The Technology of Whaling in Australian Waters in the 19th Century

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This study of the technology of the whaling industry in 19th century Australia originated as a part of a wider continuing research project into whaling in southern N.S.W. It is necessary to be aware of the technology and the artifacts involved in order to understand the surviving artifacts of the industry, both in a museum and an archaeological context, to understand the technology of the sites being studied, and to understand the economic implications of the industry both locally and in the colony as a whole. Because shore-based and ship-based whaling were very closely linked in the 19th century, both in their commercial operation and in their technology, it is necessary to look at these two aspects of the industry in order to arrive at an overview of whaling techniques and artifacts. The following paper by Michael Pearson, Historian in the N.S.W. National Parks and Wildlife Service, looks at this technology, its sources, and the hardware associated with it.

1. HISTORICAL BACKGROUND

Until the development of petroleum in the second half of the 19th century, whale-oil played a vital role in the economies of Europe and America. The chief use of the oils extracted from the carcasses of whales was illumination. Spermaceti, a waxy oil taken from the head of the sperm whale, was used to make the finest wax candles, while sperm-oil, extracted from the sperm whale's blubber, provided first class lamp-oil to light the streets and houses of many cities. The oil from the blubber of the baleen whales, such as the bowhead, humpback, and right whales, provided an oil of lesser quality than sperm-oil, but still valuable for lighting. This oil was usually called 'whale-oil' (to distinguish it from 'sperm-oil') or 'black oil', the latter term being commonly used in Australia to describe the oil of the southern right whales most commonly caught in Australian coastal waters.

The beginning of the end for whale-oil illumination was the development of coal gas lighting in the 1820s, while its demise was assured by the growing exploitation of mineral petroleum between the 1850s and 1870s, ending with the widespread use of paraffin for illumination by the 1870s.

Other uses of whale-oil included: the lubrication of textile machinery in the first flush of the industrial revolution; the cleansing of wool prior to spinning; the manufacture of paints, varnishes, putty, and soap; and medicinal use.

Whalebone, or more accurately 'baleen', the flexible cutaneous sieve plates from the mouths of baleen whales, was used mainly in the fashion industry to provide stiffening stays for crinoline frames and bustles, and stays for corsets. In these uses it was subject to the whims of fashion, and suffered from the introduction of alternative materials such as steel and synthetics. Other uses of whalebone included umbrella stays, sieves, nets, brushes, knife handles, and carriage springs. In all of these uses, whalebone was replaced by alternative materials during the 19th and early 20th centuries.

The price paid for whale-oil and whalebone on the international market up until the late 19th century ensured the profitablity of whaling voyages. Coinciding with the introduction of a new whaling technology in the last quarter of the 19th century, was the development of new uses for whale-oil based mainly on the hydrogenation, or solidification, of the oil. However this new technology goes beyond the scope of this paper.

Until the latter part of the 19th century, and the introduction of modern whaling using steam vessels and explosive harpoons, whaling had been pursued with a simple technology which had not altered greatly for centuries.[1] Furthermore, the technology was basically the same for both shore-based and ship-based whaling. This paper looks at that technology, mainly as it relates to Australian participation in the Australian coastal and southern fisheries.

Australia, although not settled by European man until the late 18th century, has had a long and close association with the whaling trade, both shore-based and ship-based. The first British whaling vessel to enter the Pacific Ocean, Enderby's *Emelia*, did so within a year of the establishment of the colony of New South Wales in 1788,[2] and as early as 1791 several ships transporting convicts to the colony undertook short whaling voyages before their return to Britain.[3] British merchants continued to exploit the presence of whales off the N.S.W. coast and around Tasmania throughout the following decades, but a prohibition against the local construction of colonial ocean-going vessels held back local participation in ship-based industry. However, shore-based whaling was established in Tasmania by 1806,[4] a reintroduction of an ancient whaling technique which proliferated in many places throughout the world in the 19th century. By 1841 there were at least 35 shore-based whaling stations in Tasmania,[5] and the practice was established on mainland Australia in 1838, by Thomas Raine at Twofold Bay in N.S.W., and William Dutton at Portland Bay in Victoria.[6]

Most of the information in this paper referring to shore-based whaling practice is based on documents and artifacts associated with the Twofold Bay whaling stations, where the old open-boat techniques were in continuous use from 1828 to 1927. Twofold Bay whaling was in the hands of numerous whaling groups over that period, the main ones being the Imlay brothers, the colourful Benjamin Boyd, and lastly the Davidson family.

The number of Australian owned and operated whaling ships increased somewhat more slowly than did the number of shore stations, due to government restrictions (both colonial and British) and the slow growth of colonial capital. The first colonial built and owned whaler seems to have been built in Sydney in 1805, and by 1827 only 5 ships were owned and operated out of Sydney, but this grew to 17 ships by 1830, and reached perhaps 60 ships at the height of the trade.[7] In Hobart, the number of locally owned and operated ships had grown to 37 by 1848,[8] shortly before the rapid decline of the colonial industry. By 1835 the total number of Australian whale ships had reached 76, far outnumbering the British whaling fleet in the southern whaling grounds at this period.[9]

The importance of whaling to the N.S.W. economy is demonstrated by the fact that whale products remained the largest grossing Australian export until 1833, when wool surpassed it.[10] The industry peaked about 1840, and fell into a sharp decline after that date, accelerated by the transfer of colonial capital to pastoral enterprises, the effects of the 1850s goldrushes, the drastic decline in the numbers of the Southern Right Whale which almost totally wiped out the shore-based stations, and the drop in oil prices in Europe. The drop in fishery products as a percentage of total exports, from 42 per cent in 1830 to 1 per cent in 1850, demonstrates this decline.[11] The last Australian sailing whale ships operating open whaleboats were the *Costa Rica Packet*, which sailed from Sydney on her last voyage in 1891, and the *Helen* which operated out of Hobart until 1899.[12]

2. THE WHALING PROCESS

The processes involved in both shore-based and ship-based whaling were similar. A factory (be it a shore station or a ship) maintained a number of long open rowing boats (whaleboats) which, when a whale was sighted by a lookout (in a mast-head crowsnest on ship, or on a cliff or tower on land), were rowed or sailed in pursuit of the whale. As the whale was approached, the leading oarsman (the harpooner) took up a harpoon, which was attached to a long whaleline, or rope, and drove it into the whale. As the whale dived and the whaleline ran out of the tubs in which it had been carefully coiled, the boat was 'backed', and the harpooner and the helmsman or 'headsman' exchanged places in the boat. The boat than hauled itself up to the whale each time it surfaced for air, and the headsman killed it by driving a lance into its vital organs. This process sometimes took a considerable length of time, in which the whaleboat might be towed many kilometres by the whale, and the chance of disaster in the form of a swamped or smashed boat was very real. Once the whale was dead, the boat crew had the unenviable task of towing the whale back to the mothership or shore station.

Once at the ship or station, the blubber (the outer fatty layer) was cut from the whole carcass with a variety of knives and spades in the form of long 'blanket pieces', which were then cut up again into 'horse pieces' some 15 inches x 4 inches in dimension, which were in turn sliced on a 'horse' to become 'sliver pieces' or 'books'. The sliver pieces were thrown into a large iron cauldron called a 'try-pot' set up in a brickwork furnace, and there the blubber was heated and stirred until all the oil had been removed, at which time the solid blubber residue was scooped off and used to feed the furnace fire, while the oil was bailed out, usually into large copper coolers. Once cool, the oil could be casked up for storage or shipment to market.

If whalebone (baleen) whales were being caught, the long plates of baleen were cut from the whale's mouth, this 'whalebone' being a very valuable commodity. If sperm whales were caught, a first class waxy oil called spermaceti was ladled from a reservoir in the whale's head, called the 'case', and the teeth were removed from the jaws, mainly for craft work activities (scrimshaw) by the crew.

The gaps in this very brief overview of the whaling process will be filled in to some extent by the description of the relevant equipment which follows.

3. THE TECHNOLOGY OF WHALING

A large part of the equipment used by whalers in Australia was imported, mainly from Britain (see Part 4), and so to gain an appreciation of the Australian technology it is necessary to look closely at overseas practice. The descriptions of whaling equipment that follow are therefore applicable to many other whaling enterprises around the world in the 19th century.

Basically, the equipment utilized by whalers can be divided into three groups:

3.1: equipment designed to take the whalers to the whale (ships and boats);

3.2: equipment designed to catch, kill and retrieve the whale (harpoons, lances, lines, guns etc.);

3.3: equipment designed to render the whale carcass into saleable oil, bone or meat (cutting-in equipment, try-works, casks, tanks etc.).

3.1 Ships and boats

Whale ships were usually slow, bluff bowed workships with tonnages ranging generally between 150 and 400 tons, and with a beam to length ratio of about 1:4. In the case of British, American and French ships, prime considerations were seaworthiness and an ability to carry a large cargo of oil in barrels and sufficient whaling gear and supplies for a voyage of up to four years' duration. All varieties of rig were encountered, from schooner to full-rigged ship, but barque rig was common on smaller vessels, and ship-rig most common on large vessels (95 per cent of British ships over 200 tons engaged in the Southern Fishery were ship-rigged[13]).

The Australian ships differed considerably from this pattern, in that they were consistently smaller than their overseas rivals. For example, during the 1830s and 40s, when British whale ships were averaging over 300 tons, Australian whale ships were averaging around 200 tons.[14] There would also appear to have been fewer ship-rigged ships in the Australian whaling fleet; for example, in 1836 the 39 whalers registered in Sydney

included 10 barques, 4 brigs, 13 schooners, 3 cutters, 4 sloops, 2 ketches, 1 brigantine and 2 smacks, and not one ship-rigged ship.[15]

The reason for the smaller size (and therefore the differing rigs) of the colonial whalers was the proximity of the Australian whaling ports of Sydney and Hobart to established whaling grounds, which removed the necessity for long voyages. Whereas British and American whalers faced voyages of 2, 3 or even 4 years, the voyages of Australian ships usually lasted less than a year. The frequent return to the home port reduced the amount of gear and stores the Australian ships had to carry, and likewise reduced the storage space necessary for the products of the chase, resulting in smaller ships being used. Only a proportion of these ships was actually built in the colonies, a large number being British-built ships totally or partly owned by Australian merchants.[16] Conflicting evidence exists as to whether the fitting-out of whale ships in the colonies was more or less expensive than in Britain. In 1823 Robert Campbell, a prominent Sydney merchant, claimed that British ships were outfitted for a third less than colonial vessels, due to the cost of importation of equipment,[17] while in 1835 John Watson, a Hobart ship builder, claimed that whale ships could fit out in Hobart at a cost of £6 per ton, as against £18 per ton in England.[18] Merchant Campbell, however, may have exaggerated his claims in an attempt to have the then existing British duties on colonial oil abandoned, as there is other evidence, such as the low colonial prices for imported oil, to suggest that colonial production costs were small.[19]

A typical layout of a medium to large whale ship, be it British, American or Australian, featured three whaleboats on high davits on the port side and one boat on the starboard quarter. A framework could be lowered amidships, usually but not always on the starboard side, to facilitate cutting-in of whales tied alongside. The try-works (Fig. 4) were usually erected on deck forward of the fore hatch, consisting of a brick furnace containing two 250 gallon iron try-pots. A wooden framework or 'goosepen' around the brick base of the try-works was filled with water, which circulated around and beneath the base of the furnace guarding against accidental firing of the deck. A cooling tank, often of copper, was to be found beside the try-works, or in larger ships between decks beneath the try-works. Once cooled, the oil was casked in wooden casks and stored below.[20]

American whalers had several refinements not found in merchant ships, such as a hurricane house structure around the helm, but these did not appear in Australian-built whalers. The following list of whaling gear carried by the Sydney whaling barque *Australian* gives some idea of the diverse materials needed for even a short voyage. Some of the items listed, such as boat repair materials and iron, were to enable the ship's carpenter and armourer to carry out repairs to boats, equipment and the ship itself while at sea.

Whaling gear on board the *Australian*, 1836-8 included:[21]

3 try-pots
2 copper coolers
4 iron tanks
2 copper ladles
1 skimmer
3 blubber hooks
4 double cutting blocks
11 single cutting blocks
2 cutting falls, 1 old
6 fluke topes
8 tubs of whale lines
1 cask and 2 coils of new whaleline
11 cutting spades
6 mincing knives
2 boarding knives
59 lances
115 harpoons
2 oil pumps
1 water pump
1 set cutting tubs
1 dipping buoy
17 bundles iron hoops
7 truss hoops
20 ash oars
5 steer oars
75 boats timbers
33 boats knees
133 boats boards
1 stern and 1 stern post
4 gunwale pieces
1 keel piece
½ coil whale line
quantity of iron and lance poles
3 chain head straps
3 capstan bars
5 handspikes
4 crowbars
14 luff tackle blocks
1 long boat hook and 1 short boat hook
3 ships compasses and 1 tell tale
1 lead and line
1 speaking trumpet
5 boats compasses
18 boats anchors
& other items of general use in the ship.

Notable oversights from this list are whaleboats (up to 5 normally carried) and barrel staves (hoop iron and truss hoops for cooperage are included in the list). Barrels were usually shipped as component parts, and assembled by a cooper as needed. Many of the items on this list will be described below.

Whaleboats: The whaleboat as it was known in the mid-1800s was developed during the 18th century by European whalers. The possibility that the design was largely influenced by Scandinavian boat design used by 9th century Norwegian whalers has often been suggested, but never proven. The obvious links between 18th and 19th century European whaleboats argue strongly against the belief often held by American historians that the whaleboat was an adaptation of the American Indian bark canoe. However, it is possible that observation of canoe design did cause U.S. boat builders to substantially lighten the timbers of the European whaleboat, to produce the highly specialized American whaleboat which had become so common by the 1850s.[22]

The typical whaleboat of the mid-19th century in the Southern Fishery was 27 to 31 feet long (8.2–9.4m), and about 1/5th that in width. From the 1820s British whaleboats included both clinker-built and carvel-built hulls, and throughout the rest of the century both types were common. The U.S. boat builders developed a combined clinker (lap-strake) and carvel form which included the use of internal seam battens in the 1830s, and favoured carvel construction especially after 1850.[23] Carvel-built boats were thought to be quieter in use, an important consideration when approaching whales, and were also far easier to repair than clinker boats. The introduction of steamed ribs and bow and stern posts in the 1820s allowed rapid construction of standard components, and resulted in very light boats. However, natural crooks and curved timbers were still used by some builders throughout the 19th century.

Whaleboats of the American design, which dominated Australian whaling, were double-ended, with a good deal of sheer (i.e. 'dip' from bow and stern towards the waist), and could be rowed by a good crew 5 miles in the first hour and 4 in the second.[24] The stem and stern sections of the boat had a short length of decking.

Through the stern deck (called the 'cuddy board') projected a loggerhead, a bollard around which the whaleline ran.The end of the whaleline was not attached to the boat in any way, simply coiled loosely in two tubs which lay in the waist of the boat. The bow deck (or 'box') was below the level of the gunwale, and its aft edge supported the thigh board, a thwart at gunwale level which had a semicircular notch in it to support the harpooner's thigh while hurling the harpoon. This was called the 'clumsy cleat'. The extreme tip of the bow was notched to hold the whaleline, which was prevented from jumping out of the notch (the 'chocks') by a soft metal, bone or wooden peg inserted across its mouth. The purpose of the chocks was to ensure that the boat was always towed bow first when fast to a whale, and to prevent the whaleline sweeping across the boat and injuring the crew.

Whaleboats had thwarts for 5 to 8 oarsmen, while the 'headsman' stood at the stern handling a sweep steering oar 18 to 24 feet long (5.5–7.3m). The sweep oar enabled the boat to be manoeuvred without headway when working close-in to a whale. The lightness of the whale-boats' construction also allowed easy handling, and it is claimed that a whaleboat at full speed could be stopped within its own length by backing the oars.[25]

The whaleboat was designed as a rowing boat, and did not convert into a very good sailing boat. However, the use of sail was often an advantage when whaling. The simplest form of sail rig, which was used throughout the 19th century, was a mast mounted through a hole in the second thwart which enabled the boat to run before the wind. American builders improved on this with a hinged mast step invented in 1837, and with the introduction of the drop centreboard in 1841.[26] A detachable rudder was also locked into position while under sail. American whalers used sail increasingly after 1870 as whales became less numerous and shy of the approach of boats.

In Australia, sails were occasionally used in Tasmanian whaleboats,[27] and Ben Boyd's manager, Oswald Brierly, refers to the use of sail in Twofold Bay, N.S.W. in 1844.[28] However, there is no evidence for the use of either centreboards or rudders in Australia, although there are photographs of boats at Cascade Bay station on Norfolk Island which have both (Mitchell Library: Small Picture File, 'Norfolk Island'), the boats possibly having been acquired from visiting American whale ships. These advances in whaleboat technology failed to be adopted in Australia for several reasons. In the case of both deep-water and shore-based whaling the perfection of the American sailing system came after the colonial industry had gone into decline. Added to this was the fact that centreboards and rudders were not suited to shore operations, where they were easily damaged while beaching and launching boats.

Some New Zealand shore station whaleboats used sails, but it is not clear if they used centreboards and rudders.[29] However, the long Azorean whaleboats, called 'canoas', which were originally built by American boatyards in the second half of the century, certainly did use the hinged mast, centreboard and rudder.[30]

Before the 1840s the 'typical' Australian whaleboat, is such a thing existed, was clinker-built of cedar or Huon pine, and about 30 feet long (9.1m). As elsewhere the typical boat was 5-oared, but larger boats were by no means rare, especially at shore stations where manoeuvrability was often sacrificed to speed in the face of stiff competition. Boats at the Twofold Bay station, for example, included both 5- and 7-oared varieties, and 9-oared boats were said to have existed.[31] The number of pulling oars (the headsman is not included in oar counts) was usually odd, so that when the head oarsman, the harpooner, stood to attack the whale, and while the whale was being killed, the number of oars on each side of the boat was even. Shore-based boats were usually better maintained and longer-lasting than ships boats, due probably to the difficulty of replacing them, and the greater amount of time available ashore for maintenance than could be afforded aboard ship.

In Tasmania, at least, and it would appear elsewhere in Australia, the American influence was shown in the varying lengths of the oars used. British boats had oars of uniform length, while American boats had oars of different lengths for different oarsmen, the practice recorded in Tasmania. The differing lengths of oars in American-designed boats was due to the pronounced curve of the boats gunwale, requiring longer oars at bow and stern than amidships. British boats had straighter sides and could use equal-length oars. The American influence is also to be seen in the apparent predominance of the stern-mounted loggerhead over the early 19th century British practice of using a bow-mounted bollard to check the whaleline. The absence of references to the use of bow-bollards in Australia would suggest that those whaleboats imported from British boatbuilders were built on the American pattern rather than the earlier British one.[32]

Australian boats seem always to have been a mixture of imported and locally constructed craft (see Part 4) and during the 1840s carvel-built boats began to appear. The first carvel-built boat to be introduced at Twofold Bay in 1847 created considerable local interest, and its superiority over clinker-built craft led to more orders for similar carvel boats from its builder, Thomas Day Jnr. of Sydney.[33]

Some Australian shore station whaleboats maintained an old tradition by being decorated. Early 19th century American whaleboats sometimes had red bows and red diagonal slashes aft, on a white hull, or had their hulls painted blue or green. By mid-century, the ship-board boats had lost such decoration, having at most a black gunwale and rubbing strake. However, the Californian bay-whalers' boats maintained the tradition with eyes painted on the bows or having their hulls painted tri-coloured red, blue and green.[34] New Zealand shore station boats also adopted the use of decoration, sometimes having a star, crescent or an eye on the bows and the name of the boat on the stern.[35]

In Australia, at Twofold Bay, decoration took several forms. A painting by Oswald Brierly[36] of the shore station shows two whaleboats, one with a brown hull with a darker gunwale, green loggerhead and yellow bow decking. The second boat is a yellowish brown with red rubbing strakes, dark gunwale, and a grey-brown circle on the bow. The Davidson family, later in the 19th century and into the present century, painted their Twofold Bay boats green.[37] In Tasmania, also, there is evidence of whaleboat decoration. A painting of the Hobart whale ship *Aladdin* engaged in bay whaling in Tasmania in 1849 shows whaleboats with their bows painted white or red, and with painted white lines below black gunwales. The pattern is the same as that used by some British boats in the early 19th century.[38]

Equipment carried in a whaleboat might include:

1 water keg	5 paddles
bucket	compass
boat hook	box of biscuits
2–4 harpoons	coats for crew
candles or lamp	2–3 lances
tinder box	bottle of rum
anchor	harpoon crutch
boat spade	drag (drogue)
boat knives	hatchet
mast and sail	line tubs and line
	waif or flag on pole

This gear, which could weigh as much as 900 pounds (408kg), or nearly the weight of the boat unladen,[39] was carried to facilitate the approach, capture and retrieval of the whale and to ensure the survival of the crew in the case of being blown or towed out to sea or away from the ship.

The whaleboat, especially as it was refined by the American boat builders in the mid-19th century, was an extremely specialized craft. With the development of steam whaling, the whaleboat disappeared except at a few isolated shore stations (e.g. Twofold Bay, Norfolk Island, Azores, Long Island, Bequia, Tonga and Java). The form of the whaleboat survives, however, in such boats as the naval 'whaler' and the Australian surf boat (also now disappearing and giving way to fibreglass copies).

3.2 'Whalecraft', equipment designed for the capture of whales

'Whalecraft' is the 19th century American term for the harpoons, lances, lines and other gear used in the actual whale hunt. Although this equipment is very simple and changed little throughout the long history of whaling, some technological advances were made in the 19th century which are worth noting, and which influenced Australian whaling.

Harpoons: Harpoons were designed to attach a line to the whale, while the killing was done with the lance. The hand-thrown harpoon head consisted of an iron shaft with a socket at one end and an iron point or head at the other. The socket fitted over the end of a wooden shaft (Fig. 1) which enabled the harpoon to be thrown and gave the weight necessary to drive the harpoon into the whale.

The most common method of whaling in the 19th century was to have two harpoons attached to the whaleline, with a short length of rope between them called a 'foreganger'. The harpooner attempted to set both harpoons into the whale in quick succession to ensure a good anchoring of the line. However, if the whale accelerated or sounded before the second harpoon could be thrown, it was simply tossed overboard before the short length of line between it and the first harpoon ran out.

Harpoons, when not in use, were protected with a wooden sheath over the head.

The earliest form of harpoon heads were the bone or ivory varieties used by various Eskimo and American Indian tribes to hunt whales. The earliest iron heads were like a broad-arrow in shape, with two sharpened blades called 'flues' (Fig. 1). This variety was used in European and American whaling for over 200 years, until the increased trade and competition of the mid-19th century stimulated improvement in the technology. Oswald Brierly's various paintings (e.g. in Art Gallery of N.S.W.) of Twofold Bay in the 1840s clearly show two-flued harpoons in use.

A problem with the two-flued harpoon was that in entering the whale it created a hole of the same dimensions as the harpoon head, which meant that the iron pulled out easily and the whale could be lost. Attempts to rectify this design fault began in the 1840s when over 100 patents on new harpoons were taken out in the United States. In 1841 an American, Will Carsley, designed a two-flued iron with a twist to the head, so that when pressure came upon the iron it locked into blubber (an example of this type can be seen in the New Bedford Whaling Museum collection). This design was not very effective, however, and another modification was the single-flued iron (Fig. 1) introduced in the 1830s and 1840s. In this design the single flue was set on one side of the soft iron shaft, so that when the pressure of the tow was applied the shaft and head bent slightly, locking the iron in place. New Bedford blacksmiths followed up the promising lead of the single flued harpoon by inventing the 'toggle' iron about 1846-8. The invention is sometimes attributed to one James Temple, and one variety bears his name.[40] The toggle iron had a separate iron head pivoted at the end of the iron shaft, which swung across at right-angles to the shaft after entering the whale, and prevented the harpoon drawing out. This design was very successful, and several varieties were produced. One had a forked shaft, in which a solid head was inserted and attached with an iron pin, on which the head pivoted. In another variety, the head itself had a groove in it, into which a flattened shaft was slotted, and again attached with a pin. The latter variety was sometimes called a 'Provincetown' toggle iron (Fig. 1),[41] but there would appear to be some inconsistency in the use of this and several other terms relating to whaling gear, which is perhaps the result of either varying regional usage, or of misunderstanding by secondary sources of the sometimes confusing descriptions of gear given by original sources.

The harpoons used by the Davidsons at Twofold Bay, and those used in 20th century open-boat whaling in Norfolk Island, the Azores, Bequia in the West Indies, and in Tonga were all of the toggle iron variety, usually of the 'Provincetown' variety as described above.

A third variation on the toggle design was the grommet iron. Whereas in the other varieties the toggle was held in the closed position with a light wooden pin, which was broken when pressure came upon it, the grommet iron had a ring or grommet slipped over the end of the barb of the toggle, which was forced off the toggle when the harpoon entered the whale, leaving the toggle free to swing open when pressure was applied to the line (an example can be seen in the New Bedford Whaling Museum collection).

An alternative to the toggle iron was a harpoon with pivoted barbs, similar in profile to the two-flued harpoon, which had been in use in the Greenland fishery in the early 1800s. The weakest point of this design was the pivoting pins, a fault overcome in the 1820s by George Manby's design (Fig. 1), in which the barbs when expanded hinged against the body of the harpoon-head, taking the pressure off the pivot pins.[42] The pivot-barbed harpoon remained in use throughout the century, but never achieved the popularity of the simple but highly efficient toggle iron.

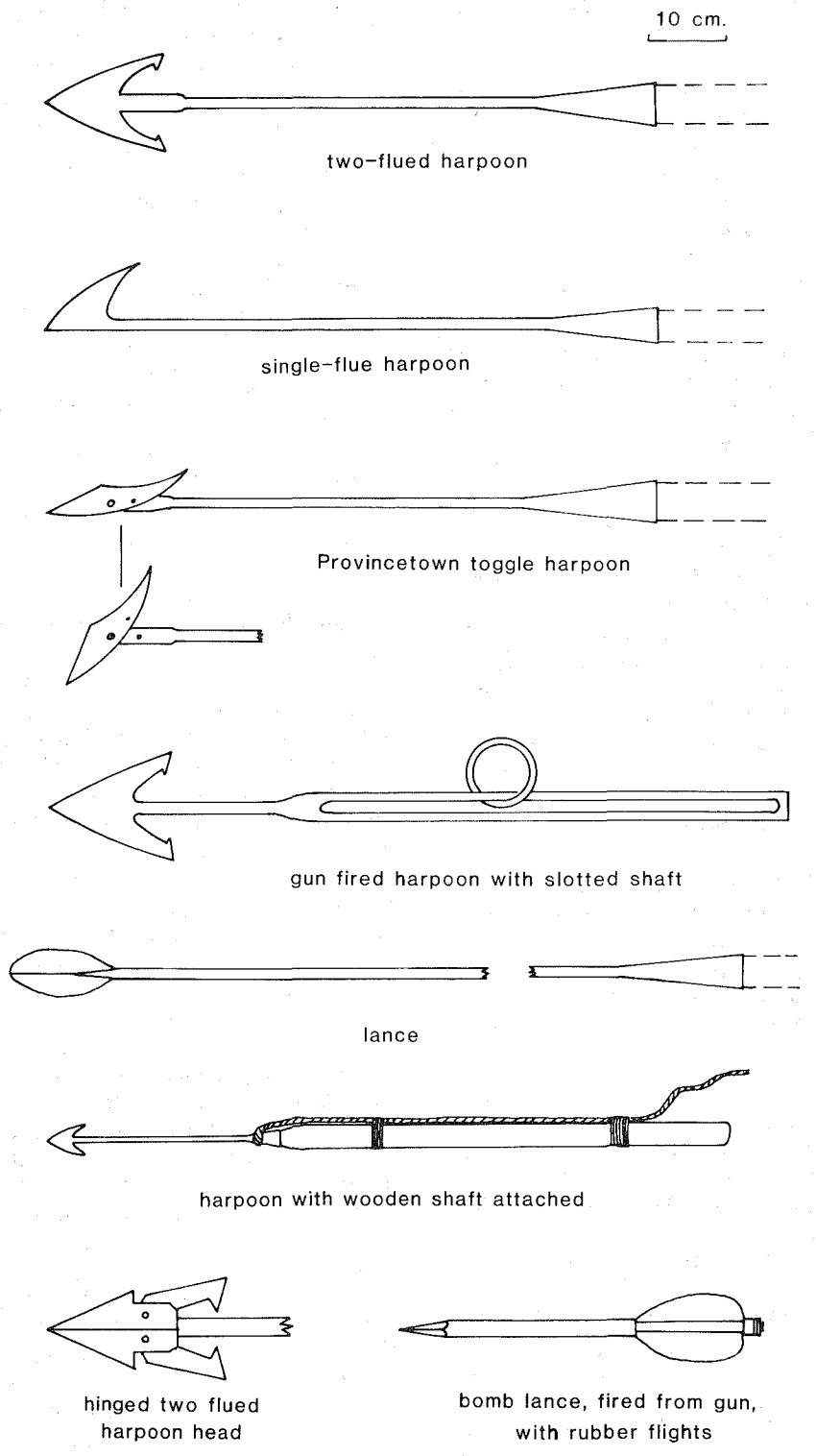

Fig. 1: Harpoons and lances.

Harpoons fired from guns, or with explosive heads, are described below under the heading 'Guns and explosives'.

Although little evidence exists, what there is suggests that the Australian use of harpoons followed the international pattern, with no local innovation; indeed, it is unlikely that many harpoons were actually manufactured locally in the colony, but were imported instead (see Section 4). During the heyday of local whaling in the 1830s and 40s, the traditional double-flued 'broad arrow' style of harpoon predominated, although single-flued harpoons were advertised in the Sydney press in 1840 (*Sydney Herald* 13/1/40). It is not yet known when the new American 'toggle' irons were introduced into the Australian industry, the earliest direct evidence of them being late 19th century photographs. It is likely that the new harpoons only became available in Australia after British equipment suppliers began to stock them, and that probably did not occur until the 1850s, after the massive decline of the local industry. It is therefore unlikely that the toggle harpoon played much part in the boom period of Australian whaling.

Line: The line connecting the harpoon with the boat was an essential piece of whaling equipment. American whalelines were usually 300 fathoms long, while British lines were 200–220 fathoms long. Lines were originally of hemp, ⅔ to 2 inches (16.9–50.8mm) in diameter, while later the stronger, water resistant, manilla was used.[43] In more recent times manilla rope with a nylon core has been used in the Azores.[44]

Information on the use of whaleline in Australia is scarce. Ropewalks existed in the colony from its earliest days, but no reference is made to the manufacture of rope specifically for whaling purposes. There was, however, a considerable importation of whaleline from Britain (see Section 4), which included manilla line from the early 1840s. One reference, to Davidson's shore station at Twofold Bay in 1909, mentions 100 fathoms of ⅞ inch hemp being used as a whaleline.[45] The short length of the rope could reflect either the poor financial status of the industry at that date, or the shallowness of the waters in which Davidson carried out his purely opportunistic whaling.

The whaleline was coiled into two tubs which lay in the bottom of the whaleboat, and when a harpooned whale dived or 'sounded', the line ran rapidly out of the tubs, around the loggerhead in the stern, then down the length of the boat between the oarsmen and through the chocks in the bow. Water was poured over the loggerhead to prevent the wood or line catching fire through friction. The shear of the whaleboat, that is the dip from bow and stern towards amidships, meant that the line was kept above the rest of the gear in the boat when running out, and was in a convenient position for the oarsmen to haul upon it when called upon to do so. The line was rewound into the line tubs as the boat drew up to the whale for lancing.

If a whale sounded to a great depth, using up all the line carried in the boat, the line end could be transferred to another boat and bent onto the end of their line, or it could be tied to a drag or drouge, a flat piece of wood which created a strong drag when pulled through water, and which floated to the surface with the end of the line, enabling the boat to recover the line when the whale had exhausted itself.

Sometimes the line had to be cut, due to trouble in the boat in one form or another, and to allow this to be done quickly a couple of boat knives and a hatchet were kept ready at hand.

Shorter lines were used in the boat for other purposes. A 4–6 fathom line (or 'warp' or 'foreganger') was used to attach another harpoon to the whaleline if needed. An 8 fathom line was attached to the lance to allow its retrieval and re-use. Another line was attached to a grapnel which was useful in securing dead whales, or retrieving loose lines in the water.

Lances: The lance (Fig. 1) was an implement for killing whales. It had a leaf-shaped head, about 4 inches long and 2 inches wide (101 x 50mm) on the end of about 5 feet (1.5m) of malleable iron shaft. This was set on the end of a 6 foot (1.8m) pole, making a long weapon which was driven into the whale many times to kill it by damaging vital organs. The lance was attached to the boat by a line about 8 fathoms long, with which it was retrieved after each lunge. The lance shaft was often bent in these fierce encounters, but its being made of malleable iron enabled the headsman to straighten it out on the boat's gunwale.[46] In American boats the port chock timber had a groove in it in which a bent lance could be straightened, and a mallet attached by a lanyard under the thighboard could also be used to hammer lances straight for the next throw.[47]

'Explosive' or 'bomb' lances are described in the section on 'Guns and explosives'.

Boat spade: A boat spade was a cutting tool with an iron head about the size of a man's hand, shaped like a spade with a sharpened leading edge, and attached to a long wooden shaft (Fig. 3). It was used to cut the tail ligaments of the whale in the final stages of the capture, to prevent or slow down the damaging and often fatal tail thrashings.

Guns and explosives: The use of explosives and explosive-powered projectiles in whaling is surprisingly old, although some of the directions taken in this field proved to be dead ends. As early as 1821, for example, Congrieve rockets were used as long-distance lances to capture nine whales.[48] Rockets returned to favour from time to time throughout the 19th century, but were never perfected as a reliable method of capturing whales, despite the brave claim of an 1865 advertisement for a new rocket launcher which guaranteed connection by line to the whale.[49]

The development of harpoon-firing guns had a more promising future. The first recorded use of a gun in whaling was in 1731, and in 1733 Elias Bird, an ex-South Sea Company captain, carried out successful experiments. The manufacture of guns improved slowly, and in 1771 an American blacksmith, Abraham Staghold, invented the slotted shaft (Fig. 1) which did away with the problem of attaching the line to the harpoon without unbalancing it. This design is still used in whaling harpoons today.[50]

In 1793 John Bell invented a new gun with twin flintlocks, and a range of 40 yards. Then, in 1821, George Manby invented a new explosive harpoon, a shell 9 inches long and 2 inches in diameter with spring-loaded barbs and an explosive head. Thus, by the second decade of the 19th century, two of the major elements of modern whaling, the harpoon gun and the explosive harpoon, had already been invented.

The most efficient of the guns used in open whaleboats was the Greener's harpoon gun (Fig. 2), similar guns being made by several other companies. This design incorporated percussion locks under a brass cover, which overcame the problem of damp powder that had plagued the older flintlock guns. The 75 pound gun was mounted on a stout swivel in the bows of the whaleboat. The harpoon weighed about 10 pounds, and was seldom shot more than 25 yards, although Greener achieved an extreme range of 120 yards in trials in 1845.[51]

Such guns as Greener's were used extensively in some American whaling grounds, for example in California in the 1850s.[52] The ultimate in fixed gunnery came in the 1860s when Svend Foyn perfected his gun and explosive harpoon, designed to be mounted in steam-powered whale chasers. The Foyn gun was much heavier than the Greener type, and fired a 55 kg harpoon with barbs which sprang out in an umbrella pattern after penetrating the whale. The harpoon was armed with an explosive head which detonated 3 seconds after penetration.This new gun, allied with swift steam vessels, heralded the beginning of the slaughter of the bigger, faster whales, and its contin-

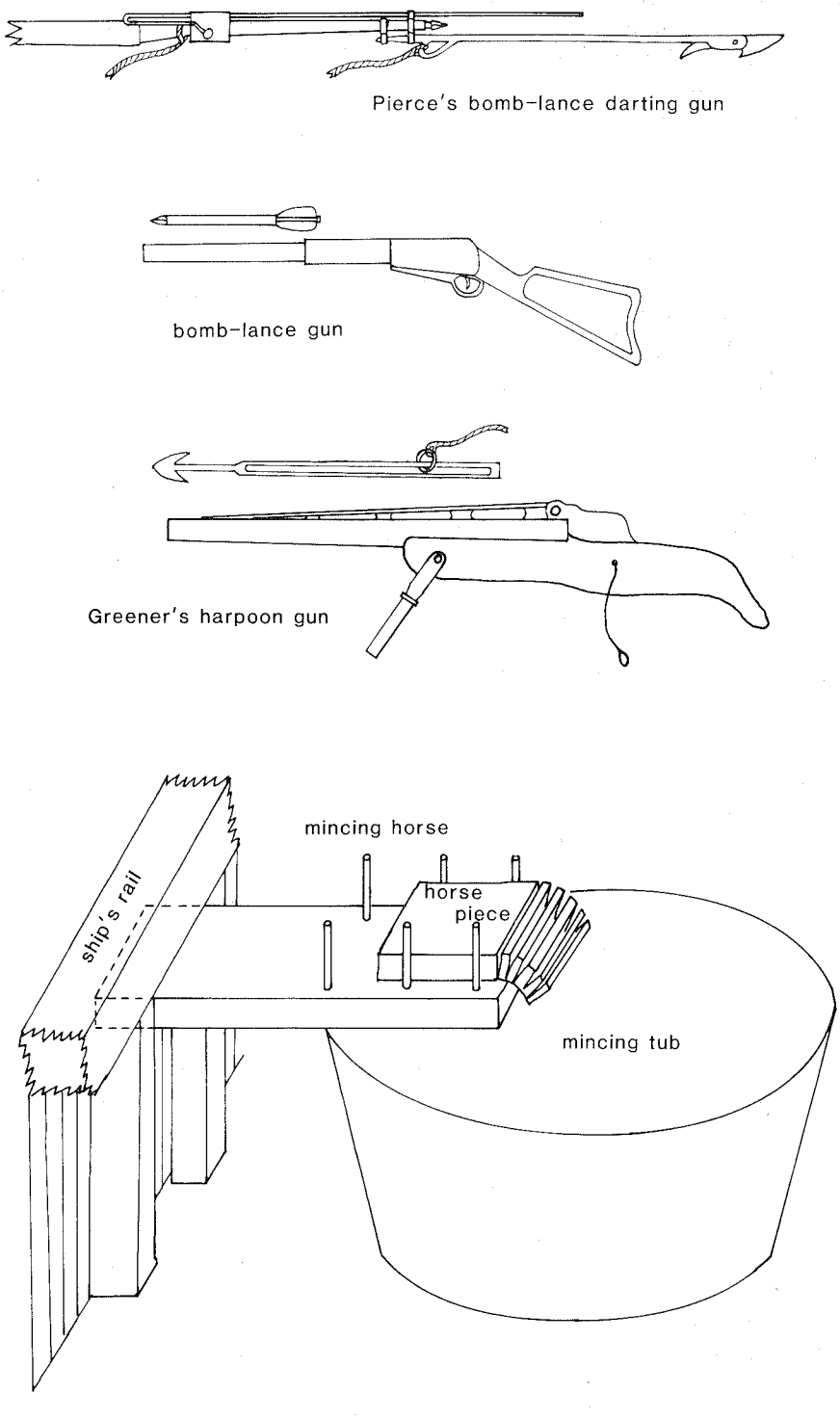

Fig. 2: Guns and mincing equipment.

ued use for 100 years has led to the appalling depletion of whale numbers, only now being fully understood.[53]

The other major piece of artillery used in whaling was the hand-held shoulder gun. Really only large-bore shot guns, these weapons were used to fire both harpoons[54] and, more commonly, bomb-lances (Fig. 2). The bomb-lance (Fig. 1) was a large explosive shell fired into the whale after it had been harpooned.[55] Invented in the U.S. by Robert Allen in 1846, and improved in 1852 by C. C. Brand, the bomb-lance had a time fuse and india rubber tail flights to direct its flight.[56]

A weapon combining the harpoon and the bomb-lance was Pierce's darting gun (Fig. 2). This had a simple tube-like bomb-lance gun attached to a toggle-iron harpoon, the gun being automatically discharged when the harpoon entered the whale. This weapon became very common among American whalers, especially in the bowhead fishery where quick death of the whale could prevent its loss under ice floes.[57]

Experiments in many other methods of dispatching whales took place in the 19th century. These included the use of strong poisons (such as strychnine,

prussic acid or curare) held within the harpoon head to be ejected after impact into the whale's bloodstream. Such a harpoon, containing a phial of prussic acid (hydrocyanic acid), was announced in the Sydney press in 1836.[58]

The poison certainly killed whales quickly, but it could also kill the men who had to cut them up, and the system was abandoned.

Another method was to embed a conductor wire in the whaleline, then electrocute the whale with a charge of electricity from a hand-operated generator in the boat. This system was first tried in the 1850s, and has often been experimented with over the last 100 years, but never with much success.[59]

Australian whalers seem to have made very little use of guns or explosives, although it is not known if they were used by visiting whalers in Australian waters.

Ben Boyd brought a whaling gun and 'rockets' with him to Australia in 1842, but there is no reference to them ever having been used.[60] An all-metal shoulder-fired bomb-lance gun, possibly that referred to in 1842, was recovered from the wreck of Boyd's ship *Wanderer* and is now housed in the Port Macquarie Historical Society Museum in N.S.W.

Another bomb-lance gun, built of brass, was owned by the whaler George Davidson at Twofold Bay, but was seldom used as it was said to frighten the killer whales which assisted in the chase.[61] This gun, and one of the lances it fired, are held by the Eden Museum at Twofold Bay. Bomb-lance guns were also used occasionally in Tasmania, and a harpoon gun of unknown design was used by Bunbury (W.A.) whalers in 1850 without much success.[62]

3.3 Processing equipment

Cutting-in equipment: Several types of edge implements were used for removing blubber from the whale carcass: 'flensing' or 'cutting-in' as it was called. One method of cutting-in, used at sea and in many shore stations, was to cut long strips of blubber, then 'peel' them off the whale with block and tackle and a capstan. These 'blanket pieces' as they were called were usually cut with boat spades of several types, such as head spades, cutting (or blubber) spades and bone spades (Fig. 3). The other major cutting tools were boarding knives (Fig. 3) and flensing knives, and a variety of pikes, gaffs, hooks and toggles (Figs. 4 & 5) were used to move the large pieces of blubber around. The second major process was to reduce the blubber to a size where its oil could be boiled out most efficiently. The large 'blanket pieces' were cut into 'horse pieces', strips 15 inches long by 4 inches wide, using a flensing knife or a boat spade. The term 'horse piece' derives from the wooden trestle or 'horse', on which the next step in the process was carried out. The 'horse pieces' were placed on the horse and sliced *almost* right through, in parallel cuts across the width of the strip of blubber (Fig. 2). This was done using a long blade with a handle at each end, called a 'mincing knife' (Fig. 3). The 'horse pieces' were then called 'sliver pieces', which were thrown into mincing tubs to await boiling down, or 'trying-out' in the try-pots.

The 'mincing' process was one of the few whaling activities which was mechanized to some degree in the second half of the 19th century, although this was not widespread.

Trying-out equipment: During the 19th century all trying-out of whale blubber was done in try-pots, round-bodied, large-mouthed iron cauldrons of 150 to 250 gallons capacity (Fig. 4). Two, or sometimes three, try-pots were placed on an iron grate or set of 'try-bars', a short height above a brick base, and a brick wall was then built around the pots, with a firedoor being built in front of each pot to give access to the furnace area thus created around and below the pots. The try-works (Fig. 4) usually had very short chimneys built into the back wall of the furnace to create a draught. Aboard ship the try-works was often reinforced with iron plates, knees and bands, to counter movement at sea, whereas at some shore stations the try-works were very rudimentary.

Often try-pots had a flattened face on one side so that two pots could fit snuggly into the minimum space, ensuring optimum use of the heat of the furnace. Occasionally pots also had a pouring lip built into the rim to allow oil to drain automatically from one pot to another, or into a cooler.

Once the try-works was under way, the furnace was fed with the 'scrap', the crisp remains of the blubber after the oil had been boiled out. The sooty smoke from the scrap, combined with the oily steam, was responsible for much of the dirt and stench usually associated with whaling ships and stations.

Implements used during the trying-out included: a stirring-pole (Fig. 5), to stir the contents of the pot and prevent the oil at the bottom of the pot burning, which discoloured the oil; blubber forks (Fig. 3), being long-handled 2-pronged forks used to transfer the minced 'sliver pieces' from storage tubs into the try-pots; and skimmers (Fig. 5), large spoon-shaped scoops, with perforations through the spoon-shaped section, which were used to skim off the boiled-out scrap which floated to the top of the try-pots. The perforations allowed the oil to escape. The oil was ladled from the try-pots into large cooling tanks with bailers (or dippers, Fig. 5) which were like small buckets attached to long poles.

Cooling tanks were usually metal tanks in which the oil cooled before being barrelled. Cooling was necessary because the hot oil, if barrelled immediately, shrank the barrel staves and caused leakage. The tanks used were often made of copper, especially aboard ship. In Australian shore stations, however, large square iron tanks were often used, which had originally been used as containers in which perishable goods were shipped to the colonies (and commonly called 'ships tanks').

The oil when cooled was pumped or ladled into barrels for storage. Shore stations often had problems with storage of full barrels, as extreme fluctuations in temperature and humidity could result in shrinkage of the staves and leakage of oil. This problem plagued the Encounter Bay station in South Australia,[63] but was avoided at Twofold Bay where Boyd's oil was stored at a reasonably stable temperature in a hulk moored in the Bay,[64] while Davidson's oil was kept in 400 gallon ships tanks and barrelled only when a shipment was ready for market.[65] These ships tanks still exist at the Davidson station site.

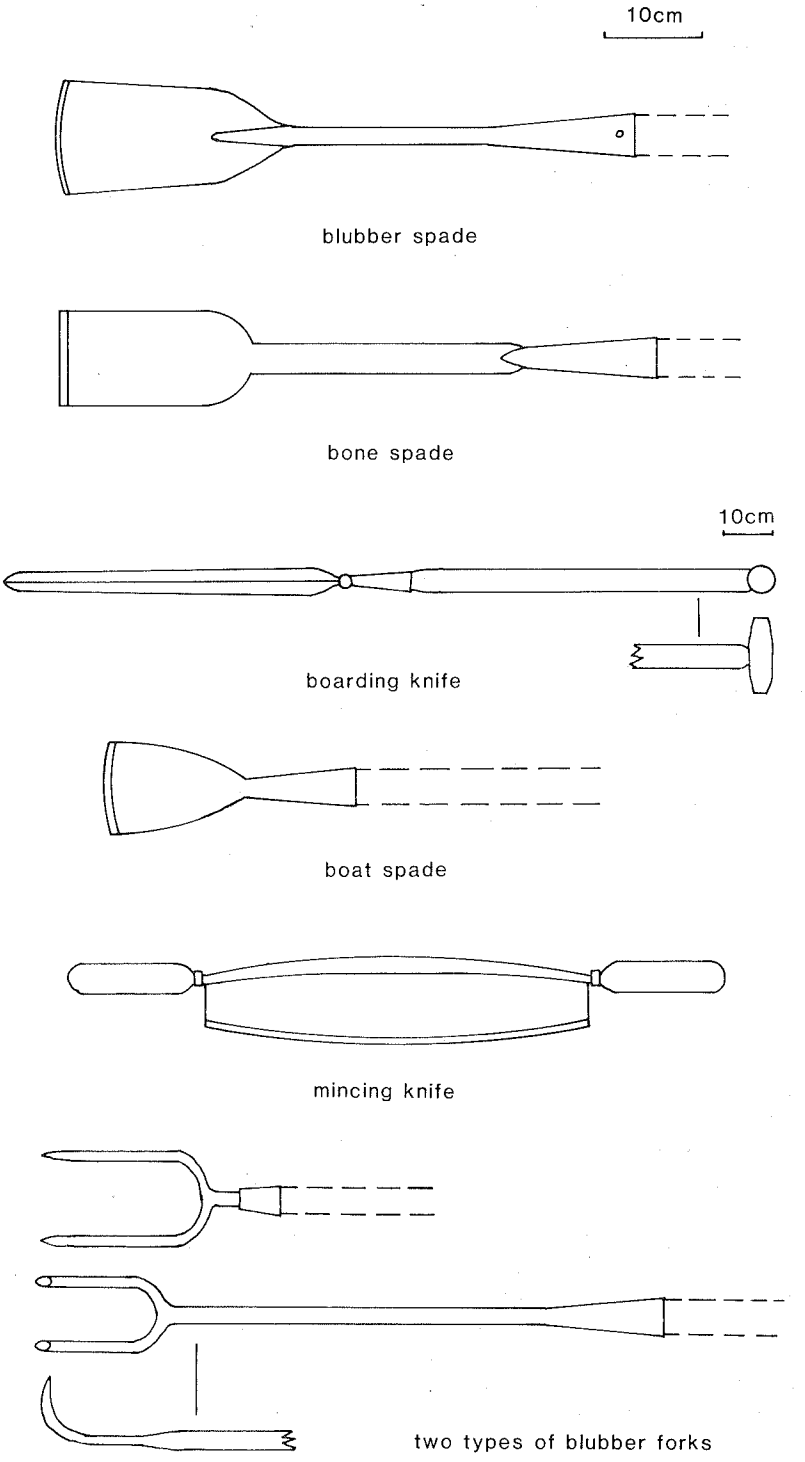

Fig. 3: Cutting-in and trying-out equipment.

4. SOURCES OF WHALING EQUIPMENT IN AUSTRALIA

In Australia in the 19th century, whaling equipment could be acquired from two sources, importation and local manufacture. By far the largest supply of equipment was imported, mainly from Britain. Some idea of the scale of this import can be had from the 'Shipping Gazette and Sydney General Trade List' published regularly in the *Sydney Herald* during the 1830s and 1840s. An example of a single shipment from Britain is that arriving on the *Prince of Orange* from Leith on 19/2/1842, which included 49 whalelines, 106 harpoons, 97 lances, 75 blubber knives, 22 chopping knives, 22 blubber spades and 5 coils of foregangers. Other gear, imported in varying quantities from time to time, included whaleboats, try-pots, try-work knees, doors, frames and bars, casks, copper coolers, ladles, oars, blubber forks and blubber hooks, as well as a large quantity of equipment simply described as 'whaling gear' in the manifests.[66]

There are difficulties in using the newspaper manifests as statistical evidence, as much equipment was imported in bulk, and described as consisting of so

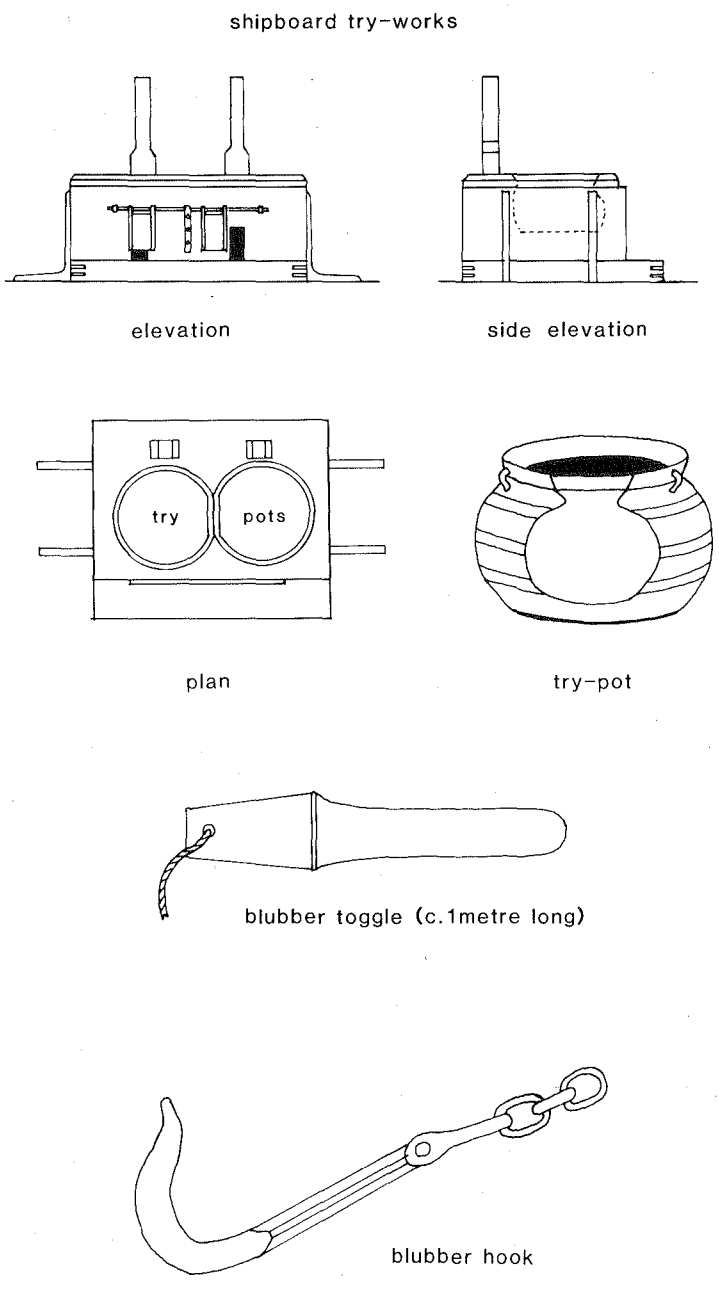

Fig. 4: Cutting-in and trying-out equipment.

many 'packets', 'packages', 'bundles', 'cases' etc., which makes it hard to estimate the actual amount of gear imported. Other problems include: doubts about the completeness of such reports; the large numbers of parcels of undescribed 'whaling gear'; and the likelihood of the distortion of import figures through the re-importation of equipment from Australian outports and from New Zealand which had already appeared on previous cargo manifests through Sydney. However, the newspaper cargo reports do give some idea of trends, for example the only item listed in which exports exceed imports is the whaleboat, which suggests a healthy local industry in boatbuilding, but a dependence on the importation of other varieties of equipment.

All import and export lists for the years 1832, 1835 and 1840 have been analysed fully, and the following trends were apparent. Shipments of whaling equipment came predominantly from London (67 per cent of total). Other imports were divided equally between Hobart and New Zealand (probably re-importation of gear originally supplied from Sydney, due to the seasonal nature of shore-whaling, and the high turnover of companies working in Tasmania and New Zealand, whose gear was returned to Sydney for auction), the U.S.A. (Boston and New York), and Mauritius. With some items, such as whaleline, harpoons and try-pots, London supplied at least 75 per cent of all imports, and more if re-importation from other colonial ports is taken into account. The greatest amount and variety of equipment was imported in 1832, perhaps reflecting the establishment of shore stations at that time. After the early 1830s a pool of imperishable equipment, such as try-pots and coolers, had been established, and the need for new or replacement items

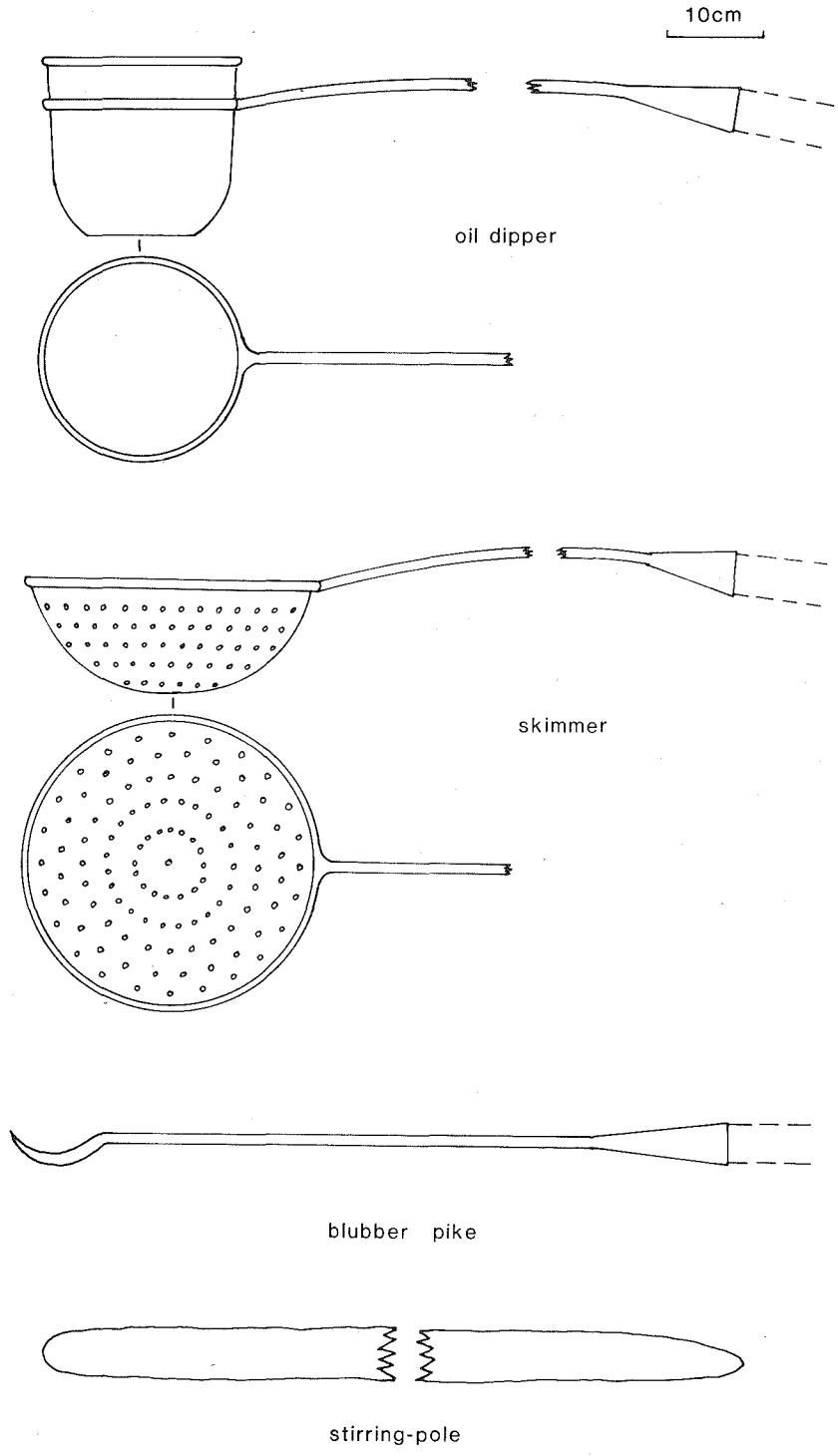

Fig. 5: Cutting-in and trying-out equipment.

would have been quite low. Thus 58 try-pots were imported in 1832 but only 26 in 1835 and 1840 combined. Perishable items, such as whaleline, were in constant demand, 302 coils being imported in the three sample years. Only 7 boats were imported in the same years, however, reflecting the local boatbuilding industry's capacity to supply the local market. The boatbuilders may not have had the raw material for oar production, however, as in 1832, 263 oars were imported from London.

Exports of whaling gear from Sydney were to three destinations, New Zealand, Tasmania and Twofold Bay, and included all types of equipment, but especially boats, whaleline, try-pots and casks, items which could not be begged, bought or bartered from visiting whale ships. A large export market in 'whaling stores' also existed, mainly to the 'South Sea Fishery' and also to New Zealand, but 'whaling stores' is clearly distinct from 'whaling gear' in the manifests.

It has been noted that in order to reduce whaling costs to the minimum, whaling entrepreneurs sometimes imported their own gear, and in their own vessels.[67] This is borne out by the newspaper shipping lists, which show a total of 17 merchants importing whaling gear in the three years studied, and of these 7 are known to have been the owners of whale ships. The importing merchants advertised their newly arrived gear for sale in the local press soon after

unloading (i.e. that gear which they did not reserve for their own use). These advertisements are often more descriptive of the nature of the equipment imported than are the shipping records. A notice in 1842, for example, announced the arrival of '70 coils of manilla whaleline', the material not being specified in the shipping lists and, again, in 1840 an advertisement specified the availability of both single and double flued harpoons,[68] whereas the shipping lists merely refer to 'harpoons'.

In at least one case, an advertisement also contains information about the makers of imported gear; in 1840 the entire cargo of the *Henry* was sold by auction, which included 'a complete assortment of whaling gear from Scarrow'.[69]

Further information about 19th century whaling equipment imports can come from the study of equipment surviving in Australia in museum collections and elsewhere. For example, try-pots surviving at Twofold Bay have the inscription 'T. Bryant/Milwall/London' cast into them, perhaps the successor of one 'Richard Bryant, Anchor and Ship-smith, Ferry Road, Millwall', listed in an 1837 London commercial directory.[70] It is interesting that the whalers at Twofold Bay, in the late 19th century, used Sydney-made sheep tallow boilers as cooling tanks, and perhaps also for trying-out. Several of these sheep boilers survive, cast by R. Dawson of Sydney, probably for use at Ben Boyd's boiling-down works at Boydtown on Twofold Bay. Richard Dawson advertised the availability of his 100–1500 gallon capacity sheep boilers in the Sydney press in the 1840s. Dawson had operated a foundry in Sydney since 1833, and had carried out successfully castings of up to 4 tons in weight.[71] While the technology and expertise to cast try-pots for whaling obviously existed in the colony in the 1830s and 40s, there is no evidence either in newspaper reports or advertisements, nor from surviving pots, to suggest that try-pots were ever locally manufactured.

The fact that the colony, while capable of producing the castings necessary for whaling equipment, did not establish such an equipment industry, would suggest that the imported equipment was cheaper than that which could be manufactured locally. While Australian whaling entrepreneurs might complain of the expense of imported equipment,[72] the relatively small local demand for equipment would have resulted in high production costs per unit which would put local manufacturers at a disadvantage compared with British manufacturers. This would explain the failure to establish local whaling equipment production in Australia, noted by Little.[73]

However, the manufacture of at least two essential pieces of whaling equipment did occur in the Australian colonies, whale ships and whaleboats. Blainey has called shipbuilding the largest and most dynamic colonial manufacture in the first half of the 19th century, and has pointed out that whaling was a mainstay for the shipyards of Sydney and especially Hobart.[74] Shipbuilding did not suffer from the problem of specialization as did the founding industry, as whale ships could be easily converted for general merchant shipping if whaling proved uneconomic, thus protecting the owners' investment. Further details of local ships have been given in Part 3.1 of this paper.

Whaleboats were also built in Sydney and Hobart, and at several out-ports. These boats seem to have been built to the American pattern, but with varying degrees of expertise. Some boats built at the out-ports left much to be desired; for example, those built by Ben Boyd's boatbuilder at Twofold Bay were described as being 'only canoes' compared with the fine boats built by Thomas Day in Sydney.[75] In 1844 Day was building 7-oared clinker-built boats for the shore-based stations, and his first 7-oared carvel-built whaleboat which appeared at Twofold Bay in 1847 was hailed as a very superior boat.[76] Other well known whaleboat builders later in the century included Lark Macquarie, a Hobart builder whose boats won awards at Melbourne and Sydney trade exhibitions in 1894, Mr. Williams, and John Nichols, both of Hobart.[77] Tasmanian out-ports also produced whaleboats, but of unknown quality; for example, Port Arthur boatyards turned out 44 whaleboats between 1839 and 1841.[78] As mentioned previously, the local production of whaleboats greatly overshadowed the importation of boats. In 1840, for example, two whaleboats were listed on incoming shipping manifests at Sydney, while 19 were exported, mainly to New Zealand.

An important factor in the availability of whaling equipment in Australia was the re-distribution of used gear, usually by auction. Equipment thus re-cycled included barrels, copper coolers, whaleline, harpoons, lances, skimmers, pumps, try-pots, ladles, mincing knives, cutting blocks, blubber forks and knives, compasses and ship's rigging.[79] In this way imported and locally made equipment could be used by many whalers in its lifetime, and might be used on both ship and shore stations, helping reduce the cost of colonial whaling.

5. CONCLUSION

From the evidence presented here, it can be seen that although the technology of the Australian whaling industry was similar to that used by the other nations engaged in the Southern Whale Fishery, the isolation and economic climate of the colonies and the mixture of ship and shore-based whaling resulted in a distinctive industry which was of major importance in the growth of Australia, despite the minimal impact it had on the colonial manufacturing industries.

While it is true that the general technology of whaling altered little before the introduction of steam chasers, it has been shown that the hardware of whaling did change considerably throughout the 19th century. Because of the factors of isolation and supply difficulties, the timing of the Australian whaling boom, and Australia's proximity to the whaling grounds, the golden age of Australian whaling employed a suite of artifacts which distinguishes it quite clearly from the peak periods of both British and American whaling in the Pacific.

NOTES

1. For the history of whaling generally, see : Dow 1925; Hohman 1928; Jackson 1978; Stackpole 1953.
2. Dakin 1963: xxv–xxvii suggests 1789; Rickard 1965: 4, says the *Emelia's* voyage commenced in September 1788; while Jones 1981 (2): 94 gives the date as 1787.
3. Dakin 1963: 9–11.
4. Dakin 1963: 41. Shore-based whaling was carried out on Long Island, U.S.A., from 1640 to 1918, so to claim

that shore-based whaling was re-invented in Australia is not valid.

5. Dunbabin 1926: 3–8; Dakin 1963: 43.
6. *S.H.* 15/8/1828; Dunbabin 1926; Dakin 1963: 47–49.
7. Blainey 1966: 107; Bach 1976: 74–5; Dunbabin, 1925: 21, Kable & Underwood's 185 ton *King George* built Sydney 1805.
8. Philp 1936: 35.
9. Blainey 1966: 107; Jones 1981 (2): 91–99.
10. Blainey 1966: 115.
11. Little 1969: table, 125.
12. Dakin 1963: 140–144; O'May n.d. *(Whalers)*: 95; further reading on Australian whaling see also Colwell 1969.
13. Jones 1981 (1): 26.
14. British figures see Jones 1981 (1): table 5; example of Australian figures see O'May n.d. *(Hookers)*: 30–31, showing Hobart whalers averaging 226 tons in 1849.
15. O'May n.d. *(Whalers)*: 25.
16. O'May n.d. *(Hookers)*: 29; Little 1969: 126.
17. Little 1969: 126.
18. O'May n.d. *(Whalers)*: 22.
19. Little 1969: 124.
20. For further description see Church 1938; Villiers 1974.
21. Rhodes 1954: 94–5.
22. Ansel 1978: 5–6.
23. ibid.: *passim.*
24. ibid.: 17.
25. ibid.: 21.
26. ibid.: 66.
27. O'May n.d. *(Whalers)*: 15–16, 96.
28. Brierly 1844: A534 Sept. 1844.
29. Rickard 1965: 14.
30. Housby 1971.
31. Brierly 1847: A542 and paintings; Colwell 1969: 79.
32. Ansel 1978: 32; Philp 1936: lists boats' equipment; O'May n.d. *(Whalers)*: 96. See Spence 1980: 95–97, 103–4, 133; Ashley 1938: 59–60 for British boat design.
33. Brierly 1847: A542, A540 April 1847 & Sept. 1847; Day was one of Sydney's 15 boatbuilders in 1847 (cf. *Low's Directory of the City and District of Sydney).*
34. Ansel 1978: 95–6; Scammon 1968: 271.
35. Rickard 1965: 75; Wakefield 1845: 322.
36. Brierly, *Whalers off Twofold Bay*, watercolour, Art Gallery of N.S.W. : Brierly came to Australia with Benjamin Boyd in 1842 and partly managed Boyd's Twofold Bay whaling station for 7 years. Brierly subsequently undertook expeditions with Owen Stanley and Keppel as an artist, was war artist in the Crimea with Keppel, became marine artist to Queen Victoria, was knighted, and ended his life in 1894 as keeper of the Painted Gallery at Greenwich. His diaries and paintings are the most complete record of a shore-based whaling operation in Australia.
37. Hawkins & Cook 1908: 269.
38. Painting by William Duke, *Off Shore whaling with the 'Aladdin' 1849,* Tasmanian Art Gallery, Hobart; British boats shown in several paintings in Brewington 1965: 22, 30, 52.
39. Scammon 1968: 224; Dakin 1963: 35; Rickard 1965: 14–15; O'May n.d. *(Whalers)*: 96; Ansel 1978: 64.
40. Housby 1971: 26; Church 1938: plate 55; Ashley 1938: 86.
41. Church 1938: plate 55.
42. Blackmore 1971: plates 140 & 143; Manby 1823: 214–16.
43. Dakin 1963: 6; Ansel 1978: 60–64.
44. Housby 1971: 22.
45. Brady 1909: 37–42.
46. Housby 1971: 22; Scammon 1968: 225–9.
47. Ansel 1978: 52–3.
48. Blackmore 1971: 301–7.
49. loc. cit.
50. ibid.: 302–3; Jackson 1978; 159.
51. Blackmore 1971: 304–5.
52. Scammon 1968: 248.
53. Frost 1978; Blackmore 1971: 301–7; Ommaney 1971.
54. Blackmore 1971: plate 143.
55. Scammon 1968: 225–7.
56. Brown 1887: 254.
57. loc. cit.; Ashley 1938: 58.
58. *S.G.* 26/5/1836.
59. Frost 1978: 173.
60. Brierly 1843: A539 August 1843.
61. Hawkins & Cook 1908: *passim.*
62. Philp 1936; Heppingstone 1966: 37.
63. Borrow 1947.
64. Brierly 1844: A534 22/8/1844.
65. Brady 1909: 42.
66. *S.H.* various dates 1831–44.
67. Little 1969: 116–117.
68. *S.H.* 5/3/1842, 13/1/1840.
69. *S.H.* 21/2/1840.
70. Piggott & Co. 1837: 92.
71. Fowles 1973: 16; *S.H.* 23/3/1844.
72. Little 1969: 116–117.
73. loc. cit.
74. Blainey 1966: 117.
75. Robinson 1844: 175 (21/9/1844).
76. Brierly 1847: A542, A540 April 1847 & Sept. 1847.
77. O'May n.d. *(Hookers)*: 28; O'May n.d. *(Whalers)*: 28, 92–3.
78. O'May n.d. *(Whalers)*: 33.
79. *S.H.* 13/1/1840, 19/4/1842, 6/4/1844.

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