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An Analysis of the Metal Containers from Chinese Sites in the Cromwell Area, Central Otago, New Zealand

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ABSTRACT

Metal containers are an under-studied component of historic archaeological sites. This paper presents the results and conclusions from a study of metal containers from seven nineteenth century Chinese miners' habitation sites in Central Otago. The paper also incorporates a typology designed as a baseline for future New Zealand "can research" and includes discussion of the utility of can remains for dating.
Keywords: METAL CONTAINERS, CHINESE SITES, TYPOLOGY, DATING.

INTRODUCTION

Metal containers of various shapes and sizes have been used extensively in the western world for about the last 150 years for packaging, preserving and distributing foodstuffs and other products. Although metal containers are commonly called "tins" or "cans" (O.E. canne—a vessel for liquids), most are made of rolled steel which is tin-plated to prevent rusting. It is also important to appreciate the difference between "metal boxes" which were made in a wide range of shapes and sizes for packaging, and "preserved canned goods", i.e. foods packed in hermetically sealed cans. "Tin" (as described above) has been the predominant metal used in packaging. All containers described in this report are composed of "tin" unless otherwise stated.

Once "tinned" products were consumed, the containers were usually discarded, sometimes in quite large quantities. Although their potential as sources of cultural information has been recognised by some overseas archaeologists (e.g. Busch 1981, Rock 1980), only a few "can reports" have been produced (e.g. Hunt 1959 (noteworthy for its time), Fontana and Greenleaf 1962, Rock 1984). The only detailed metal container studies undertaken in New Zealand to date are those by Anson (1983) and Bedford (1984) on tin wax vesta boxes. This lack of specialised can studies is attributable to two factors:

1. Despite their extensive usage, cans have a relatively low durability compared with other cultural debris such as bottle glass and ceramics.

2. There is a general lack of understanding of or inability to discern the cultural information which can be derived from the study of cans. Even those in very poor condition can be usefully analysed, provided they are studied carefully, constructional and chronological features recognised and the remains compared with control specimens.

This report embodies the results of one of a series of specific studies of various artefact-types uncovered from Chinese sites in the Cromwell area (see Ritchie 1980, 1983, 1984, Ritchie and Harrison 1982, Anson 1983, Foster 1983, Ritchie and Bedford 1983, Bedford 1985). The work is part of an on-going archaeological mitigation programme (the Clutha archaeology project administered by the New Zealand Historic Places Trust), made necessary by the construction of a series of hydro-dams in the upper Clutha catchment.

The main assemblages used in the study are derived from seven Chinese miners' habitation sites: the Chinese urban enclaves at Cromwell (Chinatown; S133/48) and Arrowtown (S123/249), a Chinese store (S123/250) also at Arrowtown, three Chinese hut sites in the Upper Clutha Valley—the Poplars (S115/44), Ah Wees (S115/54) and QB2 (S124/207), and a rockshelter in the Cromwell Gorge, Caliche shelter (S133/223). Can remains from some 50 other Chinese and European sites in the Cromwell area were also used for comparative purposes. In addition this study incorporates information from the following sources:

(1) research into canning history and technology;

(2) the establishment of a comparative collection (*ca.* 200 units) composed of metal containers obtained from a wide range of sites and surface structures;

(3) study of labelled metal boxes and cans in museums and private collections.

Analysis of the main excavated assemblages has revealed that a minimum of 1099 metal containers are represented (587 cans and metal boxes and 512 tin wax vesta boxes). This number probably represents only a small percentage of the canned products actually used at each site but it is assumed that each site assemblage reflects preferences and the main types of canned products which were bought and used. The relatively small can assemblages, particularly from the long term occupation sites (Chinatown and the Arrowtown Chinese settlement), are attributable to decomposition of can remains in the relatively damp soil conditions of these two sites and, possibly, off-site disposal.

OBJECTIVES AND ANALYTICAL PROCEDURE

The objectives of the study were threefold:

(1) to provide a body of baseline data for future studies of metal containers in New Zealand;

(2) to determine the utility of cans for dating historic deposits;

(3) to examine the socio-economic role of canned products amongst the nineteenth century southern Chinese.

The cans and metal boxes from each hut or site were analysed separately. After cleaning (brushing) the cans were placed into categories based on a determination of the original contents or product-type of each container. If the original contents were unknown, the cans were categorised on morphological characteristics. Only cans in good condition were retained; all fragmentary and part cans, unless of rare or unusual form, were discarded after analysis.

Product identifications were facilitated by research into company and brand names, by comparison of can morphology (using comparative, labelled museum or modern specimens) and through detailed study of the constructional features of each can. Minimum numbers were determined by counting only positively defined can remains such as bases or lids. This system may have produced conservative calculations but avoided artificially maximising totals. Size variations in each basic can type were also recorded.

HISTORICAL BACKGROUND

Tin plate was first manufactured in Bohemia in the fourteenth century and for the next three centuries German tin plate predominated. Britain became the leading tin plate manufacturer after 1730 and dominated the market, particularly in the area of tin box packaging, until the end of the nineteenth century, but it was American

canners, who introduced several innovations after 1830, including automating the can making process, who "really sold" preserved canned foods to the public for the first time (Clark 1977:6-10).

The first recorded use of hermetic sealing to preserve food was a method perfected in France in 1809 by Nicholas Appert who won a 12,000 franc reward offered by Napoleon for the invention of a successful method of preserving foods. Appert's method, the foundation of modern canning, involved packing food in glass jars tightly sealed with cork and wire and cooking them in boiling water. A year later, an Englishman, Peter Durand, took out a patent for canning in tin canisters. The English firm of Donkin and Hall began commercial canning in 1812, the British Army being the first big consumer. Sir Joseph Banks, then president of the Royal Society, called them "embalmed provisions" (Davis 1967:80). Initially, there was considerable consumer reluctance to accept canned foods, but they soon became staples on military and exploratory expeditions.

Ironically, despite the early innovations and dominance of the British tin plate manufacturing industry, the British preserved food canning industry remained insignificant until after the First World War. In the interim, Britain had developed a dependence on a rising tide of preserved food supplies from Australasia, Argentina and the United States. However, the British tin box industry flourished, especially after 1830 when many home based industries began using tin boxes for packaging products such as matches (wax vestas), biscuits, tobacco, cocoa, tea, coffee, pharmaceuticals, mustard, paints and varnishes, solvents and petroleum (Reader 1976:7-8). Each manufacturer developed their own distinctive tin box; for example, Huntley and Palmer introduced their well known paper-labelled, returnable biscuit tins in 1830 (Davis 1967:71). Tin boxes dominated the packaging market until the introduction of cheaper cardboard packaging.

Soon after commercial food canning had developed in Britain, English migrants introduced the technology into the United States which became the major innovator. Briefly, the major developments were as follows. In 1819, Thomas Kensett began canning oysters, meat and vegetables in New York, whilst in the same year William Underwood commenced canning fruit and vegetables in Boston (initially both used glass containers, not changing completely over to tin canisters until 1837). In 1853, Bordon introduced canned condensed milk (patented in 1856). The tapered meat can was developed by Chicago meat packers in 1875 (Davis 1967:82), whilst the major technical innovation, the introduction of the so-called "sanitary" can (discussed below) was developed in the 1890s, becoming the mainstay of the canning industry after the turn of the century (National Canners Association 1963; Clark 1977; Can Manufacturers Institute 1978; Busch 1981).

Other nations were quick to see the benefits of commercial canning. In Scotland various kinds of fish were packed in cans in the 1820s, while the French introduced canned sardines in oil in the same decade. In Russia, powdered milk was canned in 1842-43, as was salmon in Ireland in 1849. The Anglo-Swiss Condensed Milk Co (later Nestles) established canneries in many countries after 1867, whilst in Australia, two firms (in Sydney and Newcastle) began canning meat for export in 1848 (Davis 1967:81).

In New Zealand, several enterprising firms took up the new technology. Their efforts, like those of their Australian counterparts, were particularly directed towards the canning of meat, which promised a huge but unfulfilled overseas market prior to the advent of refrigerated shipping in 1882. The Woodlands Packaging and Canning Co (initially a branch of the Glasgow Meat Preserving Co), established at

Woodlands near Invercargill, is claimed to be the first canner in New Zealand (Cyclopedia of New Zealand Vol. 4:1064). An article in the *Southland Times* (20/5/1870) indicates the company had begun boiling down and that "everything was in readiness to carry out the primary objective—the preservation of meat by the tinning process" (Trotter 1973:37). By 1900, the annual canned output of the works was 10,000 cases of canned rabbit meat and 4,000 cases of canned beef and mutton. A variety of other products were also canned from time to time including corned beef, cheek soup, tail soup, bouilli, bovril, ox tongues and oysters (ibid. 41).

At Kakanui, in North Otago, the New Zealand Meat Preserving Co (whose headquarters were in Glasgow) built an extensive plant for the canning of meat for export in 1870. The factory had its own tin making plant too. However, the silting of the port at the Kakanui river mouth and the advent of refrigeration killed the enterprise (McDonald 1962:132-133).

The *Otago Witness* (15/4/1871:17) reported a large meat preserving works had commenced operations at Green Island near Dunedin in 1871. Meat was being preserved at the rate of 400 sheep or 25 head of cattle per day. The article describes the canning process thus:

> The manufacture of the tin canisters in which the meat is preserved is carried on upon an extensive scale...The tin is cut to the required size and the bottoms and lids are cut and shaped by means of two large dies. In the lids a small hole is perforated (to release the steam in the cooking process). The tins thus cut and shaped are passed into the Tinning room where they are soldered, and the meat put into canisters containing 6lbs, 4lbs and 2lbs respectively...

The article goes on to describe the rest of the canning and cooking process in detail. Significantly, in these three earliest New Zealand canneries the meat was being packed into hand made cans produced on-site. A number of other products were being canned in New Zealand in the nineteenth century including fruit and vegetables at Nelson in 1881 (Kirkpatrick and Co), whitebait at Greymouth in 1884 (Cyclopedia of New Zealand Vol. 5: 100, 573) and condensed milk (the Underwood Milk Preserving Co at Wallacetown near Invercargill) in 1892 (Cyclopedia of New Zealand Vol. 4: 913).

CAN LABELLING

The labelling of metal containers has a history of its own. In the first half of the nineteenth century, labelling methods included hand painting, stencilling or embossing the container itself, attaching paper labels or soldering on embossed labels. Transfer printing on tin was pioneered in London in the 1860s. Metal lithography appeared in the 1880s, but it was the advent of the rotary offset lithographic press, patented in 1903, which saw the widespread acceptance of the method used in most tinplate printing today (Clark 1977:11, 27-28). Metal lithography became the norm for cans which were not hermetically sealed such as containers for tea, spices, gunpowder, drugs and tobacco. In our experience can labels do not fare well in archaeological contexts, consequently, their usefulness is limited. The only labels which consistently survive are those which are embossed (impressed) into the can body or lid (e.g. Fig. 10).

THE MAIN METAL CONTAINER FORMS

Although the methods of metal container manufacture (and more recently materials) have changed considerably over the years, there has been marked

conservatism with regard to container-forms. Thus, through analysis of a container's morphology, it is often possible to deduce the general product-type, if not its original contents. Furthermore, the presence or absence of particular constructional features also provide clues to a metal container's original use, and its antiquity.

In the following discussion the main metal container forms found in the study sites, and their characteristics, are described.

1. THE STANDARD CYLINDRICAL CAN

The mainstay of the canning industry since its inception has been the standard cylindrical can made in a range of sizes, for the preservation of a wide variety of foodstuffs, particularly vegetables, fruit, fish and meat. As a result of increased mechanisation, several innovations have occurred in cylindrical can manufacture, but as stated earlier, one is particularly notable—the advent of the modern "sanitary or packers" can in the 1890s which succeeded the "hole-and-cap" can.

(a) The Hole-and-Cap can. Initially, cans were manufactured completely by hand. To make the body, a piece of metal (tin plate) was bent into shape on a roller and the overlapping seams soldered together. Two discs of tin plate were then cut for the ends, their edges being bent down or flanged to fit the body of the "can". The "bottom disc" was soldered on to the can body immediately, but there were two commonly used techniques for "lidding" cans—the "lid" could be soldered on after the can had been filled, or the apparently equally common "hole-and-cap" technique was employed. This involved soldering on a top with a centrally located circular hole in it (*ca.* 3 cm in diameter), before the can was filled. The food was pushed or poured through the hole, then a cap with a small venthole was soldered over the opening. During processing, when a sufficient amount of steam had escaped, the venthole was closed with a drop of solder (Busch 1981:96; see Fig. 1). The hole-in-cap can changed little in style throughout the nineteenth century, although its manufacture was increasingly mechanised by innovations such as the modification of a drop press in the late 1840s to convert flat discs into flanged can ends (Rock 1984:100), and the development of a semi-automatic machine by the Norton Brothers in 1883 to solder side-seams. The machine produced cans at the rate of 2500 per hour, compared to 60 per hour in the 1870s, and 5 or 6 per hour in the early nineteenth century (Clark 1977:18).

(b) The Sanitary or Packers Can. Probably the most far reaching innovation in canning history occurred in the late 1890s with the advent of the so-called "sanitary can" (Fig. 2), beginning the gradual demise of the hole-and-cap can. The sanitary or open-top can was initially developed in Europe where ends were attached by hand crimping the edges, a seal being effected by a rubber gasket. In 1897, the Ams Machine Co brought out a new machine which automatically crimped the ends to the body with a double, locked seam. The new can was considered more sanitary because it was soldered on the outside only. It was also attractive because the process was fully automated, the cans could hold larger pieces of food and be filled more easily. By the 1920s the sanitary can was totally accepted by the public and virtually replaced all other can types. The modern sanitary can is basically the same as it was at the beginning of the century, although the manufacturing process has been further automated, can weight has been reduced by cold rolling the metal (steel), and the use of electrolytic tin plating (since 1937) has further reduced the tin content (National Cannners Association 1963:18).

Not surprisingly the early canners soon developed a range of can types, both hermetically sealable and reclosable, for specific preserving or packaging purposes. The main variants and known or inferred products and brands are now discussed.

2. FISH CANS

According to Fontana and Greenleaf (1962:72) the flat oblong can used for packing seafood was developed at the outset of commercial canning. The earliest cans were made in three pieces, then soldered. By 1880, the peak of mechanical automation, the base and body were being drawn in one piece. Fourteen years later, "open-top" double-seamed sardine cans were introduced.

(a) Sardine Cans. The flat, rectangular "sardine can" was in regular use before 1880. The popularity of canned fish led to experimentation with quick-opening devices. In 1895, E. Norton of Chicago developed a key-method of roll-opening a scored strip on the lid of a sardine can. A refinement, the key opener for the "open-top" double-seamed sardine can, was patented in 1906 (Fontana and Greenleaf 1962:71). Although generally smaller than their predecessors (Fig. 3), modern sardine cans retain the same basic features, ideally suited for tightly packing and processing small fish such as sardines.

(b) Oval Fish Cans. These cans (Fig. 4) were developed in the late nineteenth century (probably in England or Scotland) for packing and processing larger fish such as herrings. Again the basic shape has been retained through the years, although can technology has progressed from soldered to crimped seams, to one-piece seamless cans bearing all the hallmarks of fully automated production. As with many can styles, the modern versions tend to be smaller than their fore-runners.

(c) Squat Cylindrical Cans. Large scale canning of salmon commenced on the Sacramento River in California in 1864 (Busch 1981:97). Initially, the fish were packed by hand, but the process was soon automated partly through the use of a squat cylindrical can (Fig. 7), a compact shape which was well suited for packaging fishmeat and continues to be widely used today for the same purpose. Red meat was also packed in large cans of this type before the advent of refrigeration.

3. MEAT CANS

Three types of cans were predominantly used for packaging meat.

(a) Cylindrical Meat Cans. These were essentially larger versions of the form described earlier. Presumably it was found convenient to package meat in relatively wide, shallow cans, so the form became established. Three types of squat cylindrical cans (Fig. 7) have been uncovered in the study sites: hole-and-cap, locked seams and the modern sealed seam type. In New Zealand, products such as corned beef, sheep tongues and rabbit meat have been canned in tins of this type.

(b) Tall Rectangular Hole-and-Cap Cans. A few tall rectangular hole-and-cap cans (Fig. 6) have been uncovered. These are believed to have contained meat. The form seems to have been shortlived, probably being superseded by the "tapered meat can".

(c) The Tapered Meat Can. The hole-and-cap tapered meat can was patented in 1875 by Chicago meat-packers (Davis 1967:82). The design was intended to facilitate the easy removal of the processed cooked meat from the tin (Fig. 5). Again the can form survives to the present day, but modern examples tend to be smaller. The key opening device developed by the Norton Brothers (Fig. 8) was rapidly adopted by meat-packers after 1895 (Rock 1984:100).

4. FLANGED LID CANS

(a) Tall Rectangular Flanged-Lid Cans. This type of can (Fig. 9) has virtually gone out of existence, having been replaced by cheaper cardboard packaging. Cans of this type first appeared in quantity after about 1870. They were designed to contain dry products used in relatively small quantities. Thus a can could be opened and resealed as often as desired until the contents were consumed. Colmans' Mustard (in four sizes) was probably the best known product in cans of this type in New Zealand. Most flange-lid cans had paper labels (which seldom survive in archaeological contexts) but their lids (or bases) were often embossed with the name or brand of the product (Fig. 10). Many fancy imported cans of this type had transfer or machine-painted labels.

(b) Cylindrical Flanged-Lid Cans. Like the rectangular flanged-lid cans, this form has also become virtually obsolete. Their use also dates from *ca.* 1870 and they contained similar dry products which were generally used in small quantities. Frys "chocolate" and "cocoa" were common imported tins of this type, while the main products packed in this type of tin in New Zealand included Edmonds custard and baking powder (Fig. 12), the latter in three sizes, cigarettes and tobacco (described next), spices (e.g.Greggs (Fig. 11), also Wilsons, Wilson Balk and Co, and Strangs) and coffee and chicory (Greggs "Club Coffee" (Fig. 13), and Strangs).

5. TOBACCO AND CIGARETTE TINS

Two major can forms have been used for packaging tobacco and cigarettes—cylindrical flanged-lid tins (slip lids) and small hinged-lid rectangular tins (pocket tobacco). However, other can types were also used, including lever-lid (press-top) cans for bulk sales (e.g. Riverhead tobacco) and squat, rectangular flanged-lid cans with hinged lids (e.g. Camerons' Havelock Tobacco). In the nineteenth century tobacco was also sold in soldered top boxes (see below).

(a) Cylindrical Flanged-Lid Tobacco Tins. This type of tin is no longer used for tobacco or cigarettes but was in vogue until about 30 years ago. Two main size variants exist, standing 5 cm and 10 cm high respectively. Usually the paper labels have decomposed on archaeological specimens but the brand or packer's name (e.g. W.D. & H.O. Wills, Fig. 17a) is often discernible on the embossed lids. The "slip-lid", an ingenious modification of the basic cylindrical flanged-lid, was patented in 1888 (Reader 1976:18). Before then, cigarette manufacturers were reluctant to use flanged-lid tins because they were not completely air-tight. The problem was solved by the invention of the "slip-lid cutter" (Fig. 17b). The tin had an inner cover made of tagger (tin foil) which was surmounted by a flanged-lid with an inbuilt cutter. The cutter rested outside the tin (and under the label) until it was wanted, when it could be pushed inwards. This action pierced the tagger and by turning the lid, the cutter opened the air-tight inner cover.

(b) Rectangular Hinged Lid Tobacco and Cigarette Tins. Because of their convenience, rectangular "pocket" tobacco and cigarette tins (Fig. 18) gradually became the favoured packaging for these products, although they too have been largely superseded by cardboard packaging. Hinged pocket tobacco tins were first produced in 1892 (Anon n.d.2).

6. RECTANGULAR SOLDERED-TOP BOXES

This is another obsolete metal box form (Fig. 15). Rectangular tin boxes of this type were used to contain tobacco in the nineteenth century (but may also have contained other products). Usually they are found with the soldered lid partly prised off to facilitate removal of the contents.

7. HINGED LID BOXES

These containers are essentially "tin boxes" with a hinged lid. Typical examples are the square biscuit tins (pioneered by Huntley and Palmer in the 1830s) and tea boxes (Fig. 16). Tea boxes usually measure about 30 cm long, 20 cm wide and 20 cm deep and have a hinged lid with a slight overlapping flange.

8. PRESS TOP (OR LEVER LID) CANS

This type of can was developed by the Self Opening Tin Box Co of London in 1895 (Tyrrell pers.comm.).

Cylindrical press tops. These are the most common form (Fig. 14). Their easy opening yet airtight seal made them particularly attractive to paint manufacturers, but other products, such as viscous foods like treacle, syrup and honey, and dry products like baking powder and coffee and chicory (Strangs) were also packed in press-tops. Other forms of press-top cans (not excavated) include "internal press-tops" (here the lid fits snugly down the inside of the can body) and square press-top tins (e.g. Twinings tea tins).

9. WAX VESTA BOXES

Wax vestas (matches) were first sold in small rectangular tin boxes in the 1830s, the practice continuing until about 1940. The many types and utility of this container type for dating sites have been demonstrated by Anson (1983). An extended but simplified classification system has recently been presented by Bedford (1985).

10. KEROSINE-TYPE CANS

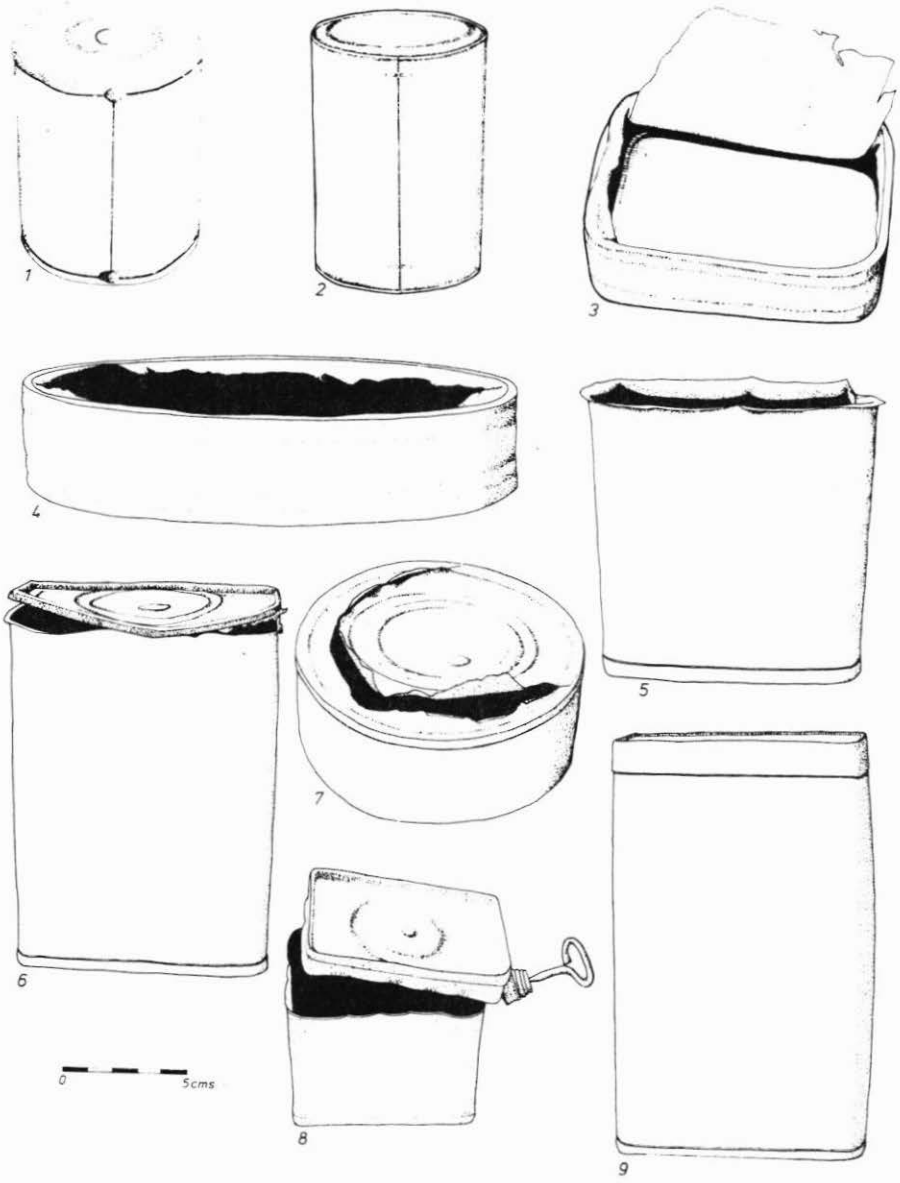
These ubiquitous cans appear in sites dating from *ca.* 1870 through to the present. They were produced in 2 and 4 gallon capacities. The cans are essentially square in cross-section but have rounded corners. The main distinctive features are on the lid-area where a screw top pourer hole is located and occasionally an embossed product name. Early examples had a rigid bracket handle, whereas later specimens have a wire handle which can be folded flat on the top of the can. Although cans of this type were primarily used for the conveyance and distribution of liquid fuels and solvents, cans of similar construction were also used for packing bulk supplies of viscous foods such as jam and fruit pulp.

11. REINFORCED DRUM-CANS

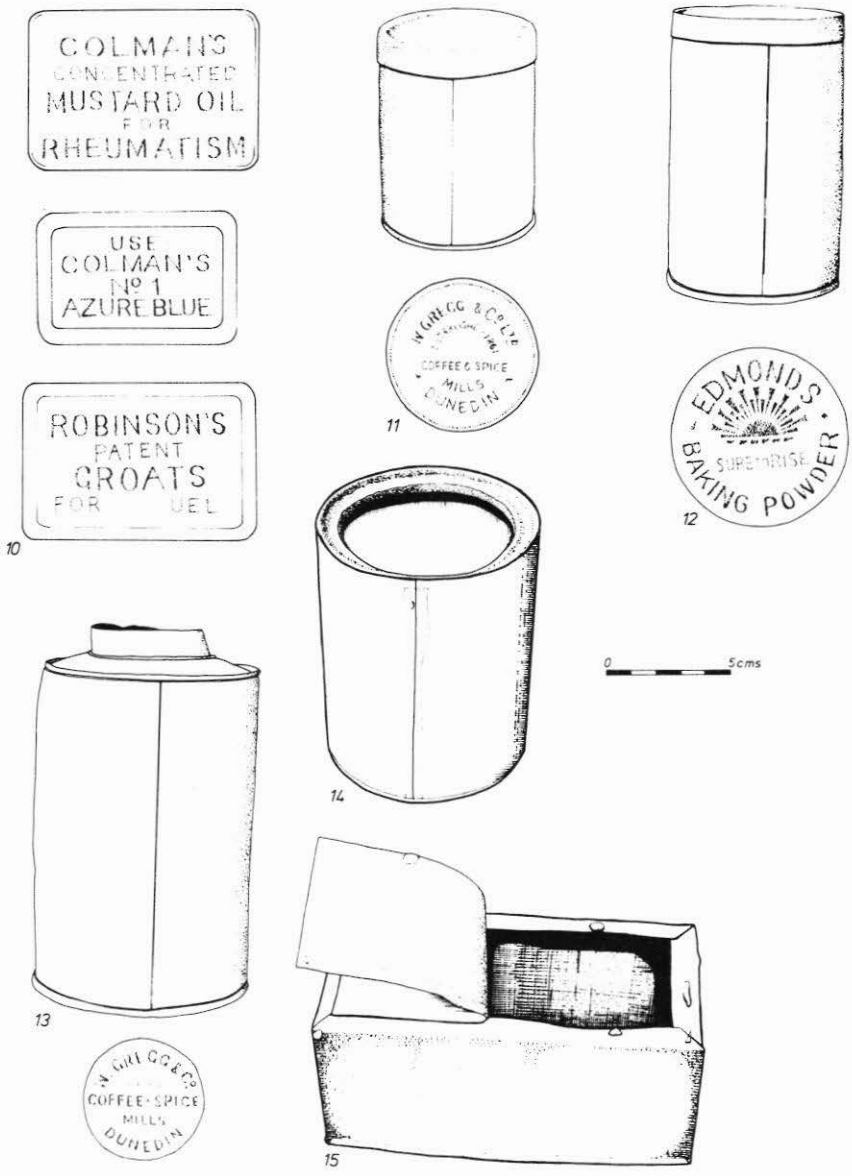
In the nineteenth century, some paints and varnishes (and perhaps nails) were imported into New Zealand in solid drum-like cans 42 cm high and 28 cm in diameter with 3-cm-wide reinforcing bands around their base and top. After their original contents were used, handles were often added to empty cans so they could be reused for purposes such as coal and ash buckets and for kibbles (buckets suspended from a windlass over a mineshaft). Their robust construction made them ideally suited for these purposes.

12. OPIUM CANS

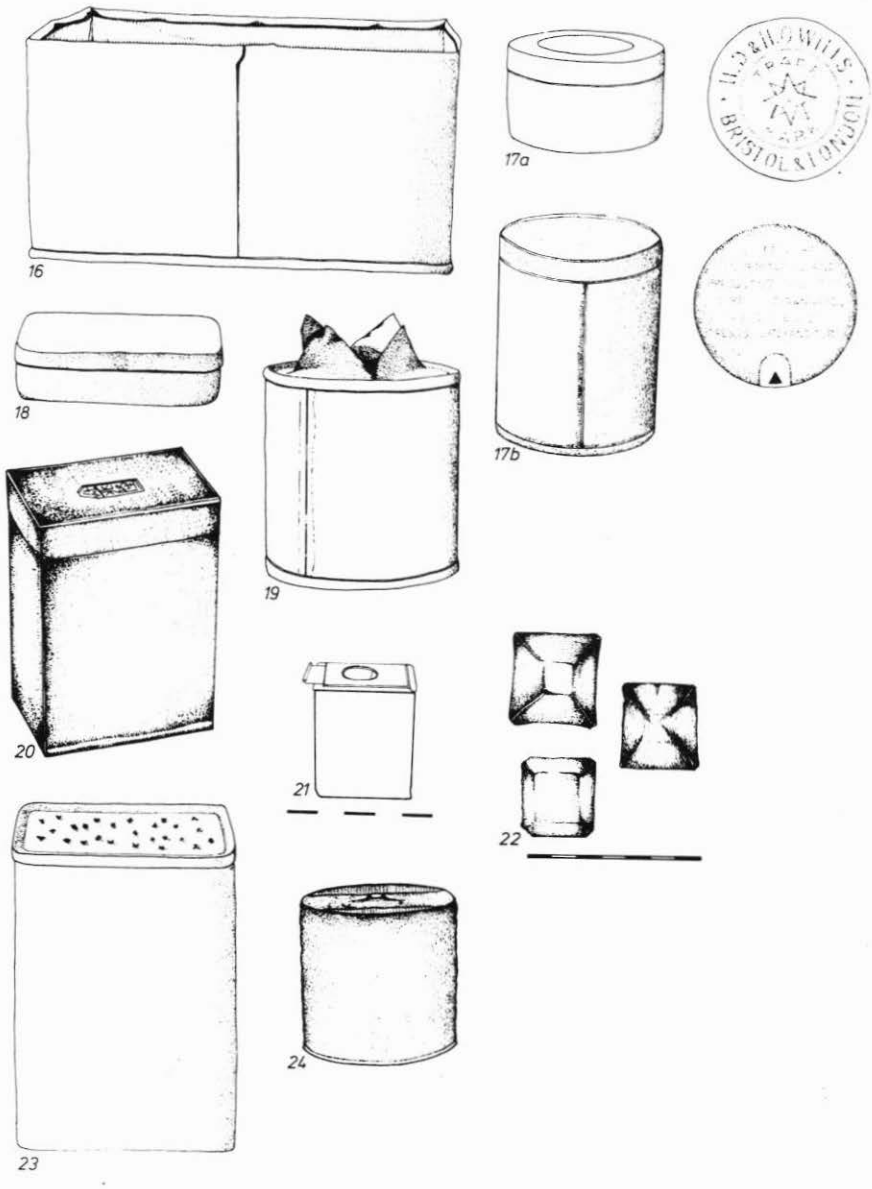
Until 1901 opium was legally imported in large quantities from China by the Chinese migrant population. The opium resin was packed in distinctive brass rectangular flange-lid containers (Fig. 20). The construction and manufacture of these containers has been described by Ritchie and Harrison (1982:18). Remnants of these cans are found in most Chinese sites in Central Otago.



Figures 1-9 : 1. Hole-and-cap can. Note soldered seams. 2. Sanitary can (also known as open-top or packers cans). 3. Sardine can. 4. Oval fish can. 5. Tapered meat can. 6. Rectangular hole-and-cap meat can. 7. Squat cylindrical hole-and-cap meat can. 8. Key-opening meat can. 9. Rectangular flanged-lid can.



Figures 10-15: 10. Embossed lids from rectangular flanged-lid cans. 11. Circular flanged-lid spice tin with embossed lid. 12. Circular flanged-lid can with embossed lid. 13. Circular flanged-lid can, "Club Coffee", embossed on base. 14. Lever-lid or press-top can. 15. Soldered-top box.



Figures 16-24: 16. Tea box. 17a. Circular flanged-lid tobacco tin and embossed lid. 17b. Slip-lid cigarette tin with cutter. 18. Pocket tobacco tin. 19. Condensed milk can showing common method of opening. 20. Brass opium can. 21. Opium antidote can (?). 22. "Fun trays" made from opium can metal. 23. Rectangular flanged-lid can with perforated base. 24. Jam tin modified into opium lamp base. Scale as for previous figures, except Figs 21 and 22.

13. OPIUM ANTIDOTE CANS (?)

The small can depicted in Figure 21 is reputed to be an "opium antidote container" (Ritchie and Harrison 1982:20). The slide-lid covers a 1-cm-diameter aperture. To date, six of these containers have been excavated (at Cromwell's Chinatown and the Arrowtown Chinese settlement) but we have been unable to confirm their original usage. However, it is known that a group of Chinese merchants in Dunedin set up a shortlived anti-opium organisation (called the Cherishing Virtue union) in 1888. One of its objectives was the free distribution of "anti-opium medicine" (Don 1888:106). Possibly these cans contained that medicine.

DISCUSSION

The can assemblages were analysed with two primary queries in mind:

(1) gleaning insights into the role of canned products.

(2) examining the utility of "can dating" and corroborating the dates of occupation at each site, where possible.

In the following discussion, the Chinatown assemblage is first treated separately and then compared with the assemblages from the other sites under review. The tin matchboxes from each site are listed in Table 1 but are omitted from further consideration because they have recently been discussed elsewhere (Anson 1983, Bedford 1985). Matchboxes are also omitted from the can-type/ratio calculations outlined in the text because their highly variable numbers cause an unrealistic distortion of the percentage frequency of the various can-types per site.

THE CHINATOWN ASSEMBLAGE

A final statement on the relative importance of canned products in Chinatown is not possible until the analyses of other containers such as glass and ceramic are completed. However, cans appear to have constituted approximately 20 percent (by volume and number) of the containers at Chinatown. This percentage is likely to be higher, perhaps 40 percent, if the rapid degradation of tin cans is taken into account.

Five types dominate the 173 can (minimum number) assemblage from Chinatown, namely general food and circular flanged-lid cans, tobacco tins, opium cans and wax vesta boxes. Not surprisingly, "general food cans" are one of the most common can types uncovered at Chinatown (32 specimens, comprising 18.5 percent of the total assemblage). Analysis of the cans from each hut revealed they span the occupation of Chinatown from *ca.* 1870 until 1920 but no hut could be positively described as "early" or "late", i.e. a broad time span was indicated. The cans are likely to have contained products such as preserved vegetables (beans and tomatoes?), soups and condensed milk. Some of the early cans (generally hole-and-cap type) were found with their tops opened in the manner depicted in Figure 19, a method of opening which we have so far found to be unique to some (but not all) Chinese sites. Presumably it enabled a can to be easily opened with a knife, the contents poured and the lid partially reclosed if desired.

A related can type, the squat cylindrical form (nine specimens, 5.2 percent) probably contained meat products such as corned beef or sheep tongues. The four rectangular hole-and-cap cans also probably contained preserved beef. In addition, three keyed and two unkeyed tapered meat cans were recovered. These are the classic "bully beef" type. Collectively, meat cans comprise 10.4 percent (18 specimens) of the Chinatown assemblage. Five fish cans were recovered. Two of these are the typical rectangular "sardine box" type, whilst the other three are oval, akin to the well known "herring tins". Fish cans represent 2.9 percent of the assemblage.

Circular flange-lid tins represent 17.3 percent (30) of the assemblage. This type of container was generally used for the packaging of dry powder products such as coffee, spices, chocolate and cocoa beverages and custard powders. Four embossed tins bore the following inscriptions—"Greggs Coffee and Spice Mills, Dunedin", "Strang's Chocolate and Cocoa", "Fry's Cocoa" and "Edmonds" (presumably baking or custard powder). Several small flange-lid tins, measuring 5.5 cm in diameter and standing 7.5 cm are typical spice tins.

There were 10 circular press-tops (lever-lids) in the assemblage. These tins are generally used for viscous liquids such as paint and treacle, but they were also used by some dry product manufacturers (e.g. Strang's coffee). In the absence of labels or embossing, it is not possible to ascribe a specific product to these can remains with certainty, but they probably contained foodstuffs rather than paint (the Chinatown huts were built of stone and the roofs were unpainted).

Tobacco tins of all types including circular, hinged rectangular and soldered-top boxes constituted 15.0 percent (26 specimens) of the assemblage. Only two brand names could be positively determined from embossed or painted labels, namely W.D. & H.O. Wills "Capstan Navy Cut" (in circular flange-lid cans, with and without "slip-lid cutters") and Cameron's "Havelock Tobacco" (in squat, rectangular flange-lid tins with hinged lids).

Seven 4 gallon capacity "kerosine cans" were uncovered. In most instances the top had been cut out and a handle added to facilitate their use as buckets. This type of can had many uses which are discussed later, but few survive in archaeological contexts because they tend to degrade rapidly after being flattened and buried.

Twenty-two opium cans (12.8 percent) were found at Chinatown; that is about the same percentage as tobacco. The prevalence of opium cans in Chinese sites in Central Otago (and hence its common usage) has been documented by Ritchie and Harrison (1982). However, the durability of the brass opium cans must be taken into account. Presumably they survive better in the ground than the tin-coated tobacco cans.

Other metal food containers uncovered at Chinatown are listed in Table 1. They include tea boxes (2) and biscuit tins (2).

CANNED PRODUCTS USAGE—ALL SITES

Not surprisingly, tin wax vesta matchboxes dominate the overall site assemblages, constituting from 15.2 to 75.3 percent. Wax vestas were used extensively in the predominantly male mining communities for lighting fires, cigarettes, pipes, lamps and candles. Consequently, empty matchboxes were frequently discarded. Their primary archaeological significance is their utility for dating historic deposits (see Anson 1983, Bedford 1985). As stated above, they are omitted from the can-type/ratio calculations because the large numbers recovered from some sites cause considerable distortion in the inter-site ratios of the various can-types.

Table 1 details the numbers and percentage composition of the main can types found in the study sites. Because of the problems associated with differential survival and precise determination of can contents, assumptions about specific products and the social role of canned goods have an inherent inaccuracy factor which is difficult to quantify. Some broad trends are outlined now but comments are restricted to the relative volumes and hence significance of the various can-types (which reflect particular food types). Further studies will be required to confirm or refute these patterns. Specific brands as revealed by embossed lids are listed in Appendix 1.

TABLE 1
DISTRIBUTION OF PRINCIPAL CAN TYPES BY SITE

Food Category	Can/Product	Can Numbers & Percentages/Site														Range
		C		Cal		QB2		AW		Pop		ACS		AL		
Preserved Foods	general foods	32	18.5	5	12.8	7	21.0	12	29.2	16	34.0	35	15.8	3	8.8	8.8–34.0
Fish	oval fish/sardines	5	2.9	4	10.2	4	12.5	4	9.7	7	14.8	28	12.7	7	20.5	2.9–20.5
Meat	squat Cyl./tapered/ rect h/c/key cans	18	10.4	2	5.1	1	3.1	3	7.3	3	6.4	9	4.1	0		0–10.4
Sub Total		55	31.8	11	28.2	12	37.5	19	46.3	26	55.3	72	32.6	10	29.4	29.4–55.3 M = 37
Dry Products	Circ. flange	30	17.3	5	12.8	4	12.5	3	7.3	4	8.5	56	25.3	2	5.9	5.9–25.3
	Rect. flange	5	2.9	0		3	9.4	1	2.4	2	4.25	3	1.4	1	2.9	0– 9.4
	Others +	11	6.4	4	10.2	3	9.4	2	4.8	3	6.4	9	4.1	0		
Sub Total		46	26.6	9	23.1	10	31.25	6	14.6	9	19.1	68	30.8	3	8.8	8.8–31.25 M = 22.0
Smokables	(all types) tobacco cans	26	15.0	12	30.8	0		3	7.3	0		26	11.8	12	35,3	0–35.3 M = 14.3
	opium cans	22	12.8	4	10.2	7	21.9	11	26.9	11	23.4	33	15.0	6	17.6	10.2–26.9 M = 18.
Sub Total			27.8		41.0		21.9		34.2		23.4		26.8		52.9	
Other Cans %	kerosine/solvents/ undiagnosed	24	13.9	3	7.7	2	6.25	2	4.8	1	2.1	22	9.95	3	8.8	2.1–13.9 M = 7.6
	opium antidote	(2	1.2)									(4	1.8)			
																Overall Totals
matchboxes		41	19.2	7	15.2	49	60.5	49	54.4	144	75.3	210	48.7	12	26.0	512
all other cans		173		39		2		41		47		221		34		587
Site Totals		214		46		81		90		191		431		46		1099

+ includes biscuit tins, tea boxes and press top cans

The numerical data give an indication of the role of hermetically preserved foods such as vegetables, soups, meat and fish. Condensed milk cans were relatively rare (see below). Preserved food cans varied from 29.4 percent of the assemblage at Ah Lums to 55.3 percent at the Poplars; however, the mean (of all seven sites) 37.3 percent is probably a more accurate indicator of the role of preserved canned foods relative to other tinned foodstuffs. Notwithstanding the fact that these figures may be partly attributable to differential survival, the percentage of preserved can-foods is noticeably higher at the sites most distant from the major service towns, Cromwell and Arrowtown.

"Dry food" cans (i.e. rectangular and circular flange-lid cans) contained products such as baking and custard powder, curry and spices and coffee and chicory, although the Chinese do not appear to have consumed much of the latter two products judging from bottle remains (Ritchie and Bedford 1983). A small percentage of these can forms (evidenced by embossed lids) contained non-foods such as washing blue and starch, but these products probably account for less than 10 percent of these can-types. The percentage of dry food cans in the sites shows an interesting inversion on the preserved food trend. Here the most distant sites, the Poplars and Ah Wees, have the lowest percentages for this type of container (12.75 and 9.7 respectively), while at the closer-in sites, except Ah Lums, percentages varied from 12.8 to 26.7. The small number of dry food containers in Ah Lums is not readily explainable. As "dry food cans" constituted on average 22 percent of the studied assemblages, their contents were obviously important components of the Chinese diet, but understandably these products were used in lesser volumes than preserved canned foods in most instances.

Cans containing opium and tobacco varied from 21.9 percent (at QB2) to 52.9 percent (at Ah Lums) of the total site assemblages, although no allowance has been made for can size. Thus two of the three tobacco cans at Ah Wees were the bulk soldered-top tins which have ten times the volume of a pocket tobacco tin. Presumably, the varying proportions of tobacco and opium cans reflect individual preferences for either drug (except, of course the combined Chinatown and Arrowtown assemblages). Opium was being smoked at all the sites, often in considerable quantities, reflecting its historically documented widespread usage by the Chinese. The absence of tobacco and cigarette cans in two of the seven sites was surprising, but alternative tobacco smoking evidence in the form of two clay pipes was found in each site. Contemporary accounts clearly indicate that tobacco smoking was an entrenched habit. For example, Don (1882:87), the Presbyterian missioner to the Chinese, noted "After meals the Chinese almost to a man cut up some tobacco and make and smoke a small cigarette". A few years later he recorded "Opium smokers pay for their own opium, but as a non-tobacco smoker is about as rare as a non-tea drinker, or a non-rice eater, partners in work include tobacco in the common account" (Don 1888:166).

"Other cans" represent a miscellany of canned products such as kerosine, solvents, flea powder, opium antidote (?) and fragmentary, unidentified cans. They constituted from 2.1 to 13.9 percent of the site assemblages.

Between 1870 and 1910, production of and demand for canned foods expanded rapidly. Understandably, canned foods had a particular appeal to the mining community. In the absence of refrigeration, a stock of cans ensured a ready supply of rodent-proof provisions which also required minimal cooking time and effort. Although contemporary observations indicate the Chinese miners generally grew more fresh vegetables than their European counterparts, it is clear from the

assemblages studied that they too appreciated the convenience of all forms of canned provisions. They appear to have purchased them frequently despite their cost. Although there are more "late" than "early" cans in the assemblages, suggesting that the consumption of canned food progressively increased, we cannot demonstrate this unequivocally because of the problem of differential survival with the more recent cans being more likely to have survived.

No European site assemblages were included in this study but a notable difference is apparent in surface scatters in that European sites have a much higher incidence of condensed milk cans. The archaeological evidence and contemporary observations suggest the Chinese were not great consumers of milk products.

SECONDARY USES OF METAL CONTAINERS

The other major socio-economic use of cans involves their re-use for other purposes. This in turn can be divided into two categories:

(1) empty, essentially unmodified containers used for storage;

(2) the modification of empty containers for another purpose.

Empty reclosable tins were probably used extensively by the Chinese for holding small objects and as rodent-proof food containers. Wax vesta boxes have been uncovered containing small nails, a key, pumpkin seeds and a fragmentary piece of paper (possibly a gambling coupon). Empty general food tins were used for storing items such as nails, bar soap and utensils.

Modified can uses were considerably more varied. They range from fitting wire handles to topless kerosine cans or nail drums, so they could be used for water and coal buckets or kibbles, to punching holes in the base of same to enable their use as watering cans or, perhaps, showers. Kerosine cans were also used extensively for metal sheeting. A "sheet" was produced by cutting the ends out of a tin, cutting it up one side and flattening the metal out to produce a sheet measuring about 1 m long and 30 cm wide. The tin-sheets were used for roofing, patching, garden borders and lining the outer walls of mud huts to prevent rabbits from burrowing in (Ritchie 1984:34). A European (but not definitely Chinese) re-use of kerosine tins involved cutting them lengthwise down the middle to produce two shallow trays. These were used as seed beds and usually had a few punched drainage holes.

Reclosable cylindrical flange-lid cans (especially the small spice cans) are often found with numerous small holes (less than 1 mm in diameter) punched in the lid. They appear to have been used as "condiment shakers".

Occasionally, food cans are uncovered with holes punched in their base (Fig. 23). They may have been used as soap containers. Another common re-use of general food cans involved cutting down one side of a can to make a candle holder and flame-guard. Larger tin tea-boxes which are found with numerous holes (of 2-3 mm diameter) punched in the base may have been used as colanders for draining foods or as "steamers".

Small cylindrical food cans were used as the fuel reservoir in Chinese opium and reading lamps. Don (1887:163) specifically noted the use of "jam tins" for this purpose when he preached a sermon in an opium and gambling shop in the Nevis Valley.

> Picture us if you can! The preacher with an empty kerosine tin laid flat on a table for a desk; ditto standing on end for his seat, the congregation seated and reclining on short stools and opium benches; the sacred page lighted by an opium lamp (a jam tin filled with tallow, a cotton wick and the upper part of a brandy bottle for a shade).

Usually a metal bracket was fitted over the top of the reservoir-can to hold the wick (Fig. 24). Two cans modified in this way have been uncovered (at Ah Wees and Arrowtown).

The brass opium cans were extensively re-used by the Chinese. Several lids have been recovered with numerous small punched holes suggesting they were being used as "salt-shakers" whilst the many angular off-cuts of can metal (particularly the body metal) found in most Chinese sites, as well as numerous complete artefacts, attest to regular artefact production from opium can metal. Improvised artefacts include "washers", "discs" (game counters?), "funs trays" (Fig. 22, small trays for holding pieces of prepared opium), "tie tags" (made of strips of can metal) and small gold blowing trays (Ritchie and Harrison 1982:22).

ORIGINS OF CANNED PRODUCTS

Preserved canned foods do not appear to have been widely used in New Zealand until about 1870, their increasing use after that date possibly being spurred by the establishment of an indigenous canning industry. However, the earliest New Zealand canners saw canning as a means of packaging and preserving food surpluses (particularly meat) for export rather than supplying the local market. But by the 1880s there was increasing acceptance and a growing local demand for preserved canned foods. A burgeoning reciprocal trade with Britain had developed; Britain taking our farm produce in return for manufactured goods including many products packed in metal boxes, e.g., Colmans' mustard, starch, etc., Fry's chocolate and cocoa, and wax vestas. The latter were first produced in England in 1832 and exported to the colonies in large volumes after that date. Other European countries, e.g., Belgium, also exported wax vestas to New Zealand (Anson 1983; Bedford 1985).

Gradually New Zealand manufactured goods began to displace imports. The first New Zealand made wax vestas were produced in 1895 (Anson 1983:135). New Zealand food manufacturers appreciated the utility of metal containers too; some of the most prominent users were the manufacturers of coffee and chicory and spices, e.g., Greggs, Wilsons, and Strangs (see Appendix 1). Their tins were made by local tinsmiths under contract or on-site using imported machinery. Advertisements like the following were relatively common in Dunedin newspapers of the 1880s and 1890s:

> Tinsmiths Machines of every description made on the very latest approved principles for the rapid production of Canisters etc. Dies made to any pattern. Meat works supplied with complete outfits ... Get prices from the following before ordering elsewhere. F J Lake, Moray Place, Dunedin. (*Otago Daily Times* 1/1/1898:5)

DERIVING OCCUPATION DATES FROM CANS

Dating cans involves the recognition of construction features which reflect changes or innovations in can manufacturing technology over the past 150 years. In particular, it is necessary to determine the sealing or closing system of each can, the type of seam (particularly whether it is hand soldered, overlapped or double seamed) and ascertain the longevity of a can's usage. Most of the major innovations were patented (hence datable) and are documented in a number of publications (e.g. National Canners Association 1963; Can Manufacturers Institute 1978; and Busch 1981). A problem to be wary of is that sometimes several years elapsed between the granting of a patent and the widespread distribution of cans reflecting the new innovation. The antiquity of a can may also be gleaned from research into product types or manufacturers if their names appear on the can remains.

Table 2 outlines the approximate known or inferred dates of usage of the main can types in New Zealand. The stated time-spans are broad but they are able to be narrowed considerably, or specific can-types seriated, by recognition of the "dating features" inherent in the construction of each can. Obviously, those which have short production (or user) spans are the most useful for dating, but most cans have some utility for dating in broad terms, so long as they are intact enough to enable one to recognise construction features. If cans are in fragmentary or poor condition, their utility for dating is correspondingly reduced.

All the can forms listed (except opium cans) have undergone construction changes since their first appearance and their present form (or obsolescence), yet all have retained the same basic shape. The changes through time include the virtual obsolescence of hole-and-cap cans after 1910, a progressive tendency to reduce both the size and the body weight of cans, machine soldering virtually eliminating hand soldering after about 1900, the introduction of the locked seam (which eliminated any soldering on the inside surfaces) and the development of seamless containers.

TABLE 2
KNOWN OR INFERRED DATE RANGES OF METAL CONTAINERS

Type/Product	Date Range	Utility for Dating
1. General Food Cans		
a. hole-and-cap	1840s-c.1930	good (most pre 1900)
b. overlapped/single seam	1885-1900	good
c. double seam	1900-present	
2. Meat Cans		
a. rectangular hole-and cap	1850s-1900	good
b. tapered cans	1875-present	good
c. squat cylindrical	1880s-present	
d. key-opening cans	1890-present	
3. Dry foods		
a. rectangular flange-lids	1830s-c.1950	poor, unless embossed
b. circular flange-lids	1830s-present	poor, unless embossed
4. Press Tops (lever lids)	1895-present	poor
5. Tobacco and Cigarette Cans		
a. circular flange	1870-c.1950	
b. slip-lid with cutter	1890-c.1950	good
c. soldered-top box	pre 1900	good
d. pocket tobacco	1900-c.1950	
6. Fish Cans		
a. sardine	1880-present	good
b. oval cans	1880-present	good
7. Wax Vesta Matchboxes See Anson (1983), Bedford (1985)	1830s-1940	excellent
8. Opium Cans	pre 1910	
9. Kerosine Cans	c.1880-today	

CONCLUSIONS

Cans are commonly discarded artefacts which have considerable potential for more detailed analysis and hence the generation of new information on user-groups. Their potential is at present unrealised, partly because of the concentration by archaeologists on the analysis of more durable materials such as glass and ceramics.

Although cans and metal boxes are "fragile" in the sense that their survival rate, due to oxidation, is a somewhat unknown factor, it is usually possible to determine both the form and approximate age of those that do survive, even if the remains are very fragile. There is also a difficulty in linking individual cans with specific contents but it is still possible to generate meaningful cultural information by identifying particular can forms and deducing their likely contents, in a general rather than a specific sense.

Our research soon revealed that the earliest can manufacturers and users in New Zealand are poorly documented (although from the outset they manufactured their own cans) and there was little archaeologically derived comparative material to draw on. Consequently, emphasis has been placed on defining can types, their construction features and changes through time and determining likely contents, in order to produce a baseline study for New Zealand which other researchers can build on. Future studies will provide additional insights into the growing role of canned foods in New Zealand in the latter half of the nineteenth century and help confirm or refute some of the trends defined in this study. More product-specific analyses are needed to narrow or subdivide the broad date ranges which at present exist for some can types.

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APPENDIX 1. EXCAVATED EMBOSSED AND PAINTED CANS/LABELS

Merchants Name	Location	Product	First Appearance	Provenance	Type of Can
W. Gregg & Co	Coffee & Spice Mills Lower Rattray St., Dunedin	"Club Coffee" Spice	post 1861	CH/4, Poplars S133/22	circ. flange-lid circ. flange-lid
R. Wilson & Co	General Merchants, Coffee and Spice Manufacturers Bond St., Dunedin	Spice Tins	firm est'd in 1861	QB2 QB2	rect. flange-lid circ. flange-lid
Wilson Balk & Co	Spice Merchants Bond St, Dunedin	Spice Tin	post 1898	ACS/4	circ. flange-lid
Strangs	Invercargill. General Merchants. Marketed their own cocoa, chocolate, coffee & chicory and spices	Strangs "Chocolate & Cocoa". Coffee Powder	post 1887	CH/7 Poplars, S133/21	circ. flange-lid circ. flange-lid
Edmonds	Christchurch. Manufacturers of custard & baking powder	Baking/custard powder	post 1880	CH/36	circ. flange-lid
WD & HO Wills	Wellington. Cigarette Makers & Tobacco Packers	"Capstan"	post 1880	CH/4. CH/26, CH/33, ACS/2	circ. flange-lids slip-lid cutters
Cameron's	England?	Havelock Tobacco	post 1890	CH/34	rect. hinged flanged-lid
British/Australian Tobacco Co.	Australia?	Havelock Tobacco	post 1890	ACS/6 (2) Ah Lums	pocket tobacco
Colman's	England	Mustard	c.1870	Poplars	rect. flange-lid
Colman's	England	Azure blue (no. 1)	c.1870	S133/69	rect. flange-lid
Colman's	England	Starch	c.1870	S123/144	rect. flange-lid
Robinson's	England?	Groats	c.1870	S133/69	rect. flange-lid
Fry's	London & Bristol	Cocoa & chocolate	c.1870	CH/23, Poplars QB2	circ. flange-lid
–	England	Bournville Cocoa	c.1870	Ah Wee's, Rapids	circ. flange-lid
–	England?	Blossom Ointment	–	Ah Lums	circ. flange-lid (possibly screw-top)
Colman's	England	Mustard Oil for Rheumatism	c.1870	S123/144	rect. flange-lid
Colman's	England	Concentrated Mustard Oil	c.1870	S133/69	rect. flange-lid

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