense competition, and the retention of lanolin, simply by filtering the scour liquor, was a source of additional economic return. However, there seems to have been little or no lanolin retention practiced in the nineteenth century in Australia, even among town-based mechanical scourers.[33] The reason for this is not clear, as the technology for lanolin extraction is extremely simple. It may have been that there was a relatively low demand for lanolin by Australian chemical industries, and that the export market was already saturated. However, more study is required in order to explain this failure of the Australian wool producers to adopt a potential source of additional income.

3. HISTORY OF THE MOUNT WOOD WOOLSCOUR

Mount Wood station was taken up as a lease by Captain George Dorward, probably on behalf of the consortium: Moore, Dorward and Palmer of Moama, in 1883. The lease covered approximately 500,000 acres (202,347 hectares). The homestead for the property was moved twice before the present location was chosen in 1892, and the existing homestead was built in 1897.[34]

The woolscour at Mount Wood was probably built in 1897, and almost certainly post-dated the final move of the homestead and associated functions to their present locations in 1892. The Mount Wood records for 1897 include a stocktaking list of equipment located at the woolscour. This includes the following items:

Item		Value in pounds, shillings & pence
1 engine, pump & tanks		320. 0. 0
1 hydro-extractor		100. 0. 0
1 woolpress		35. 0. 0
1 woolcart		12. 0. 0
4 William boxes		20. 0. 0
1 platform scale		7. 0. 0
140 woolsheets		60. 0. 0
8 woolforks		1. 4. 0
2 shovels		5. 0
2 tarpaulins		2.10. 0
1 set stencil plates		15. 0
6 wool baskets		1.10. 0
	Total	£560. 4. 0

In the same year there was an account for masonry work on the soak tank and woolscour. This was valued at eight pounds two shillings, with materials and carting being one pound eighteen shillings extra.[35]

The woolscour was established just as the effects of a disastrous period of drought were being felt. The western division of New South Wales had from the 1860s been progressively stocked with coarse-woolled sheep to meet the British and European demand for worsted fabric. Sheep numbers increased during a series of good years, only to crash in the late 1890s due to the drought. Sheep numbers west of the Darling stood at 7,700,000 in 1891, but had plummeted to 2,800,000 in 1901.[36] The stock numbers at Mount Wood reflected this decline, falling from 65,733 sheep in 1894 to 39,954 in 1899. The former stocking rates were never regained, and indeed fell even further, for example down to 6580 sheep in the 1926 drought, and the stocking rate stood at only 25,000 in 1972, immediately before the station was incorporated into Sturt National Park.[37]

It has not yet been possible to analyse the Mount Wood Letterbooks and provide a year-by-year breakdown of the percentage of the annual clip that was scoured, but figures are available for a few years. In 1899, a drought year, 600 bales were scoured, which must represent a large proportion of the year's 160,313 pound clip. On the other hand, in 1918, in the middle of another drought, only 24 bales were scoured, out of 757 bales of wool produced, perhaps reflecting low water levels in the scour dam after prolonged drought.[38]

A similar problem affected scouring on nearby 'Connulpie Downs' station in 1899, where the scour had to be shifted to a new waterhole halfway through the scouring. 'Connulpie' also suffered from not having a hydro-extractor, which necessitated exposing the wool in the drying yard for four times the time otherwise necessary. Occasionally the fleeces had to be rolled up before they dried, due to dust storms.[39]

The longevity of scouring at Mount Wood (until the 1920s) was largely due to the difficulty of transporting the clip out of the isolated north-west. Crude and expensive transport necessitated reducing the weight of the clip as far as was practicable by scouring. Although camels did not predominate in the carting of goods and materials in the Broken Hill area until about 1915,[40] they were established in the Tibooburra trade from an early date. Whereas bullock teams could only operate on the Tibooburra route in good years, camels, which could travel for a week or more without water, were far more tolerant of the normal arid conditions. The owners of Mount Wood, in order to secure constant access to a camel team, and to reduce their transport costs, went into partnership with a Broken Hill camel team driver, Abdul Khalick, in or before 1899.[41] These camels carted the clip to Wilcannia, carrying up to 300 kilogrammes of wool each, or pulling twice that much on drays. The camel was king for only a few years, being gradually replaced on the Tibooburra run from 1920 by motor vehicles. The last camel team operated out of Broken Hill in 1929.[42]

With the relative ease of transport provided by the motor vehicle, combined with the market pressures against station-scoured wool referred to above, woolscouring became redundant, and the Mount Wood scours were abandoned in the 1920s. The site silted up with flood debris and wind-blown sand, the William's boxes were for some reason removed and dumped in the former drying paddock, but other than that the site was largely undisturbed until the current excavations.

4. ABOVE-GROUND EVIDENCE AND QUESTIONS POSED

Mount Wood woolscour is located approximately 1.8 kilometres south-east of the Mount Wood homestead, and 1.2 kilometres south-east of the woolshed (Fig. 1). The scour was built beside a small intermittent tributary of Thomson's Creek, which flows through very gently undulating country towards the Bulloo Overflow country to the east. The unnamed creek at the woolscour is dammed to form the scour dam. The dam has been enlarged in recent years, but was originally relatively small in size. This, together with the low 214mm annual average rainfall, would lead one to expect shortage of water to be one of the problems faced at the scour.

Adjacent to the dam is a Tangye centrifugal water pump, designed to be belt-driven from a detached engine (Fig. 3). The pump has an 8 inch (203mm) diameter intake pipe, which draws vertically from a sump built into the side of the dam, and now completely silted up. The water was delivered to a standpipe rising directly from the top of the pump to a height of about 2.5m, from which a pipe would have originally delivered the water to tanks resting on the tankstand (see below). Bush poles which once carried this supply pipe still stand. Adjacent to the pump, another set of upright posts marked what was tentatively identified as the shed which housed an engine to drive the pump.

Eight metres to the north-west of the pump is a series of upright posts in two rows, approximately 1.2m apart (centre-to-centre) and extending for 8m. These posts are joined at the top by horizontal rails, forming a long, narrow framework, 1.37m high, which I have interpreted as a tankstand. This tankstand would accommodate four ship tanks (123cm cubes) each of which would hold 400 gallons (1818 litres) of water.

Immediately adjacent to the tankstand, and parallel to it, is the top edge of a rectangular concrete tank, 8.26m long by 2.62m wide, with the exposed tops of the concrete tank

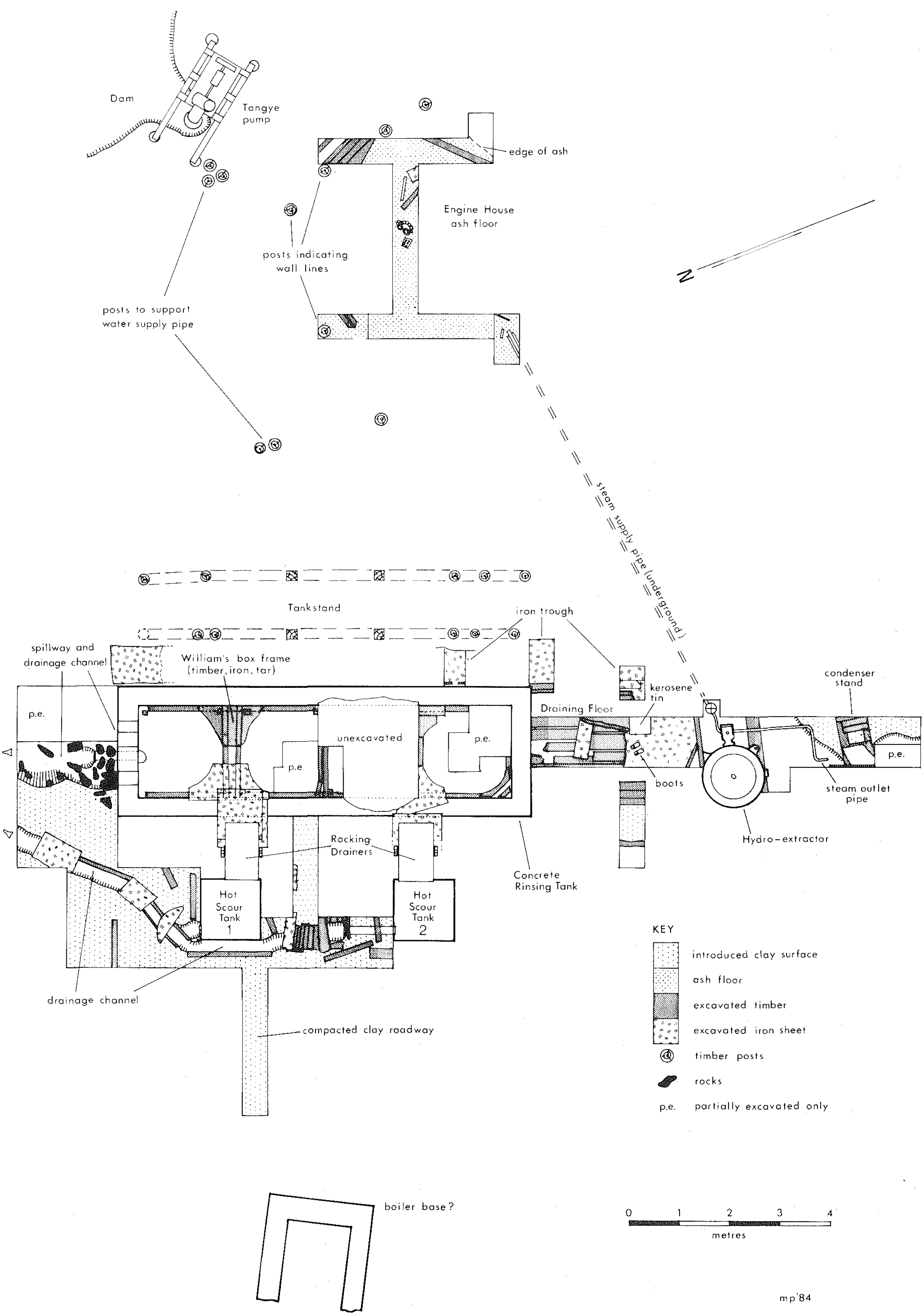

Fig. 3: Plan of the remains above ground and those located by excavation.

walls being 40cm thick. This concrete tank was for cold rinsing, and originally contained the four William's boxes, but before excavation the tank was silted up to the top of the walls.

Next to the concrete tank, and 1.2m from it, are two iron tanks, formed by cutting the tops off two ship tanks. Between these two iron tanks (which are interpreted as hot scour tanks) and the concrete tank are two rocking devices, consisting of perforated iron plates housed in a wooden frame. This frame is supported by two notched upright posts on which the whole could be tilted either towards the iron tanks or the concrete tank. The most likely explanation of the devices is that they allowed fleeces removed from the hot tanks to be drained briefly before being transferred to the rinsing tanks, thus allowing excess hot water and soap to drain back into the hot tanks. The rocking motion would simply enable this draining process to be done easily, then by tilting the frame towards the concrete tank would allow the workers there to pull the fleeces into their tanks for rinsing. The two rocking devices, which are shown on no known photograph of woolscours, are in a very poor state of preservation.

To the south of the concrete tank, and 3.5m from it, is a large cylindrical hydro-extractor, 122cm in diameter, bearing the maker's name in raised letters: 'Thos. Broadbent & Sons, Patentees & Makers, Huddersfield England'. Before excavation the hydro-extractor was buried in silt to such an extent that none of its steam piston or steam pipes were visible.

Five metres west of the iron hot-scour tanks is a stone masonry structure, which possibly held a boiler to supply steam to heat the scour water.

Four metres south-west of the hydro-extractor is the eastern fence of the wool-drying paddock. This is a roughly square paddock with sides approximately 50 – 60m long, built up of boughs placed vertically in the ground. Most of these have rotted to ground level. On the northern side of the drying paddock is the ruin of a small woolpress room, with parts of the press still lying around, where the dry wool was baled for shipment. A bough loading crane still stands adjacent to the press room. Near the hydro-extractor is a large portable steam engine, however this does not appear to be associated with the use of the woolscour, unless it was the original motive power for the water pump, in which case it has subsequently been moved.

All of the above features were heavily silted, so that drainage systems, water and steam supply lines, the interiors of the tanks, and any flooring or other on-ground features were buried from view.

The basic questions posed for the excavation were of two types. Of immediate practical importance was the need to identify the extent and condition of the built fabric on the site, to enable appropriate conservation plans to be developed. It was also necessary to gain some better understanding of the woolscouring process to enable a valid interpretation programme to be developed to explain the site to the public.

The second set of questions related more to the research aspects of the site. The first question was how did such a site work? The literature, as shown above, was of little direct use in sorting out the technology and processes involved. During the short test excavation questions became more specific: what were the water retention systems used; what was the water consumption of the process; what was the extent of boarded area revealed in a small test pit; were underground steam lines used to heat the hot scouring water; what was the nature of the internal timber structure inside the concrete tank; were the water pump and hydro-extractor powered from a single engine; what was the direction of wool and water flow through the site and how was the wool transported? Most of these questions were answered by the evidence uncovered during the excavation, and a very good picture of this type of station-based woolscour was built up for the first time.

5. THE EXCAVATED ARCHAEOLOGICAL EVIDENCE

The excavations will be discussed in four parts:

1. the hot scour tanks and adjacent areas;
2. the concrete rinsing tank;
3. the draining floor and hydro-extractor;
4. the engine shed.

The layout of the scour is shown in Figure 3.

Standard archaeological excavation techniques were employed using a fixed reference point grid system. The deposit consisted basically of three clearly defined units: post-1920s silts and sands; woolscour fabric and associated deposit; and pre-woolscour natural soil. The only post-woolscour element of cultural origin in the deposit appears to be a chicken-wire netting fence, which was found in several parts of the site within the upper deposit. This may indicate that the area of the scour was fenced off as a chicken pen or for similar purpose after it ceased operation.

5.1 The hot scour tanks and adjacent areas

The bases of the two iron ship tanks, which I have identified as hot scour tanks in Section 4 above, were excavated, together with the drainage channel and working floor around them. The bases of the two hot scour tanks consist of the filling-port sides of the ship tanks (i.e. the ship tanks were inverted and their bases cut off to form the scour tanks). The screw-mounted lids for both tanks are intact. On the northern side of each tank, centred approximately 20cm from the north-west corner, and elevated 6cm above the base, is an 11cm-diameter drainage hole which feeds into the common drain leading from each tank. An 'L' section angle iron runs completely around the inside of each tank, 15cm above the base, to support sheets of perforated iron, a piece of which was found in one of the tanks. This perforated false bottom can be interpreted as a method of ensuring that the fleece did not come into contact with the dirt just washed out of it. A large proportion of the solid dirt would fall through the perforated plate to be flushed out through the drainage hole at the base, a similar principle to that of the perforated William's boxes in the rinsing phase.

The northern-most hot scour tank (henceforth Hot Scour Tank 1) drained directly into a roughly hemispherical sump dug into the introduced clay described below. The water then fed from this c.30cm-diameter sump over a timber sill into a timber-edged channel leading away to the north-east. This channel, which varied in width from 20 to 30cm and in depth from 20 to 33cm below the ground level at the time of operation, is a continuation of a channel or drain leading from the southern hot scour tank (henceforth Hot Scour Tank 2). The draining hole of Hot Scour Tank 2 is connected to a 1-metre-long cast-iron pipe of the same diameter (i.e. 11cm), from the end of which the scour water discharged into another sump, or an enlargement of the end of the channel.

The drainage channel which drains both hot scour tanks and flows off to the north-east into unexcavated deposit, is cut variously into the introduced clay surface and into the natural alluvium and heavy clay soil. At various points along its length, as can be seen on the excavation plan (Fig. 3), this channel is bridged with both timber and metal covers. These covers consist of off-cuts from planks and boards, galvanized flat and corrugated iron sheets, a boiler door and what appears to be part of a boiler wall plating. It is possible that the channel was originally covered for its entire length, to allow safe working in the area and reduce the amount of water splashing about.

The whole area west and north of the concrete rinsing tank, surrounding the hot scour tanks, and extending as far as the stone boiler housing to the west, was covered with a thick layer of white sandy clay. This material, through which the drainage channel is cut, would appear to have been transported to the site from a distance as yet unknown,[43] to provide a working surface more capable of withstanding wet conditions than the natural alluviums and heavy clays over which it is lain. This natural soil is very tacky when wet. The clay surface would also reduce the level of dust on the scour site in dry times.

Around the hot scour tanks and drainage channel were several areas where remnants of hessian cloth (bagging material?) or the impression of it were found embedded in the top of the clay layer. This may indicate the spreading of hessian to improve footing in the slippery, wet conditions around the scour.

The clay layer, which is approximately 25cm thick in most places, has a large percentage of stone mixed with it in the area between the hot scour tanks and the stone boiler foundations to the west. Across this 5-metre space the clay surface (which is approximately 18cm below present ground surface) is almost level. This together with the high stone content, suggests a heavy-duty working surface, it probably being the road where carts were driven into the scour site carrying greasy wool.

The supply of water (and/or steam) to the hot scour tanks was the subject of one question asked in this area archaeologically. There was no archaeological evidence found for underground water or steam pipes connecting the stone boiler foundation (assumed to be the source of the hot water) and the hot scour tanks, so it is assumed that such pipes were carried overhead in the same way as the water was transported from the dam to the concrete rinsing tank.

5.2 The concrete rinsing tank

The 8.26 × 2.62m concrete rinsing tank, which was silted up completely, was found on excavation to contain the remains of a timber framework which originally supported four William's boxes and three walkways between them. It being obvious that the tank was divided into four bays for rinsing purposes, three of the bays were excavated to varying depths to ascertain the method of construction and purpose of the framework, while the fourth bay was left unexcavated as a reference deposit (Fig. 4).

In the three bays excavated, a milled timber framework had been constructed against each wall of the concrete tank. This framework survived except at the northern (spillway) end, where the timber had been removed. The framework consists of a set of two beams, one sitting on the other. Measurements of the timbers and relative positions within the tank are very much affected by the decayed nature of the timber, but the framework appears to have originally been made of 4 × 2 inch (100 × 50mm) beams, with the top of the framework being between 12 and 17cm below the upper edge of the concrete tank.

In Bay 2, from the northern end of the tank, a similar beam was found along the angle between the base and side of the tank, and it is safe to assume that this also was carried around all four walls of the tank originally. The sides of the concrete tank (interior) are approximately 64cm high from the base to the upper edge.

The double set of beams forming the upper part of the frame are supported by short squared timber posts (100mm square) located at each corner of each of the four bays, near the point where other beams crossed the tank from side to side. The crossing or transverse beams rest on the lower of the double beam set, the upper beam being divided into short lengths which butted up against the ends of the transverse beams. Although very decayed, the transverse timbers would appear to be the same size as the rest, i.e. 100 × 50mm.

These cross beams, which occur in pairs, support narrow platforms which cross the tank between the presumed resting places of the William's boxes. The central cross platform (between Bays 2 and 3) is very narrow, the pair of beams actually touching each other, and it may not have been used as a working platform. The other two platforms, however, between Bays 1 and 2 and Bays 3 and 4, are clearly designed as working areas. That between Bays 1 and 2 was fully excavated, while that between Bays 3 and 4 was only excavated in the Bay 4 half. Between Bays 1 and 2, the transverse beams were approximately 20cm apart at the eastern side, but slightly angled to be only about 10cm apart on the western side of the tank. These transverse beams supported a very decayed series of floor boards and smaller lateral beams or joists. The floor boards were in turn covered with flat iron sheets and bitumen, resulting in a platform which progressively broadened, from a narrow waist in the centre of the tank, towards each side of the tank, where it was 1.2 to 1.5m wide. This fan-shape gave a curved form to each side of the platform, to accommodate the edges of the circular William's boxes and enable fleeces to be forked straight from the platform into either William's box. (See Fig. 2 for the relationship of these platforms to the William's boxes.)

The rocking drainers, on which fleeces from the hot scour tanks were placed, are so located that when tilted in the direction of the concrete rinsing tank the fleeces could be easily forked onto the platform between two William's boxes.

The same pattern of platform is shown in that section excavated in Bay 4, and in the south-west corner of Bay 4 were found two rough timber planks shaped to continue the curve of the William's box and so enclose it completely. It seems likely that similar plank platforms existed at the other three corners of the tank originally, but were removed, possibly when the William's boxes were lifted from the frame.

The central transverse beams, between Bays 2 and 3, showed no evidence of having been covered with a working platform, the two beams simply being connected by a twist of wire in two places. As this would not appear to be an important standing place for the men operating the William's boxes, it is possible that the spaces between the edges of the tank and the boxes were filled with some lightweight covering which has been completely removed. It is reasonable to expect some form of bridging material to cover this space, in order to prevent any badly aimed or over-agitated wool escaping from the William's boxes in Bays 2 and 3 and being lost in the flowing water beneath the boxes.

The circular perforated iron tanks now located near the scour, and which have been interpreted as being William's boxes, would fit neatly into the circular spaces enclosed by the platform in the concrete rinsing tank. These William's boxes have an elaborate iron rod and wooden interlocking support framework, which probably enabled them either to sit freely on the bottom of the concrete tank, or to be suspended in some manner from the platform edges. There is no archaeological evidence either on the extremely decayed platforms, nor on the base of the concrete tank, to suggest which method was used.

At the northern end of the concrete tank is a spillway and draining pipe. From the manner in which the spillway is constructed, it is clear that it originally consisted of two or three semi-circular notches in the top of the tank wall, each about 13cm deep. However, at some time this was greatly enlarged by the cutting of a square section from the tank side extending to 30cm below the top. Water flowing over this spillway ran down a rough rock ramp into a drainage channel cut 56cm into the natural soil (95cm below present ground level) and lined with white clay, a continuation of the surfacing around the hot scour tanks. Time did not allow excavation to determine where this drain went, but it is on a converging course with the hot scour tanks' drainage channel, which itself trends towards the dam.

An 11cm-diameter cast-iron pipe is recessed into the base of the concrete tank below the spillway, and extends out to the base of the rubble spillway ramp, clearly to allow flushing of the tank after scouring in order to remove accumulated dirt. In the basal deposits of the concrete tank, and in the bottom of the drainage channel running from it, are 5–10cm-deep deposits of bright red and white sands, which are interpreted as sand scoured from fleeces of sheep grazing in sandhill country (red) and clay pan country (white). These

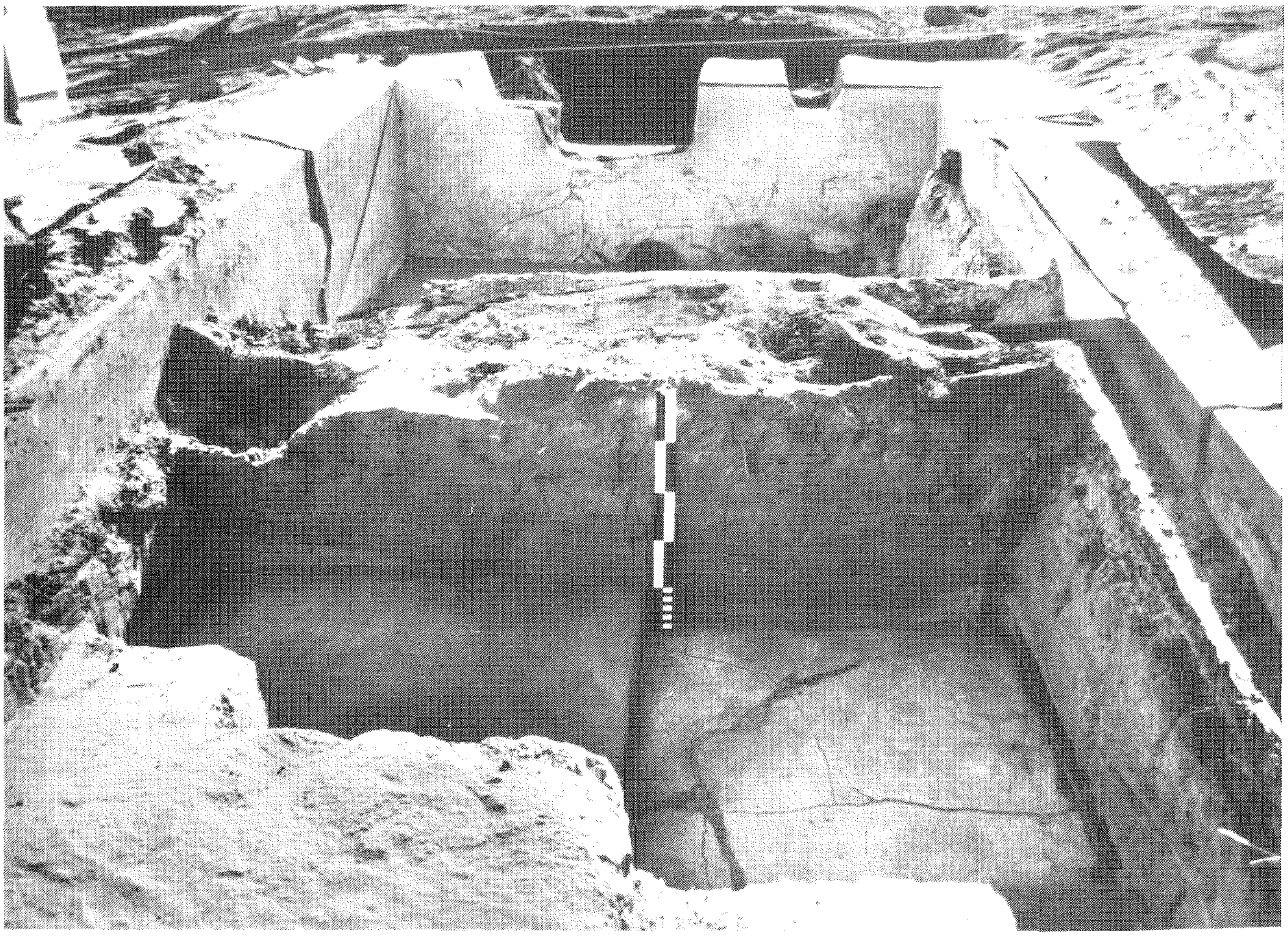

Fig. 4: Looking north along the concrete rinsing tank, showing Bays 1 and 2, parts of the timbers of the frame inside the tank, and one of the walkways which separated the two William's boxes. At the far end of the tank is the spillway with the edge of a rocking drainer on the extreme left. Photograph M.P. 1983. Scale in 10cm divisions. [The deeper shadows have been masked out on this photograph. (Editor)]

deposits are quite different from other deposits in the tank or elsewhere on the site.

The size of the spillway allows a calculation to be made of the maximum and minimum rates of flow of water through the rinsing tank, based on an estimate of the two ends of the range of possible positions of the William's boxes vertically in the tank, and working on the assumption that the boxes would have to be nearly full to the top to work effectively. This calculation gives a minimum flow of 7.2 litres per second and a maximum flow of 15.5 litres per second.[44] This means a minimum flow of 25,920 litres (5702 gallons) per hour through the tank.

The concrete tank itself is constructed of cement with an aggregate of large stones, which while given a thick floated cement skin on the inside of the tank, were only cemented over lightly or not at all on the outside. The relatively high seismic activity in the Tibooburra area has led to some movement in the tank, resulting in cracking and in the dislodging of some of the stone aggregate from the outside of the tank walls.

5.3 The draining floor and hydro-extractor

Between the eastern side of the concrete rinsing tank and the row of posts which form the tankstand is a 90cm-wide space. Before excavation a section of galvanized iron sheet, supported on low (c.10cm) timber posts, protruded from the deposit at the northern end of this space. Two 50cm-wide trenches were excavated at the southern end of the space, one opposite the Bay 3–4 platform and the other overlapping the southern end of the concrete tank and extending onto the draining floor. These trenches revealed a galvanized-iron-sheet trough, varying from 70 to 85cm wide and 12 to 18cm deep below a timber edging assumed to be at original ground level.

The interpretation of this feature is that it was a sloping trough down which wet fleeces, from the rinsing tank, were sluiced or raked to the draining floor at the southern end of the concrete rinsing tank. A third excavation near the southern edge of the draining floor shows that the trough extended right along the eastern side of the draining floor.

The draining floor is a timber-boarded area 3.6 × 2.5m in extent. This area was partially excavated with a 1m-wide north-south trench, with two 50cm-wide trenches at right angles to the first, exposing the limits of the floor on each side. The boards making up the draining floor are laid in a north-south orientation and are up to 32cm wide. They are laid directly on a clay surface, which is a continuation of the introduced clay surface noted in Subsection 5.1 above. This clay surface extends 70cm beyond the edge of the boarded area, where it is separated from the natural soil by a timber edging. In the southern half of the boarded area, as exposed in the 1m-wide trench, the timber boards are covered with a layer of thin, flat, iron sheets, now in a very decayed and fragmentary condition, which is in turn covered in places with fragments of hessian cloth.

From fragments of iron found elsewhere on the floor (which is approximately 30cm below present ground level) it seems possible that the iron sheeting originally covered the entire draining area, and that this in turn was covered with hessian strips or old bags to provide secure footing. Resting on the draining floor were found two children's-sized elastic-sided riding boots, evoking the pleasures of working barefoot on a wet job in a hot climate.

The draining floor was the area where the wet fleeces were stockpiled before being put through the hydro-extractor, which abuts the draining floor on the southern side.

Excavation around the hydro-extractor revealed both the heavily lagged steam-feed-pipe, the exhaust steam-pipe and the steam piston which drove the extractor. The steam cylinder has an internal diameter of 12.7cm (5 inches) and a length of 29.2cm (11.5 inches), the piston driving a crank shaft which rotated the perforated spin-tub from beneath. Steam was supplied to the cylinder by an underground steam-pipe from the engine-house area, the supply regulated by a steam cock on the pipe. Exhaust steam was taken off by another pipe which leads southwards and ends adjacent to a timber framework. This framework is interpreted as a base for a simple drum condenser, in which case the end of the exhaust pipe would have been attached to a rising pipe to take the steam into the condenser. The condenser base rests on another area of introduced clay. The use of a condenser would have reduced the loss of water, a major consideration in this locality.

The main water outlet from the hydro-extractor was the drain from the spin-tub. Unfortunately, the pipes which would have led from this outlet have been removed at some time in the past, and the route of this pipeline is not retraceable without far more extensive excavation. It is likely, however, that it led back into the dam by a route independent of the hot scour and rinsing tank drainage system.

From the hydro-extractor the wool would have been taken by cart or basket (both named in the 1897 inventory) to the adjacent drying paddock for final drying.

5.4 The engine shed

An area to the east of the tankstand, identified in Section 4 above as the engine shed, was excavated to establish the validity of this assumption. An 'H'-shaped series of 50cm trenches was excavated, consisting of two parallel trenches 3.5 and 4m long, connected by a 3m linking trench at right angles to the other two. Most of the area excavated revealed an ash layer. To the north-east and south-east, at right angles to each other, were found several timber beams, some with nails and one with a grooved edge. These beams, being in line with the few remaining upright posts, and clearly separating the ash deposit from areas of soil free of ash, are taken to be the remains of two walls of an engine shed. To the south-west the end of the steam supply pipe for the hydro-extractor was excavated. Adjacent to this pipe, and partly buried only, was found a swan's-neck-shaped section of pipe with a bolted flange on it. This is taken to be the pipe which connected the steam boiler to the steam-pipe. Also adjacent to the end of the steam-supply pipe was found a length of clear glass tubing, which may be a water-level indicator tube from the steam boiler. Other finds in the boiler house area were a length of pipe, a length of chain, an iron rod and a light axle.

A steam boiler and engine in this location would have driven the Tangye water pump by belt drive, and supplied steam for the hydro-extractor.

5.5 Excavated artefacts

The vast majority of artefacts located during the excavation were items of hardware and building material. These included very corroded nails, wire, bolts, pipe, iron sheet and plate, milled timber, bitumen, pieces of boiler wall, fire doors, and hessian. Some finds were identifiable parts of machinery used at the scour, such as the boiler water-level tube, a piece of William's box perforated screen, a butterfly-screw from a William's box water-supply nozzle, a broken sheep shear, a snig chain and an axle, all found in the engine shed trenches. The only excavated artefact of a domestic or personal nature were the child's riding boots found abandoned on the draining floor.

None of the excavated finds were very useful in explaining the scouring process nor in illuminating the life of the men who worked there. However, the above-ground artefacts scattered around the scour were very useful in the reconstruction of the use of the site, especially the remains of the William's boxes, water nozzles and sections of steam and water pipe.

6. RECONSTRUCTED SCOURING PROCESS

From an analysis of the documentary and archaeological evidence presented in this paper, it is possible to reconstruct the scouring process as it was carried out at Mount Wood. While it is clear that there were many variations in the scouring process from station to station, due partly to environmental constraints but perhaps due mainly to personal choice on the part of the station owner/designer, the Mount Wood scour, as the first described in detail, can be used as a model for the process with which others can be compared.

At the Mount Wood woolscour two flow patterns can be discerned, one of wool, the other of water (Fig. 5). The flow of wool through the scour commenced with the arrival of greasy wool, probably by cart, on the clay driveway in front of the hot scour tanks. Wool unloaded from the carts must have been stockpiled, either on the ground, or on hessian sheets or boards. The wool was then piled into one of the two hot scour tanks which contained hot soapy water. After agitation by fork in the scouring liquor, the wool was forked out onto the adjacent rocking drainer, excess water and soap draining back into the hot tank. Once room was made for more wool in the rinsing tank, or once sufficient water had drained out of the fleece, the rocking drainer was tilted towards the concrete rinsing tank, and the wool forked onto the platform between two William's boxes, and then into one or other of the boxes. Here the wool was again agitated by fork, and subjected to a broad jet of water delivered by a pipe and nozzle from the elevated ship tanks behind, all residual dirt being washed out of the perforated William's boxes in the process.

Once sufficiently rinsed, the wool was forked out into the galvanized-iron trough between the concrete tank and the tankstand, and forked down the trough to the draining floor at the tank's southern end. Again, wet wool would be stockpiled here while it was put in small batches through the hydro-extractor, after which it was carried by cart or basket to the drying yard where it was spread on sheets, probably of canvas held down by stones. Once dry, the wool was gathered up and pressed into bales in the small press room adjacent to the drying yard, and loaded onto camels or drays for the long haul to Wilcannia.

The water flow was almost in the opposite direction. Water was pumped from the scour dam by the Tangye pump and delivered via an elevated pipe to the four ship tanks atop the 1.37m-high tankstand. From the tanks the water flowed down pipes to special nozzles with broad slit openings, which exactly spanned the gap between the outer edge of each William's box and the inverted oval tub in its centre. The water then escaped through the perforated sides and bottom of each William's box, carrying dirt with it, into the concrete tank and ran out over the spillway and back to the dam via a shallow channel.

Water may also have been led from one of the elevated ship tanks, by way of a raised pipe, to a boiler or water-heater placed on the masonry base at the western side of the scour complex. Here water was heated and supplied, again by overhead pipes, to the hot scour tanks. This part of the reconstruction is more tentative than that for any other part of the process described here, due to the absence of any archaeological evidence to prove it, other than the location of the masonry boiler base. The alternative, though less likely, reconstruction is that separate pipes led from the same boiler as drove the pump engine and supplied steam to the

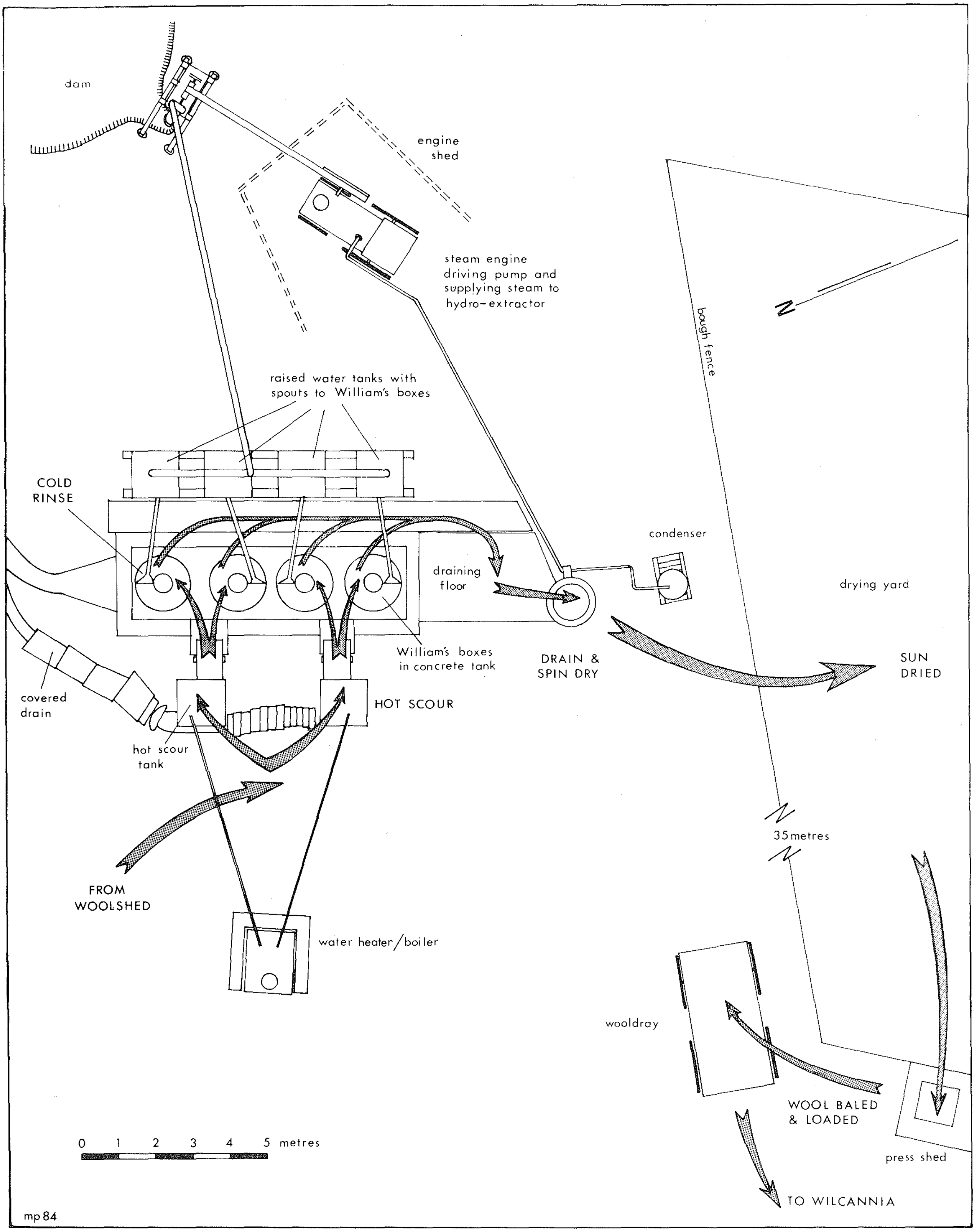

Fig. 5: Reconstruction of the scour layout and the flow of wool through the scour.

hydro-extractor, the pipes being heavily lagged and elevated above the heads of the workmen to deliver steam which could be injected into the hot scour tank water to heat it.

From the hot scour tanks the water would have been discharged at regular intervals as the soap lost its scouring ability. Let out through the pipes at the bases of the tanks, the water flowed along the narrow channel which was bridged over to prevent the workmen stepping in it. This channel probably joined up with the outlet channel from the concrete rinsing tank, leading back into the scour dam.

Water from the wet fleeces, and steam, were concentrated at the hydro-extractor. The steam was condensed and possibly found its way back to the boiler at intervals. The water from the fleeces was drained off to the south, possibly into pipes or a channel leading anti-clockwise around the scour to the dam. Evidence of this system, however, was not located during the current excavations, which did not test much of the relevant area.

7. DISCUSSION

The Mount Wood woolscour shows an interesting conjunction of purchased manufactured components and bush workmanship and 'make-do' in the construction of the scour. From the 1897 inventory (see Section 3 above) it is known that the engine, pump, hydro-extractor, William's boxes, woolforks and other associated items were purchased. However, the way these elements were put together, and the style and construction of the other elements, such as the tanks, rocking drainers, William's box frames, and drainage systems, have a rough and ready quality which suggests that they did not come from a pattern book or do-it-yourself woolscour guide. Some elements, particularly the use of clay to prepare a working surface, were a local requirement worked out by the builder rather than specified by the equipment supplier. This element of bush craftsmanship in scour construction is evident also in the photographs of other scours, no two of which are the same. It is a characteristic also very evident in other aspects of pastoral processing, such as the construction and layout of woolsheds and yards.

A feature of the woolscour at Mount Wood which was to be expected, but was nonetheless useful to confirm by excavation, was the presence of rudimentary water-preservation systems, the drains and condenser. However, not all the questions one would like to ask about water are solvable archaeologically, and they have not been answered by the documentary evidence researched to date. The key problem is this: wool scouring, being a very heavy user of water, cannot have been a very efficient process in this and similar arid areas, an assertion born out by a few documentary references quoted above. Despite this the process was clung to, at Mount Wood at least, for between twenty and thirty years. This suggests that there were cost benefits, even in using an unreliable and unpredictable scouring process, when long distance transport costs were taken into account. However, the full investigation of this cost relationship can only come from an analysis of station records such as letterbooks, account books and wool records. As yet no station records have been fully studied for this type of information.

Clearly the aridity problem of Tibooburra did not apply to all areas where station-based woolscouring was carried out, but other apparently regional economic differences have yet to be fully explained. One such difference referred to in this paper is the entrepreneurial nature of wool scouring on the Darling around Bourke, as opposed to the individual property operations in the far north-west. One explanation might be that the virtually assured water supply along the main rivers guaranteed a full annual scouring season at each station, a situation which would encourage an entrepreneurial approach by wool scourers with either their own portable scouring equipment, or just offering a work-force skilled at scouring. Both varieties of contract scourer have been shown to have existed. On the other hand, in the arid north-west, where sufficient water for scouring from season to season or for the full duration of any one clip could not be assured, such independent itinerant scourers would be unable to maintain the steady flow of work that would be necessary to justify acquiring scouring equipment or employing an experienced labour team.

Where the threshold of entrepreneurial viability lay, and what the statewide pattern of station-operated and contractor-operated scouring may have been, are questions which can only be answered through a study of local newspaper reports, and again, the study of station records.

8. CONCLUSIONS

The study of the documentary and archaeological evidence of woolscouring, presented in this paper, has put the various forms of woolscouring in New South Wales into perspective and provided a detailed description of the technological process involved in station-based scouring. The importance of woolscouring to the nineteenth-century wool-growing industry, particularly in areas serviced by extended and poor transport networks, is made clear.

Although archaeological research, including excavation, was necessary to gain an understanding of the scouring process, the most important questions raised during the study will be largely answered by the detailed study of individual station records. This documentary resource is unfortunately scattered, fragmentary and difficult to locate, and is in most cases in great danger of being lost in the 'cleaning up' of apparently useless and outdated paper work by individual property owners. There is therefore considerable urgency in the collection of data on this and other poorly documented rural industries in Australia.

ACKNOWLEDGEMENTS

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NOTES

1. Hawkesworth 1911: 403; various station records from north-western N.S.W. show a weight reduction of from 50% to 65% after scouring.
2. For examples of sheep washing see: Ritchie 1971: I, 108 and II, 85; Adam-Smith 1982: 27; Wilson 1968: 115; Harris 1982: 18; McEwan & Co. *Catalogue*: 215; Freeman 1980: 35; Menzies 1882: *passim*; Downes 1944: 36. Existing sheep washes described in *Heritage of Australia* 1981: 3/104 'Bessiebelle' Station, Victoria, 3/126 'Bindi' Station, Omeo, Victoria, 4/66 'Beaconsfield' Station, Queensland. Connah 1977 & 1978 describe the sheep wash remains at Saumarez Station, N.S.W.
3. Diderot 1959: II, 304.
4. Chandler 1952: *passim*.
5. Bonwick 1887: 170 (scoured wool prices); Painter 1979: 60; Sommerlad 1972: 151.
6. Jenkins & Ponting 1982: 103; for a description of a mechanical scour see Kammlade 1947; Hawkesworth 1911: 397.
7. Gerritsen n.d. [1980]: 16; Jervis 1952: 142.
8. Gerritsen n.d. [1980]: 16.
9. Hawkesworth 1911: 394; Gerritsen n.d. [1980]: 135.
10. Hawkesworth 1911: 395–6.
11. Gerritsen n.d. [1980]: 15–16; see also Hardy 1977: 107, photograph facing 158; Painter 1979: photograph 60; Mitchell Library Small Pictures File, 'Scouring on the upper Yarra' (reproduced in Adam-Smith 1982); Freeman 1980: photographs 34 and 35.
12. Painter 1979: 73.

13. Bonwick 1887: 170.
14. The most useful photographs of this technique are: Kerry photograph 'Washing Wool' reproduced in Millar 1981: 110; 'Weilmoringle, N.S.W. — Wool Scour', National Library of Australia; Everett's 'Olera' woolscour, in Gilbert 1980: 98; 'Weilmoringle Scour' in Adam-Smith 1982: 26. (Charles Kerry, a prominent late-19th-century photographer, travelled much of western N.S.W. on government commission to photograph wells and bores. Photographs he took at that time, including Fig. 2 in this paper, are a reliable and rare insight into western N.S.W. settlement.)
15. Smith 1914: 136, 186.
16. Mt Wood Letterbooks, July 1897, presently held by N.P.W.S.
17. Millar 1981: 110.
18. 'Weilmoringle, N.S.W. — Wool Scour', National Library of Australia.
19. Bourke and District Historical Society 1967–8: Vol. II, 170, from 'Currawinga' Diaries, 17/10/1870.
20. ibid.: August 1872.
21. ibid.: 1877.
22. *Town and Country Journal* 6/7/1874: 93.
23. *Town and Country Journal* 1872: Vol. I, 359.
24. Bourke and District Historical Society 1967–8: Vol. II, 124–5, from 'Toorale' by Mrs H. Glover.
25. Diderot 1959: II, 304; Bischoff 1842: 389; Hawkesworth 1911: 400.
26. Adam-Smith 1982: 29.
27. Menzies 1882: 6.
28. loc. cit.; Hawkesworth 1911: 400; Jeffrey 1907: 131–2.
29. Bourke and District Historical Society 1967–8: Vol. II, 142; Menzies 1882: 6, suggests making own soap; Jeffrey 1907: advertisement for Burford's soft soap at rear of book.
30. Bourke and District Historical Society 1967–8: Vol. II, 135–43.
31. Jeffrey 1907: 131–2.
32. Arkell & King 1917: 9.
33. Hawkesworth 1911: 403.
34. Based on Gerritsen n.d. [1980]: *passim*; Holmes R. 1981; Anon. n.d.; Mt Wood Letterbooks (now held by N.P.W.S.).
35. Mt Wood Letterbooks: July 1897.
36. Jeans 1972: 277–9.
37. Mt Wood Letterbooks: relevant years; Holmes 1981.
38. Mt Wood Letterbooks: relevant years.
39. Gerritsen n.d. [1980]: 134, quoting 'Connulpie Downs' letterbooks.
40. Stokes 1983: 88.
41. Gerritsen n.d. [1980]: 52.
42. Stokes 1983: 88–90.
43. Clay identified as foreign to the site by Roger Stanley of N.S.W. Soil Conservation Service.
44. Calculated by N.P.W.S. engineers using Bernoulli's equation.

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