THE BEOTHUK ADOPTION OF IRON TECHNOLOGY

LAURIE ALLAN MacLEAN, B.A.

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BY

© Laurie Allan MacLean, B.A.

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ABSTRACT

The research described in this text addresses the Beothuk Indians' adoption of iron technology during the historic period in Newfoundland. This industry is interpreted using archaeological, historical, metallurgical and linguistic data. A large sample of iron artifacts in storage at Memorial University and the Newfoundland Museum provides physical evidence of many, if not all, aspects of Beothuk ironworking and is the central focus of the examination.

Chapter one deals with the background information, including historic, archaeological and comparative data, utilized in deriving research questions pertaining to the descriptive aspect of this thesis. This approach resulted in the first comprehensive typology of Beothuk iron tools, outlined in chapter three. The resulting overview brings together artifacts that have been found by the public sector during the historic period and through archaeological excavations over the past 25 years.

The combined sample referred to here includes traditional Beothuk iron implements, including projectile points, awls, fish spears and possibly scrapers, that were mostly recycled from European items. The sample also contains European objects possessed by the Beothuk and debris from the recycling processes that produced traditional Native tool-types. Identification of the specific stages in Beothuk manufacturing processes facilitated the formation of

metallurgical research questions relating to structural changes in iron that would occur in such reworking of European material. These queries are listed in chapter four, along with background information describing the properties of industrial wrought iron, cast iron and steel in Beothuk context.

Chapter four also outlines the results of a laboratory analysis of Beothuk iron undertaken in Ottawa. In addition to generally corroborating historic descriptions of Beothuk ironworking, these data indicate that during the industry's formative period, ca. A.D. 1650-1720, European-made projectile points and associated forged objects were somehow acquired by the Newfoundland Natives. These artifacts possibly represent some form of peaceful interaction between the Beothuk and other people, such as Europeans or the Montagnais, a proposal usually considered untenable by students of Newfoundland history.

After the Beothuk iron industry is described, these data are compared to contemporaneous mainland North American cases, including the Onondaga Iroquois, Labrador Eskimos and Nova Scotia Micmacs. This highlights the Beothuk iron industry relative to North American history.

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TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF PLATES

CHAPTER 1: BACKGROUND INFORMATION TO BEOTHUK IRON

The Beothuk iron industry represents a Native technology attributable to Europeans' arrival in Newfoundland. Archaeological and historical information provide a useful introduction to the Beothuk use of iron and its incorporation into their society. Three comparative cases of North American Aboriginal iron industries provide further data for deriving research questions pertaining to the descriptive analyses of artifacts and the role of iron in Native economies. Background metallurgical information is left until Chapter 4, when the laboratory component of this research is described. The anthropological-archaeological implications of the terms "industry" and "technology", as utilized in this thesis, are described below.

The sample referred to in this thesis permits derivation of the first comprehensive typology of Beothuk iron objects, consisting of three general groups: (1) recycled traditional types, including projectile points, awls, fish spears and possible scrapers; (2) debitage of manufacturing processes, and (3) unmodified European items. Once adequately defined, this inventory assists morphological analysis for possible trends in tool production and use. Identification of the physical aspects of Beothuk ironworking is also a prerequisite to the metallurgical assessment of manufacturing processes.

Iron Technology: Definition

Technology has been interpreted as, "that complex of learned behaviors giving rise to material culture, embracing the means by which people modify their natural environment moreso than the objects themselves. It can refer to human activities on several levels of abstraction, from all technical pursuits in total, to others more specific to place and time, i.e. Western European [or Beothuk iron] technology, or to individual/subsidiary endeavors, namely subsistence or ceramic technol ,ies" (Spier 1973:1-2).

Viewing a culture's technology in terms of its general adaptive strategy moreso than just its diagnostic materials (Ridington 1982:469) provides a useful framework for evaluating artifacts' significance within that society. This is similar to the approach taken here, namely that references to Beothuk iron technology must take into account these people's continued ability to meet their subsistence needs in addition to obtaining and recycling supplies of iron. This thesis deals with the latter two processes and other internal aspects of Beothuk iron technology at one level of abstraction. Hypotheses about iron's overall significance in terms of Beothuk activities, i.e. their general adaptive strategy, constitute a second level of abstraction. In order to accentuate the distinction between these two points of view, Beothuk ironworking, encompassing artifact morphology and manufacturing processes, is referred to as an "industry" that exists within a general technology.

The Archaeological Record

Archaeological data indicate that the Beothuk were the final component of Newfoundland's Recent Indian occupations that also include the prehistoric Little Passage and Beaches complexes. The Beothuk represent the historic phase in the continuum and were preceded in time by the Little Passage, which is tentatively placed in the A.D. 1000 - European contact interval (Penney 1984:185; Pastore 1989:personal communication). A Beaches component from Boyd's Cove has been radiocarbon dated to roughly A.D. 990 (Beta 10235; Pastore 1985:323), while a comparable assemblage from Cape Cove Beach, Bonavista Bay, may have been used as long ago as A.D. 135 (Austin 1984:119).

Each Recent Indian group is characterized by distinctly shaped stone projectile points, with the Beothuk's use of iron making them further unique. Little Passage projectile points tend to be small, mostly under 18 x 42 mm., stemmed or corner-notched, and predominantly made from fine-grained grey-green chert (Schwarz 1984:1, 74). These seem to have declined in quality throughout the historic period (Schwarz 1984:4) as the Beothuk increasingly utilized iron. Beaches projectile points are typically larger than Little Passage examples and exhibit side- or corner-notching (Pastore 1985: 323). Little Passage stone toolkits also include triangular bifaces, variably-shaped endscrapers, and linear flakes. It is also possible that bone awls and other bone tools were used during the Little Passage period.

Little Passage sites suggest three variations, the first being base camps situated in inner coastal zones where terrestrial and marine food resources were equally accessible. The second type often occurs in similar inner coastal locations, but is characterized by less diverse tool assemblages and is interpreted as central exploitation camps from which hunting expeditions could be mounted in any number of directions. These expeditions would have resulted in the third type of site, namely special exploitation camps situated in close proximity to a particular resource, such as seals or caribou (Schwarz 1984:39-41). Little Passage sites typically lack the substantial house features often found at Beothuk occupations, although their structures may have been similar to those represented by boulder tent rings at Point Revenge localities in Labrador (Fitzhugh 1975:351). It has been suggested that the evolution of more elaborate and substantial Beothuk houses is an historic development reflecting access to more efficient European iron tools (Pastore 1984:107).

On the basis of the aforementioned site typology, a Little Passage subsistence/settlement pattern is proposed in which people, during late winter, would move down river from inland sites to base camps along bays or river mouths. From these locations, throughout the spring and summer, expeditions would be organized to central occupation camps where the resources of a particular area could be monitored, and also to special exploitation sites within regions of reliably rich resources. In the fall Little Passage groups would leave the coast via bays and rivers, presumably to spend late autumn/winter hunting caribou (Schwarz 1984:43-46). This is a hypothetical model for Little Passage settlement/subsistence patterns and may be subject to modification after suitable faunal samples are analyzed.

Archaeological Evidence for Beothuk Toolkits

Beothuk material culture underwent significant changes during the historic period as iron tools gradually replaced more traditional items that were mostly made from stone. Over the past 15 years archaeological excavations have discovered much evidence of this iron industry, often in association with stone artifacts. The latter are more common at older Beothuk occupations. Figure 1 illustrates the sites contributing collections to this research, while Figures 2, 30-35 depict the artifact assemblages found in undisturbed housepit interiors. The latter are important activity areas for tool production and use, which makes them useful in interpreting the socio-cultural significance of iron. The historic material in Figure 2 is supplemented by artifacts found elsewhere at these sites, producing the totals listed in Figure 3. Stone items are omitted in Figure 3 because of the often high frequency of prehistoric specimens outside Beothuk housepits.

Throughout the 1982-85 field seasons, Dr. Ralph Pastore supervised excavation of a Beothuk-Recent Indian site at

Boyd's Cove, Notre Dame Bay (DiAp:3). Artifactual evidence and a radiocarbon date of 270 $\pm$ 70 B.P. (Beta 6729) imply an occupation from A.D. 1650-1720. This suggested date is strengthened by the high proportion of iron to stone artifacts and the site's location, which at that time lay between a French fishery to the northwest and an English fishery to the southeast (Pastore 1982:137; 1983:98, 102).

Over 1700 iron artifacts have been recovered to date from Boyd's Cove, including 903 from four undisturbed housepit interiors and a 1m x 2m trench in a fifth. These house features also contained 677 glass trade beads, smaller amounts of other historic materials and 140 stone items (Figures 2, 35). Recycled iron projectile points, fish spears, awls and possible scrapers were found, along with related unidentifiable manufacturing debris and European objects. The latter include complete items and partly modified fragments. The iron is described in greater detail in chapter 3.

The 140 stone artifacts are spread over 15 categories, including projectile points, bifaces, scrapers, utilized flakes, hammerstones, abraders and whetstones (Figures 2, 35). Projectile points, and possibly some of the bifaces, attest to hunting in the Boyd's Cove area while retouched flakes, utilized flakes and linear flakes imply butchering, food-processing and assorted domestic activities. Scrapers were undoubtedly used in preparing hides while hammerstones and cores relate to stone tool production at Boyd's Cove

(Schwarz 1984:34). Analogous use-wear studies indicate that stone projectile points were often applied to cutting, chopping and scraping tasks in addition to hunting (Ahler 1971:107; Montet-White 1974:15), which suggests multi-purpose usage.

Boyd's Cove's diverse toolkit, including traditional materials along with recycled iron and European items, implies a wide choice of implements for the Beothuk. The accompanying faunal sample, consisting of polar bears, black bears, caribou, seals, smaller mammals, birds and fish, is interpreted as evidence for the efficiency of the hunter and his weaponry at this site, especially in the procurement of large carnivorous species (Cumbaa 1984:11-18). The elaborate toolkit, healthy faunal record and large, substantial houses at Boyd's Cove suggest a successful Beothuk existence that could be partly attributable to their access to European materials, although relations between the two groups would eventually break down, probably by A.D. 1720 (Pastore 1989:personal communication).

The Boyd's Cove artifacts are complemented by smaller assemblages from coastal and interior Newfoundland. Approximately 20 km. away, at the opposite end of Dildo Run, is Inspector Island (DiAq:1) where 291 iron artifacts were obtained from one completely excavated housepit interior, two 1m excavation units from a second housepit, and outlying features. The housepit interiors produced 67 iron objects, six clay pipe sections, five lead fragments, three trade beads and 22 lithic tools. The excavated housepit had an overlying, disturbed garden zone containing another 24 iron objects, in addition to four of stone, three lead shot and two clay pipe fragments. The iron was in poorer condition than that from Boyd's Cove, possibly due to a less favourable soil environment, but a comparable sample of projectile points, European tools/fragments, and modified pieces was obtained.

The Beothuk stone tool assemblage at Inspector Island, including projectile points, bifaces, cores, a scraper and various specialized flakes, strongly resembles that from Boyd's Cove. A Little Passage faunal sample taken at Inspector Island has not yet been analysed, but preliminary examination suggests the presence of seal, fish and bird bone (Pastore 1989:personal communication).

Iron is obviously the preferred material for tools at Inspector Island which, along with the site's location - further away from advancing English settlement - tentatively suggest a later occupation than Boyd's Cove, probably during the A.D. 1720s. It is hypothesized that Inspector Island represents the Beothuk retreat westward due to the spread of English settlement on the coast (Pastore 1989:personal communication).

At the Beaches site, Bonavista Bay (DeAk:1), 16 stone artifacts and 20 badly corroded iron items were found in a Beothuk housepit. Stone objects include a projectile point, seven assorted tool fragments, seven utilized flakes and one abrader (Devereux 1969:42-45). The Beaches toolkit suggests hunting activities and subsequent preparation of resources similar to those associated with Boyd's Cove and Inspector Island. The Beaches faunal sample, including seals, black bears, caribou and birds (Devereux 1969:42-45), corroborates this claim, although the high proportion of seals, 90%, reflects a major preoccupation with sea mammal hunting.

The Beaches' mixed stone and iron assemblage was only dated to the general historic period (Devereux 1969:57), pending further research to fix more firmly the time of this occupation. Its location suggests a pre-A.D. 1675 usage, as the English presence in Bonavista Bay grew rapidly afterwards. From A.D. 1675-1681 the summertime European population of Bonavista Bay increased from 401 to 754, represented by some 138 boats. In A.D. 1675 there were approximately 100 permanent residents and by A.D. 1700 this number had increased to 600-800 (Head 1976:15, 55). This growing population probably resulted in the Beothuk retreating westwards towards Notre Dame Bay.

At the Fox Bar site in Bonavista Bay (DeAk:2), 50 iron artifacts, 34 shell beads/fragments, 28 bone pendants/fragments, 20 stone items, 10 other worked bone pieces, eight clay pipe sections and a European potsherd were discovered in a Beothuk burial. The site was disturbed prior to archaeological discovery, similar to other Beothuk graves found to date, which probably accounts for the absence of more diagnostic lithic artifacts than the cores and flakes present. All the remaining items are covered with red ochre (Carignan 1973:13; Newfoundland Museum sample). Unfortunately the Fox Bar iron is badly corroded which severely limits its applicability in this thesis. Its location and mixed assemblage, including 4 stone cores, utilized flakes and a large rimsherd of sgraffito ware, a popular seventeenth-century European pottery (Woodhouse 1974:103), suggest a relatively early deposition, ca. A.D. 1600-1650.

In 1970 Helen Devereux's excavations at Indian Point, Red Indian Lake (DeBd:1) produced 16 Beothuk iron artifacts and no diagnostic lithic material, mostly from features outside housepits (Devereux 1970:28-30a). Twelve of these iron items were examined by the author in Ottawa and the whereabouts of the other four are unknown. At its time of excavation, Indian Point could only be dated to the general historic period (Devereux 1970:55, 56), although new interpretations outlined in this thesis suggest that at least some of Devereux's material is relatively recent, probably post-A.D. 1750.

A large amount of caribou bone from the upper, i.e. Beothuk, level at Indian Point tentatively suggests a late fall-early winter occupation (Stewart 1971:20). The sample mostly consists of healthy caribou which indicates the work of efficient hunters who were capable of selecting choice animals (Stewart 1971:11). This also reflects the effectiveness of the Beothuk toolkit, which almost exclusively consisted of iron items by now. A minimum of 16 caribou and smaller numbers of other animals were identified from 2134 bone fragments, with another 10,529 pieces yet to be examined (Stewart 1971:3).

In 1964 Devereux coordinated excavations at Pope's Point (DfBa:1), on the Exploits River, which resulted in the recovery of Beothuk iron along with modern and prehistoric materials. Unfortunately, these artifacts were mixed together throughout most levels of the site, but a Beothuk occupation is implied by the presence of modified iron, 41 glass trade beads, 7 clay pipe sherds, 20 copper and 9 unidentifiable metal items (Devereux 1965:13-16). The author examined iron projectile point preforms and other Pope's Point artifacts in Ottawa, but the location of some diagnostic iron, including a complete projectile point, is unknown. The site report indicates one intact iron projectile point along with three fragments/preforms and another three possible preforms (Tables 4e, 4h; Devereux 1965:Plate 16 e-i, k, l).

There are 38 stone objects, including three prehistoric Dorset Eskimo projectile points and 15 scrapers, from Pope's Point. Preliminary analysis of the faunal sample indicates a preponderance of caribou bone along with some beaver and bird remains (Devereux 1965:12). Dating the Beothuk use of this site is problematic in view of the incomplete data, but the iron artifacts and the absence of late Little Passage/ early historic lithics imply a relatively late occupation, probably after A.D. 1750.

In 1972, 131 iron artifacts, 15 stone abraders and three hammerstones were found during excavations at Wigwam Brook (DfAw:1) (LeBlanc 1973:114-116). Much of this site had been previously disturbed by looting, but the absence of stone cutting and piercing tools implies that the Beothuk were not using such items by this time, ca. the late eighteenth-early nineteenth century A.D.. Wigwam Brook's historic component and location, corresponding with John Cartwright's A.D. 1768 map in which Native houses are three miles upstream from the "Falls" (Grand Falls) around Nimrod's Pool, are the basis for the estimated time of occupation (LeBlanc 1973:148).

Faunal material from Wigwam Brook consists mostly of caribou bone and suggests a year round occupation (Stewart 1973:17, 18, 25). This corroborates the suggested late Beothuk occupation here, presumably after they had stopped utilizing coastal resources because of their fear of Europeans (Howley 1976:33, 278; Tuck 1975:76). Historic data report that early in the nineteenth century A.D. large amounts of caribou were regularly taken by the Beothuk (Howley 1976:79, 87, 123), although soon thereafter, probably by A.D. 1823, they had fallen on leaner times. In 1823 three starving Beothuk women, including Shanawdithit, were captured as they foraged for food in New Bay, Notre Dame Bay. Another Beothuk female and a man were shot as they approached their would-be captors (Howley 1976:169). Shanawdithit later reported that there were 13 other Beothuk left in the interior at this time (Howley 1976:229).

Beothuk iron has also been recovered from graves on Newfoundland's northeast coast at Comfort Island (DiAr:1) and Swan Island (DiAs:1), in the Bay of Exploits; Burnt Island, in Notre Dame Bay, and Western Indian Island, in Hamilton Sound. Similar grave goods were found on Rencontre Island, near Burgeo, on the south coast (Howley 1976:331, 333, 334). Most of this material is now scattered over Canada and the world, which precludes more detailed analysis of it here. Altogether, the sample of readily observable iron artifacts totals over 2200 pieces which proved generally acceptable for the task at hand.

The extant sample of Beothuk material culture has recently been significantly increased by the Newfoundland Museum's acquisition of over 1200 iron artifacts and smaller amounts of other items from 27 sites, mostly found along the Exploits River and the northern end of Red Indian Lake. A few of the new items were found at the inland sites previously mentioned here. Some of the objects are included in the test sample, but detailed examination of most of the collection is pending. Preliminary analysis by the author suggests that the evolution of Beothuk ironworking, as proposed in this thesis, is borne out by this material. Much of the new iron is not firmly datable due to incomplete provenience data, but a large amount appears to be fairly recent, probably coming from the latter eighteenth century A.D..

Historic Record

Written descriptions of Beothuk people are scanty compared to other North American natives, but the available information offers some insights into the former's traditions, including the widespread pressure for change manifest by Europeans in Newfoundland. Historic perceptions of Beothuk settlement/subsistence patterns and material culture, with specific references to iron, are examined here.

Data are especially scarce for the early historic period, ca. pre-seventeenth century A.D., but some of the older documents mention Natives, that may have been Beothuk, on North America's east coast. While the ethnic identity of these groups is not clearly identified, such reports are significant in depicting a Native material culture devoid of iron objects. Corte-Real noted in A.D. 1500 that, "in this country there is no iron, but they (inhabitants) make swords of a kind of stone, and point their arrows with the same material" (Howley 1976:5). In A.D. 1509 Estienne noted that natives of Newfoundland "pointed" their arrows with fish bone or stone (Howley 1976:8). After Parmentier sailed to the New World in A.D. 1529 he reported that the people living between Cape Race and Cape Breton tipped their arrows with black stone or fish bone (Hoffman 1963:14).

The European fishery in the New World expanded throughout the sixteenth century A.D. to a scale at which over 100 ships were annually sailing to Newfoundland by A.D. 1600

(Trudel 1981:291). Many vessels never touched shore as, in the early migratory fishery, fish were mostly caught, split, salted and stored on board ship, so that fishermen had no need of terrestrial resources, except for possibly fresh water and/or firewood. This implies that the Beothuk had limited access to European goods during much of the 1500s until around the mid-sixteenth century A.D. when, following England's lead, the fishery shifted from a "wet" to a "dry" format, involving more use of the Newfoundland mainland (Innis 1978:21, 46). The new approach incorporated shore-based operations, utilizing wooden stages, flakes, cook houses and other facilities, from which fishermen made daily excursions in small boats and returned to dry their catch on land (Head 1976:5). The English were mainly concentrated around the Avalon Peninsula, but along with the French and other Europeans, also fished to the northwest and southwest. The "Petit Nord", along northern Newfoundland, refers to a French area with no English settlers until late in the eighteenth century A.D. (Mannion 1977:23; Innis 1978:21, 90; Quinn 1978:525).

The increasing European activity around Newfoundland throughout the sixteenth century A.D. would logically make their materials more accessible to the Beothuk through direct or indirect contact. Shipwrecks provided one source of iron in which interaction with Europeans would not have been required. In May, A.D. 1594, an English ship, the Grace, sailed into Bay St. George where it encountered the wrecks of two Basque whalers still containing iron bolts plus the chains used in hanging the main shrouds and fore shrouds. A nearby Beothuk camp on the mainland contained no iron artifacts (Quinn 1979:64), although the Beothuk were probably using the metal by this time. The occupants of this camp may have been lured there by the shipwrecks containing large supplies of iron. It has been suggested that Micmac and other northeastern people adjusted their settlement patterns to facilitate obtaining European goods on the Atlantic coast during the summer (Bourque 1974:9; Burley 1981:213; Sanger 1982:202). By A.D. 1594 the Beothuk conceivably had an equal desire for such materials, especially iron, and the Grace may have arrived in Bay St. George before the wrecks had been stripped of their prize.

After A.D. 1550 the shore-based facilities associated with the dry fishery provided the Beothuk with more predictable sources of iron that could be stolen. In A.D. 1621 Richard Whitbourne wrote, A Discourse and Discovery of the Newe-founde-lannde, noting that a problem existed in Trinity Bay with Beothuk coming from Bonavista Bay in the night to steal knives, axes, sails, clothes and other items from European camps (Cell 1982:118, 119; Howley 1976:20). The fishery continued to grow during the seventeenth century and by A.D. 1700 some 700 ships, carrying a total of 7000 men, were sailing annually to Newfoundland (Trudel 1981:291). Eighteenth-century migratory fishermen were increasingly pushed to more outlying harbours as Newfoundland's choice ports, especially those on the Avalon Peninsula, were manned by the permanent population which totalled some 3500 by A.D. 1730 (Head 1976:82). By A.D. 1750 there were 8000 year round residents, mostly of English stock, and each summer the population doubled during the migratory fishing season (Trudel 1981:342).

After ca. A.D. 1550 the Beothuk may have been able to get iron from fishing premises left vacant by Europeans returning home in the fall. In later years, however, the growing permanent European population in Newfoundland and the increasing Beothuk demand for iron likely led to confrontations between the two groups (Pastore 1987:59). This probably contributed to the widespread depiction of the Beothuk as thieves (Hewson 1983:13, 18, 27, 30, 45), which reflects possibly ethnocentric feelings, considering that Native concepts of ownership and use of tools likely differed from Europeans'.

Also, the extent of damage that fishing premises suffered from the Beothuk seems to have been distorted by history, as documentation attributes an equal or greater amount of destruction to rival European fishermen. The shore-based facilities essentially consisted of shoddily-built flakes, stages, huts, cook houses and other structures that were often not expected to last more than one fishing season. Many times these constructions were destroyed by their owners in the fall to be used as fire wood on board ships returning to Europe (Head 1976:3, 17). Others were torn down by men not wishing to give any advantage to next year's fishermen who might precede them and claim the best facilities not taken away by ice. Many harbours in autumn often retained only the barest material remains of the summer's shore operations, such as a few small boats or bundles of last year's wood hidden nearby (Head 1976:17, 18).

Furthermore, the first Europeans to land in a particular harbour in the spring often selected the best of any remaining structures and destroyed the rest to secure an advantage over subsequent arrivals. Latecoming fishermen often had to spend the first 20 days of the season securing materials and constructing the necessary premises. Similar modes of sabotage between Europeans commonly persisted throughout the fishing season as well (Innis 1978:56, 57; Quinn 1978:527). This information indicates that the Beothuk were part of a larger socio-economic system creating problems for the migratory fishery.

The first recorded proof of Beothuk possessing iron dates to November 6, 1612, when John Guy's party of explorers encountered canoe-travelling Indians at Bull Arm, Trinity Bay and the two groups exchanged gifts. A few days earlier Guy's men had discovered Beothuk houses containing a very bright copper kettle, an old sail and a fishing reel (Quinn 1979:154). At Bull Arm iron knives, scissors, needles, a hatchet and other objects were given, or sold, to the Natives. In return for an unarmed arrow shaft, a

Beothuk male received a dozen "points" (Quinn 1979:154-156), which, in view of data described in this thesis, were probably nails or spikes that could be transformed into projectile points. It is also possible that they were European-made projectile points, which were popular trade objects and gifts throughout much of North America (Bauxar 1959:40-58; Russell 1967:320-327; Salwen 1978:163; Trigger 1978:347). The Beothuk's use of disarmed arrows and bows as peace offerings were eventually acknowledged by Europeans to represent a desire to engage in trade (Duckworth Papers n.d. :4645).

Available documentation indicates that the Beothuk were heavily dependant on iron tools by the mid-eighteenth century A.D., although they had probably begun using such items much earlier. In summarizing his 1768/69 explorations of Newfoundland, George Cartwright noted that the Beothuk made arrow heads from old nails about six inches in length and stuck them into the notched ends of three-foot long pine shafts where they were secured by lashings of deer sinew (G. Cartwright 1792 vol. 1:10). A map drawn sometime during the 1768-73 interval by Captain John Cartwright shows Beothuk arrows with iron tips, but conspicuously lacking sinew bindings (Marshall 1977:240). This illustration is interpreted as an authentic depiction of Beothuk material culture (Marshall 1988:65) and suggests possible functional or stylistic variations on eighteenth-century arrows.

In the latter half of the eighteenth century A.D. some

Europeans noted that Beothuk were becoming less common on the sea coast (G. Cartwright 1792 vol.1:5, 6; Hewson 1983: 15; Howley 1976:33). This is in marked contrast to historic depictions of a Beothuk migratory existence that alternated between summers on the coast and winters in interior Newfoundland (Hewson 1983:14; Howley 1976:33). Changes to this pattern imply new modes of resource procurement and use, including the gradual replacement of stone tools by iron items and the concomitant evolution of the latter industry.

The Beothuk's eventual great desire for iron is reflected in government-sponsored attempts at friendly contact that included extensive lists of appropriate objects to be used as gifts. In A.D. 1808 Governor J. Holloway authorized the purchase of 18 tin pots, 24 helved hatchets, twelve helved hatchets (possibly different in some way from the other 24), and 100 pounds of seven-inch nails for Lieutenant Spratt's unsuccessful A.D. 1809 search for Beothuk (Howley 1976:67). The large amount of nails is interesting, considering the Beothuk tendency to rework them into other tools. Unmodified nails were reportedly used in the construction of a nineteenth-century canoe (Howley 1976:192) and an eighteenth-century wooden frame for drying skins (Hewson 1983:20, 41), but such accounts are rare.

In A.D. 1811 Lieutenant David Buchan led a goodwill expedition into interior Newfoundland that found well-maintained European axes along with hundreds of bright and sharp iron projectile points at Beothuk camps. Buchan's group eventually engaged in ill-fated contact with Beothuk that resulted in the death of two of his marines (Howley 1976:76-80, 86). In A.D. 1820 Buchan made a second attempt at friendly contact, carrying with him iron projectile points made by his ship's armourer as gifts. No Beothuk were seen so the intended presents were left at various spots in the interior known to be frequented by the Natives (Howley 1976: 124, 341).

Primary data regarding the Beothuk were greatly enhanced in the nineteenth century A.D. when two of their women were captured by settlers. Demasduit, also known as Mary March, lived among Newfoundland's European population from March, 1819 until January, 1820. Shanawdithit, called Nancy by her captors, was taken in 1823, along with two other females. She survived for six years during which she supplied much information pertaining to Beothuk material culture, religion, population, language and some of her people's views of Europeans (Howley 1976:93-95, 169-262).

Shanawdithit described two types of iron "spears", one designed for killing seals and the other for "deer", in this case, caribou. The first of these tools is now recognized as a toggling harpoon that is similar in function to items employed by many North American Natives in sea mammal hunting. These a-aduths, in Beothuk terminology, consisted of a triangular iron blade with a straight stem set in a bone socket, that was in turn hafted to a 12-foot long wooden shaft (Plate 10; Figure 11; Howley 1976:247). The socket detached from the wooden shaft upon the blade's penetration of the prey animal, but remained connected to the hunter via a line. Shanawdithit's depiction of a toggling harpoon is markedly different from standard versions of these tools in which the bone socket is attached to the shaft via a foreshaft. Possibly her recollection of the implement is somewhat inaccurate, or the Beothuk versions of toggling harpoons did not perfectly imitate the examples from which they may have been copied, such as Micmac or Dorset. The toggling harpoon is described in more detail, along with the other types of Beothuk iron objects, in chapter three.

The second type of spear referred to by Shanawdithit was apparently mainly used in caribou hunting. These tools, a-min or a-mina in Beothuk terminology, consist of elongate, tapered blades whose long stems, or tangs, were permanently set into wooden shafts similar to toggling harpoons' The blade's widest portion occurs near the base, forming two sharp, obtuse-angled shoulders that taper to the much narrower tang (Howley 1976:248). Many similar implements are found in the sample of Beothuk iron described in this thesis (Figures 7-10; Plates 4-7).

Shanawdithit and her sister-captives' preference for iron objects, including kettles, hatchets, hammers and nails, over European trinkets, linen, paper or other items offered them indicates the Beothuk's high regard for the metal. The three women, one of whom was weak with sickness, regularly returned to their sleeping quarters under loads of literally staggering proportions (Howley 1976:172). They may have envisioned returning to their people with a wealth of usable tools and raw materials for subsequent recycling.

A description of how the Beothuk recycled European iron is supplied through an eighteenth-century A.D. report by John Peyton Sr., an English settler living in Twillingate. In 1792 he told Lieutenant G.C. Pulling that he had seen a "... wounded Beothuk man hammering the bed of a trap into arrows on a rock inside a wigwam during the winter of 1781" (Hewson 1983:27, 45). Another report mentions the use of flat rocks as anvils to "...beat out their (Beothuk) arrows and spears on" (Hewson 1983:20).

A more elaborate account of Beothuk ironworking is attributed to George Wells, a resident of Exploits Island, Notre Dame Bay, who told J.P. Howley that he had witnessed such activities in the early A.D. 1800s. He explained that the piece to be modified was first kept in a fire for a few days to soften it. An old axe inserted poll-first (butt-first) into a "junk" of wood was then utilized to shape the raw material by working the iron back and forth along the axe's cutting edge. The proposed working edge of the new tool was next sharpened by grinding it on a stone, producing arrow heads about six inches long (Howley 1976:271).

W.E. Cormack conducted extensive research on the Beothuk and attempted to find survivors in the late 1820s. In A.D. 1829 he reported to the Beothuk Institution in St.

John's that nails were much prized by them and tended to be reused (Howley 1976:192). He later explained that iron eventually completely replaced stone and bone as raw materials for arrow heads and spear points. Supplies of iron were obtained from European shipwrecks, assorted debris around settlements, and sometimes pilfered from fishermen's premises (Howley 1976:230).

Historic descriptions of Beothuk graves indicate the strong position of iron in these people's ideology. Grave goods are typically interpreted as being necessary for the deceased person's survival in the after-world and have been reported from many Amerindian sites (Jenness 1932:165). There are a number of references depicting nails, iron pot fragments, axes, other European objects and more traditional Beothuk materials, including birch bark, bone pendants, red ochre and stone tools, in burials (Howley 1976:289, 332, 335). One bone pendant from a Comfort Island grave has an incised design that is very representative of iron projectile point blades (Locke 1975:30). This burial also contains a possible Basque iron whaling harpoon.

Evidence of new physical and ideological stimuli, attributable to European influence, in Beothuk material culture can be seen in the number of words added to their language during the historic period (Appendix A). The list shows a gradual increase over the years, starting with the "Clinch Vocabulary", compiled in the late eighteenth century A.D. from information supplied by a captured Beothuk girl, Oubee. These data, first released in The Pulling Manuscript in A.D. 1792 and as the "Clinch Vocabulary", proper, in A.D. 1800, have ten clear references to European words (Hewson 1978:14-21). Another vocabulary compiled by Leigh in A.D. 1819, with assistance from the aforementioned Demasduit (Mary March), contains some thirty-five examples clearly attributable to a European influence (Howley 1976:38-50). The "King Vocabulary", released shortly after A.D. 1829, has six new words allegedly supplied by Shanawdithit (Howley 1976: 107-113).

This research indicates that 50% (17/34) of utilitarian European objects listed in the vocabularies were recycled by the Beothuk into more traditional forms of tools. Nine of 15 European iron items were variably reworked into projectile points, awls, fish spears and possibly scrapers, while other metals and boat sails were modified for other functions. All the European objects, with the possible exception of guns, could have been recycled or otherwise incorporated into extant Beothuk functions. Access to firearms holds greater potential for changing traditional hunting/settlement patterns and for more aggressive relations with other people.

Comparative Cases

In order to assess more fully the socio-cultural implications of Beothuk ironworking, analogous industries from eastern North America are examined here. This approach is somewhat in line with Trigger's concept of a Colonial North American history within which Native and European themes are contributing parts (Trigger 1982:11). Data relating to the Onondaga Iroquois from the present New York state area, mostly compiled by James W. Bradley, and material pertaining to Labrador Eskimos, taken mainly from Susan Kaplan's work, are referred to in this regard. A third analogue, comprised of Micmac grave goods from the Hopps site, Nova Scotia (BkCp:1), contains a selection of European-made projectile points that are very similar to two items from interior Newfoundland.

Between A.D 1550 and 1650 the Onondaga Iroquois made predominant use, or reuse, of European axes as raw materials in the production of celts, hammers, mauls and hoes. Broken European knives and sword blades were recycled into chisels, gouges, other woodworking tools and harpoons, depending on the condition of the iron fragment (Bradley 1980:10). There is an obvious tendency towards the production of tools connected with farming and woodworking by these people, as opp.sed to the Beothuk emphasis on projectile points. This is not surprising given the differences in subsistence activities between the two groups. The demands of farming in Onondaga (Tuck 1971:19) would have required implements for clearing land and tilling the earth. The Beothuk environment, on the other hand, necessitated a mobile hunter-gatherer economy.

The Beothuk and Onondaga early contact, or proto-historic, periods (Tuck 1971:171) differ in that the latter people acquired European materials via Native middlemen before meeting the newcomers (Bradley 1980:109). By contrast, in the late fifteenth and early sixteenth centuries A.D., some of the first Europeans to arrive in the New World met possible Beothuk on the coast during the summer. After A.D. 1550 the Beothuk had access to iron at shore-based operations associated with the European migratory fishery. The Onondaga introduction to European materials provided them with time to absorb some of the latter's impact upon their culture before being exposed to the stress implicit in direct or close contact with the visitors.

By the mid-seventeenth century A.D. the Onondaga were practically dependant on European materials and implements (Bradley 1979:292). Bradley concludes that the Onondaga's ironworking methods illustrate the retention of prehistoric, stone age procedures, although any working of iron involves technical knowledge surpassing the Neolithic level (Bradley 1980:111). This suggests that Onondaga ironworking incorporated extant tool-making skills to their fullest potential. Iron fragments displaying U-shaped grooves on their surfaces are cited as evidence of sandstone or other lithic abraders being used to etch lines in the metal along which it could be broken. The presence of v-shaped incisions on iron from later sites is interpreted as proof of the eventual replacement of stone abraders by metal files. Tertiary stages of production saw stones used to sharpen the cutting edges of the new tools (Bradley 1980:111).

The proposed Iroquois combined application of old and new techniques to work a strange material is interesting with respect to the Beothuk. Onondaga people made ornamental items from native copper before they had access to iron, and thus had been exposed to metal (Bradley 1980:111; Beauchamp 1903:12). Metallurgical evidence suggests that the properties of copper-working are not directly relevant to iron-modification (Knauth 1974:84), although any association with metal would likely have been beneficial in this new industry. Since the Beothuk had no native copper, only their skills in working stone, and possibly bone, would have prepared them for recycling iron.

The Onondaga recycled less iron concomitant with the increased availability of European goods (Bradley 1979:110). This does not seem to be the case in Newfoundland where a late Beothuk site at Wigwam Brook yielded a high proportion of reworked iron objects and manufacturing debris, compared to finished European tools (LeBlanc 1973:106, 131). The other Beothuk sites referred to here similarly indicate large amounts of ironworking. Late Beothuk sites display a lack of stone tools, except for hammerstones and a few abraders, but European material, consisting mostly of iron, was usually recycled rather than used intact (Devereux 1970: 37; LeBlanc 1973:114-116). These points are dealt with in greater detail when the sample of Beothuk artifacts is introduced.

The Onondaga desire for European objects resulted in an elaborate trade network involving other Iroquois nations and their neighbours. The Iroquoian-speaking Susquehannock and the members of the Iroquois Confederacy, the Mohawk, Seneca, Cayuga, Onondaga and Oneida, acquired new socio-economic power as middlemen peddling the new items to inland people via major rivers (Bradley 1979:357). Long-established settlement patterns and trade routes were altered to accommodate the demand for European materials. Midway through the sixteenth century A.D. the Susquehannock moved south to the Washington Boro basin, at the bottom of Chesapeake Bay, conceivably to position themselves better for obtaining European supplies (Bradley 1979:378). Early in the seventeenth century A.D., the traditional trade network shifted towards an east-west flow from the older north-south direction (Bradley 1979:396).

Traditional trade relationships were subjected to additional stress as rivalries between different groups gradually subsided, aided in part by the assimilation of refugees from war and epidemic diseases. Refugees were usually adopted into smaller Iroquoian villages, ultimately resulting in the creation of large towns covering miles of territory. By the eighteenth century A.D. these settlements exhibited much European influence in their architectural and agricultural design (Bradley 1979:348-350).

In Labrador a contemporaneous iron industry occurred among the Eskimo population (Kaplan 1983:V1). On Eskimo Island Three in Hamilton Inlet, sixteenth and seventeenth-century A.D. European material was found in Native context from that period (Kaplan 1983:413, 420). Nails, spikes and other iron objects were cold hammered into semilunar knives, projectile points and harpoon endblades (Kaplan 1983:231).

Archaeological assemblages containing mostly traditional objects, along with recycled iron, suggest that from A.D. 1600-1700 Hamilton Inlet was generally the southern limit of Eskimo camps, although Inuit occupations are reported in the Strait of Belle Isle (Martijn 1980:105, 106; Tuck 1984:232). The Inuit obtained some European goods through trade, but much was taken through pilfering, to the ire of fishermen (Jordan 1978:176; Taylor 1972:135, 139, 140). This is an interesting parallel with the Beothuk although the course of each iron industry eventually ran quite differently.

The Labrador people's settlement-subsistence patterns underwent significant modifications early in the historic period as Eskimos were drawn, by the presence of European goods, to the Strait of Belle Isle region from central and northern Labrador (Kaplan 1983:331). Settlement shifted from outer coastal sites, with an associated dependance on marine mammals, to more marginal inner areas where terrestrial food resources, including caribou and fish, the latter probably taken with European nets, became the optimum game (Kaplan 1983:298).

Eskimos who remained along the Labrador north coast during the early period found themselves in a situation analogous to the Onondaga Iroquois whereby they received iron and other European goods from Native middlemen before meeting the strangers responsible for the items. The Labrador middlemen were fellow Eskimos who had moved to the Hamilton Inlet area earlier in the historic period and as the scale of European trade increased, especially in the A.D. 1700-1800 interval, they gradually achieved status associated with a more wealthy, influential class. The onset of these powerful men among a normally egalitarian society is marked by a number of socio-cultural transformations, including a new practice of burying such people in solitary graves, with associated caches, on hilltops overlooking villages or hunting grounds (Kaplan 1983:240, 331, 849). Residency patterns also changed throughout the seventeenth and eighteenth centuries A.D. as large family groups began sharing the same house, under the control of a dominant male figure (Kaplan 1983:357).

The Labrador Eskimos became increasingly reliant upon European materials, as did the Beothuk and Onondaga people. By the latter seventeenth century A.D., steel knives had completely replaced traditional slate and nephrite examples although some older tool-types, such as toggling harpoons, were still in use, albeit equipped with iron endblades. Similar to the Onondaga, Eskimo ironworking declined drastically as more European goods became available (Jordan and Kaplan 1980:40). Guns were available in Labrador by A.D. 1850, but toggling harpoons with metal endblades were still regularly used by hunters at this time. These items' perseverance indicates a theme of cultural continuity dictated by environmental conditions (Kaplan 1983:248).

After A.D. 1800, in compliance with the Moravian missionaries' desire for a more terrestrial-based economy, most Labrador Eskimos had forsaken their regular settlement/subsistence habits in favour of living around missions or in small, scattered villages on the mainland and inner islands (Kaplan 1983:298-300). By this time foxes, wolverines and other fur bearers were the predominantly sought after animals, which provided furs for barter at trading posts, but insufficient meat for hunters' families. Seals were procured by Eskimo men whenever possible, but most often European food supplements were required. Missions fed their Native followers in times of need, on the condition that there was to be no sharing with non-Christians (Kaplan 1983: 365). This represents some Europeans' attempts to eliminate older, "pagan" tendencies concerning communal living and integrate the Labrador Natives into the colonial development of the New World.

The contemporaneous development of ironworking among Labrador Eskimos and the Beothuk spawns obvious questions concerning possible exchanges of ideas and/or materials across the Strait of Belle Isle. Labrador Natives regularly visited the tip of the Great Northern Peninsula (Taylor 1972:139, 144) although no Beothuk artifacts, suggesting contact between the two groups, have yet been found in that area. The parallel development of Beothuk and Eskimo iron industries remains thought-provoking considering possible contact with Europeans and methods of recycling iron. The tendency for each group to pilfer European iron and the indicated changes in Eskimo culture are potentially relevant to the poorly-documented Beothuk.

The Onondaga and Eskimo cases of ironworking both contain useful models of the potential pressure for socio-cultural change inherent in Native use of European goods. Each example manifests its own reactions concerning trade, settlement/subsistence habits and the fate of their indigenous material cultures. These themes will be reexamined throughout this thesis in terms of Beothuk iron technology and summarized at the end for all the groups.

The Micmac represent a different reaction to the European presence in that they rarely modified iron. Their geographical position put them in direct contact with Europeans from the beginning of the contact period onwards, and their willingness to engage in trade guaranteed a supply of the newcomers' materials (Burley 1981:209, 211). Unlike the other comparative cases, Micmac people closely interacted with early European visitors. For example, during the sixteenth century A.D. they freely boarded Basque fishing vessels, helping themselves to fish and various objects (Whitehead 1987:17). The Micmac became important participants in the European fur trade, trapping animals and acting as middlemen for other Aboriginal people in the Gulf of St. Lawrence and the Gulf of Maine (Whitehead 1987:33). Late sixteenth-century and early seventeenth-century A.D. graves indicate that they soon became dependant on European tools for their various activities, which by then consisted mainly of obtaining furs for trade (Whitehead 1988:62-64).

The Micmac's participation in the fur trade, combined with their involvement in French-English conflicts and the influence of missionaries, resulted in changes to their traditional settlement/subsistence patterns. Recent archaeological/ethnohistorical research suggests that prehistoric/early historic Micmac predominantly lived in riverine settings which facilitated seasonal excursions to inland or coastal areas at peak resource times. This arrangement contrasts with historic reports of them spending summers on the coast and the rest of the year hunting furs in the interior, which possibly represents a modified settlement pattern designed to obtain European trade goods brought over each new fishing season (Bourque 1973:9; Burley 1981:213; Sanger 1982:208). Eventually the depletion of fur bearing animals from accustomed hunting areas and population pressure from European settlers living on the coast pushed the Micmac into more marginal areas where their survival could only be achieved through further dependance on the colonists (Whitehead 1988:35; Burley 1981:213).

Micmac artifacts included in this test sample include a modified nail that is similar to Boyd's Cove and Inspector Island specimens, and French-Basque projectile points that resemble some Beothuk items. The Micmac items hold potentail ramifications for the Beothuk use of iron, with respect to modification processes and contact, including the possibility of trade, with other groups. The Micmac artifacts are described in detail along with the Beothuk sample and in Appendix B.

CHAPTER 2: SPECIFIC RESEARCH QUESTIONS

The central question in this thesis asks why the Beothuk adopted iron as an alternative to stone and bone - does it represent an inherently superior material resulting in more efficient tools, or were other factors involved? Archaeological and technological literature indicate that stone projectile points are equal, or superior, to iron examples in terms of cutting edge function (Pope 1923:369). Iron is tougher than stone, however, and thus produces tools less prone to breaking. This information suggests that there are functional advantages to each material and the preferred use of one over the other is also attributable to additional reasons.

Such factors may include changes in Beothuk subsistence/settlement patterns in response to the European presence in their homeland. Historical and archaeological data suggest that the Little Passage/early Beothuk practiced a migratory type of existence that alternately utilized coastal and interior resources (Hewson 1984:14; Howley 1976: 33; Schwarz 1984:43-46). This pattern apparently became inapplicable as Newfoundland's European population increased and gradually confined the Beothuk to the island's interior. The isolation from coastal foods and other resources has been identified as a possible instrumental factor in the extinction of the Beothuk (Tuck 1976:76). Traditionally, they most likely resembled prehistoric Newfoundlanders, including Eskimo and Indian cultures, who regularly visited coastal quarries for preferred types of stone, usually chert for the Beothuk, to be made into tools (Auger 1985:124; Simpson 1987:115). It is possible that the Beothuk eventually found European iron to be more accessible than these traditional materials, resulting in technological change, and when they began living in the interior all year round, iron continued to supersede lithic tools even though good quality stone is available in such regions (Robert Stevens 1988:personal communication).

Other statistical questions constitute the first comprehensive typological analysis of the Beothuk iron industry yet undertaken. The total number of classes/types of tools are identified and interpreted with respect to possible use-patterns relating to space and/or time. Possibly there were specific conditions that affected the rate at which iron technology evolved, such as proximity to the coast and/or dates of occupation. For instance, were adequate supplies of European iron more accessible to latter period Beothuk than they were to their predecessors? It is important to note that the more recent Beothuk, by living year round in the interior, were further removed than their forefathers had been from concentrated European settlement on the coast. This indicates the need for careful interpretation of the archaeological record.

Other questions concern the processes by which the Beothuk modified iron - were any techniques retained from their older bone and lithic industries? Ethnoarchaeological studies indicate that many Stone Age craftspeople heated their lithic materials to enhance tool production and successful use of this procedure implies extensive knowledge of the physical properties of the stone involved (Bleed and Meirer 1980:502, 503, 505; Flenniken 1975:125). Could this practice have been carried over to a burgeoning iron industry? Similarly, to what extent were tools associated with older industries applied to ironworking? The historic record suggests that Beothuk iron was subject to both cold working and hot working techniques. Conceivably, different combinations of these treatments were utilized and, if so, do Beothuk iron tools exhibit evidence of this? If heat treatment was used, was it universally applied or subject to specific conditions?

The answers to these questions facilitate comparing the Beothuk iron industry to other contemporaneous cases from eastern North America. Following the description and interpretation of the Beothuk iron industry, this study evaluates three other variations of Indigenous peoples' transition from stone technologies to specialized iron industries featuring recycled and/or intact European tools.

Methodology

Non-metallurgical research problems, requiring morphological analyses of Beothuk assemblages, were approached through examination of data and artifacts in St. John's. This permitted suggesting the general rate at which Beothuk iron replaced older materials by comparing the frequencies of tools found at undisturbed sites. Visual analysis of artifacts, mostly conducted at Memorial University and the Newfoundland Museum, facilitated detecting the types of objects made by Beothuk craftsmen and the European materials used as raw materials. Once clearly delineated within the sample, the recycled items were subjected to further descriptive appraisal involving tabulated attribute values, recorded in mm., to indicate any trends in tool production. Use-wear studies of analogous lithic artifacts are cited in suggesting some of the functions associated with traditional activities that iron objects may have performed.

The sample referred to in this thesis, containing finished implements, preforms, manufacturing debitage and European objects/raw materials, permits tentative identification of some of the different techniques involved in tool production. Establishing a typology of Beothuk iron tools is a prerequisite for assessing the growth of toolmakers' ironworking abilities over space and/or time. Improvements in these skills could have resulted in more efficient tool production, reflected in a wider range of high quality objects utilizing a greater selection of European items as raw materials.

Questions relating to changes in iron's physical constitution, including variable hardness v lues, preferred raw materials, and the effects of hot working, relative to cold hammering, were best answered by a laboratory analysis of pertinent artifacts. These tests examined iron objects for differences in grain structure attributable to particular modification techniques. Parks Canada's Conservation Labs in Ottawa provided the necessary facilities and personnel for metallurgical appraisal of Beothuk iron from Boyd's Cove (DiAp:3). These results are presented in Chapter 4 and Appendix C.

The preceding paragraphs address internal aspects of the Beothuk iron industry that must be determined before cross cultural comparisons with other groups can be attempted. The rates at which the particular iron industries evolved, focusing on the tools produced, the raw materials utilized and the different techniques involved, are potentially informative concerning Native-European interactions. For the Beothuk, these data are potentially important in terms of possible changes to traditional subsistence/settlement patterns and local material culture inherent in closer alignment with Europeans or increased use of the latter's goods.

CHAPTER 3: ARCHAEOLOGICAL ANALYSIS OF BEOTHUK IRON

This section begins with a description of important internal aspects of the Beothuk iron industry, including the types of recycled tools and their suggested manufacturing processes. The degree to which these objects seem to have been supplemented by intact European items is then addressed and the perceived relationship between the iron and the older stone industries, in terms of functional efficiency, is broached.

Iron Projectile Points

Beothuk iron projectile points consist of two major parts: a pointed, often symmetrical, blade and a much narrower tang section that was hafted to a wooden shaft or bone socket (Figures 4-11, 24-26; Plates 1-10). This description closely resembles the definition posited by Ahler in his study of stone projectile point form and function, in which such tools are typically "...bilaterally symmetrical and bifacially flaked, consisting of two parts: a distally pointed blade, and a haft element usually distinguished from the blade by means of grinding, notching, lateral constriction or other modification" (Ahler 1971:6). This section of the thesis examines Beothuk iron projectile points' physical attributes along with their functional implications, in terms of manufacture and use.

Thirty-one projectile points retaining enough of their original form to permit morphological examination are assessed in terms of blade length, blade width and blade thickness, with the latter value taken across their widest part. They are also examined with respect to tang length, tang width and tang thickness, with the latter two parameters taken at the distal end that articulates with the blade. In the case of another 19 artifacts, missing all or most of their blades, it is unclear if they are broken projectile points or preforms. An additional nine objects are clearly preforms (Tables 1-3; Figures 4-11, 24-26; Plates 1-4, 6-8, 18, 19).

The analysis resulted in the division of the sample into four types, that in three of four cases, are further split into subsets. This organizational scheme, illustrated graphically in Figures 13-23, reflects artifact morphology rather than function, which leaves it amenable to the possibility that the some of the different types were used in similar tasks. For instance, projectile points with blades under 65.0 mm. long were probably used in hunting large game, such as caribou, black bears and seals, along with less formidable prey, i.e. small fur bearers. These tools may have also been utilized as knives. A second set of projectile points exhibiting longer tangs in combination with more variable blade sizes, including some up to 90 mm. in length, may have seen similar use despite sometimes being much larger than members of the first group. A third group of projectile points, with blades 101-170 mm. long and tangs 300-378.8 mm. in length, were most likely mainly used in procuring and preparing big game animals. The latter tools occur only in interior Newfoundland which strongly associates them with caribou hunting.

The smaller items resemble historic references to arrow heads (G. Cartwright 1792: vol. 1:10; Marshall 1977: 240), while the largest variations resemble Shanawdithit's description of "deer spears" used by her people (Howley 1976:248). The largest of the middle-sized blades might suggest classification as deer spears, but their tangs' slight cross sections are more characteristic of arrow heads and they are difficult to label as either. The terms "arrow head" and "deer spear" also downplay iron projectile points' potential multi-functional nature, including possible butchering and other tasks in addition to hunting applications. In the hope of imposing a rigorous, objective classification scheme for Beothuk iron projectile points, the potentially ambiguous terms "arrow head" and "deer spear" are not utilized in this thesis. In their place the four types of projectile points are denoted by a numerical prefix, with sub-types designated by the appropriate number and specific letter, namely 1a, 1b, 2a, 2b, 2c, 3a, 3b, 3c and 4.

Projectile Point Typology

Type 1: Lanceolate Blades n=8

The eight type 1 projectile points are characterized by lanceolate, or non-shouldered, blades atop tangs that are square in cross section (Figures 4-6, 9; Plates 1-3, 6). These are divided into sub-types 1a (n=6) and 1b (n=2) on the basis of trends in their blade and tang shapes (Figures 13-23). Five of the 1a artifacts were found at Boyd's Cove, on the coast, while the sixth 1a item and the two 1b objects come from inland sites around Red Indian Lake. Their exact provenience is unknown due to their collection some time ago by untrained personnel. Two 1a preforms found on the coast and one from interior Newfoundland (Table 1) provide more tentative evidence for the suggested higher density of lanceolate, non-shouldered blades in littoral regions.

The Type 1 artifacts from interior Newfoundland cannot be clearly dated due to incomplete provenience data, but their area of origin, the northern end of Red Indian Lake, indicates significant reuse throughout prehistory and history, similar to Boyd's Cove. Conclusions introduced here suggest that the interior 1a artifact is probably contemporaneous with Boyd's Cove examples while sub-type 1b occurs slightly later.

Sub-type 1a: Lanceolate Blades

Tangs < 62.01 mm. Long and Square in Cross section n=6

1a blades are 49.8-62.7 mm. long, 9.4-18.6 mm. wide and 1.5-2.85 mm. thick, with a mean size of 56.97 x 13.27 x 2.16 mm. (Table 2; Figures 4-6, 9, 13-20; Plates 1-3, 6). They tend to have gently convex sides that attain their widest area around mid-length. Some, such as DiAp:3:2423 and DiAq:1:815 (Figures 5, 6; Plates 2, 3), with more sharply curved sides are referred to as possessing "pseudo-shoulders" in order to distinguish them from other 1a specimens clearly not possessing this trait.

The two intact 1a tangs are 44.6 and 62.0 mm. long, combining for a mean of 53.3 mm. that is slightly less than the average 1a blade length (56.97). The longest item, DiAp:3:18 from Boyd's Cove, has a blade length of 62.7 mm. and a tang length/blade length (TL/BL) ratio of 0.99/1 (Table 2; Figure 18). The other complete tang, NF 3174 from Red Indian Lake, has an incomplete blade that is 31.5 mm. long while missing a small distal portion (Table 2; Figures 4, 9, 18; Plates 1, 6). The blade's tip angle suggests the broken section is no more than 9.0 mm. long and that its tang is slightly longer than its complete blade would have been.

One 1a artifact, DiAp:3:2423, is completely missing its tang. The five remaining 1a tangs are 3.45-6.40 mm. wide and 1.00-4.90 mm. thick, for an average of 5.17 x 3.13 mm. (Table 2; Figures 21-23). 1a tangs tend to be somewhat thicker than 3.13 mm., however, as 80% (4/5) of the sample is 4.20-4.90 mm. thick (Table 2). All 1a tangs are square/rectangular in cross section and appear to be made from wrought iron nails. The absence of modification, through hammering, cutting or grinding, on their surface is an important distinction between them and the rest of the sample whose tangs portray evidence of reworking, as do their blades. The essentially unmodified 1a tangs suggest a basic level of ironworking that possibly reflects their antiquity relative to the rest of the sample.

Sub-type 1b: Lanceolate Blades:

Tangs Square in Cross Section and > 62.00 mm. Long n=2

As the title implies, differences in tang length are strong distinguishing criteria between 1a and 1b projectile points. The two 1b tangs measure 117.50 x 4.00 x 4.50 mm. and 122.60 x 2.70 x 2.55 mm., for a mean of 120.05 x 3.35 x 3.52 mm. that is much longer and narrower than the 1a average of 56.97 x 5.17 x 3.13 mm. (Table 2; Figures 9, 21-23; Plate 6). The 1b tangs are thinner than all 1a items, except one that is 1.00 mm. thick. This item seriously lowers the 1a average, considering that the remaining 1a tangs are 4.2-4.9 mm. thick (Table 2).

Analysis also revealed morphological differences between 1a and 1b blades. The intact 1b blade, NF 3172, has dimensions of 56.4 x 11.2 x 1.45 mm. and is within the range of 1a specimens, except for being thinner. The broken 1b blade, NF 3170, measures 20.85 x 7.2 x 0.80 mm. and corroborates NF 3172 in suggesting that 1b types are thinner than 1a. Both 1b blades are also narrow in comparison to 1a examples. NF 3170's implied combination of a very small blade with a much longer tang makes it additionally distinct from 1a items (Table 2; Figures 4, 5, 9; Plates 1, 2, 6).

The discrepancies in form between both classes of Type 1 projectile points may relate to functional factors and/or specific manufacturing criteria pertaining to where and when the artifacts were used. Sub-type 1a is more common at coastal sites which also appear to be older than many of the inland localities referred to here. Unfortunately the interior Type 1 artifacts, namely NF 3174 (1a), NF 3170 (1b) and NF 3172 (1b), can only be dated to the general historic period due to their collection by enthusiastic, but incautious nonprofessionals. As explained above, NF 3174, the individual 1a artifact from interior Newfoundland, might be older than the 1b examples and could reflect a more rudimentary level of ironworking. It may have been made on the coast before being carried into the interior via Beothuk seasonal migrations, or it might be an early iron projectile point manufactured at a lacustrine or riverine living area.

In addition to the preceding temporal factors, longer tangs may have provided the Beothuk with stronger, more durable projectile points that could better cope with the increased physical stress implicit in killing large amounts of caribou, and other animals, in interior Newfoundland.

Similarly, the trend towards narrower, thinner blades in the interior possibly represents the evolution of more efficient penetrating tools that required less effort in slaying animals. A functional study of stone projectile points suggests that suitably streamlined blades achieve this effect (Browne 1940:209).

It is important to reiterate that the different Type 1 attributes represent possible trends in Beothuk iron projectile points occurring over space and time. Sub-type 1a is characterized by a tang length/blade length (TL/BL) ratio of 0.99/1, while the comparable figure for 1b artifacts is 1.61/1 (Table 2; Figure 18). Similarly, the average 1a tang length/blade width ratio (TL/BW), 4.52/1, and its mean tang length/blade thickness (TL/BT1), 33.65/1, are much smaller than the corresponding 1b values of 13.76/1 (TL/BW) and 112.14/1 (TL/BT1), which reflect the trend towards long tangs from 1a to 1b (Figures 19, 20). The resulting hypothesis asserts that future 1a and 1b projectile points should be distinguishable from one another on the basis of blade/tang ratios, in addition to their actual measurements (Table 2; Figures 13-23).

Suggested Type 1 Manufacturing Procedure

The large sample of Beothuk iron from Boyd's Cove includes various uncompleted projectile points, i.e. preforms, that are indicative of the techniques used to manufacture them. This permits tentative reconstruction of the sub-type 1a manufacturing sequence which can then be extrapolated to 1b artifacts and others.

Wrought iron nails, including 234 complete items and 945 fragments, comprise the most popular raw material for recycling at Boyd's Cove. One hundred seventy five purposely modified nails/fragments indicate that items up to 20 cm. long were brought through a series of stages that usually began with the shaft being hammered flat 2-4 cm. below the head, until it could be broken off (Figure 24; Plate 15). This produced two distinct sections; (1) a modified nail fragment - retaining the head, and (2) a partially flattened shaft (Figures 24, 26, 27; Plates 2, 3, 14). Modified nail fragments could have provided iron substitutes for stone hide scrapers, while the shaft sections are more suitable for reworking into projectile points or awls.

Derivation of a finished projectile point apparently involved hammering the partially flattened nail shaft to bring about the approximate desired blade size. Grinding the preform on a stone abrader would then refine the blade and render an overall smooth finish on both surfaces, besides sharpening the cutting edges. A Boyd's Cove artifact, DiAp:3:1236, has the tip of its blade partially outlined, presumably through these techniques (Figure 5; Plate 2). Additional abrasion would probably have been employed to remove more of the unwanted iron until the pointed tip was satisfactorily formed.

The author's attempts at replicating Beothuk projectile points from wrought iron nails reveal that grinding the latter on suitable stones is an effective, albeit tiresome and time-consuming, method of altering the metal's shape. The major byproducts of this activity are copious amounts of fine black dust and obvious use-wear, in the form of grooves, on the surface of the abraders/grindstones. The presence of nine abraders from Boyd's Cove, 15 from Wigwam Brook, and 25 from other interior sites (Newfoundland Museum collection) attest to the Beothuk frequent grinding of iron. Some of the inland abraders are especially worn, with deep grooves up to two centimeters thick extending over much of their surface area, which implies a greater Beothuk reliance on ironworking at interior sites, compared to coastal areas where lithic tools were retained for a longer time.

Sub-type 1b projectile points were probably manufactured through a sequence similar to that proposed for 1a examples, except that the longer 1b tangs imply a need for additional modifications. These extra steps might increase the likelihood of failure and this potential risk in manufacturing 1b items could be reduced by using suitably-sized raw materials that would require minimal reworking, as in the case of 1a objects. Nails might be acceptable, except that their tapered shafts would often need alterations to achieve the more uniform 1b cross sections. Rod iron fragments, chain links and fishhooks would provide adequate amounts of metal for recycling, but they are usually round in cross section, unlike most projectile point tangs, which are square. It seems that additional hammering, cutting and grinding would be needed to derive the 1b tangs, no matter what raw materials were used.

Interior assemblages include a number of projectile point preforms that cannot be conclusively categorized within the typology due to their incomplete nature or surfaces marred through corrosion. Wigwam Brook (DfAw:1)'s possible Type 1 preforms include #s 76, 77 and 79 (Plate 4), whose square-edged tangs suggest they may have been made on small wrought nails. DfAw:1:75's slightly angular blade (Plate 4) is suggestive of Type 2 artifacts described in the next section of this thesis. DfAw:1:80, consisting of a slightly flattened area atop a tang that is square in cross section, and DfAw:1:78, portraying a similar morphology except for being round in end view, manifest primary stages within the manufacturing sequence which renders them inconclusive as to what type of projectile point they represent (Plate 4). From the museum collection, NF 3166 has a lanceolate blade with unsharpened edges and a broken distal end that are possibly attributable to problems experienced during manufacturing (Figure 9; Plate 6).

One preform, DiAq:1:815 (Figure 6; Plate 3; Table 3), from Inspector Island has a pseudo-shouldered blade similar to some Type 1 artifacts from Boyd's Cove, but indicates aberrant choices of modification technique and raw material. This blade, instead of being hammered out on one end of a long, narrow object, has been carved, possibly utilizing a chisel, file or axe, on the surface of a flat, rectangular piece of iron reminiscent of trap fragments mostly found at interior sites. The proto-blade has been partially undercut from its iron core through a sideways application of force, again probably using one of the aforementioned European tools. Once removed, the blade preform might have been subjected to grinding on a stone to refine its shape and cutting edges.

This suggested technique appears cumbersome compared to those proposed for Type 1 projectile points in which wrought iron nails were often utilized as raw materials. The absence of a complete tang on DiAq:1:815 could reflect manufacturing difficulties that should not be surprising if it is an example of Beothuk experimental ironworking. On the other hand, this artifact is morphologically similar to a Boyd's Cove item, Diap:3:2423, described earlier as having a pseudo-shouldered blade. Both of their flat, thin, relatively short tang areas are suggestive of Type 4 objects (Plate 10, Figure 11) which suggests that DiAq:1:815 and DiAp:3:2423 are endblade preforms.

Type 2 Projectile Points:

Shouldered Blades < 90.0 mm. Long n=17

Type 2 projectile points display greater morphological diversity than do Type 1 examples and, in manufacturing terms, are technologically more complex. These qualities may be partially attributable to some Type 2 tools having been made by Europeans as trade items or gifts for Beothuk people or other North American Natives. As explained in the historic background, this was a popular European tactic in their assimilation of the New Worlds's indigenous people. Other Type 2 items, especially some from inland sites, were probably made by Beothuk after their ironworking skills had improved, subsequent to the Type 1 period. This proposed increase in abilities is reflected in the more intricate design of Type 2 tools and the wider selection of European objects utilized as raw materials in their manufacture.

Type 2 blades' widest area, referred to as the shoulders, occurs near the base which adjoins to the distal end of the tang (Figures 4-7, 9; Plates 1-4, 6, 7). Six items are assigned to sub-type 2a, another eight are designated 2b examples, and three more with exceptionally large blades are placed in sub-type 2c (Tables 1, 2; Figures 13-23). As for Type 1, morphological trends within the Type 2 category appear to conform to geographical-temporal boundaries in which the artifacts are divided between coastal and inland sites, with the latter containing the more recent material. All the 2a items were found at Boyd's Cove and Inspector

Island, while the other Type 2 objects come from interior Newfoundland (Table 1). One Type 2 preform has been found on the coast and three more come from inland proveniences.

Sub-type 2a Projectile Points n=6

Tang Length < 76.31 mm.

Tang Length/Blade Length < 1.91:1

Tang Length/Blade Width < 4.95:1

Two 2a blades are intact in terms of length while five can be assessed for maximum width and thickness at the latter parameter. The complete blades, DiAp:3:784 and DiAp:3:1769, are 39.1 and 28.7 mm. long respectively, for an average value of 33.9 mm.. Longer 2a blades than these occur, however, as indicated by an incomplete artifact, DiAp:3:1565, whose remaining distal section is 49.0 mm. in length (Table 2; Figure 3; Plate 1). The 2a blades are 13.4–19.0 mm. wide and 1.3–3.45 mm. thick, for an average cross section of 14.86 x 2.09 mm. (n=5; Table 2).

The complete 2a blades are shorter than the smallest 1a example (49.8 mm.) and the complete 1b item (56.4 mm.). The 2a mean blade width, 14.86 mm., is larger than 1a's (13.27 mm.) and 1b's (9.2 mm.). The narrowest 2a blade (13.4 mm.) is wider than four of the six 1a artifacts and all 1b items. The 2a average blade thickness, 2.09 mm., is below 1a's (2.16 mm.) and larger than 1b's (1.22 mm.). One 2a blade is under 1.5 mm. thick, the 1a minimum, and one 1b blade is thinner than 1.30 mm., the smallest 2a value (Table 2;

Figures 13-15).

Intact 2a tangs are 42.8-76.3 mm. long and average 61.57 mm. (n=4), compared to the contemporaneous 1a mean of 53.3 mm.. Two 2a tangs are longer than 62.0 mm., the 1a maximum, one 2a item is shorter than 44.6 mm., the 1a minimum, and the other two 2a examples are within the range of 1a values (Table 2; Figures 18-22). All 2a tangs are much shorter than the minimum 1b length of 117.5 mm.. The 2a tangs are square in cross section, measuring 4.30-5.50 mm. x 4.05-5.00 mm., with a mean of 4.77 x 4.40 mm. (Table 2; Figure 23). This is smaller than 1a's average width, 5.17 mm., but larger than the 1a mean thickness, 3.13 mm., although the latter statistic is somewhat inaccurate due to one very thin tang measuring 1.00 mm. (Table 2; Figure 23). Barring this artifact, 1a tangs are 4.20-4.9 mm. thick, with a mean of 4.45 mm. that is very similar to 2a's. The 2a cross sections are generally larger than 1b examples. whose maximum is 4.00 x 4.50 mm. (Table 2; Figures 21-23).

Concerning their tang length/blade length (TL/BL) relationship, 2a projectile points are more similar to 1b artifacts than they are to 1a (Table 2; Figure 18). The 2a average TL/BL ratio is 1.87/1, with 1.85/1, its lowest individual value, being larger than the solitary 1b figure of 1.61/1 and 1a's, 0.99/1 (Table 2). The 1a value clearly reflects its large blade and proportionally short tang, compared to 1b and 2a objects.

On the question of tang length, relative to blade width, 1a and 2a artifacts closely resemble each other, as indicated by TL/BW average ratios of 4.52/1 (1a) and 4.02/1 (2a), compared to the 1b figure of 13.76/1 (Table 2; Figure 19). 1a and 2a tang length/blade thickness values are also quite similar, with TL/BT1 means of 33.65/1 (1a) and 33.74/1 (2a), that are very different from the 112.14/1 describing 1b (Figure 20; Table 2)). These statistics reflect 1b's extremely long tangs and narrower, thinner blades, compared to 1a and 2a examples. Similarly, these data reflect the reported increases among 2a tang lengths and blade widths, occurring along with decreased blade thickness, relative to 1a.

As mentioned earlier, 2a and 1a artifacts from Boyd's Cove fall within the A.D. 1650-1720 period, which, in view of their significant morphological differences, raises questions pertaining to manufacture. The shoulder areas of 2a blades and their longer tangs imply a need for additional working than would be required for 1a's lanceolate cutting areas and basically unmodified haft sections. Boyd's Cove iron artifacts were examined by a material culture specialist, John Light, who subsequently remarked that some, referred to here as sub-type 2a, exemplify too high a quality to have been made by Beothuk or other relatively late entrants into this technology (John Light 1987:personal communication). Documentary information suggests that in industrialized cultures ironworking skills tended to be acquired slowly and were difficult to teach to other people.

Until the twentieth century, smelting and forging of iron were largely dependant on intuitive decisions by artisans rather than strict adherence to formula. Craftsmen relied on their experience, acquired through long apprenticeship and extensive practice, to bring iron successfully through numerous changes in shape, texture and physical constitution to the desired end products (Schenck and Knox 1986:27; Vlach 1981:17; Weygers 1973:15).

The suggestion that some Boyd's Cove iron was reworked by artisans more experienced than the Beothuk were by A.D. 1650-1720 is supported by laboratory testing of artifacts, indicating that a number of recycled items were hot-worked under conditions only attainable in a forge (Chapter 4; Appendix C:242). The forged items consist of modified nails and a projectile point preform which, although presumably European-worked, are clearly designed for trade with Natives. The items' status as unfinished tools also suggests that Europeans reworked these items near Boyd's Cove (Appendix C:244).

The evidence for European-worked nails at Boyd's Cove is contrary to the theory that the Beothuk were self-sufficient in the production of iron tools at this site (Pastore 1989:57, 66). If Europeans were forging iron in the Boyd's Cove area for trade purposes, possibly with Montagnais or Beothuk people, Natives might have learned important information about how to manufacture projectile points themselves. It is possible that the shouldered 2a blades from Boyd's Cove provided models for Beothuk tool-makers to emulate and the 1a items ound there represent their early attempts at making iron projectile points. This theory presumes that the production of shouldered projectile points implies a level of skill generally not achievable by Beothuk people throughout the seventeenth century A.D.. The writer's first hand experience in replicating iron projectile points indicates that lanceolate blades are obtainable after only a few hours trial and error, involving the destruction of three or four nails. Derivation of the blade shoulder areas is a much more difficult matter.

A Boyd's Cove preform, DiAp:3:2422, interpreted as a Type 2 artifact because of its shouldered blade, suggests that the Beothuk may have at least attempted to make such tools at this site. This is the only clear evidence for a shouldered preform at Boyd's Cove and in view of metallurgical data indicating the presence of European-modified preforms here, it might be another example of the latter. It is suggested that the Beothuk's lack of experience in ironworking at this time would preclude the manufacture of such tools. DiAp:3:2422 implies a similar production sequence to Type 1 items in which the tang was completed before the blade, which was gradually finished, starting at its proximal end. DiAp:3:2422's crude tip appears to be awaiting terminal grinding to refine its point.

While these data do not necessarily mean that the Beothuk obtained modified iron directly from Europeans, they strongly imply such contact, or possible interactions with other Natives. Such a link between the Beothuk and the Labrador-based Montagnais Indians has been proposed elsewhere (Pastore 1984:101-102). Other evidence indicating possible cooperation between the Beothuk and foreign people includes the presence of Normandy stoneware in Beothuk housepits at Boyd's Cove (Pastore 1984:101). A large number of European-made glass trade beads found at Beothuk sites also imply the latter people's peaceful contact with other groups. On the coast, Boyd's Cove has 677 trade beads and Inspector Island yielded three. From interior Newfoundland, Pope's Point contained 41 trade beads, Red Indian Falls III (DfBb:3) had 1030, and South Exploits (DfAw:7) produced 14 (Newfoundland Museum collection). The Boyd's Cove beads were classified pertaining to Kidd's criteria (1972), with the following results; House 1: IIa12 (white) 456, IIa56 (blue) 79; House 3: IIa12 (white) 89, IIa56 (blue) 36; House 4: IIa12 (white) 7, IIa56 (blue) 10. In total there are 552 white beads and 125 blue beads (Pastore 1989:personal communication).

The possible Beothuk-European peaceful contact in Notre Dame Bay is even more plausible in view of a recent reexamination of Boyd's Cove's faunal material, which indicates a high proportion of fur bearing animals compared to other large samples from Indian Point and Wigwam Point. This strongly suggests that the Beothuk procured pelts for exchange at this coastal site (Peter Rowley-Conway 1989:

personal communication).

The 2a example, DiAq:1:792, from Inspector Island is tentatively dated at post-A.D. 1720 (Pastore 1989:personal communication), suggesting that it is more recent than Boyd's Cove artifacts (Figure 6; Plate 3). It may reflect the evolution of Beothuk ironworking to the level at which European-manufactured goods could be closely replicated, or it could be a fragment of a trade object. Unfortunately, due to corrosion, most of the other Inspector Island artifacts cannot be satisfactorily classified within this typology, which precludes interpreting the preferred projectile point styles at this site.

The argument for increasingly complicated Beothuk ironworking at Inspector Island, compared to Boyd's Cove, finds support in the projectile point preform, DiAq:1:815, indicating recycling techniques not practiced at the latter site. It also suggests the use of a raw material that is potentially more difficult to modify than wrought iron nails, the predominant choice at Boyd's Cove. These conditions foreshadow activities discernible in sub-types 2b, 2c, 3a, 3b and Type 4, representing the continued evolution of Beothuk ironworking throughout the eighteenth and early nineteenth centuries A.D., mostly in interior Newfoundland.

<u>Sub-type 2b Projectile Points n=8</u>

<u>Includes Some Longer Tangs than 2a</u>

<u>TL:BL > 1.90</u>

<u>TL:BW > 4.94:1</u>

Four 2b blades are complete in terms of length, eight are referred to concerning width, and six are assessed for thickness (Tables 1, 2; Figures 6, 7, 9; Plates 3, 4, 6, 7). Blade lengths are 26.5-53.0 mm., with an average of 34.82 that is very close to the 2a mean (33.9). Two, of four, complete 2b blades are shorter than 28.7 mm., the minimum 2a length (Ta le 2; Figure 13), and one 2b blade is longer than 49.0 mm., the 2a maximum. The 2b blades are 6.4-18.2 mm. wide and 1.1-3.04 mm. thick, with a mean cross section of 12.37 x 2.00 mm. that is less than the indicated 2a average of 14.86 x 2.09 mm.. Five of the eight 2b blades are narrower than 13.4 mm., the smallest 2a width, and one 2b example is thinner than 1.3 mm., the lowest 2a thickness. Two other 2b items are only slightly thicker than this (Table 2). On the average, 2b blades are smaller along all parameters than 1a's mean of 56.97 x 13.27 x 2.16 mm., and shorter than 1b's, 56.4 x 9.2 x 1.22 mm. (Figures 13-15).

As suggested by the heading for this section, long tangs are the strongest distinguishing attributes between 2a and 2b artifacts. The eight 2b tangs are 56.35-124.3 mm. long, with a mean value of 90.44 mm., compared to 2a's, 61.57 mm.. Six 2b tangs are longer than 76.3 mm., the maximum 2a figure (Table 2; Figures 19, 20). The 2b tangs are 2.00-5.25 mm. wide and 1.80-5.20 mm. thick, for a mean of 4.23 x 3.78 mm. that is smaller than the 2a average of 4.77 x 4.40 mm. (Table 2; Figure 23). These differences in cross section averages reflect the fact that three 2b tangs are less than 4.3 mm. wide, the narrowest 2a value, and five 2b haft elements are thinner than 4.05 mm., the lowest 2a thickness (Table 2; Figure 23).

2b tangs are also proportionally larger, with respect to their blades, than are 2a varieties. The average 2a TL/BL value of 1.87/1 is significantly lower than 2b's which, at 2.89/1, includes all four members above the 2a maximum of 1.90/1 (Table 2; Figure 18). The 2a TL/BW mean, 4.02/1, is noticeably below 2b's, 7.65/1, and the 2a TL/BT1 average of 33.74/1 is similarly smaller than 2b's, at 47.05/1 (Table 2; Figures 19, 20).

Sub-type 2b tangs also tend to be longer and have smaller cross sections than 1a examples. Seven, of eight, 2b tangs are longer than 62.0 mm., the 1a maximum, and three 1a tangs are wider than 5.25 mm., the largest 2b value. One 2b tang is narrower than 3.45 mm., the minimum 1a width. The 2b tangs are typically thinner than 1a specimens, except for IP-b (2b) that is slightly thicker than 1a items and DiAp:3:2668 (1a) that is extremely slight. One 2b tang is longer than 122.6 mm., the 1b maximum, while seven 2b tangs are shorter than 117.5 mm., the minimum 1b width. One 2b tang is less than 2.70 mm. wide and 2.55 mm. thick, the 1b minimums (Table 2; Figures 21-23). 2b tangs manifest a range of sizes, including some that closely approximate other sub-types and others that are more distinct (Figures 21-23) and a larger sample would be desirable to adequately assess the relationship between the different classes suggested here.

Four 2b tangs have square cross sections, while two are round and two are irregular. The irregular items are square in isolated areas and may have originally been this shape all over, before being disfigured through corrosion, or they may have been left awaiting terminal modifications that would have given them a more homogeneous, quadrangular finish. The two tangs with round cross sections may be attributable to the use of objects other than wrought iron nails, such as fishhooks and chain links, as raw materials for recycling. Projectile points with narrow, thin blades, NF 3170 for example (Figure 9; Plate 6), could have been recycled from fishhooks, whose typically small breadth. compared to nails, would have mitigated against the production of larger cutting areas. A Boyd's Cove preform, DiAp: 3:1437, with a round (cross section) tang, also appears to be a modified fishhook (Figure 5; Plate 2) and a similar item comes from Pope's Point (Figure 10-k). Similarly-worked chain links in the Newfoundland Museum collection may have been more difficult to modify because of their bigger cross sections. Chain links are mostly concentrated within interior Newfoundland which implies they were often obtained from furriers' traps.

The morphological similarities shared by 2a and 2b items suggest that some of the latter projectile points may also have been made by European artisans or that they represent the continued evolution of Beothuk ironworking. A possible European-made 2b projectile point, from the Sandy Lake area, has a finely-detailed tang with gently convex sides and a square cross section that tapers on each end. Its symmetrical blade contracts evenly along concave edges to the haft element (Figure 9; Plate 6). The tang is especially distinct from most others in the sample that tend to be more uniform in cross section or proximally tapered. If the Sandy Lake artifact is European-made, it was probably obtained before the Beothuk began living permanently in interior Newfoundland around the latter eighteenth and early nineteenth centuries. This shift in settlement patterns, apparently directed at reducing contact with Europeans, would also have effectively distanced the Beothuk from the latter's goods, although relatively late European attempts at friendly contact often included various gifts for the Natives.

It is also possible that some, or all, 2b artifacts postdate their 2a counterparts and reflect the continued evolution of Beothuk ironworking that resulted in higher quality products than were previously achievable. At least three diagnostic 2b preforms are present in the sample and some of the three Type 1 preforms, as well as some the unclassifiable fragments, may actually be 2b items in the very early stages of manufacture (Table 1). The 2b preforms typically contain a finished tang and an incomplete blade which indicates that the latter section was worked on after the haft element. The best examples of 2b preforms, DfAw:1:75 (Plate 4) and Locke-3 (Plate 7), illustrate this process. The Locke example mainly requires work to the distal tip of the blade to finish it and appears nearer completion than does the Wigwam Brook artifact.

Similar to Type 1, production of 2b projectile points would be simplified through the use of suitably-sized raw materials that would require a minimum of reworking, through hammering, cutting and/or grinding, to render the desired shape. The relatively small 2b blades and their slight, albeit elongate, tangs imply that preferable sources of iron would have compact cross sections while being of sufficient length. The available sample indicates that nails, fish-hooks, chain links and small-diameter rod iron generally filled these criteria. More formidible European objects, including animal traps and axes, seem to have been reserved for the manufacture of projectile points larger than Types 1, 2a and 2b.

<u>Sub-type 2c Projectile Points n=3</u>

<u>Blades > 72.99 mm. Long</u>

<u>Tangs Similar to Sub-types 2b and 1b</u>

Sub-type 2c consists of three projectile points whose shouldered blades are larger than other Type 2 examples while their tangs are relatively unchanged (Tables 1, 2; Figures 9, 10, 13-23; Plates 1-4, 6, 7). The two complete 2c blades are 73.0 and 83.95 mm. long, while the third member of this set, DfAw:1:217, is a preform spanning 89.27 mm. (Table 2). Similar to other uncompleted examples, this blade requires work on its distal end which restricts its significance here primarily to width and thickness. DfAw:1:217's blade measures 25.6 x 3.1 mm. in cross section, while the complete example from Pope's Point is 15.2 mm. wide. The thickness of the Pope's Point item is not available. Artifact NF 3171 is severely corroded in the proximal blade area and its cross section dimensions of 11.0 x 1.10 mm. cannot be accepted as accurate (Figure 9; Plate 6). The 2c blade values effectively portray the great size difference between them and other Type 2 examples (Table 2; Figure 13).

The Pope's Point artifact has the only intact 2c tang, which, at 110.4 mm. long, is shorter than the largest 2b example, measuring 124.3 mm. (Table 2; Figures 18-22). The 2c item is slightly bent and was originally longer than 110.4 mm., although its length is probably not missing any more than ten millimeters (Figure 10). DfAw:1:217's broken tang is 10.40 mm. long, while NF 3171's tang, measuring 60.9 x 3.2 x 1.85 mm., is also incomplete and probably had a larger cross section before suffering a significant loss of iron through corrosion.

2c tangs' cross section measurements are within the upper range of figures encompassing Types 1, 2a and 2b. The

2c items are 3.21-5.70 mm. wide, with an average of 4.04 mm. that is larger than 1b's (3.35) while being smaller than 1a's (5.17), 2a's (4.77) and 2b's (4.23) (Table 2; Figure 23). DfAw:1:217, the only accessible 2c tang thickness, measures 3.75 mm. which is greater than 1a's mean (3.13) and 1b's (3.52), while being smaller than the 2a average (4.40 mm.) and the 2b value (3.78 mm.). The 2c tang is actually thinner than all 1a artifacts except for one very small value (Table 2; Figures 21-23).

Although 2c tangs are similar in size to 1b and 2b examples, 2c tangs are proportionally smaller, relative to their large blades (Table 2). The representative 2c TL/BL ratio, 1.52/1, is below 2b's (2.89/1) and 1b's (1.61/1) (Table 2; Figure 18). The 2c TL/BL ratio is likewise smaller than 2a's average (1.87/1), indicating that the latter's tangs are much longer than their blades, while this relationship is less pronounced in the former (Figure 18). The 2c TL/BW ratio, 7.27/1, is below 2b's (7.65/1) and 1b's (13.76/1), but greater than 2a's (4.02/1) (Table 2; Figure 19). The 2a TL/BW value is undoubtedly a reflection of their short tangs and concomitant wide blades, relative to much of the sample. Tang length/blade thickness comparisons are not available for 2c artifacts.

The Pope's Point artifact has been cited elsewhere as a possible European trade item (Devereux 1965:14) and the author was able to compare its available measurements with a sample of French gooc., from a Micmac burial at the Hopps site (BkCp:1), Nova Scotia. Nearly 200 European-made iron projectile points have significantly longer, wider blades and larger tang cross sections than does Pope's Point-1 (Table 2; Appendix B). It is useful to note here that the Wigwam Brook preform, DfAw:1:217, and 14 similar artifacts recently obtained by the Newfoundland Museum indicate that the Beothuk produced 2c projectile points at interior sites. More metallurgical and morphological tests are necessary to determine the ultimate source of the Pope's Point implement.

Type 3: Shouldered Blades Over 100.00 mm. Long n=5

This category, consisting of the largest Beothuk iron projectile points found to date, is split into three sub-types; 3a, 3b and 3c. The Newfoundland Museum has three additional 3a projectile points and 15 preforms which were acquired subsequent to this research. All Type 3 artifacts come from interior Newfoundland, a distribution that is significant concerning differences in their implied functions, manufacturing procedures and time of use, relative to Types 1 and 2. One badly corroded, possible Type 3 item has been reported at the Beaches site, Bonavista Bay (DeAk:1), but the available data suggest this was not a finished tool (Devereux 1969:plate 3).

Sub-type 3a: Tangs Square in Cross-section n=3

These projectile points, recovered at sites around Red Indian Lake and the Exploits River, have blades 101.0-170.0

mm. long with an average length of 128.10 mm. (Tables 1, 2). Blades are 17.1-30.4 mm. wide and 2.7-5.8 mm. thick, for a mean cross section of 21.87 x 3.73 mm. that is much bigger than any of the previously described projectile points' (Table 2; Figures 8, 13-15; Plate 5). A 2c preform, DfAw:1: 217, has a comparable blade cross section, 25.6 x 3.1 mm., but probably would be smaller if it had been finished.

The two intact 3a tangs measure 300.5 and 376.8 mm. in length, which makes them much longer than any others in this sample. They are also proportionally longer, relative to their blades, than any of the other examples except for two 2b members, NF 3169 and IP-b (Table 2; Figures 7, 9, 18-22). The 3a TL/BL ratios are 2.98/1 and 3.33/1, compared to the 2b values of 3.66/1 and 3.96/1 (Figure 18). The three 3a tangs are similarly large in cross section, ranging from 6.20 to 8.20 mm. wide and 5.60 to 8.20 mm. thick, for an average of 7.08 x 6.77 mm. (Tables 1, 2; Figure 23) A 1a preform, DiAp:3:1168, has a 6.4 mm. wide tang, but probably would have been narrower in a finished state. All the 3a tangs are square in cross section.

A total of six 3a projectile points, along with 15 preforms and 15 blanks/trap parts, recently acquired by the Newfoundland Museum show that the Beothuk recycled these tools from European fur traps in interior Newfoundland (Plates 5, 17, 18). The suggested manufacturing process is similar to that implied by Types 1 and 2 except that new sources of raw materials, fur traps, were utilized. Trap jaws, bases and springs, with rectangular cross sections sometimes over 10 mm. thick, were initially hammered flat in preparation for formation of the tang. The next step apparently involved cutting away excess iron, probably using an axe and hammer, resulting in the rough tang outline. Many 3a proto-tangs have significant amounts of plastic deformation, i.e. lipping, indentations, etc., over their surfaces, indicating they were hammered and cut in their early stages. Tangs were most likely finished by grinding on stone abraders to render a smooth, even surface.

As for Types 1 and 2, the initial stage of 3a blade production seems to consist of hammering one end of the iron core to a thinner, wider cross section than the tang. Additional cutting, hammering and grinding produced a triangular blade tapering in width and thickness from the shoulders towards the distal tip. The final steps of blade formation most likely involved grinding the tip and edges to a sharp finish.

The successful manufacture of a 3a projectile point implies numerous applications of cutting, hammering and grinding to a piece of iron as it was gradually remodelled into its new shape. Tang production would have been especially problematic, considering that these sections are often only half as wide as the trap spring, jaw or basal fragment used as a raw material. Completion of 3a projectile points might have been facilitated by heat treating and many iron artifacts from interior sites were recovered from hearths which might reflect attempts at this procedure (Locke 1975a:1). However, clear identification of hot worked iron requires laboratory examination similar to that undertaken with Boyd's Cove objects. The Beothuk may have incorporated hot working techniques that they had previously learned at Boyd's Cove, and possibly other sites, in their subsequent recycling of iron.

The longer, more elaborate 3a manufacturing sequences suggest a higher chance of failure than for Types 1 and 2, implying that the manufacturers of the larger projectile points were more accomplished ironworkers. The 3a artifacts may represent the ultimate evolution of Beothuk ironworking abilities that started with 1a projectile points, characterized by minimally worked blades and tangs that are unmodified nail shafts. Some long-tanged Type 2 projectile points are proportionally very similar to 3a examples (Table 2), but the Type 2 objects' smaller size implies they could be obtained with a much reduced amount of labour. The 3a items are also more complicated in terms of raw material, fur traps, that would have been more difficult to recycle than the wrought iron nails preferred at early sites.

Sub-type 3a has not been satisfactorily dated due to incomplete provenience data, but it appears to include relatively recent Beothuk tools, from ca. the late eighteenth-early nineteenth centuries A.D.. Fifteen trap parts were found at Boyd's Cove, but none indicates signs of recycling like that portrayed in Plates 18 and 19 and by similar fragments, mostly from interior Newfoundland. Inspector Island (DiAq:1), a Beothuk occupation subsequent to Boyd's Cove, contained a preform, DiAq:1:815, made from a trap, axe or other European object rarely modified at the older site. The Inspector Island artifact may be a prelude to the Beothuk iron industry characterizing more recent inland sites.

If 3a tools posed a significant challenge to Beothuk artisans, completed examples might have been highly-prized possessions. The Beothuk obviously selected the large 3a design over smaller alternatives, considering that the latter were sometimes fashioned from the same raw materials as were bigger items (Plate 19). The 3a variations may represent more efficient hunting tools, compared to Types 1 and 2, that evolved in conjunction with the increased importance of caribou to late-period Beothuk. The long 3a blades appear well-designed for penetrating large animals' body cavities while the elongated 3a tangs could be securely hafted to strong shafts which would increase leverage and the force behind the hunter's thrust. This would have been an important factor in killing caribou at close quarters, such as from canoes in Red Indian Lake and the Exploits River or on land from behind the cover of deer fences or other blinds. These traits may represent improvements to sub-type 2c, presuming that the 3a design is better suited for repeatedly withstanding the significant physical stress to be expected in slaughtering caribou and other available animals. This would suggest that the evolution of Type 3 projectile points was conditioned by functional demands as well as technical factors relating to ironworking.

Types 1 and 2 were probably more multi-functional than 3a, considering that the smaller projectile points could have been used in hunting big and small game, in addition to being possibly utilized as knives and scrapers. Type 3a projectile points are implicitly too large, especially when hafted, for use in procuring smaller animals and probably were too cumbersome to be effectively used as knives and scrapers.

Sub-type 3b: Blades Similar to 3a

Tangs Round in Cross Section n=1

This division of Type 3 projectile points, comprised of the largest Indian Point example, has a blade measuring 126.4 x 20.9 mm. (no available thickness) (Table 2: Figures 7, 13). Its tang, which is broken off just below the distal end, is round in cross section with a diameter of 5.35 mm. that is significantly less than most 3a cross sections, except for one with a thickness of 5.60 mm. (Tables 1, 2; Figure 21-23).

The 3b artifact is also significant because of its resemblance to European-manufactured trade goods found in Micmac graves at the Hopps site (BkCp:1), Nova Scotia (Ruth Whitehead 1988:personal communication). The author's examination of the Micmac artifacts at the Nova Scotia Museum corroborates this proposed morphological connection (Appendix B; Plate 11; Figure 7), although more extensive tests, including metallurgical analyses, are necessary to determine the Indian Point item's ultimate source.

The Hopps site artifacts have been dated to the A.D. 1570-1620 interval, while the Indian Point item is less firmly fixed in time. This timespan could be correct for the 3b item's deposition at Indian Point, although two smaller 2b endblades from separate areas of the site (Devereux 1970:21, 22, 26) suggest a later use, probably in the eighteenth century A.D.. As mentioned earlier, Indian Point appears to have been regularly occupied since prehistory and the Beothuk might have procured this long-bladed object from Europeans, Micmac, Montagnais or others, through trade, accidental discovery or theft. If the Beothuk had access to the 3b artifact around the time suggested by the Nova Scotia dates, it could have provided another useful model for tool-makers to imitate as they learned the rudiments of ironworking.

Sub-type 3c: Blades Similar to 3a and 3b and Manufactured by British Navy n=1

These projectile points were made in A.D. 1820 on board Captain David Buchan's ship in the Bay of Exploits as gifts for Beothuk people whom Buchan and his men hoped to meet as they explored the Newfoundland interior (Howley 1976:341). The 3c blade clearly bears the "broad arrow" trademark of the British military upon its surface (Figure 11; Plate 9). The tools' late deposition implies that they could not have had much influence over the Beothuk iron industry and are mostly important here in a comparative sense.

The individual 3c item was found somewhere along the Exploits River and subsequently donated to the Newfoundland Museum. It has a large blade, measuring 120.00 x 23.00 x 3.80 mm., that is similar to the 3a items, except for being much thinner (Table 2; Figures 13-15). It has a fairly uniform thickness, unlike most Beothuk projectile points that become progressively thinner from their base towards the distal tip. Its widest portion occurs near its mid-length, also unlike other Type 3 blades, and its sides are more gently rounded (Figure 11; Plate 9).

The 3c tang is roughly square in cross section and its relatively small dimensions, 4.00 x 3.40 mm., resemble Type 2 haft elements moreso than Type 3 versions (Table 2: Figure 23). It corroborates a reported European practice of using a minimum amount of material in the production of trade goods/gifts for the New World Native market (Fitzgerald and Ramsden 1988:159). The tang is 41.80 mm. long and may be broken, judging from its jagged, proximal end.

Type 4 Projectile Points: Toggling Harpoons

Toggling harpoons are rarely associated with the Beothuk; none have ever been found through archaeology, although Shanawdithit describes such iron-tipped tools in references to her people's material culture (Howley 1976: 248). The artifact referred to here (Newfoundland Accession No.:VIIIA-71) was taken some time ago from a Beothuk cave burial near Comfort Cove and is now in storage at the Newfoundland Museum (Figure 11; Plate 10).

The harpoon head consists of a finely-worked iron endblade with its stem firmly set, and lashed with animal sinew, into a bone socket. The triangular blade is 23.5 mm. long and 41.9 mm. across the base. It is roughly symmetrical, measuring 31.9 x 30.4 mm. down its two sides (Table 2; Figure 13; Plate 10). Its uniform thickness, 1.5 mm., and bifacially bevelled, sharp edges indicate high quality workmanship. Dorso-ventral striations are clear evidence that the endblade was bifacially ground to its desired thickness on a stone abrader in the terminal stages of production. The marks on one surface are approximately perpendicular to those on the opposite face. The blade edges were also ground to their final form as indicated by striation marks on their much smaller surface areas.

This endblade's tang is mostly embedded inside the bone socket, but x-ray analysis revealed it is rectangular in shape (Pastore 1989:personal communication). It is 12.0 mm. wide, which is much broader than others in the sample, that are up to a maximum of 8.20 mm. (Table 2). The tang thickness, 1.5 mm., is unchanged from the blade and differs from most Beothuk-produced projectile points whose blades become gradually thicker towards their proximal end that joins with the haft section (Table 2). The endblade's overall thin cross section implies that it was derived from a fragment of sheet iron, such as is available in trap pans. This very distinct morphology suggests production techniques unlike those implied by Types 1-3, possibly including increased grinding.

A Type 4 preform, DfAw:7:95 (Figure 11), from the Newfoundland Museum collection, was found by a private excavator at the South Exploits site (DfAw:7), on the Exploits River. This object, which appears to have been cut from a trap pan, is sufficiently corroded to mask possible surface evidence of grinding like that on the complete endblade described above. Its asymmetry and lack of bevelled edges indicate it is a preform. It is slightly larger than the finished endblade, but would be smaller in completed form due to grinding on its edges (Tables 2, 3).

Beothuk Iron Awls and Fish Spears

Awls are grouped with fish spears here because of their morphological similarities and comparable manufacturing processes, including the use of European fishhooks and wrought iron nails as raw materials. Two awls made from straightened fishhooks were found at Boyd's Cove, two similar artifacts are in the Newfoundland Museum's Red Indian Lake collection and two were reported at Indian Point (Devereux 1970:22). The barbs of the Boyd's Cove examples are absent and were probably removed through grinding to facilitate the modified fishhooks' use as needles or perforators. The Boyd's Cove and Museum specimens retain their slightly flattened proximal ends where the fishing line would have been attached, which suggests that the Beothuk may have tied cord or other material to them (Figure 12; Plates 12, 13). Indian Point produced two straightened fishhooks which, by retaining their distal barbs, suggest use as fish spears. One of them with wood still adhering to its shaft implies evidence of its former hafting (Figure 12)(Devereux 1970:29). Historical documentation attests to the use of recycled fishhooks in such a manner (Hewson 1984:19, 40).

Appropriately shaped nail fragments may also have been used as awls by the Beothuk. Plate 15 (a), illustrates a wrought iron nail split into a truncated (upper) fragment and its accompanying (headless) shaft section that suggests an acceptable awl or projectile point blank. There are 130 nail shaft fragments retaining their pointed ends from Boyd's Cove, along with 66 similar items from Inspector Island, six from the Beaches, five from Wigwam Brook and a few in the Newfoundland Museum collection, implying a ready supply of awl/projectile point preforms.

Some nail shafts were subjected to further modification in order to produce suitable awls. An Inspector Island artifact was worked distally to derive a sharply pointed tip and proximally to achieve a flat, square end (Figure 12; Plate 12). Its square cross section is indicative of a wrought iron nail. Similar tools from Boyd's Cove had been hammered to produce less-tapered shafts (Figure 24:#113; Plate 12).

Pope's Point produced nine items classified as awls, two of which were made from rod iron while the other seven were made from plate iron (Devereux 1965:13). Similar plate iron awls from other interior sites are in the Newfoundland Museum collection (Figure 12). The rod iron awls could have been made from straightened chain links, fishhooks or stock rod iron. Plate iron awls might have been made from trap pans and splinters of cast iron objects, such as cooking pots or kettles. Cast iron is unsuitable for other recycling because of its brittle nature due to a high impurity content, which produces weak points prone to fracturing (Frurip et al. 1983:12; Hodges 1981:89). The Aspen Island awl's (DfAw:5:51; Figure 12) edges indicate having been cut by an axe and hammer, while the Slaughter Island example

(DfBa:5:7) is too corroded to contain such information.

Other Recycled Tools

Modified nail fragments, which are mentioned earlier in the description of Type 1 projectile point manufacture, have wide distal ends that are very suggestive of stone hide scrapers' working edges. These nail sections, like iron projectile points, could have been ground on stone abraders to derive sharp working edges. The previously mentioned Hopps sample (BkCp:1) from Nova Scotia contains a large spike with approximately the bottom 25% of its shaft hammered flat, producing a complete version of a modified nail fragment (Appendix B). A researcher at the Nova Scotia Museum noted the resemblance of this object to hafted stone hide scrapers (Whitehead 1988:personal communication).

No complete nails exemplifying similar reworking have yet been found in Newfoundland, but ten Boyd's Cove modified nail fragments display long shaft sections that are reminiscent of the Hopps specimen (Plate 14). These are probably the best candidates for use as hide scrapers because their length implies that the necessary leverage for scraping could be supplied without recourse to a wooden or bone handle, as stone examples and shorter modified nail fragments would require (Plate 14). The shorter examples imply no preparation of the distal working edge while the longer items are typically flatter and may have once been quite sharp before suffering damage through corrosion. If the

Beothuk used modified nail fragments as hide scrapers, this would represent an efficient recycling industry in which the amount of wastage/debitage was minimized.

Anomalous Modified Iron

A few Boyd's Cove artifacts display reworking unlike the more common methods pertaining to projectile points, awls and fish spears. Plate 16 (b and c) shows two wrought nails that are split/cut longitudinally rather than transversely as seems to the case for most modified nails. Item 16c, DiAp:3:718, represents unique treatment of a modified nail fragment in which the flattened shaft area has been partially cut lengthwise, possibly in an attempt to narrow it. In metallographic terms the object indicates significant plastic deformation in being sharply twisted, resulting in its innermost layers being turned out to the surface. These alterations may be attributable to this nail having been heated to enhance reworking. It is the only incidence of a modified nail fragment being reused in this manner and the reasons for these modifications are unclear, unless they reflect Beothuk experimentation in ironworking.

Another nail, DiAp:3:1532 (Plate 16 b), displays similar treatment to DiAp:3:718, although with some differences. The former is a complete specimen, the head of which has been bifacially hammered flat and bifacially cut longitudinally, probably using an axe. The fissure is slightly off-center, proceeding for almost three centimeters down the shaft. The purpose of these alterations is unclear except for reducing the nail's width in its widest area, which is around the head. No other nails indicate this sort of modification, which raises the possibility that it is another product of Beothuk experimental ironworking.

The third artifact shown in Plate 16, DiAp:3:80, is a modified nail shaft with its two ends hammered flat in directions perpendicular to each other. This is another unique recycling product and it could represent a projectile point preform beset with manufacturing problems, such as cracking or breaking, as its blade was hammered out on one of the ends. An enterprising artisan may then have tried to form the blade on the opposite end of the shaft as a means of finishing the projectile point and saving a valuable piece of wrought iron. The second effort at completing the tool may have also ended in failure which would account for its present condition. Alternatively, it could be another product of Beothuk experimentation or someone's apprenticeship in ironworking.

Discussion: Beothuk Iron Tools

This section interprets Beothuk iron tools in terms of implied functions relative to the Little Passage items they replaced and perceived historic developments. Beothuk iron projectile points are typically larger than their Little Passage counterparts, including triangular bifaces. A previous analysis of 171 Little Passage projectile points shows that the majority of the sample was 14-42 mm. long, including their stems, and 6-18 mm. wide. Their blades are therefore shorter than 42 mm. (Schwarz 1984:49, 74-78, 83-85, 89). Little Passage triangular bifaces are up to 55.6 mm. long although most, 82.4% (14/17), are under 30.2 mm. (Penney 1985:129-132).

Iron projectile points are much larger, with 74% (14/19) of complete iron blades, excluding tangs, and two broken items examined in this thesis being longer than 42 mm.. Six (37%) of nineteen complete iron blades, and two examples missing distal portions, are 49.0-62.7 mm. long, while eight other intact iron blades (42%) are 73.0-170 mm. in length. In total length, 29 of the 31 iron projectile points, including whole and broken items, are greater than 42 mm.. One Inspector Island item (DiAq:1:792), missing most of its tang and part of its blade, is shorter and the complete length of the iron endblade (VIIIa-71) is not known because it is hafted into a bone socket (Table 2; Figures 11, 13; Plate 10).

Beothuk iron projectile points' tangs are also much longer than their stone predecessors. All iron projectile points have greater tang length/blade length ratios than do Little Passage lithic examples and this characteristic indicates evolutionary variability within the metal items. The largest expressions of tang length/blade length ratios come from interior artifacts that also appear to be more recent, suggesting that long tangs were advantageous in caribou hunting, which was probably the most important economic activity away from the coast. The long tangs also reflect later Beothuk ironworkers' greater attention to detail and more complicated manufacturing procedures that are indicative of improved recycling skills.

Five faunal samples from Boyd's Cove, the Beaches, Indian Point, Pope's Point and Wigwam Brook indicate that Beothuk hunting practices, utilizing iron implements, were quite successful. Boyd's Cove features the richest and most diverse selection of animal remains, including fur bearers which may have been used to purchase European materials (Rowley-Conway 1989:personal communication). The Beaches faunal record indicates a large amount of food, but consists of 90% seal and is less varied than the Boyd's Cove sample.

The faunal record from interior Newfoundland mainly contains caribou bone which, along with the recycled iron objects found, suggests more recent occupations than the coastal assemblages included here, ca. post-A.D. 1750. The large interior faunal samples attest to the effectiveness of iron tools, which by then had probably completely replaced stone implements. These data support historical information suggesting that the Beothuk killed large numbers of caribou as late as A.D. 1820 (Howley 1976:123).

The Beothuk's continued reliance on traditional food-sources, albeit with a shift in emphasis to terrestrial species later in history, suggests that iron tools were called upon to perform functions similar to those associated with prehistoric/protohistoric Little Passage objects. The latter toolkit included at least 6 cutting/slicing stone tools, namely projectile points, triangular bifaces, scrapers, linear flakes, utilized flakes and retouched flakes, in addition to bone awls. A smaller selection of comparable Beothuk iron objects, including projectile points, awls, fish spears and, less commonly, European items, suggests that some of the metal types combined the duties of the older lithic examples.

Shanawdithit's information indicates that iron projectile points were used in hunting (Howley 1976:248), but data introduced here imply they may have also been applied to roles formerly handled by stone scrapers, knives, triangular bifaces, linear flakes and utilized flakes. Analogous use-wear studies indicate that stone projectile points performed chopping, slicing, bashing, and scraping functions in addition to strictly hunting applications (Montet-White 1974:15) and it is conceivable that Beothuk iron versions would have been similarly used.

As mentioned earlier, modified nail fragments may have been utilized in hide scraping functions at Beothuk coastal sites at Boyd's Cove and Inspector Island. These artifacts do not occur at more recent sites in interior Newfoundland where the indicated high amounts of caribou taken by Beothuk hunters imply a ready supply of hides for processing. The absence of stone scrapers and modified nail fragments from interior assemblages suggests that European knives and axes, recycled iron projectile points and expediently-used bone tools were applied to hide scraping in these areas. At Indian Point, 24 bone artifacts and 31 other possibilities contained evidence of having been used on a soft material, such as animal skins or food (Stewart 1971:19). Five similar bone fragments and 16 less obvious examples were found at Wigwam Brook (Stewart 1973:24). The bone artifacts were modified through use rather than fashioned into specific tools, which indicates their expedient nature.

Although the Beothuk iron toolkit may have been functionally equivalent to its directly ancestral Little Passage counterpart, the preferred use of metal over stone holds a number of technological implications. Hunter-gatherers often coordinate group movements to maximize their environmental knowledge, including topography, seasonal changes and resources. Among such people, items that must be carried with them are highly valued compared to those that can be expediently made (Ridington 1982:471). Little Passage linear flakes, utilized flakes and retouched flakes were often made from locally available, or sometimes curated, stone and thrown away after being used, probably most often in butchering animals. High quality cherts are available in interior Newfoundland (Robert Stevens 1988: personal communication), which suggests that stone might not have to be carried that often. Their implied replacement by increasingly reusable iron objects, that did not occur naturally or probably as commonly in the environment, may have resulted in ideological and operational modifications to traditional practices as the Beothuk attempted to live independantly of the European influence. Bone tools may have become more popular under these conditions than they had been previously, but until Little Passage sites with good organic preservation are excavated, such comparisons between Beothuk and their immediate ancestors are largely conjectural.

CHAPTER 4: METALLURGICAL ANALYSIS OF BEOTHUK IRON

Problems in Reworking Iron

The morphological analysis of Beothuk iron artifacts produced a typology of implements and suggested processes by which European objects were recycled into traditional tool types, including projectile points, awls, fish spears and possibly scrapers. Although there is ample physical evidence of many of the recycling procedures involved, surface analysis does not adequately explain exactly how the iron was modified. Iron is a more complicated material, in terms of tool production, than the cherts and other types of stone that made up the majority of prehistoric-protohistoric Beothuk toolkits until European goods became available in Newfoundland. Early Beothuk/late Little Passage people may have made pendants, awls, needles and other tools from bone, but, unlike many comparable indigenous North Americans, they did not have a native copper industry which raises the question of how they learned to modify iron.

Stone and iron differ in that the latter offers a wider choice of reworking methods to toolmakers, although the various techniques often require specific conditions for their successful implementation. Beothuk lithic materials were worked exclusively by chipping, while wrought iron's tendency to sustain a degree of plastic deformation in response to hammering is one important difference between it and stone. If the Beothuk and their prehistoric ancestors, the Little Passage people, were accustomed to grinding bone artifacts, this may have prepared them slightly for ironworking, although the properties of bone and iron are clearly quite different.

Obvious questions arise concerning how the Beothuk acquired the knowledge of iron's physical properties implicit in successful recycling. Their experience in traditional industries, although of limited value to ironworking, would conceivably have been applied to the utmost in modifying the new material. As explained earlier, bone and stone industries resemble Beothuk ironworking in that all feature the gradual derivation of tools through a series of size reductions from larger fragments. This suggests a cumulative expansion of knowledge as might be expected in technological evolution (Moore 1972:8).

The recycled items at Boyd's Cove include the earliest firmly-dated artifacts in the sample, implying that by A.D. 1650-1720 the Beothuk had sufficiently mastered many of the limiting factors pertaining to reworking iron. The historic background suggests that Europeans did not make much use of mainland Newfoundland until around A.D. 1550 and that permanent settlement was not attempted until A.D. 1610 (Howley 1976:19), which indicates that the selection of non-Native materials, including iron, would have remained marginal until the seventeenth century A.D.. This is one possible explanation for the predominant use of nails as raw materials at Boyd's Cove and Inspector Island. It also suggests that the Beothuk acquired the skills inherent in the earliest Boyd's Cove artifacts over roughly a 100 year period, ca. A.D. 1550-1650.

The Beothuk may have begun to rework iron throughout the sixteenth century A.D., although there is no clear evidence for this. They may have accumulated knowledge of ironworking through contact with friendly Europeans, Natives, such as the Montagnais or Micmac, independent invention, or any combination of these factors. Metallurgical data introduced here help clarify the question of technological influences on Beothuk ironworking and provide other information pertaining to this industry. A brief introduction to iron's physical constitution is presented first.

Physical Properties of Iron

Understanding the physical properties of industrial iron, including steel, wrought iron and cast iron, is essential in assessing the significance of these materials to the Beothuk. It is proposed here that European iron tools are subject to successful reworking only under strict conditions that must be learned by toolmakers/recyclers.

Iron is soft and easy to work with in its natural state, as are most metals (Frurip et al. 1983:13), and the presence or absence of particular impurities determines its hardness and toughness. A metal's hardness refers to its ability to resist deformation, measured by indentation, while toughness describes the quality of withstanding an impact load without fracturing, that is cracking or breaking (Unglik 1984:89, 91). The most efficient iron tools exhibit a balance between these two attributes.

The impurities in iron are carbon, sulphur, manganese, phosphorous and silicon (Unglik 1984:56). These metalloids, i.e. nonmetals exemplifying the properties of both metals and nonmetals, usually make up between one and three per cent of wrought iron by weight (Aston and Story 1939:2, 3). An examination of eighteenth-century A.D. British and French wrought iron nails from Fort Michilimackinac in Michigan revealed they contain about two percent impurities (Frurip et al. 1983:12). Metallographic analysis of wrought iron nails from a Beothuk site at Boyd's Cove (DiAp:3) shows similar results (Appendix C:236, 246).

Wrought iron's metalloid inclusions affect its reaction to reworking in that particular concentrations necessitate techniques such as heat treatment while other impurities render iron unsuitable for any kind of modifications. The presence of sulphur in the absence of manganese, or vice versa, results in iron that is "cold short" and "hot short", that is, brittle at normal or increased temperatures (Unglik 1984:86). Phosphorous in excess of 0.15% is detrimental to iron's ductility and thus a lower level than this is desired (Aston and Story 1939:42; Appendix C:237).

Consider the case of cast iron which is comparably brittle due to the high amounts of carbon, sulphur, phosphorous and manganese it contains. Carbon is present at three to four per cent, along with much smaller quantities of the other impurities (Frurip et al. 1983:10). To alleviate its undesirable qualities, cast iron was traditionally reheated in open hearths over charcoal fires assisted by air bellows to remove oxidizable impurities such as carbon and, if necessary, silicon. The removal of impurities in gas form resulted in the iron compound forming hot, partly solidified balls due to its increased melting point that cannot be achieved in this type of hearth. These lumps of iron, known as blooms, were removed from liquid slag concentrations heavy in metalloid content and squeezed through rollers to remove more of the unwanted minerals. The blooms were then reheated and rolled at least twice more before acceptable wrought iron was obtained (Frurip et al.:10-13). This indicates the difficulty in reworking cast iron into other tools.

The temperature at which wrought iron was worked in the final stages of tool production also has implications for subsequent reworking. For instance, "blue brittleness" is a characteristic of some iron when it is cold hammered after being previously worked in the "blue heat" range between 230° and 370° C.. Such material requires reheating in order to eliminate this condition (Unglik 1984:86). The need to reheat some wrought iron is interesting considering handmade nails from the seventeenth and eighteenth centuries A.D.. The tertiary stages of the nail-making process involved five-foot long, "pencil-thick" iron rods warmed to a "black heat" at which they will glow very faintly if held in a deep shadow. This is just past the "warm heat" level when the material is barely too hot for the blacksmith to hold in his hands (Hogg 1964:38). A brief immersion time in the hearth is thus implied here.

At this juncture the rod was removed from the hearth and its end hammered on four sides to produce a fine point, or struck on two opposite sides to derive a straight-edged nail. Then, while resting on a prism-shaped "hardy" atop an anvil, the rod was partially cut by a hammer blow to the appropriate spot. The rod was next placed point-first into a nail-holder, or "bolster", where it was snapped off and replaced in the fire. The proximal end of the "proto-nail" was then hammered into a "rosehead" or a "clasp", depending on which type of head was required. Larger spikes were subjected to a different kind of heading process using dies (Gilmour 1976:21).

The preceding description is significant because it implies that nails would not require reheating to extremely high temperatures for reworking by Beothuk or other people. Hot working nails would still be a means of safeguarding against other inherent risks attributable to high impurity content or internal fissures due to poor forging techniques (Unglik 1984:86; Appendix C:237), but might often be unrequired.

One other problem to be considered in cold hammering iron bears mention here. From 0 to -30° C. and lower, iron undergoes drastic reductions in toughness and ductility which often results in fracturing due to applied force (Unglik 1984:86). In extremely cold environments this has implications for the use of iron tools, including Beothuk modification/recycling attempts in the wintertime, such as in the previously-cited report by John Peyton. If iron were stored outside during the winter it might become more brittle and heat treatment in recycling would then be highly advisable.

The preceding paragraphs, describing some of the basic characteristics of industrial iron, suggest that recycling it into other tools can be difficult. It is somewhat paradoxical that iron's impurity content largely determines its reaction to reworking attempts while the metalloid/impurity percentage changes as the metal is modified. This implies that the ironworker must be aware of the changing nature of his material throughout the tool-making process. These same conditions apply to Beothuk toolmakers and are important in understanding the role of iron in that context.

Metallurgical Analysis of Beothuk Iron

The laboratory examination of Beothuk iron artifacts produced interesting conclusions pertaining to the types of European tools used as raw materials and some of the manufacturing processes involved in recycling. Tests were conducted by Henry Unglik, under the supervision of chief conservation scientist John Stewart, at Parks Canada's

Conservation Labs in Ottawa. The investigative procedure is explained in more detail in Appendix C.

The Test Sample

Forty-seven artifacts from Boyd's Cove (DiAp:3) were divided into nine categories representing various stages of manufacturing procedures and problem items that had not been satisfactorily identified to date. The sample includes one set of possible projectile point fragments and a second, less obvious group that could not be adequately classified as Beothuk tools or European knife fragments due to the absence of tang areas that would help identify them (Figure 25). These items and category 3 (Figure 26), consisting of obvious projectile point fragments and preforms, were tested for signs of heat treatment and the possibility that the Beothuk had, perhaps incidentally, increased their hardness through cold working. This is a known side effect of cold hammered iron (Ross 1977:64) and identification of it on Beothuk artifacts would be interesting concerning their efficiency. In metallic terminology, hardness is attained at the cost of toughness, and vice versa, which means that harder items entertain a higher risk of breaking, although their surfaces are more resistant to indentation (Ross 1977: 138). If the Beothuk, albeit unwittingly, produced iron tools that were significantly harder than the parent European object, the new items might have relatively short use-lives due to their inability to withstand stress sustained through use. On the other hand, slightly harder projectile points and awls would retain sharper working edges that would enhance cutting and puncturing functions.

It was also hoped that the examination of various projectile point preforms would be helpful in determining whether heat treatment might have been utilized at early stages of production or used throughout the process to assist refining the desired shape of implements. Category 4 (Figure 26), made up of clearly modified manufacturing debris, was assessed for signs of the same treatment received by the more diagnostic examples in categories 1-3.

Four different sets of nail fragments displaying varying degrees of reworking and possible reworking were subjected to tests similar to those previously described. Truncated nails (category 5; Figure 26), as described earlier, have broken shafts with intact heads and probably represent initial stages of tool-production. Questions here concern the likelihood that nails of varying thickness had been similarly worked or if special techniques, such as heat treatment, were employed.

Category 6 (Figure 27) consists of the previously described "modified nail fragments" that are similar to truncated nails except for having the distal end of their vestigial shafts hammered flat. These were tested for signs of hot working and the probability that their hardness values are equal to those for projectile points. If so, this would indicate that such items were detached from the distal nail shaft portion in tertiary manufacturing stages with little subsequent preparation necessary for completion of the tools. Increased hardness values could also be significant if modified nail fragments were sometimes used as chisels or hide scrapers.

Worked nail shafts, category 7 (Figure 28), differ from "modified nail fragments" in that they lack heads while exhibiting signs of lateral expansion/dorsal-ventral flattening. As described earlier, they represent projectile point and awl preforms presumably formed along with modified nail fragments in one method of reworking nails. One of the test artifacts, DiAp:3:1266, featuring a ragged, fractured edge, implies some past difficulty in recycling that is possibly attributable to high impurity content, cold working, or a combination of the two. Evidence for this and possible signs of heat treatment were sought.

Category 8 (Figure 29) consists of nail shaft fragments of different lengths and thicknesses that appear to be the articulating accompaniments of truncated nails. The absence of signs of reworking, i.e. flattening and/or hammering, on these shafts implies that they could be the earliest stage of projectile point or awl preforms. Once again the question of heat treatment at this basic level of tool production is of primary importance.

The final class of artifacts, category 9 (Figure 29), is comprised of clinched nails bent in a fish hook shape by Europeans, possibly during boat-building. As the Beothuk reportedly burned boats for the purpose of obtaining nails (de la Morandiere 1962-1966:22), these are included as a control group for comparison with any evidence of not worked iron.

Laboratory Procedures and Results

Time limitations dictated that only 22 of 47 artifacts could be examined along the advocated format. Ten items were selected from categories 3, 6 and 7, as these were the most diagnostic modified pieces, while two specimens were chosen from each of the remaining six sub-classes. All items were cut in order to assess the grain structure of the iron both in the inner core and the outer "case", as variations between these two regions are potentially informative concerning the application of different reworking techniques (Figures 25-29). Specimens were carefully sectioned in order to preserve as much of the artifact as possible and all materials were returned to Memorial University following the investigation.

The examination revealed that 18 artifacts are made of wrought iron, three are steel, and one truncated nail exhibits alternate layers of these two materials (Appendix C:236-238). The aberrant nail is an interesting piece in view of the fact that such composite examples should not be expected until the late nineteenth century A.D. when they began to be sold in the United States (Smith 1966:9). Such items clearly postdate the Beothuk occupation at Boyd's Cove and this nail fragment may represent European activities there. It may also be the result of a forging accident, such as extended immersion in a hearth fire or contact with the charcoal fuel, that produced an over-abundance of carbon and formed patches of steel (Schenck and Knox 1986:74).

In all, 15 of 22 items tested had been modified in conjunction with Beothuk ironworking. Twelve had been cold hammered at room temperature and three portray evidence of hot working. One of the hot worked artifacts was also cold hammered on one of its ends, which suggests a degree of technical dexterity by the tool-maker. Three fragments that had been cold hammered over their complete surface areas are European steel. One exhibits medium-carbon (0.3-0.4%) steel structure, while the other two constitute high-carbon (0.6-0.8%) varieties (Appendix C:241, 242, 246).

Categories 1-3 each contain one unfinished Beothuk tool made from European steel (Appendix C:244, 246), which may reflect difficulties in recycling this material at Boyd's Cove. The category 3 specimen, marked by fissuring and a ragged edge on its hammered end, implies that it did not respond favorably to modification attempts. This possible evidence for problems in tool production echoes the proposal that Boyd's Cove artifacts reflect limited ironworking skills compared to later occupations at which Beothuk abilities had evolved some. The corollary of this is that more difficult materials, such as steel, probably could not be satisfactorily recycled until later times.

Five of the cold hammered wrought iron artifacts had been completely modified while seven show reworking on discrete sections. As might be expected, these 12 items come from categories 1, 2, 3, 4, 6 and 7, containing the more diagnostic reworked material (Appendix C:241-244). Eight of the cold worked artifacts were derived from wrought iron nails which corroborates the indicated Beothuk preference for them at Boyd's Cove and the ease with which they could be recycled. The European origins of the remaining four fragments cannot be identified due to extensive hammering/deformation combined with subsequent corrosion.

Categories 5 (truncated nails) and 8 (headless nail shafts), which are both tentatively interpreted as the basic forms of tool preforms, and sub-class 9 (clinched nails), a control group, are not marked by signs of plastic deformation caused by hammering that distinguish the other items. Categories 5 and 8 were too corroded to determine how the nails were broken, but the the artifacts' clean fractures suggest a hammer blow to a sharp axe or chisel.

Concerning hot working, two modified nail fragments (DiAp:3:2480, DiAp:3:231) and one of the modified nail shafts/preforms (DiAp:3:1498) carry signs of this treatment. The latter piece was cited earlier because it had been cold hammered on the end opposite to its hot worked area. All three hot worked artifacts exhibit extreme thinning, up to a 50% reduction in thickness, compared to the 20-40% flattening describing cold worked items (Appendix

C:226, 227, 241, 242). The fact that iron could be hot worked to a thinner cross section than is achievable through cold hammering has obvious advantages concerning the formation of thin blades and cutting edges on recycled projectile points and scrapers. The ability to bring iron nails to significantly thinner cross sections under controlled conditions would also have been advantageous for safely breaking them.

The three hot worked artifacts are additionally important in that they indicate having been modified at 1000-1100° C in a forge(s), presumably by Europeans. This temperature range seems excessive because iron needs only to be warmed to 450° C and steel to 550° C for grain structure to recrystallize, which is the operative effect of hot working (Appendix C:241). The suggested temperatures are beyond the expected range of typical Beothuk housepit fires which could probably generate a maximum of 370° C. (Knauth 1974:36)

Another seven iron fragments show signs of having been heated to even greater temperatures, in excess of 1200° C., and cooled at room temperature (Appendix C:242). These artifacts include two nail shafts (category 8) that may have been heated to facilitate removing their heads. Unfortunately, in these two cases corrosion around the severed areas has removed the evidence pertinent to this question and it cannot be determined whether they were worked hot or after they had cooled down.

The distribution of iron artifacts inside Beothuk houses at Boyd's Cove and Wigwam Brook (Figures 30-34) includes some concentrations within hearths, although most material occurs elsewhere over the house floors. This suggests that the occupants did not attempt to hot work much iron. The depicted frequencies do, however, indicate that iron was often worked inside houses, especially at Boyd's Cove. The reasons for the extraordinarily high numbers there, relative to other sites, probably include its early occupation, coastal location, continued reuse by the Beothuk, and undisturbed nature. The large amount of artifacts at Boyd's Cove corroborates the suggestion that this site represents one of the last coastal areas where Beothuk were secure and successful, before being forced to move inland (Pastore 1989:66-67).

It is interesting that the hot worked items consist of intermediary stages in tool production rather than finished projectile points, awls or fish spears. This may reflect sampling error in that complete objects were not selected because of the destructive nature of the tests, but, as mentioned earlier, the hot worked preforms are significant in showing that the Beothuk are not responsible for all modified iron at Boyd's Cove, contrary to previous interpretation (Pastore 1989:57, 66). They also imply that the modifications took place in the Boyd's Cove area or nearby and that European-modified nails had some value to the Beothuk, possibly as scrapers or preforms that could be subsequently finished. It is otherwise difficult to explain trading of incomplete tools.

As mentioned in chapter 3, the Beothuk may have obtained iron objects, possibly along with other goods, from Europeans or Native allies, such as the Montagnais Indians. A third, highly improbable, possibility is that the Beothuk had access to a forge where they sometimes made iron tools. On mainland North America, Indian blacksmiths often used the forges of eighteenth- and nineteenth-century A.D. trading posts (Russell 1967:330), although in Newfoundland there is no evidence for such cooperation. The historic record suggests that some Europeans interacted peacefully with Beothuk people (Hewson 1984:8; Howley 1976:24, 265, 267; Duckworth Papers:4645; Peyton 1987:7, 10) and the Boyd's Cove hot worked iron is possible physical evidence for such contact.

Europeans in the Boyd's Cove area and elsewhere throughout Newfoundland would have required forges to repair their tools and possibly modify iron as trade objects or peace offerings for the Beothuk. No evidence of a forge has been found to date in the Boyd's Cove area, but such facilities were common on ships of the period. Furthermore, land-based forges from that time were much less elaborate than the popularly depicted coal-based smithies that are really a late nineteenth-century A.D. development. Earlier operations used wood and charcoal, rather than coal, as fuel and relied on a much smaller selection of tools. Rocks and sand were the structural materials of older fire-boxes, which were fanned by a side-blast bellows, compared to later metal or brick variations utilizing a bottom-blast of air (Light 1987:662).

As mentioned in chapter 3, the Parks Canada conclusions are corroborated by other metallurgical data asserting that some Boyd's Cove projectile points exemplify too high a quality of workmanship to have been made by Beothuk, or other late entrants into iron technology, without assistance from more skilled craftsmen (Light 1987:personal communication). The suggested evidence for Beothuk trading activity at Boyd's Cove finds further support in the presence of 677 glass trade beads, European pottery, and the high proportion of fur bearing animals killed there, compared to other sites. Trade beads and possibly European-manufactured projectile points have also been found at other interior and coastal Beothuk sites (pages 58, 67, 75).

In conclusion, it can be said that the metallurgical aspect of this research corroborates and illuminates trends noted in the historic data as well as in the physical analysis of artifacts. Wrought iron, usually obtained from nails, was the preferred raw material at Boyd's Cove, with steel being worked much less frequently. One of three modified steel fragments in the test sample exhibits cracks and a roughly fractured edge that are probably attributable to Beothuk difficulties in recycling such materials, compared to wrought iron, at this early site.

From his analysis of Boyd's Cove iron, Henry Unglik concluded that the Beothuk had knowledge of cold working and hot working but opted for the former as it was less cumbersome (Appendix C:247). Concerning the possibility that cold hammering improved the quality of iron tools, the Ottawa tests indicate that the cold worked items were significantly harder than they had been originally (Appendix C:243, 245, 247). The cold hammered artifacts are also harder than hot worked items, although this characteristic was probably not apparent or important to the Beothuk. The predominant use of cold working over hot working at Boyd's Cove implies the perseverance of basic techniques from Beothuk lithic technology, including the retention of older tool forms such as hammerstones and abraders. These represent skills and tools the Beothuk could readily apply to modifying European iron.

The hot worked items from Boyd's Cove effectively indicate that some iron was modified through procedures that cannot be satisfactorily connected with Beothuk craftsmen due to the extreme temperatures involved, which are not attainable without properly constructed hearths. Three artifacts were clearly heated and worked in accordance with Beothuk templates, while another three may have been similarly modified. Four other objects heated to over 1200 °C. and cooled very slowly, as in a forge, had not been recycled at these temperatures. Hot working suggests advantages over cold hammering in obtaining significantly thinner tools which may be important in producing more effective cutting edges.

These data indicate a significant connection between the Beothuk and items specifically modified by Europeans, even though actual contact between the two groups cannot be substantiated. The hot worked iron, along with glass trade beads and possibly other artifacts from Boyd's Cove, suggest that the Beothuk obtained European trade goods through peaceful contact with other Natives or Europeans themselves. Subsequent research may negate the theory that early Europeans in Newfoundland did not need, or want, the allegiance of the Native people as they did elsewhere in North America (Pastore 1988:60). Early European settlers/ entrepreneurs in Newfoundland might have felt compelled to befriend Beothuk people as a security measure or form some sort of economic association with them.

Metallurgical testing of iron, similar to that undertaken with Boyd's Cove material, from other Beothuk sites is now necessary to assess the status of hot working over time and space. It would be useful to discover iron that had been hot worked at temperatures within the expected range for housepit fires, to a maximum of ca. 370°C . This might provide proof that the Beothuk acquired metallurgical knowledge at Boyd's Cove, and possibly other sites, which they subsequently applied elsewhere in Newfoundland.

CHAPTER 5: CONCLUSIONS

This research elaborates on the Beothuk iron industry which, from ca. A.D. 1500-1829, gradually replaced stone tools that had developed from the Little Passage complex. Early coastal assemblages from the Beaches (DeAk:1), Boyd's Cove (DiAp:3) and Inspector Island (DiAq:1) feature mixed stone/iron toolkits, while subsequent interior sites, dated to ca. the late-eighteenth, early-nineteenth century A.D., indicate little or no use of comparable lithic items. The limited data pertaining to some of the sites provide only a general outline of the rate at which iron replaced stone among the Beothuk, and it is expected that older inland occupations containing mixed collections similar to coastal assemblages will be found through new excavations.

Conclusions derived in this thesis indicate that the Beothuk living in Boyd's Cove around A.D. 1650-1720 possessed European trade goods, although little can be said concerning the means by which such materials were obtained. Metallurgical data reveal that the Beothuk had access to European-modified nails and possibly other reworked iron. Laboratory analysis of diagnostic Beothuk iron from Boyd's Cove indicates that three out of 15 modified artifacts tested were hot worked at temperatures in excess of 1000° C. (Appendix C:242, 246, 247). These conditions are only attainable in a forge, which strongly implies they were manufactured by Europeans as trade objects or gifts for Natives, possibly including the Beothuk.

The presence of European-modified nails/preforms implies that the ironworking took place near Boyd's Cove. In addition to possibly supplying finished projectile points and related objects to the Beothuk, the close proximity of a forge and experienced ironworkers could have provided valuable technical insights concerning recycling that facilitated the development of a local Native iron industry.

Similar data were obtained from an examination of Boyd's Cove projectile points by material culture specialist John Light who reported the presence of high-quality workmanship that would not be expected at an early seventeenth-century Beothuk site (John Light 1987:personal communication). The possibility of trade or peaceful contact at Boyd's Cove is further indicated by 677 glass trade beads found in four housepits there, and a faunal sample indicating a high proportion of fur bearing animals, relative to other Beothuk sites. Nearly 1100 additional trade beads were recovered from other Beothuk sites, including Inspector Island on the coast and Pope's Point, South Exploits, and Red Indian Falls III along the Exploits River.

From the formative period suggested by early coastal sites at the Beaches, Boyd's Cove and Inspector Island, the Beothuk iron industry continued to evolve throughout the seventeenth, eighteenth and early nineteenth centuries A.D. probably with little, if any, further outside influences. The consequential Beothuk desire for European iron, mostly to be recycled into other tools, resulted in their pilfering from fishing stations to obtain supplies, which led to a worsening of relations with the newcomers. This marks the beginning of the end of the Beothuk period, probably during the eighteenth century A.D. when they began living year round in interior Newfoundland as a means of avoiding Europeans. Although faunal samples and historic data imply that the Beothuk used iron tools to kill large amounts of caribou, as well as smaller animals, in the interior, they were doomed to extinction, possibly due to their attempt to survive essentially on one major food source, caribou.

The evolutionary nature of Beothuk ironworking is implicit in the gradual production of various sizes and types of projectile points, including toggling harpoons. Latter-period Beothuk ironworkers also utilized more difficultly-worked European objects, such as scissors, hammers, axes and fur traps, that incorporated steel into their structure and/or were problematic because of their bulk. This is in contrast to the predominant reuse of easily worked wrought iron nails at earlier coastal sites at Boyd's Cove and Inspector Island. Nails were probably less available in the interior, compared to the coast, which forced the Beothuk to use other, less-favourable, European items as raw materials. Stone abraders with deep grooves attributable to ironworking are much more common at interior sites than they are on the coast, which indicates greater production of iron tools at the more recent inland areas. The prominent evidence for grinding reflects the Beothuk's increased attention to detail, including sharply-shouldered blades and long tangs with square cross sections, at later sites.

Beothuk ironworking also manifests its evolutionary nature in the manufacture of projectile points that probably were specially designed for a caribou-based economy, which represents a modified subsistence strategy for the Natives. Projectile points with large blades (sub-types 2c, 3a and 3b), including some equipped with long, sturdy tangs as well (sub-type 3a), are affiliated with relatively late, ca, post-A.D. 1750, inland sites where the most important food resource was caribou. Their resemblance to "deer spears" described by Shanawdithit may be a clue to their main function.

Concerning the broader perspective of North American Aboriginal history, Beothuk iron artifacts fit the criteria for classification within a typology of seven categories reflecting the impact of European goods on traditional New World cultures. Class five consists of "...old types of artifacts modified by the substitution of imported material for local material that was inferior in physical properties, lacking in prestige or harder to obtain. Forms remained the same" (Quimby 1966:25). The Beothuk recycled an indirectly imported material, European iron, into tools with prehistoric non-iron counterparts, including projectile points, awls, fish spears and possibly scrapers. Historic data and archaeological assemblages containing large amounts of iron artifacts indicate the high value of this metal to the Beothuk.

Beothuk iron artifacts also closely resemble Quimby's category six in which old types of artifacts, as described earlier, were modified by the substitution of an imported or heretofore unused local material, the use of which involves a different technological principle to achieve a similar end product (Quimby 1966:25). In recycling iron into traditional tool types, the Beothuk necessarily employed different technological procedures than they had previously applied to stone. Iron had to be hammered, cut and ground into the desired shapes rather than chipped, as stone was. The Beothuk and their immediate ancestors, the Little Passage complex, did not use ground slate implements. Their familiarity with grinding bone pendants and, possibly, bone needles and awls may have prepared them somewhat for abrading iron, although the bevelled, sharp edges of metal items, with deeply-grooved abraders as the most obvious byproduct, have no Beothuk or Little Passage counterpart.

Comparisons of the Beothuk iron industry with three contemporaneous mainland examples highlight some unique qualities of the Newfoundland case. Micmac Indians from Nova Scotia, Onondaga Iroquois from the present New York State area, and Labrador Eskimos all had close trade alignments with Europeans that ultimately resulted in greater access to the latter's goods than the Beothuk experienced. The Micmac were not significant recyclers of European goods as they preferred to trade for intact objects, including projectile points, knives, axes and other basics at first, until they obtained more prestigious items, such as guns. They rapidly became close allies of Europeans and were basically dependant on the latter's tools by the early seventeenth century A.D.. The Onondaga Iroquois and Labrador Eskimos initially exhibited iron industries similar to the Beothuk, although their recycling of European objects gradually waned as more valuable trade goods became available. Similar to the Beothuk, Labrador Eskimos pilfered much material from European fishermen, but like the other comparative cases, they gradually became active participants in the fur trade.

The three comparative groups altered their settlement patterns to enhance access to European objects. Normal hunting activities were redirected towards securing marketable animal skins rather than providing meat, which did not produce enough food for Native families and increased their reliance on Europeans. In contrast, as European-Beothuk relations deteriorated throughout the historic period, probably by the latter half of the eighteenth century A.D. the Natives were confined to interior Newfoundland where they reorganized their subsistence habits towards a major reliance on terrestrial resources. They pursued this goal utilizing iron versions of prehistoric tools, including awls, fish spears, projectile points and possibly scrapers. European axes, knives and other utilitarian objects supplemented these items. The shift in settlement/subsistence strategy appears to have been maladaptive for the Beothuk, however, and was probably a major factor resulting in their extinction.

In short, the Beothuk iron industry, including its implications for settlement/subsistence patterns and material culture, indicates a mixture of change and traditional continuity that differs from the more sweeping cultural transitions characterizing other contemporaneous Native groups. The Beothuk attempted to use European materials, including possible trade goods at Boyd's Cove and other sites, in traditional roles that became increasingly difficult to implement throughout the historic period. By the early eighteenth century A.D., the Beothuk attempt at living independently of Europeans had resulted in a unique iron industry and associated economy, although of a relatively short duration.

TABLES

Table 1: PROJECTILE POINT SAMPLE

1a	1b	
DiAp:3:2668*	NF 3172	
" 2672*	NF 3170	
" 2423*		
" 1168*		
" 18*		
NF 3174		

2a	2b	2c
DiAp:3: 784*	DfAw:1:249	NF 3171
" 1769*	" 73	Pope's Point-1
" 44*	Sandy Lake	DfAw:1:217
" 1565*	NF 3169	
" 1271*	NF 3175	
DiAq:1: 792*	IP-a	
	IP-b	
	Locke	

3a	3b	3c
NF 3181	IP-c	Buchan's
L-1		
L-2		

4

Toggling harpoon endblade (VIIIA-71)

Preforms/Fragments

DiAp:3:1437*
" 1236* Type 1 preform
" 896*
" 716*
" 871*
" 2422* Type 2 preform
" 2424*

DiAq:1:565*
" 774*
" 776*
" 812*
" 815* Type 1/type 4 preform
" 888*
" 890*

DfAw:7:95 Type 4 preform

* = coastal artifacts

Table 1: Projectile Point Sample (continued): Preforms/Fragments

NF 3176
" 3180 Type 2 preform
" 3167 Type 1 preform
" 3173
" 3166

DfAw:1:74 Type 2 preform
" 75 "
" 76 "
" 77 "
" 78 "
" 79 "
" 80 "

Wigwam Brook preforms (DfAw:1:75-80) are shaft/tang portions characterized by slight cross sections with one flattened end, signifying the distal area, towards the blade. The proto-blade regions, which are small and lacking shoulders, suggest poor workmanship that may be attributable to the Beothuk's attempted recycling of less favourable sources of iron than had been previously available when they spent more time on the coast of Newfoundland.

Pope's Point (DfBa:1): (Devereux 1965:Plate 16)
"e"
"g" Type 2 preform/ projectile point fragment
"k" Type 2 "

TABLE 2: PROJECTILE POINT TYPOLOGY

TYPE 1: Lanceolate Blades n=8

Sub-type 1a n=6

BL		
31.5	NF	3174*
49.8	DiAp:3:	2672
54.4	"	2668
58.5	"	1168*
61.0	"	2423
62.7	"	18
x̄=56.97		

BW		
9.4	NF	3174
11.5	DiAp:3:	1168
12.4	"	2672
13.3	"	2668
14.4	"	18
18.6	"	2423
x̄=13.27		

BT1		
1.50	NF	3174
1.65	DiAp:3:	18
2.00	"	2423
2.25	"	2668
2.70	"	2672
2.85	"	1168
x̄=2.16		

TL			X-S
25.6	DiAp:3:	2672*	S
40.95	"	1168*	I
44.60	NF	3174	S
62.0	DiAp:3:	18	S
x̄=53.3			

TW1 x TT1		
3.45 x 1.00	DiAp:3:	2668
4.30 x 4.20	NF	3174
5.70 x 4.90	DiAp:3:	18
6.00 x 4.35	"	2672
6.40 x 4.35	"	1168
x̄=5.17 x 3.13		

BL:BW		
3.28:1	DiAp:3:	2423
4.02:1	"	2672
4.09:1	"	2668
4.35:1	"	18
x̄=3.93:1		

BL:BT1		
18.44:1	DiAp:3:	2672
24.18:1	"	2668
30.50:1	"	2423
38.00:1	"	18
x̄=27.78:1		

BW:BT1		
4.05:1	DiAp:3:	1168
4.59:1	"	2672
5.91:1	"	2668
6.27:1	NF	3174
8.73:1	DiAp:3:	18
9.30:1	"	2423
x̄=6.47:1		

BL:TW1		
8.30:1	DiAp:3:	2672
11.00:1	"	18
15.77:1	"	2668
x̄=11.69:1		

BW:TW1		
1.80:1	DiAp:3:	1168
2.07:1	"	2672
2.47:1	NF	3174
2.53:1	DiAp:3:	18
3.86:1	"	2668
x̄=2.55:1		

X-S = tang cross section
S = square
I = irregular
* = incomplete artifact

Sub-type 1a (continued)

TL:BL	
0.99:1	DiAp:3:18

TL:BW	
4.31:1	DiAp:3:18
4.74:1	NF 3174
x̄=4.52:1	

TL:BT1	
29.73:1	NF 3174
37.58:1	DiAp:3:18
x̄=33.65:1	

TL:TW1	
10.37:1	NF 3174
10.88:1	DiAp:3:18
x̄=10.62:1	

TL:TT1	
11.15:1	NF 3174
12.66:1	DiAp:3:18
x̄=11.89:1	

TW1:TT1		
1.02:1	NF	3174
1.16:1	DiAp:3:	18
1.38:1	"	2672
1.47:1	"	1168
3.45:1	"	2668
x̄=1.70:1		

Sub-type 1b n=2

BL	
56.4	NF 3172
20.85*	NF 3170
x̄=56.4	

BW	
7.2	NF 3170
11.2	NF 3172
x̄=9.2	

BT	
0.80	NF 3170
1.45	NF 3172
x̄=1.22	

TL		X-S
117.5	NF 3172	S
122.6	NF 3170	I
x̄=120.05		

TW1 x TT1	
2.7 x 2.55	NF 3170
4.0 x 4.50	NF 3172
x̄=3.35 x 3.52	

BL:BW	
6.35:1	NF 3172

BL:BT1	
50.34:1	NF 3172

BW:BT1	
7.72:1	NF 3172
9.00:1	NF 3170
x̄=8.36:1	

BL:TW1	
14.1:1	NF 3172

BW:TW1	
2.67:1	NF 3170
2.80:1	NF 3172
x̄=2.78:1	

TL:BL	
1.61:1	NF 3172

X-S = tang cross section
S = square
I = irregular
* = incomplete

Sub-type 1b (continued)

TL:BW	
10.49:1	NF 3172
17.03:1	NF 3170
x̄=13.76:1	

TL:BT1	
81.03:1	NF 3172
153.25:1	NF 3170
x̄=112.14:1	

TL:TW1	
29.37:1	NF 3172
45.41:1	NF 3170
x̄=37.39:1	

TL:TT1	
26.11:1	NF 3172
48.08:1	NF 3170
x̄=37.95:1	

TW1:TT1	
0.89:1	NF 3172
1.06:1	NF 3170
x̄=0.97:1	

Type 2: Shouldered Blades < 84.00 mm. Long n=15

Sub-type 2a n=6

BL	
16.0	DiAp:3:1271*
24.2	DiAq:1: 792*
28.7	DiAp:3:1769
37.9	" 44*
39.1	" 784
49.0	" 1565AB*
x̄=33.9	

BW	
10.2	DiAp:3:1271*
13.4	" 1565
13.4	" 1769
13.5	" 44
15.0	" 784
19.0	DiAq:1: 792
x̄=14.86	

BT1	
0.60	DiAp:3:1271*
1.30	" 44
1.70	" 1769
2.00	" 1565
2.00	" 784
3.45	DiAq:1: 792
x̄=2.09	

TL		X-S
10.40	DiAq:1: 792*	S
42.80	DiAp:3: 44	S
45.30	" 1565AB*	S
53.10	" 1769	S
74.10	" 784	S
76.30	" 1271	S
x̄=61.57		

TW1 x TT1	
4.30 x 4.20	DiAp:3: 44
4.50 x 4.05	DiAq:1: 792
4.65 x 4.85	DiAp:3:1565
4.76 x 4.10	" 1271
4.90 x 4.20	" 1769
5.50 x 5.00	" 784
x̄=4.77 x 4.40	

X-S = cross section
S = square
* = incomplete

Sub-type 2a: (continued)

BL:BW		
2.14:1	DiAp:3:	1769
2.61:1	"	784
x̄=2.37:1		

BL:BT1		
16.88:1	DiAp:3:	1769
19.55:1	"	784
x̄=18.21:1		

BW:BT1		
5.51:1	DiAq:1:	792
7.51:1	DiAp:3:	784
7.88:1	"	1769
10.38:1	"	44
11.17:1	"	1565
x̄=8.49:1		

BL:TW1		
5.86:1	DiAp:3:	1769
7.11:1	"	784
x̄=6.48:1		

BW:TW1		
2.73:1	DiAp:3:	1769
2.73:1	"	784
2.76:1	"	1565
3.14:1	"	44
4.22:1	"	792
x̄=3.12:1		

TL:BL		
1.85:1	DiAp:3:	1769
1.90:1	"	784
x̄=1.87:1		

TL:BW		
3.17:1	DiAp:3:	44
3.96:1	"	1769
4.94:1	"	784
x̄=4.02:1		

TL:BT1		
31.24:1	DiAp:3:	1769
32.92:1	"	44
37.05:1	"	784
x̄=33.74:1		

TL:TW1		
9.95:1	DiAp:3:	44
10.84:1	"	1769
13.47:1	"	784
x̄=11.42:1		

TL:TT1		
10.19:1	DiAp:3:	44
12.64:1	"	1769
14.82 :1	"	784
x̄=12.55:1		

TW1:TT1		
1.02:1	DiAp:3:	44
1.04:1	"	1565
1.10:1	"	784
1.11:1	DiAq:1:	792
1.16:1	DiAp:3:	1271
1.17:1	"	1769
x̄=1.09:1		

Sub-type 2b n=8

BL

14.7	DfAw:1:73*
20.0	SL*
26.5	NF 3169
28.4	DfAw:1:249
31.4	IP-b
34.5	NF 3175*
34.5	IP-a*
53.0	L-3
x̄=34.82	

BW

6.4	DfAw:1:249
10.2	IP-b
11.1	NF 3175
11.6	NF 3169
12.15	SL
13.96	IP-a
15.3	IP-a
18.2	DfAw:1:73
x̄=12.37	

BT1

1.1	DfAw:1:249
1.35	NF 3175
1.4	NF 3169
2.2	DfAw:1:73
2.9	SL
3.04	L-3
x̄=2.0	

TL		X-S
56.35	DfAw:1:249	S
74.1	NF 3175	I
76.7	SL	S
89.5	IP-a	R
97.1	NF 3169	I
101.65	DfAw:1:73	S
103.84	L-3	S
124.3	IP-b	R
x̄=90.44		

TW1 x TT1

2.0 x 1.80	DfAw:1:249
3.55 x 3.80	NF 3175
4.22 x 4.28	L-3
4.55 x 3.20	SL
4.60 x 3.50	NF 3169
4.70 x 4.70	IP-a
5.20 x 5.20	IP-b
5.25 x 3.75	DfAw:1:73
x̄=4.23 x 3.78	

BL:BW

2.21:1	NF 3169
3.06:1	IP-b
3.80:1	L-3
4.44:1	DfAw:1:249
x̄=3.38:1	

BW:BT1

4.19:1	SL
4.59:1	L-3
5.82:1	DfAw:1:249
8.22:1	NF 3175
8.27:1	" 73
8.29:1	NF 3169
x̄=6.81:1	

BL:BT1

17.43:1	L-3
18.93:1	NF 3169
25.82:1	DfAw:1:249
x̄=20.73:1	

BL:TW1

5.76:1	NF 3169
6.68:1	IP-a
12.55:1	L-3
14.20:1	DfAw:1:249
x̄=9.80:1	

X-S = cross section
R = round
I = irregular
S = square
* = incomplete

Sub-type 2b (continued)

BW:TW1	
2.17:1	IP-b
2.52:1	NF 3169
2.67:1	SL
2.94:1	IP-a
3.20:1	DfAw:1:249
3.31:1	NF 3175
3.31:1	L-3
3.47:1	DfAw:1:73
$\bar{x}$=2.95:1	

TL:BL	
1.96:1	L-3
1.98:1	DfAw:1:249
3.66:1	NF 3169
3.96:1	IP-b
$\bar{x}$=2.89:1	

TL:BW	
5.59:1	DfAw:1:73
5.85:1	IP-a
6.31:1	SL
6.68:1	NF 3175
7.44:1	L-3
8.37:1	NF 3169
8.80:1	DfAw:1:249
12.19:1	IP-b
$\bar{x}$=7.65:1	

TL:BT1	
26.45:1	SL
34.16:1	L-3
46.20:1	DfAw:1:73
51.23:1	" 249
54.89:1	NF 3175
69.36:1	NF 3169
$\bar{x}$=47.05:1	

TL:TW1	
16.86:1	SL
17.21:1	IP-a
19.36:1	DfAw:1:73
21.11:1	NF 3169
22.12:1	NF 3175
24.61:1	L-3
26.45:1	IP-b
28.17:1	DfAw:1:249
$\bar{x}$=21.99	

TL:TT1	
17.21:1	IP-a
19.50:1	NF 3175
23.97:1	SL
24.26:1	L-3
26.45:1	IP-b
27.11:1	DfAw:1:73
27.74:1	NF 3169
31.31:1	DfAw:1:249
$\bar{x}$=24.69:1	

TW:TT1	
0.93:1	NF 3175
0.99:1	L-3
1.11:1	DfAw:1:249
1.31:1	NF 3169
1.40:1	DfAw:1:73
1.42:1	SL
$\bar{x}$=1.19:1	

Sub-type 2c n=3

BL
73.0 PP-1
83.95 NF 3171
89.27 DfAw:1:217*
$\bar{x}$=82.0

BW
11.0 NF 3171*
15.2 PP-1
25.6 DfAw:1:217
$\bar{x}$=20.4

BT1
1.10 NF 3171*
3.10 DfAw:1:217

TL		X-S
10.40	DfAw:1:217*	S
60.80	NF 3171*	I
110.40	PP-1	?

TW1 x TT1
3.21 x ? PP-1
3.2 x 1.85* NF 3171
5.7 x 3.75 DfAw:1:217
$\bar{x}$(TW1)=4.04

BL:BW
3.49:1 DfAw:1:217*
4.79:1 PP-1
7.63:1 NF 3171*
$\bar{x}$=5.30:1

BL:BT1
28.80:1 DfAw:1:217*
76.32:1 NF 3171*

BW:BT1
8.26:1 DfAw:1:217*
10.00:1 NF 3171*

BL:TW1
22.67:1 PP-1
22.63:1 NF 3171
x=24.65:1

BW:TW1
3.44:1 NF 3171*
4.49:1 DfAw:1:217
4.73:1 PP-1
$\bar{x}$=4.61:1

TL:BL
0.72:1 NF 3171*
1.52:1 PP-1

TL:BW
5.53:1 NF 3171*
7.27:1 PP-1

TL:BT1
55.27:1 NF 3171*

TL:TW1
19.0:1 NF 3171*
34.39:1 PP-1

TL:TT1
32.86:1 NF 3171*

TW1:TT1
1.52:1 DfAw:1:217
1.73:1 NF 3171*

X-S = cross section
S = square
I = irregular
? = unknown
* = incomplete

Type 3: Shouldered Blades > 100.00 mm. Long n=5

Sub-type 3a n=3

BL		BW	
101.0	NF 3181	17.1	L-1
113.3	L-1	18.1	NF 3181
170.0	L-2	30.4	L-2
$\bar{x}$=128.1		$\bar{x}$=21.87	

BT1		TL		X-S
2.7	NF 3181	214.0	L-2*	S
2.7	L-1	300.5	NF 3181	S
5.8	L-2	376.8	L-1	S
$\bar{x}$=3.73		$\bar{x}$=338.95		

TW1 X TT1	
6.20 X 6.50	L-1
6.85 x 5.60	NF 3181
8.20 x 8.20	L-2
$\bar{x}$=7.08 x 6.77	

BL:BW		BL:BT1	
5.37:1	NF 3181	29.31:1	L-2
5.59:1	L-1	37.41:1	NF 3181
6.63:1	L-2	41.96:1	L-1
$\bar{x}$=5.83:1		$\bar{x}$=36.23:1	

BW:BT1		BL:TW1	
5.24:1	NF 3181	14.74:1	NF 3181
6.33:1	L-1	18.27:1	L-1
6.70:1	L-2	20.73:1	L-2
$\bar{x}$=6.09:1		$\bar{x}$=17.91:1	

BW:TW1		TL:BL	
2.74:1	NF 3181	2.98:1	NF 3181
2.76:1	L-1	3.33:1	L-1
3.71:1	L-2	$\bar{x}$=3.15:1	
$\bar{x}$=3.07:1			

TL:BW		TL:BT1	
15.98:1	NF 3181	111.30:1	NF 3181
22.04:1	L-1	139.56:1	L-1
$\bar{x}$=19.01:1		$\bar{x}$=125.43:1	

TL:TW1		TL:TT1	
43.87:1	NF 3181	53.66:1	NF 3181
45.95:1	L-1	60.77:1	L-1
$\bar{x}$=44.91:1		$\bar{x}$=57.21:1	

X-S = cross section
S = square
* = incomplete

Sub-type 3a (continued)

TW1:TT1	
0.95:1	L-1
1.00:1	L-2
1.22:1	NF 3181
$\bar{x}$=1.09:1	

Sub-type 3b n=1 (Indian Point-c)

BL	BW	
126.4	20.9	
BT1	**TL**	**X-S**
N.A.	7.90*	R

TW1 x TT1
5.35 (diameter)

BL:BW	BL:TW1	BW:TW1
6.05:1	23.63:1	3.91:1

Sub-type 3c: Projectile Points Made by the British Navy n=1

BL		BW	BT1
120.0		23.0	3.80
TL	**X-S**	**TW1 x TT1**	
41.30*	S	4.0 x 3.4	
BL:BW		**BL:BT1**	**BW:BT1**
5.20:1		31.58:1	6.05:1
BL:TW1		**TL:BL**	**TL:BW**
30.0:1		0.34:1	1.80:1
TL:TW1		**TL:TT1**	**TW1:TT1**
10.32:1		12.15:1	1.18:1

X-S = cross section
S = square
R = round
* = incomplete

Type 4: Toggling Harpoons n=1 (VIIIA-71)

BL	BW	BT1
23.5	41.9	1.5

TL	X-S	TW1 X TT1
N.A.	F	12.0 X 1.5

BL:BW	BL:BT1	BW:BT1
0.56:1	15.67:1	27.93:1

BL:TW1	BW:TW1	BL:TT1
1.96:1	3.49:1	15.67:1

BW:TT1	TW1:TT1
27.93:1	8.00:1

X-S = tang cross section
F = flat
N.A. = not available

KEY
DiAp:3 = Boyd's Cove
DiAq:1 = Inspector Island
DfAw:1 = Wigwam Brook
PP = Pope's Point
IP = Indian Point
SL = (uncatalogued) Sandy Lake
L-1 = uncatalogued projectile point at Museum
L-2 = " " " " "
L-3 = " " " " "

TABLE 3: DIAGNOSTIC PROJECTILE POINT PREFORMS (mm.)

Type 1

DiAp:3:1236 Blade: 54.75 x 17.0 x 3.45
Tang: 32.55 x 8.3 x 4.85
7.95 x 3.8
square cross section

NF 3167 Blade: 75.5 x 10.1 x 1.5
Tang: 49.2 x 5.2 x 3.9
4.8 x 4.9
3.0 x 2.85
irregular cross section

Type 2

DiAp:3:2422 Blade: 45.5 x 9.4 x 0.9
Tang: 7.3 x 3.6 x 5.2

NF 3180 Blade: 107.0 x 11.4 x 1.5
Tang: 2.35 (wide) x 2.9
square cross section

DfAw:1:74 Blade: 76.1 x 15.78 x 4.31
Tang: 1.54 x 4.54 x 4.07
square cross section

Pope's Point (DfBa:1): Plate 16:
-g Blade: 51.0 x 8.8
Tang: 41.76 x 4.21
cross section shape unknown

-k Blade: 20.0 x 4.1
Tang: 104.25 x 3.4
cross section shape unknown

Type 1/4 (?)

DiAq:1:815 Blade: 68.3 x 31.7 x 4.55
Tang: 10.5 x 15.6 x 5.2
flat cross section

Type 4

DfAw:7:95 Blade: 43.98 x 31.53 x 4.86
Blade edges: 46.04, 42.26
Tang: 16.76 x 10.87 x 3.88

TABLE 4: INDIVIDUAL IRON ASSEMBLAGES: Nails Are Handmade Wrought Iron Types Except Where Otherwise Indicated

Table 4a: Total Boyd's Cove (DiAp:3) Iron n=1712

Nail fragments (with heads)	402
Nail shaft fragments	363
Unidentified fragments	338
Complete nails	219
Modified nail fragments	83
" nail shafts	69
" iron fragments	47
Projectile points/fragments	36
Fishhooks	21
Knife fragments	20
Nail fragments*	16
Modified complete nails	15
Strip iron	13
Trap dogs?	12
Cast iron fragments	9
Modified nail heads	8
Rod iron fragments	8
Cut nails	4
Modified strip	3
" fishhooks	3
Axe fragments	2
Shot	2
Wire	2
Tin fragments	2
Awls	2
Trap parts	2
Chain links	1
Projectile point preforms	1
Modified knife fragments	1
Gaffs	1
Saw blade fragments	1
Hinge fragments	1
Adze "	1
Buttons	1
Sheet fragments	1
Hoop "	1
Buckles	1
Total	1712

Boyd's Cove Nails

Complete	219
Fragments (with heads)	402
Shaft fragments	363
Fragments*	16
Cut	4
Modified fragments (with heads)	83
" heads	8
" shafts	69
Total nails/fragments	1179

* presence or absence of heads is not indicated

Table 4b: Total Inspector Island (DiAq:1) Iron n=291

Nail shafts	66
Unidentified fragments	36
Nail fragments (with heads)	33
Truncated nails	32
Complete nails	31
Nail heads	21
Modified nail fragments (with heads)	15
Modified nail shafts	12
Cast fragments	9
Projectile point fragments/ preforms	5
Cut nails	5
Modified complete nails	4
Trap dogs?	4
Projectile point fragments	1
" " preforms	1
Clinched nails	1
Hinge fragments	1
Rod fragments	1
Fishhooks	1
Axe fragments	1
Modified iron	1
Awls	1
Total	282

Nails

Shaft fragments	66
Fragments (with heads)	33
Truncated	32
Complete	31
Heads	21
Cut	5
Modified nail fragments (with heads)	15
Modified shafts*	13
Modified complete	4
Total	220

* including one awl/ recycled nail shaft

Table 4c: Total Beaches (DeAk:1) Iron n=19

Sheet fragments	11
Wrought nail fragments	7
projectile points	1
Total	19

Table 4d: Total Fox Bar Burial (DeAk:2) Iron* n=54

Knife fragments	13
Projectile points/fragments	9
Rod fragments	8
Modified fragments/ European tool fragments	7
Unidentified Fragments	5
Projectile point preforms/ fragments	4
Nail fragments	3
Sheet fragments	3
Trap parts	2
Rust fragments	2
Axes	1
Total	57

* very corroded collection

Table 4e: Total Pope's Point (DfBa:1) Iron n=18

Awls	8
Knife fragments	5
Projectile points	1
" point preforms	3
Modified Axe fragments	1
Total	18

Table 4f: Total Indian Point (DeBd:1) Iron n=16

Nails/spikes	5
Projectile points	3
Modified fishhooks	2
" axe heads	1
" bar/trap parts	1
Cast fragments	1
Knife fragments	1
Trap fragments (unmodified)	1
Hinge fragments	1
Total	16

Table 4g: Total Wigwam Brook (DfAw:1) Iron n=130

Wrought nails/fragments	41
Unidentified fragments	35
Sheet fragments	15
Strip "	13
Projectile point preforms	7
Cast fragments	3
Projectile points	2
Modified nail shafts	2
Scissors fragments	2
Jack-plane irons	2
Cut nails	1
Clasp knife fragment	1
Modified axe head	1
Large hook/handle	1
Tong arm	1
Chain/turn buckle swivel	1
Book clasp	1
Kettle lug/bale fastener	1
Total	130

Table 4h: Distribution of European Iron Objects

Objects	Sites
Wrought nails/spikes	BC, B, II, IP, WB, FB
Axes	BC, II, IP, WB, FB, PP
Knives/fragments	BC, IP, WB, FB, PP
Cast iron fragments	BC, II, IP, WB
Sheet iron fragments	BC, II, B, WB
Rod iron fragments	BC, II, IP, FB
Fur trap fragments	BC, II, B, IP
Chain links	BC, II, WB
Fishhooks	BC, II, IP
Machine cut nails	BC, II, WB
Hinges/fragments	BC, II, IP
Strip iron fragments	BC, WB
Bar iron	BC, II
Wire	II
Tin fragments	II
Gaffs	BC
Saw blade fragments	BC
Adzes	BC
Buttons	BC
Scissors	WB
Book clasps	WB
Tong arms	WB
Jack planes	WB

Key
BC= Boyd's Cove IP= Indian Point B= Beaches
II= Inspector Island WB= Wigwam Brook PP= Pope's Point

FIGURES

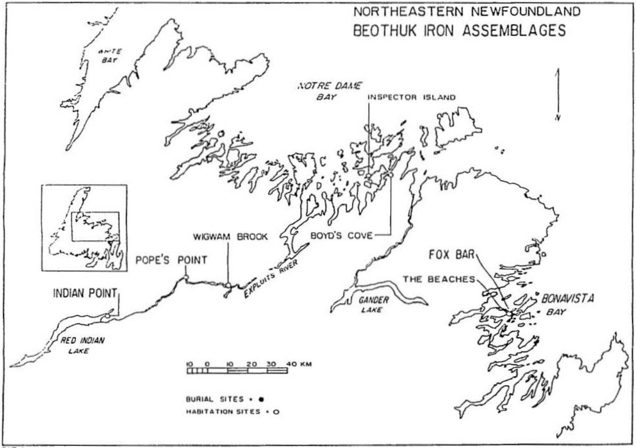
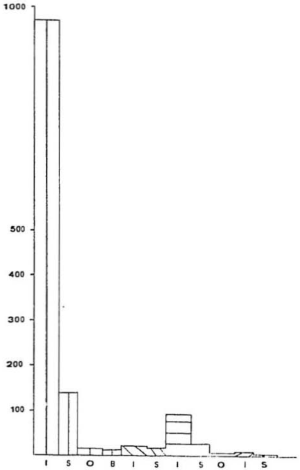

NORTHEASTERN NEWFOUNDLAND
BEOTHUK IRON ASSEMBLAGES
NOTRE DAME BAY
INSPECTOR ISLAND
N
BOYD'S COVE
WIGWAM BROOK
POPE'S POINT
EXPLOITS RIVER
INDIAN POINT
RED INDIAN LAKE
GANDER LAKE
FOX BAR
THE BEACHES
BONAVISTA BAY
10 0 10 20 30 40 KM
BURIAL SITES • ●
HABITATION SITES • O

FIG 1

BEOTHUK HOUSEPIT ASSEMBLAGES

FIG 2



I = IRON

S = STONE

O = OTHER METALS

B = BONE

|| BOYD'S COVE

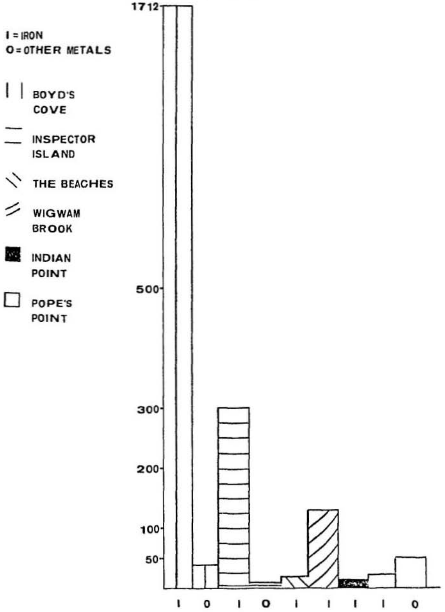
\ THE BEACHES

= INSPECTOR ISLAND

// WIGWAM BROOK

BEOTHUK IRON, OTHER METAL ASSEMBLAGES

FIG. 3



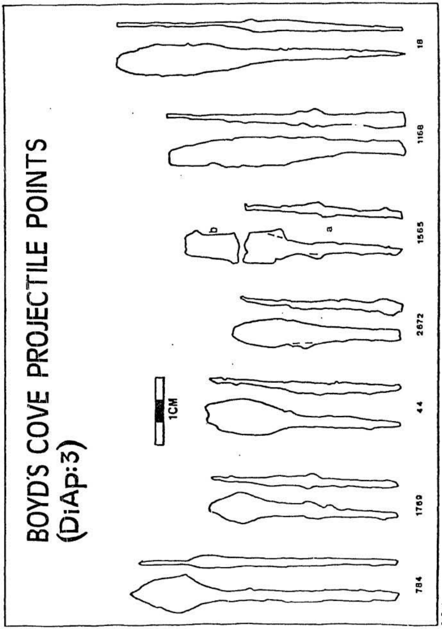

BOYD'S COVE PROJECTILE POINTS
(DiAp:3)
1CM
18
1158
1565
a
b
2672
44
1769
784

FIG 4

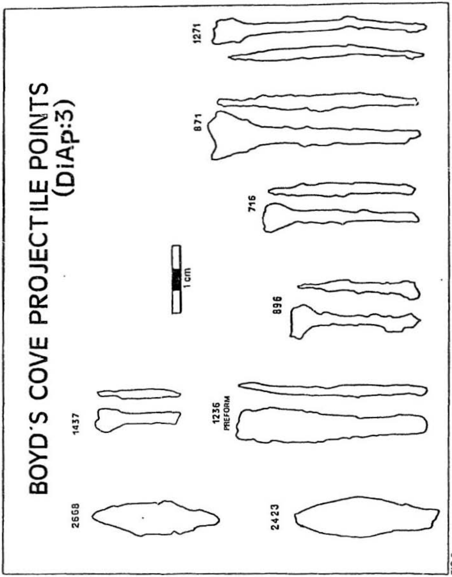

BOYD'S COVE PROJECTILE POINTS
(DiAp:3)
2668
1437
2423
1236
PREFORM
896
1 cm
716
871
1271

FIG 5

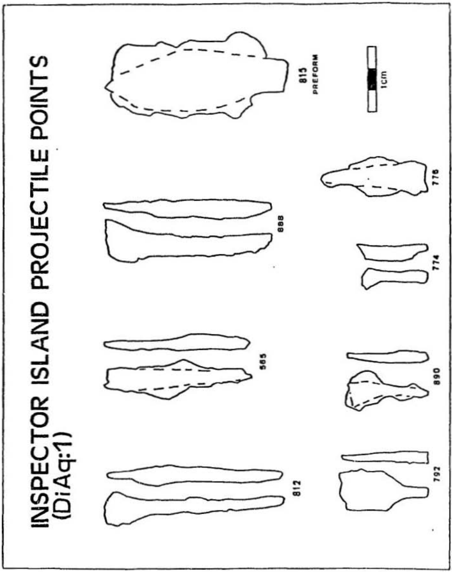

INSPECTOR ISLAND PROJECTILE POINTS
(DiAq:1)
815
PREFORM
1cm
888
776
585
774
890
812
792

FIG 6

INTERIOR PROJECTILE POINTS

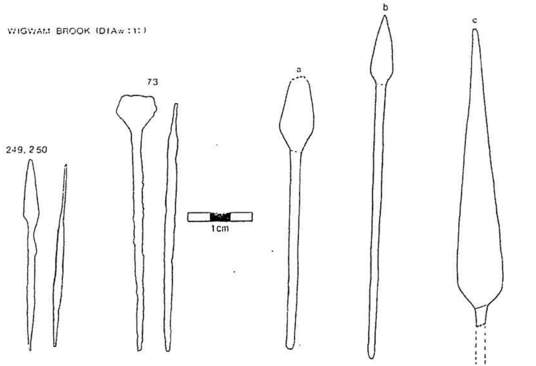


FIG 7

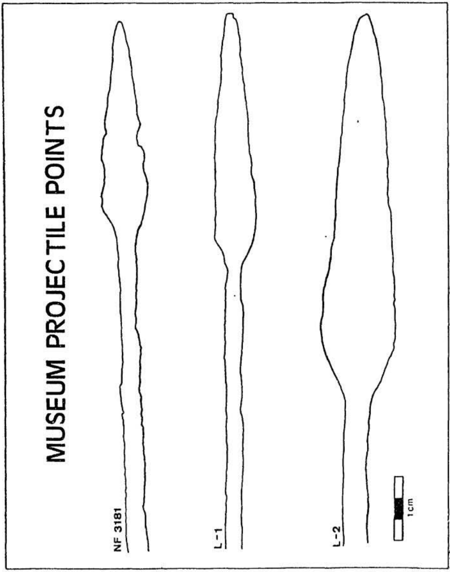


FIG 8

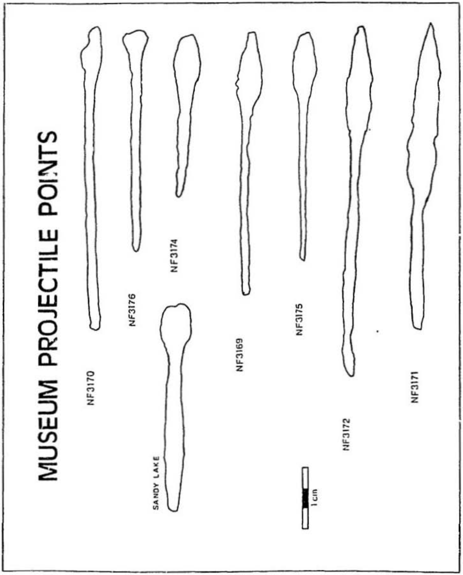

MUSEUM PROJECTILE POINTS
NF3170
NF3176
NF3174
SANDY LAKE
NF3169
NF3175
NF3172
NF3171
1 cm

FIG 9

POPE'S POINT PROJECTILE POINTS
(DfBa:1)

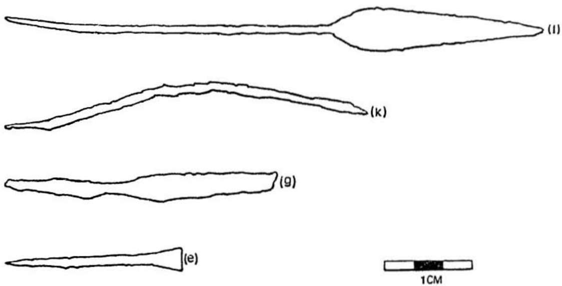


FIG 10

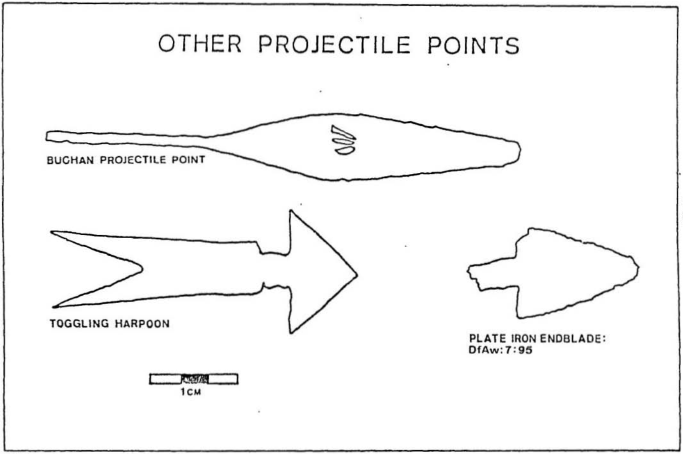

OTHER PROJECTILE POINTS
BUCHAN PROJECTILE POINT
TOGGLING HARPOON
PLATE IRON ENDBLADE:
DfAw:7:95
1CM

FIG 11

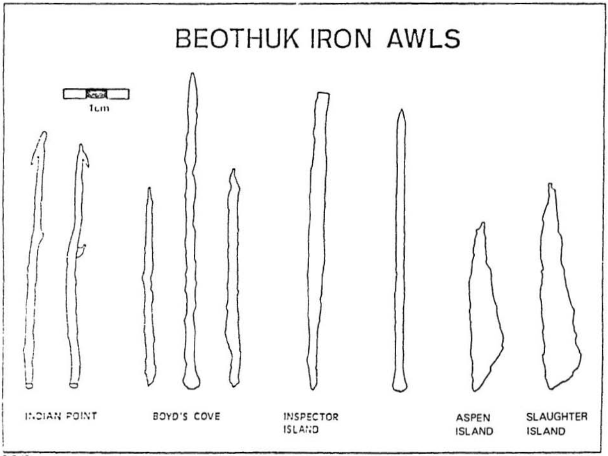

BEOTHUK IRON AWLS
1cm
INDIAN POINT
BOYD'S COVE
INSPECTOR ISLAND
ASPEN ISLAND
SLAUGHTER ISLAND

FIG 12

Key to Figures # 13-23

□	Type 1a coastal
⧄	Type 1a interior
■	Type 1b interior
○	Type 2a coastal
●	Type 2b interior
⊘	Type 2c interior
▲	Type 3a interior
▼	Type 3b interior
★	Type 3c interior
✸	Type 4 interior

BLADE LENGTH : BLADE WIDTH n=18

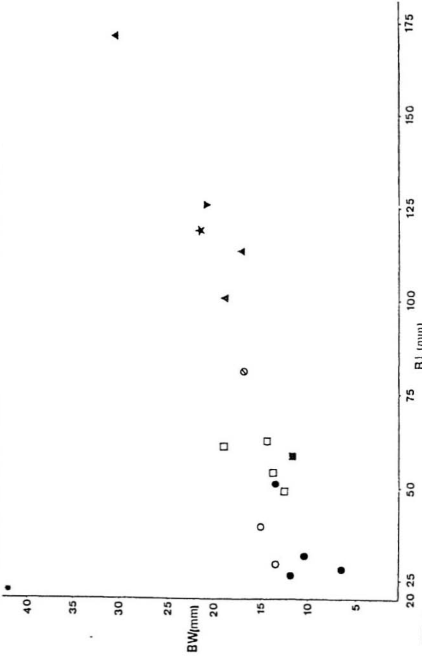


FIG. 13

BLADE LENGTH: BLADE THICKNESS n=15

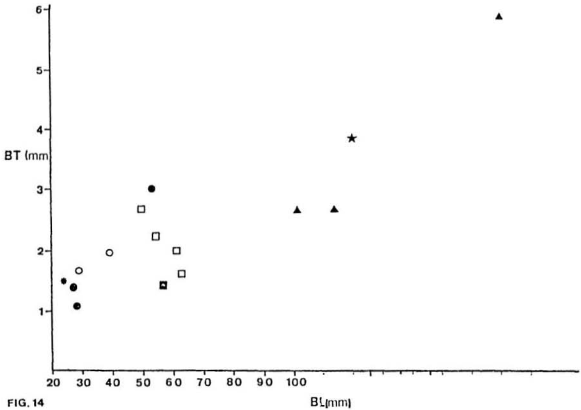


FIG. 14

BLADE WIDTH: BLADE THICKNESS n=25

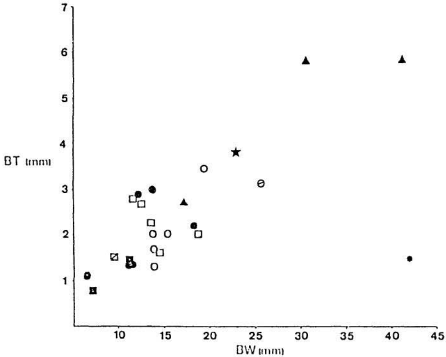


FIG. 15

BLADE LENGTH : TANG WIDTH n=17

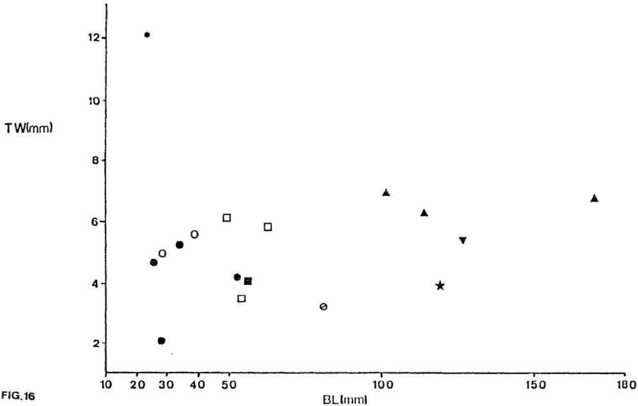


FIG.16

BLADE WIDTH : TANG WIDTH n=28

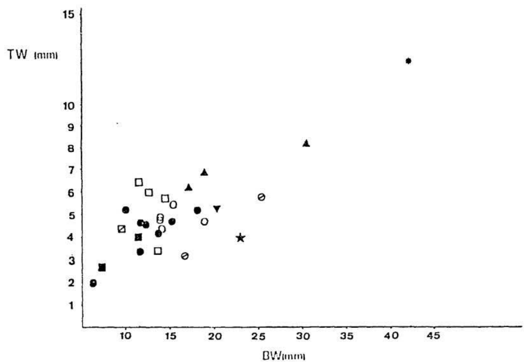


FIG. 17

TANG LENGTH : BLADE LENGTH $_{n=11}$

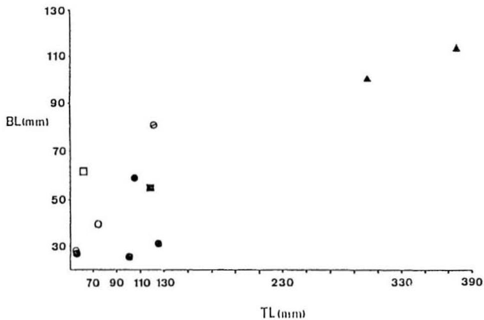


FIG. 18

TANG LENGTH:BLADE WIDTH n=18

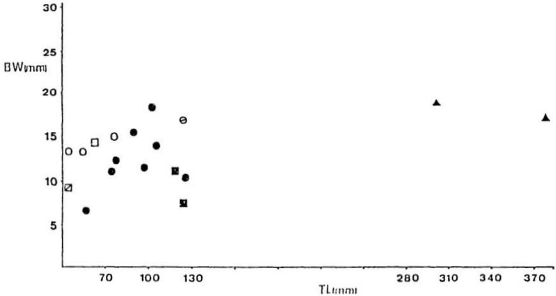


FIG. 19

TANG LENGTH:BLADE THICKNESS n=15

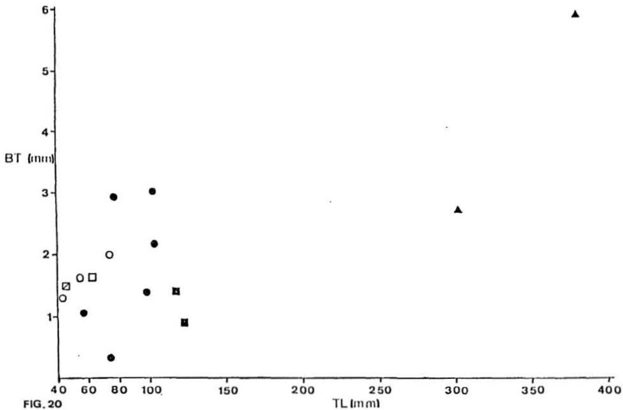


FIG. 20

TANG LENGTH:TANG WIDTH $_{n=19}$

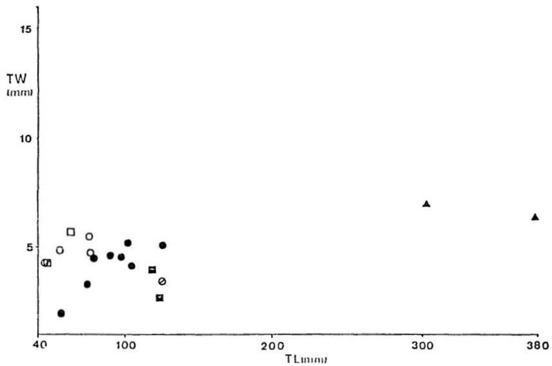


FIG. 21

TANG LENGTH:TANG THICKNESS n=16

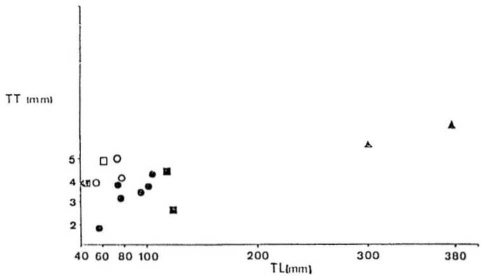


FIG. 22

TANG WIDTH: TANG THICKNESS n=25

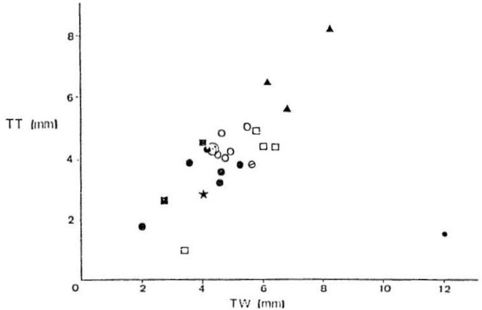


FIG. 23

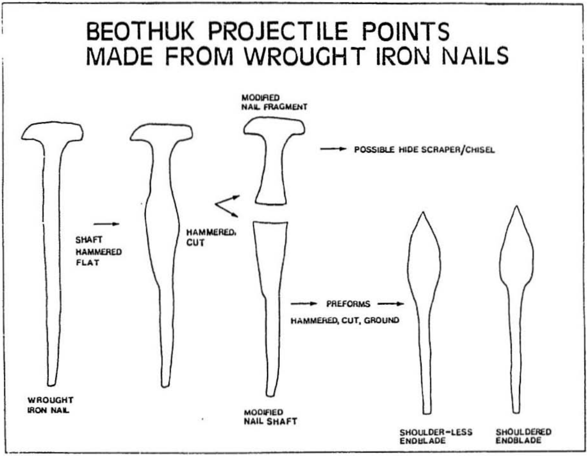

BEOTHUK PROJECTILE POINTS
MADE FROM WROUGHT IRON NAILS
MODIFIED
NAIL FRAGMENT
POSSIBLE HIDE SCRAPER/CHISEL
SHAFT
HAMMERED
FLAT
HAMMERED,
CUT
PREFORMS
HAMMERED, CUT, GROUND
WROUGHT
IRON NAIL
MODIFIED
NAIL SHAFT
SHOULDER-LESS
ENDBLADE
SHOULDERED
ENDBLADE

FIG 24

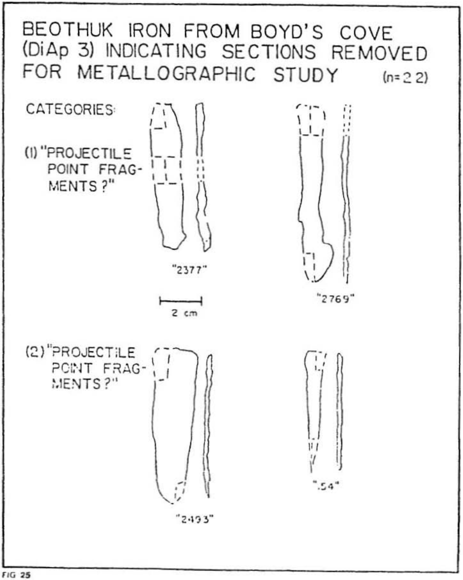

BEOTHUK IRON FROM BOYD'S COVE (DiAp 3) INDICATING SECTIONS REMOVED FOR METALLOGRAPHIC STUDY (n=22)
CATEGORIES:
(1) "PROJECTILE POINT FRAGMENTS?"
"2377"
"2769"
2 cm
(2) "PROJECTILE POINT FRAGMENTS?"
"2493"
".54"

FIG 25

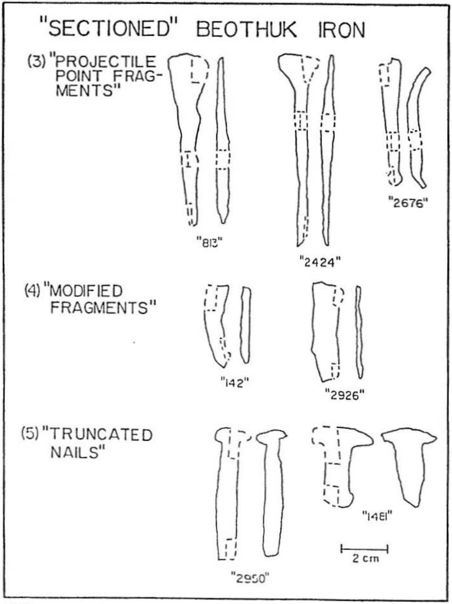

"SECTIONED" BEOTHUK IRON
(3) "PROJECTILE POINT FRAGMENTS"
"813"
"2424"
"2676"
(4) "MODIFIED FRAGMENTS"
"142"
"2926"
(5) "TRUNCATED NAILS"
"2950"
"1481"
2 cm

FIG 26

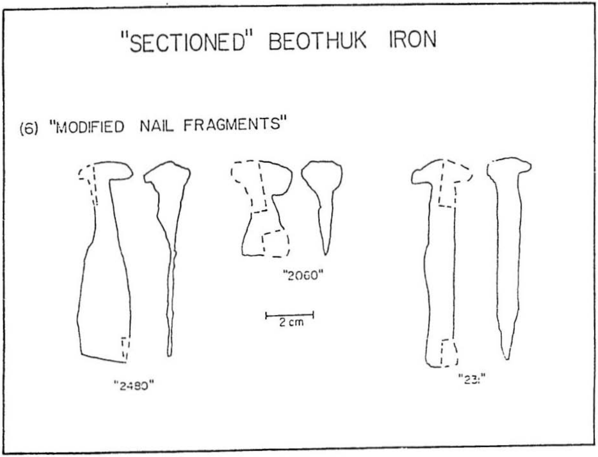

"SECTIONED" BEOTHUK IRON
(6) "MODIFIED NAIL FRAGMENTS"
"2480"
"2060"
2 cm
"23"

FIG 27

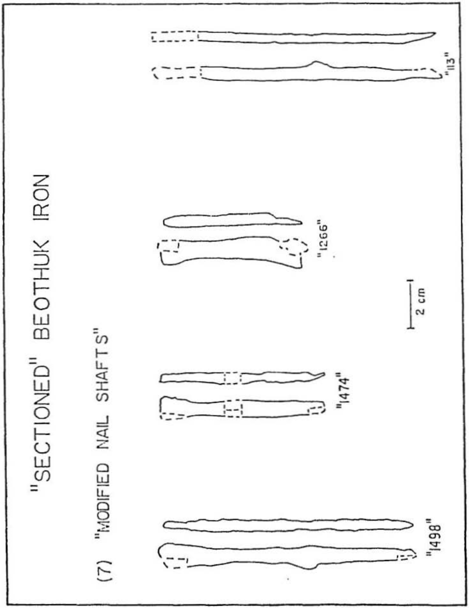

"SECTIONED" BEOTHUK IRON
(7) "MODIFIED NAIL SHAFTS"
"1498"
"1474"
"1266"
"113"
2 cm

FIG 28

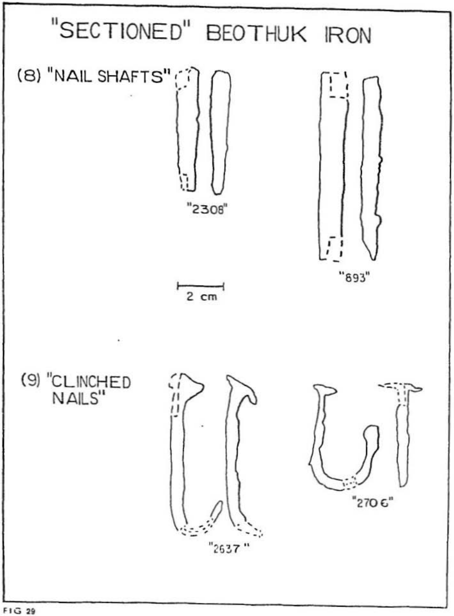

"SECTIONED" BEOTHUK IRON
(8) "NAIL SHAFTS"
"2308"
"893"
2 cm
(9) "CLINCHED NAILS"
"2706"
"2637"

FIG 29

FIG 30 DISTRIBUTION OF BOYD S'COVE IRON: HOUSE I (n=316)

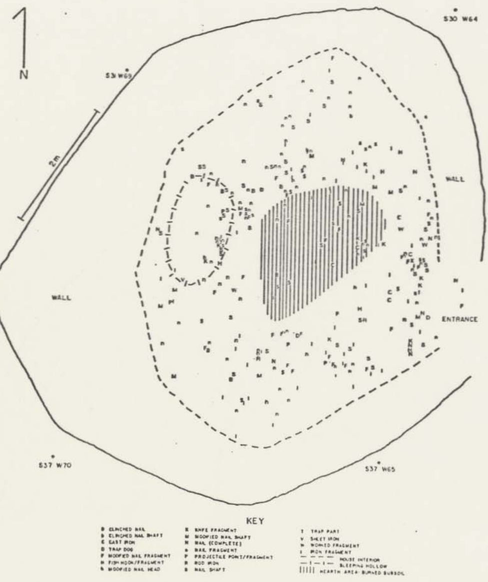


FIG 31 DISTRIBUTION OF BOYD S' COVE IRON: HOUSE 3 (n=254)

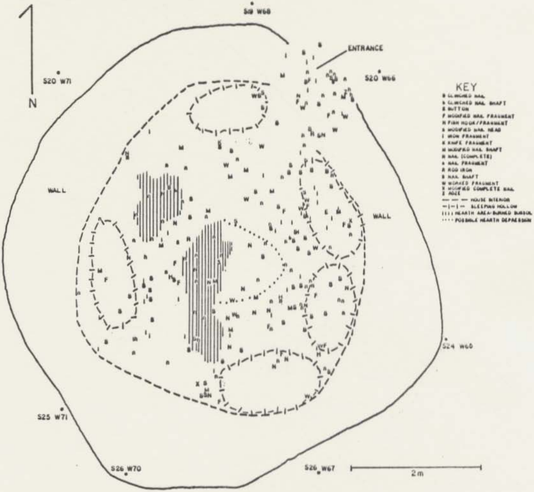


FIG 32 DISTRIBUTION OF BOYD'S COVE IRON: HOUSE 4 (n=227)

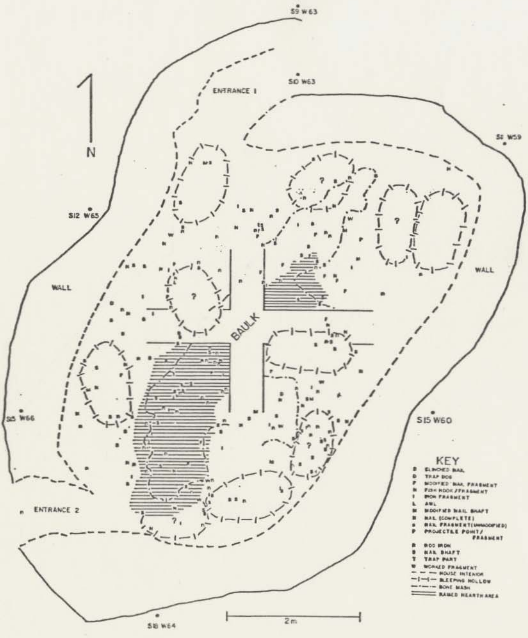
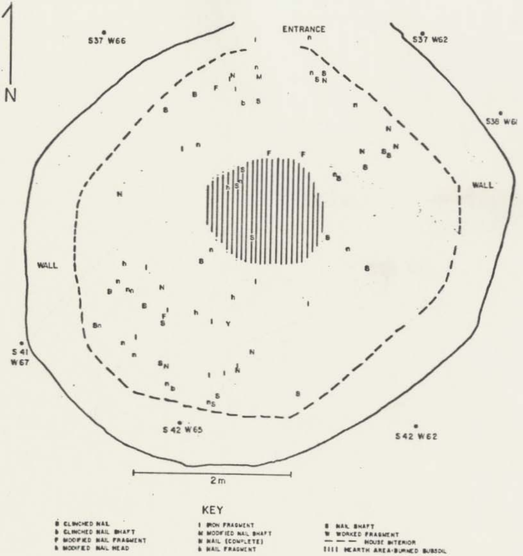


FIG 33

DISTRIBUTION OF BOYD'S COVE IRON: HOUSE II (n=77)



DISTRIBUTION OF WIGWAM BROOK ARTIFACTS:
FEATURES 10, 14; HOUSEPIT (LEBLANC 1973) n=26

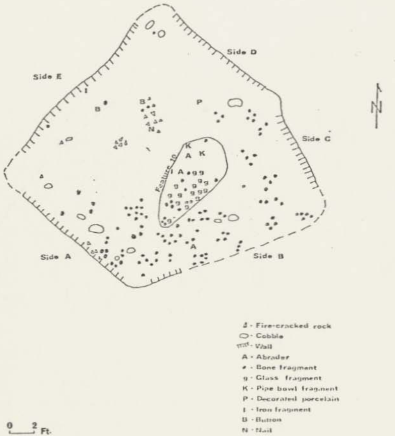


FIG 34

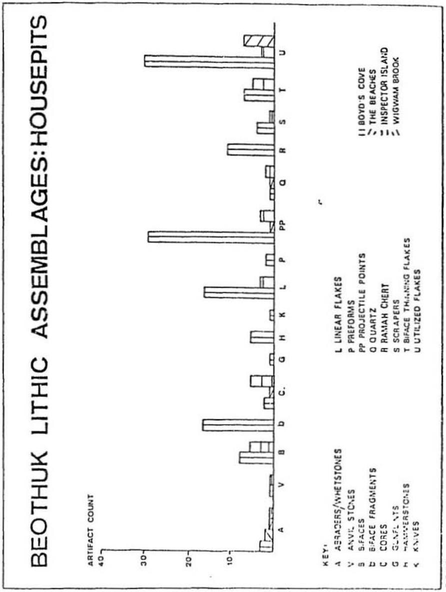

BEOTHUK LITHIC ASSEMBLAGES: HOUSEPITS
ARTIFACT COUNT
40
30
20
10
A
V
B
b
C.
G
H
K
L
P
PP
Q
R
S
T
U
KEY:
A ABRADERS/WHETSTONES
V ANVIL STONES
B BIFACES
b BIFACE FRAGMENTS
C CORES
G GUNFLINTS
H HAMMERSTONES
K KNIVES
L LINEAR FLAKES
P PREFORMS
PP PROJECTILE POINTS
Q QUARTZ
R RAMAH CHERT
S SCRAPERS
T BIFACE THINNING FLAKES
U UTILIZED FLAKES
BOYD'S COVE
THE BEACHES
INSPECTOR ISLAND
WIGWAM BROOK

FIG 35

PLATES

Plate 1: Boyd's Cove Projectile Points

A.	DiAp:3:	18 -	Type	1a
B.	"	1168 -	"	"
C.	"	2672 -	"	"
D.	"	44 -	"	2a
E.	"	1565A -	"	"
F.	"	784 -	"	2a
G.	"	1769 -	"	"


A
B
C
D
E
F
G
1 cm

Plate 2: Boyd's Cove Projectile Points/Preforms

A.	DiAp:3:1236	–	Type 1 Preform
B.	" 2422	–	" 2 "
C.	" 2668	–	Type 1a
D.	" 2423	–	" "
E.	" 1437	–	Preform
F.	" 896	–	"
G.	" 716	–	"
H.	" 871	–	"
I.	" 1271	–	Type 2a

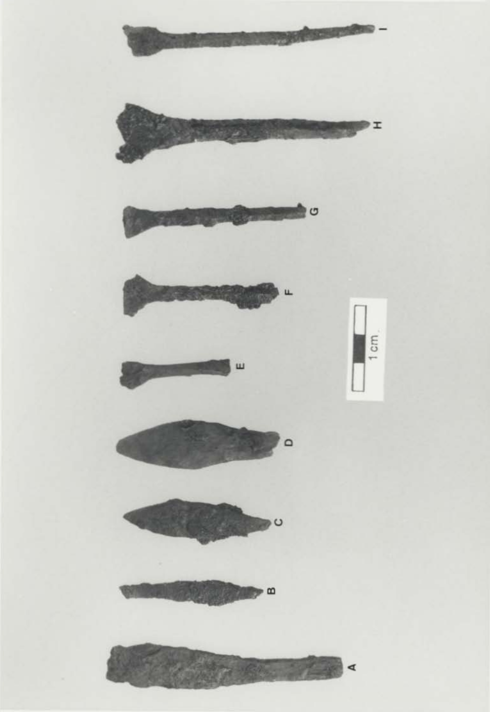

A
B
C
D
E
F
G
H
I
1 cm.

Plate 3: Inspector Island Projectile Points/Preforms

A.	DiAq:1:815	-	Type 1/Type 4 Preform
B.	"	888 -	Preform/Fragment
C.	"	812 -	" "
D.	"	565 -	" "
E.	"	792 -	Type 2a
F.	"	930 -	Blade Fragment
G.	"	771 -	Preform/Fragment


A
B
C
D
E
F
G
1 cm

Plate 4: Wigwam Brook Projectile Points/Preforms

A.	DfAw:1:249, 250	-	Type	2b	
B.	" 73	-	"	"	
C.	" 217	-	"	2c	Preform
D.	" 74	-	"	2	"
E.	" 79	-			"
F.	" 77	-			"
G.	" 75	-			"
H.	" 76	-			"
I.	" 80	-			"
J.	" 78	-			"

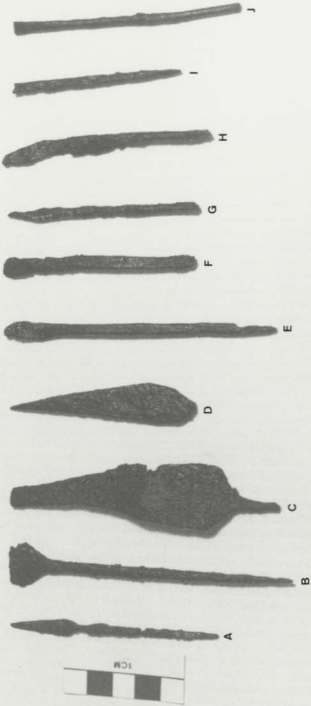

1CM
A
B
C
D
E
F
G
H
I
J

Plate 5: Newfoundland Museum Projectile Points

A. L-2	-	Type 3a
B. L-1	-	" "
C. NF 3181	-	" "

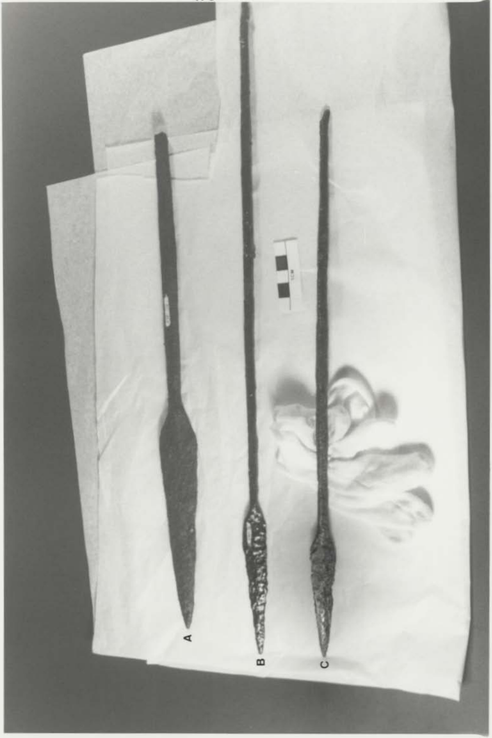

A
B
C

Plate 6: Newfoundland Museum Projectile Points

A. NF 3176 - Preform/Fragment
B. NF 3166 - "
C. NF 3171 - Type 2c
D. NF 3170 - Type 1b
E. Sandy Lake Example - Type 2b
F. NF 3174 - Type 1a

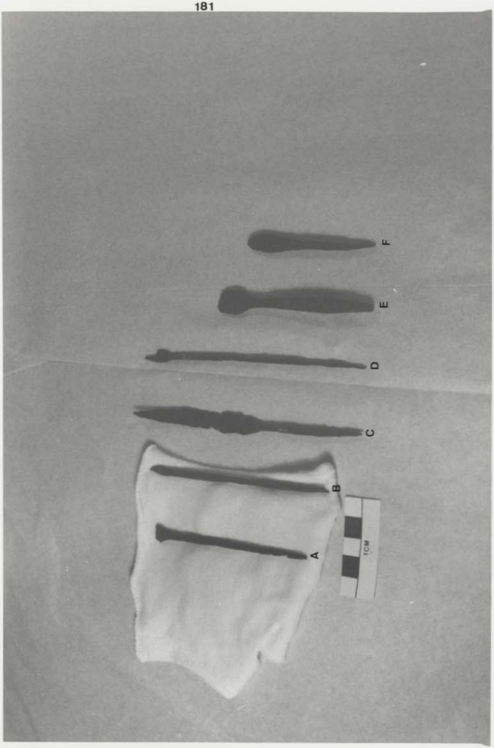

A
B
C
D
E
F
1CM

Plate 7: Newfoundland Museum Projectile Points

A. NF 3169 - Type 2b
B. L-3 - " "

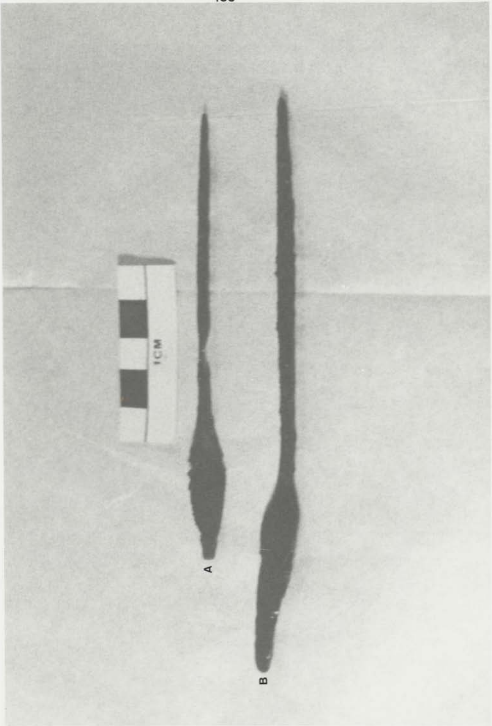

1CM
A
B

Plate 8: Newfoundland Museum Projectile Point Preforms

A. NF 3180 - Type 2
B. NF 3167 - " 1

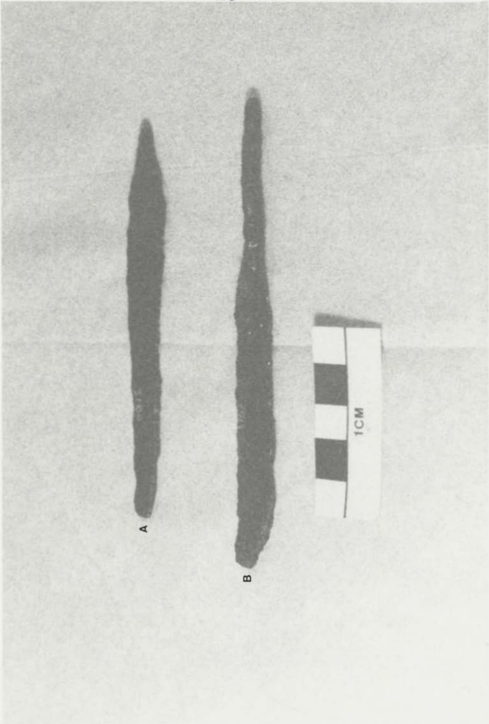

A
B
1CM

Plate 9: Buchan's Projectile Point:
Type 3c

Plate 10: Toggling Harpoon
Type 4

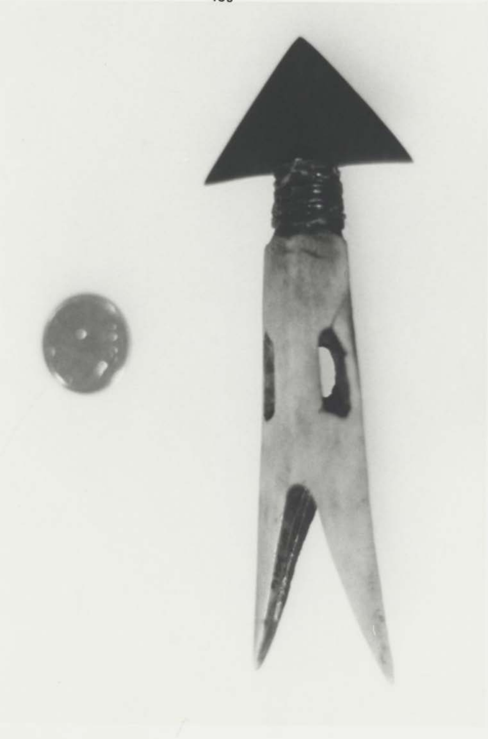


Plate 11: Hopps Site Projectile Point

Plate 12: Beothuk Iron Awls

A. DiAp:3:2652
B. " 843
C. " 793
D. DiAq:1: 610


A
B
C
D
1 cm

Plate 13: Newfoundland Museum Awl:
Modified Fishhook

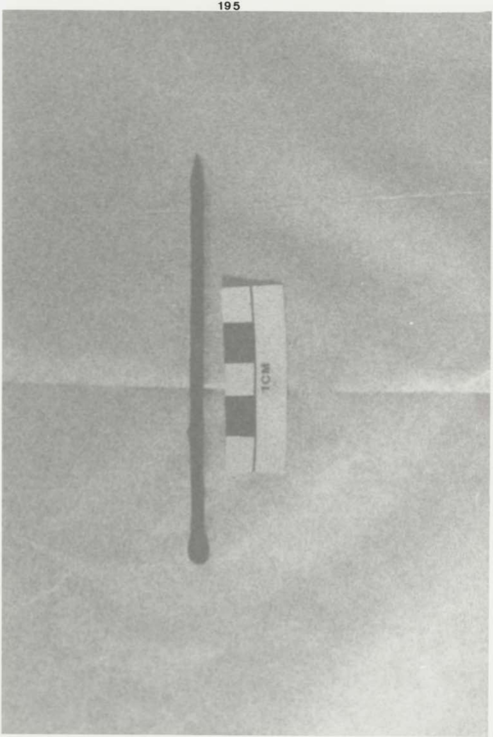

1CM

Plate 14: Modified Nail Fragments

A.	DiAp:3:	2105
B.	"	2108
C.	"	23
D.	"	217
E.	"	2407
F.	"	904
G.	"	2078


A
B
C
D
E
F
G
1 cm

Plate 15: Modified Complete Nails

A. DiAp:3:2440 AB
B. DiAq:1: 900
C. DiAp:3:2604


A
B
C
1 cm

Plate 16: Unusually-worked Nails

A. DiAp:3: 80
B. " 1532
C. " 718


A
B
C
1 cm

Plate 17: Intact Fur Trap
(Gerry Penney photo)

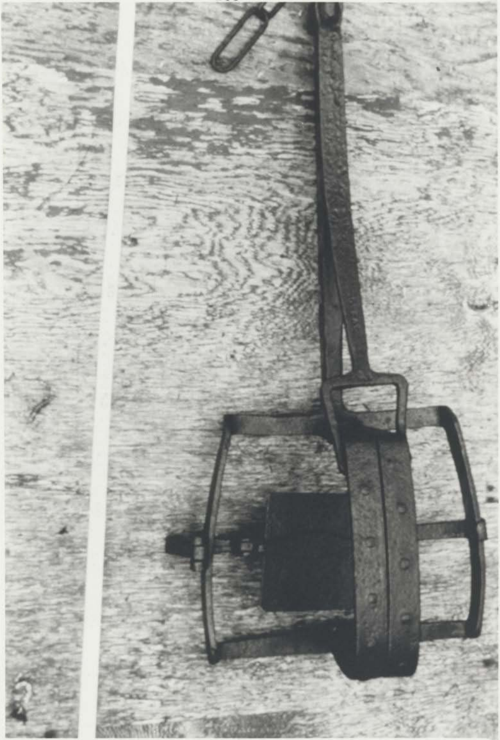
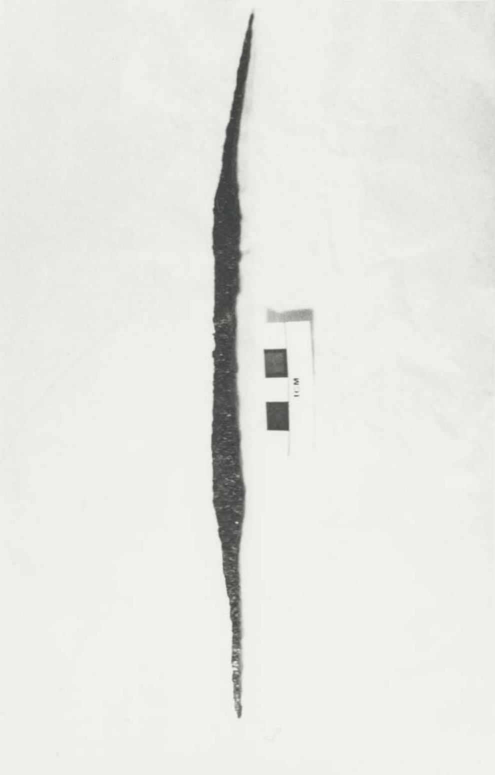


Plate 18: Newfoundland Museum Uncatalogued
Type 3 Preforms: Trap Parts

205

Plate 19: Newfoundland Museum Type 2 Preforms:
Uncatalogued (trap part)



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APPENDICES

Appendix A: Beothuk Vocabularies

Publisher	European Term	Beothuk Equivalent
Clinch	fishing line	dis-up
	gun*	harreen
	hatchet*	now-aut
	iron*	mou-a-gee-ne
	nails*	cush
	pin*	tus-meg
	shoot a gun	hod-thoo
	spoon*	han-a-mait
	trap/gin*	iib-e-mait
	twine/thread	me-roo-pish
Leigh	bonnet	aboddnec
	buttons/money	agamet
	blankets	manavorit
	cattle (cows, horses)	nethabeat
	cat (domestic)	abidesook
	candle	shaboth
	cream jug	motheryet
	dog	mammasmeet
	drawing knife*	momeshawdet
	fish hook*	adothook
	fishing line	edot
	fork*	ethewroit
	gimlet*	quadranuck
	glass	hadibiet
	gun*	adamadret
	gun powder	beasothunt
	hammer*	mattesis
	hatchet*	thingaya
	hoop*	woin
	iron*	mowageenite
	lead	goosheben
	nails*	quish
	net	giggarimanet
	puppies	mammasaveet
	sails	ejabathook
	saw*	deddoweet
	scissors*	osegeeu
	shovel*	godawick
	silk hankerchief	egibiduish
	spoon*	adadiminte
	stockings	gasset
	sword*	bidisoni
	thread	merrobish
	trap*	shebathoont
	trousers	mowead

King	bread	annaahadya
	cap	eeseeboon
	large boat	dhoorad
	tobacco	nechwa
	tea	butterweye
	white boy	bubbishamesh

* = iron objects (n=15)

__*__ = objects made of iron or other metals (n=2)

Appendix B: Hopps Site (BkCp:1) Artifacts

Projectile Points (mm.)

Paris #	BL	x	BW	TL	x	TW	BL/BW	BL/TW	BW/TW
53960a	106.00	x	20.00	–		–	5.30/1		
153961	114.15	x	24.10	18.45	x	11.40	4.74/1	10.01/1	2.11/1
59594b	132.85	x	30.80	19.55	x	17.00	4.31/1	7.81/1	1.81/1
59625	136.90	x	26.30	12.10	x	8.90	5.21/1	15.38/1	2.96/1
59621	150.65	x	31.65	28.85	x	11.50	4.76/1	13.10/1	2.75/1
53957	153.00	x	29.50	23.70	x	8.10	5.19/1	18.89/1	3.64/1
59623c	152.85	x	26.75	22.85	x	9.40	5.71/1	16.26/1	2.85/1
59620	153.15	x	31.90	18.80	x	7.80	4.80/1	19.63/1	4.09/1
59596	154.30	x	27.80	17.85	x	10.90	5.55/1	14.16/1	2.55/1
59610	154.90	x	29.60	25.15	x	13.00	5.23/1	11.92/1	2.28/1
59622	155.85	x	29.30	21.00	x	6.90	5.32/1	22.59/1	4.25/1
59611	156.85	x	34.20	26.85	x	11.10	4.59/1	14.13/1	3.08/1
53962d	157.00	x	30.00	21.00	x	9.55	5.23/1	16.44/1	3.14/1
59598	159.30	x	30.60	18.60	x	18.60	5.21/1	8.56/1	1.65/1
59626	161.75	x	26.40	16.40	x	10.85	6.13/1	14.91/1	2.43/1
53959	162.00	x	25.00	23.00	x	10.00	6.48/1	16.20/1	2.50/1
59627	164.55	x	32.90	16.90	x	9.80	5.00/1	16.79/1	3.36/1
59619	166.80	x	29.70	20.40	x	9.30	5.62/1	17.94/1	3.19/1
53956d	167.35	x	27.15	18.75	x	9.45	6.16/1	17.71/1	2.87/1
59628d	167.55	x	32.80	17.40	x	13.95	5.11/1	12.01/1	2.35/1
59593	167.85	x	31.10	21.35	x	9.60	5.40/1	17.48/1	3.24/1
53247	171.00	x	36.95	?	x	9.80	4.63/1	17.45/1	3.77/1
59595d	172.60	x	31.70	28.10	x	8.00	5.44/1	21.57/1	3.96/1
53963	180.85	x	31.25	20.85	x	11.80	5.79/1	15.33/1	2.65/1
x=	155.00	x	29.48	20.81	x	10.77	5.29/1	15.49/1	2.93/1

Key
a = non-shouldered blade
b = blade with one shoulder missing
c = intact blade
d = blades with intact lengths

(All other examples are missing tip portions and varying amounts of their maximum widths.)

Adjusted means for more complete artifacts.

Blade length:	n=5;	x=163.47
BL/BW:	n=5	x= 5.53/1
BL/TW1:	n=5	x= 16.80/1

Modified Spike

Paris #	Length mm	Width (at tip)mm	Width (below head)mm
59644	365.0	40.0	12.0

Appendix C:
Metallographic Analysis of Beothuk Iron Artifacts

METALLURGICAL INVESTIGATION OF MODIFIED IRON AND STEEL IRON OBJECTS OF EUROPEAN ORIGIN FROM A BOETHUK INDIAN SITE, BOYD'S COVE, NEWFOUNDLAND

by

Henry Unglik, P.Eng.

Prepared for Laurie MacLean, Memorial University, St. John's, Newfoundland

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OTTAWA

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

A large number of iron artifacts from Boyd's Cove, Newfoundland was forwarded to our laboratory for metallurgical examination (47 objects weighing about 0.7 Kg in total).

Boyd's Cove is a Boethuk Indian site dated to the late 17th and the early 18th centuries. The extinct Boethuk Indians were a mysterious tribe of aboriginal people, distinct from all other Indians. They lived in historic times in part of what is now Newfoundland, chiefly in the basin of the Exploits River and the shores of Notre Dame Bay and White Bay. In 1497, when Newfoundland, was discovered, the tribe was thought to number no more than 500 people. The last known Boethuk woman died in captivity in St. John's, Newfoundland, in 1829.

Though the bow and arrow, and the club and spear were everyday necessities for hunting and for defence, there is no evidence that the Boethuk Indians knew how to make metal. It is then of great interest to find at this site a large collection of European iron artifacts. According to Laurie MacLean, Memorial University. St. John's, Newfoundland, the site yielded about 1600 finished and semi-finished objects grouped into 23 categories, as well as modified fragments in various stages of completion of the reworking process. Half of the objects (c. 800) are wrought iron nails, about 130 of them are clearly modified, presumably by the Boethuk Indians.

The aims of this investigation are to identify and characterize the material, examine and interpret its structure, and determine what kind of technological processes were applied in the manufacture and reworking of the various iron objects. It is hoped that some light will be shed on the practices and techniques utilized by the Boethuk in modifying European iron objects into native weapons or tools, and that the findings will be instrumental in interpretation of the Boethuk Indian cultural development.

2. DESCRIPTION OF IRON OBJECTS

The objects, though visibly corrded, were for old iron in a good state of preservation. Nine different typological categories of objects were distinguished by Laurie MacLean among the forty-seven iron artifacts. The nine categories, each with artifacts of similar shape and character, are described below.

Category 1 - Projectile point fragments (Fig. 1)
Modified (flattened) objects in the form of metal strips of rectangular cross-section.

Category 2 - Blade fragments (Fig. 2).
Modified objects in the form of tapered blades with round end or sharp point (Fig. 2).

Category 3 - Tangs and basal sections of projectile points (Fig. 3).
Modified nails with square tapered shanks, extensively flattened head side of triangular shape, and often flattened point. In some of the objects the head end and the point end were clearly cut (3-2, 3-5 & 3-6). The objects 3-1, 3-2 & 3-5 were reduced by hammering about 30 to 40%, and the objects 3-3, 3-4 & 3-6 10 to 20%.

Category 4 - Anomalous modified fragments (Fig. 4).
Mainly irregular metal strips and square bars. These were very common objects at the Boyd's Cove site.

Category 5 - Truncated nails (Fig. 5).
Little modified nails with square or rectangular truncated shanks and often deformed rectanuglar heads with a spherical or flat top surface.

Category 6 - Modified nails (Fig. 6).

Nails with square shanks, extensively flattened to a thin edge (30 to 50% reduction), cut at the end, and rectangular heads with a spherical top surface.

Category 7 - Modified nail shafts (Fig. 7).

Square, tapered shanks with often flattened head side and deformed opposite side.

Category 8 - Nail shafts (Fig. 8).

Nails with removed heads, and often tapered, rectangular or square shanks. Two nails are clinched (8-6 & 8-7).

Category 9 - Clinched nails (Fig. 9).

Bent nails (likely by Europeans) with square or rectangular tapered shanks, and rectangular heads with a flat or spherical top surface.

Table 1 gives the designation of the objects, the approrimate size and the weight of the artifacts. It also refers to photographs of the objects taken at the outset of the investigation (Figs. 1-9).

TABLE 1. Description of iron objects from Boethuk site of Boyd's Cove, Newfoundland.

Category No.	No. of Objects	Code No.	Provenance No.	Size (mm)			Weight (gram)	Fig.
				Overall	Head	Point		
1	2	1-1	DiAp-3:2377	71x14x4			11.7	1
		1-2	2769	85x9x2			8.1	
2	4	2-1	2414	44x17/7x3			5.4	2
		2-2	2493	74x20/12x3			18.5	
		2-3	2610	60x14/7x3			7.7	
		2-4	154	54x9/3x2			2.6	
3	6	3-1	813	75x6x6	16x3x30*	5x3	13.8	3
		3-2	2424	82x6x5	11x3x15*	3x2	9.5	
		3-3	716	68x6x6	13x3x11*	4x4	6.6	
		3-4	2676	54x4x4	8x3x25*	5x1.5*	5.2	
		3-5	1437	41xØ5	11x2.5x17*	7x2x8*	3.9	
		3-6	2733	39x6x6	13x3x17*	5x2x8*	5.1	
4	7	4-1	142	34x7x5	11x5x13*	7x3	4.3	4
		4-2	2557	39x8x3			1.9	
		4-3	2763	35x31x4			7.1	
		4-4	2926	42x10x3	14x3x12*	8x3	4.1	
		4-5	2396	15x9x6			1.4	
		4-6	2484	29x9x2			1.2	
		4-7	2049	29x6x6			4.0	
5	7	5-1	2617	19x8x7	20x14x6		10.5	5
		5-2	2747B	41x7x4	15x11x3	12x8	7.0	
		5-3	2950	57x9x9	16x15x5		24.2	
		5-4	1481	35x11x11	30x25x8	18x11*	31.0	
		5-5	2517	30x10x8	24x21x6		19.9	
		5-6	1424	52x10x6	20x17x4	6x6	13.8	
		5-7	2359	30x7x7	19x17x8		10.8	
6	5	6-1	2480	86x10x10	26x22x7	22x3*	43.9	6
		6-2	194	37x16x9	29x25x6		29.4	
		6-3	231	89x11x11	31x23x10	14x4*	76.3	
		6-4	23	98x9x9	26x24x9	20x2.5x23*	59.4	
		6-5	2060	40x10x10	28x20x7	19x3*	30.9	
7	5	7-1	987	70x3x3	9x2.5x10*	2.5x2.5	5.0	7
		7-2	1498	105x5x5	10x2.5x30*	3x3	10.8	
		7-3	1474	68x6x6	10x5x10	5x3	8.6	
		7-4	113	116x5x3	5x2*	4x2	9.6	
		7-5	1266	59x9x3			6.0	
8	7	8-1	2306	55x11x10	11x10	7x6	22.1	8
		8-2	1470	61x9.4x5	8x5	4x3	6.2	
		8-3	2052	84x10x10			43.2	
		8-4	893	82x10x9			36.3	
		8-5	276	57x7x7			9.5	
		8-6	1178	32x6x6			3.0	
		8-7	2326	32x5x5				
9	4	9-1	2437	60x5x5	19x15x3		11.3	9
		9-2	1436	58x6x4	18x13x3		11.0	
		9-3	2381	52x4x4	16x15x3		7.9	
		9-4	2706	47x7x7	17x13x3		14.2	

*Modified

Fig. 1. Appearance of iron objects, at x 0.6.
Category 1: Projectile point fragments.

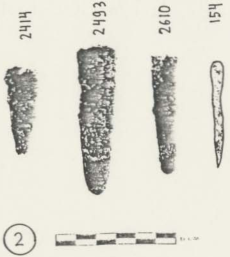


Fig. 2. Appearance of iron objects, at x 0.6.
Category 2: Blade fragments.

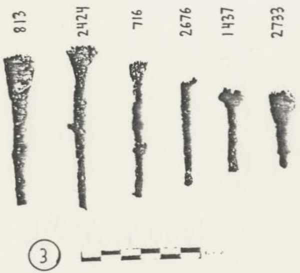


Fig. 3. Appearance of iron objects, at x 0.6. Category 3: Tangs and basal sections of projectile points.

Fig. 4. Appearance of iron objects, at x 0.6. Category 4: Anomalous modified fragments.

Fig. 5. Appearance of iron objects, at x 0.6.
Category 5: Truncated nails.

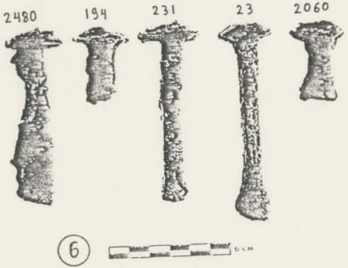


Fig. 6. Appearance of iron objects, at x 0.6.
Category 6: Modified nails.

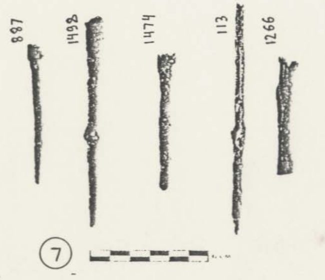


Fig. 7. Appearance of iron objects, at x 0.6.
Category 7: Modified nail shafts.

Fig. 8. Appearance of iron objects, at 0.6.
Category 8: Nail shanks

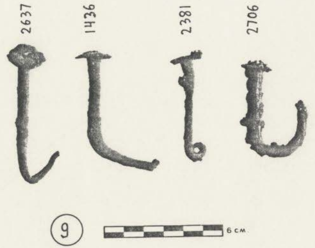


Fig. 9. Appearance of iron objects, at x 0.6.
Category 9: Clinched nails.

3. EXAMINATION PROCEDURE

Two or three typical objects were selected from each category for sectioning and metallographic examination (22 artifacts in total). The specimens for microscopic examination were cut from the artifacts using a low-speed saw with a diamond blade. Sketches of the examined objects and the location of the sections are shown in Fig. 10. After sectioning and cold-mounting in expoxide resin, the specimens were ground on four silicon carbide abrasive papers of progressively finer grit size (Nos. 240, 320, 400 and 600) in combination with running water as lubricant and coolant. Rough polishing on a napless nylon cloth with 6 micron size diamond paste was followed by a medium nap velvet cloth with 1 micron paste. Interstage washing was done to avoid transfer of grit from one stage to the next; specimens were rinsed in a stream of hot water, flooded in alcohol and rapidly dried in a hot air blast. To reveal the structure, the specimens were etched in 4% nitric acid solution in ethanol (nital).

The structure of polished and etched specimens was studied by reflected-light microscopy (Leitz "Othoplan") at magnifications of 100, 160, 300 and 800 diameters. The grain size was determined in accordance with the comparison procedure of the American Society for Testing and Materials (ASTM) Standard E 112-74. Micrographs were recorded to supplement the metallographic examination.

Hardness measurements were taken on polished and mounted sections using the Rockwell Superficial method of hardness testing in accordance with the ASTM Standard E 18-74. Rockwell Superficial T measurements, obtained with a ball of 1/16 in. diameter under 30 kg load, had been converted to standard Brinell HB10/3000 as approximate equivalent hardness (ASTM E 140-72). The number of indentations depending on the specimen size was usually 2 to 4.

4. STRUCTURE OF IRON OBJECTS

Microscopic examination of polished (not etched) sections showed the structure of most iron objects to be typical for wrought iron containing an assortment of slag inclusions elongated in the direction of prevalent plastic deformation. The slag stringers are often non-uniformly distributed and vary in amount and size (Figs. 11-13). As shown in Fig. 14, most of them are of duplex structure comprising light wustite dendrites (FeO) in a dark matrix of fayalite ($2FeO.SiO_2$). There are also present many slag inclusions of a uniformly black single-phase structure having a silicate matrix.

Nital etching revealed that the structure of the iron objects consists, with few exceptions, of either equiaxed or elongated ferrite grains. Since ferrite is nearly pure iron with less than 0.05%C, the iron objects have predominantly a low carbon structure so characteristic for wrought iron.

The equiaxed ferrite grains, indicative of hot working, vary widely in size from object to object and within a single object (Figs. 15-17). Most of the artifacts have a medium grain size of ASTM No. 5 to 7, though several of them have coarse grains varying in size from ASTM No. 4 to 2 (Code Nos. 3-1, 5-3, 7-3, 8-1, 8-4 and 9-1). In few objects very small grains (ASTM No. 8/9) occur at the head surface (in 1-2, 5-4, 6-5 and 9-4).

The presence of banded structure in the form of alternate bands of fine and coarse equiaxed grains and serrated layers was observed in objects 3-1, 4-4, 7-3, 8-4, 9-1 and 9-4 (Fig. 18). This layering is associated with phosphorus segregation, the coarse-grain bands being rich in phosphorus and the fine-grain bands being poor in phosphorus. Variable phosphorus would be expected from the inhomogeneous distribution in the ore and the fact that the diffusion coefficient of phosphorus in iron at 1300°C is relatively small as compared to that for carbon, with therefore very limited movement of phosphorus through the structure. Hot working caused the segregated regions of phosphorus to be elongated in the direction of plastic deformation. The presence of higher contents of phosphorus induces in iron cold-shortness or brittleness at ordinary temperatures, although the same metal may be quite malleable at or above red heat.

There is no reason, in this case, why the smith working a high phosphorus iron should be dissatisfied with his products, especially sinc phosphorus will harden iron almost as much as carbon. Such material would be completely satisfactory for nails.

The lightly to heavily elongated ferrite grains following directional deformation were formed during cold working (Figs. 19 & 20). This type of structure was found in objects 1-1, 1-2, 2-2, 3-1, 3-2, 3-4, 4-1, 7-4 and 7-5, and in nail heads 3-1, 3-2 & 7-3 as well as nail points 6-5 & 7-2. Elongated grains were also observed at the head edge of two nails with deformed heads (6-5 & 9-1), and at the shank surface of nail 5-4.

In two nails, 7-3 and 9-1, ferrite grains at the head's top surface are crossed by relatively straight bands, all parallel with one another within a given grain but changing direction from one crystal to the next (Fig. 21). These are Neumann bands (mechanical twins) and their presence also indicates some low temperature distortion of the material, probably a hammer blow to the nails head.

Three objects with none or little slag inclusions (1-1, 2-4 & 3-4) have a medium to high carbon structure of ferrite and pearlite or typical for steel. The structure of medium carbon steel strip 1-1 (with 0.3-0.4%C) consists of elongated ferrite grains with pockets of pearlite (Fig. 22). In high carbon steel blade 2-4 (with ~0.8%C) elongated pearlite is the predominant phase (Fig. 23). The point of the blade shows partial surface decarburization. It can be seen in Fig. 24 that the closer the distance to the surface the larger is the amount of ferrite of Widmanstatten pattern (Fig. 24). In high carbon steel nail 3-4 (with ~0.6%C) pockets of elongated ferrite occur in the elongated pearlite matrix (Fig. 25).

A rather uncommon, laminated structure of wrought iron and steel strips was found in truncated nail 5-4. It consists of the following sequence of layers. A surface layer of equiaxed ferrite grains of medium size (ASTM No. 6) followed by a layer of steel (~1 mm thick) with pearlite and grain boundry ferrite (~0.6%C), a layer of equiaxed ferrite with some pockets of pearlite (~0.1-0.2%C), and a surface layer of heavily elongated ferrite grains. The head contained close to the centre a high carbon streak (~0.6%C) resulting from primary carburization, and at the surface a high carbon area (2 mm thick) of fine pearlite and ferrite grains (ASTM No. 9). A steely area of ferrite and pearlite (0.2-0.3%C) was also observed at wide end of object 4-4, and a ferrite and pearlite streak in nail 6-5.

The structure of the individual iron objects is summarized in Table 2 describing the distribution of slag inclusions, the type and shape of phases present, the grain size, and the approximate carbon content.

TABLE 2. Structure of iron objects from Boyd's Cove, Newfoundland.

Core No.	Prov. No.	Slag inclusions	Phase type(a)	Phase Share	Grain Size (ASTM No.)	Approx. %C (b)	Remarks
1-1	2377	None	(F+P)/F	elongated, equiaxed	6	0.3	
1-2	2763	Many	F	elongated	large, (c)	<0.05	
2-2	2493	Some	F	elongated	medium	<0.05	
2-4	154	None	P	elongated		0.8	Point: (P+F),∼0.5%C
3-1	813	Many	F	equiaxed (shank), elongated (head)	7/4	<0.05	Banded structure
3-2	2424	Numerous	F	equiaxed (shank), elongated (head)	5	<0.05	
3-4	2676	Some	P+F	elongated		0.6	Equiaxed grains at the surface
4-1	142	Considerable	F	elongated		<0.05	
4-4	2926	Some	F/(F+P)	equiaxed	7 & 5 (c)	<0.05/0.2	Banded structure (F+P) at head's side
5-3	2950	Many	F	equiaxed	2 & 4 (d)	<0.05	
5-4	1481	Considerable	F/(P+F) (f)	equiaxed, elongated (at surface)	6 (c)	<0.05/0.6	Laminated structure
6-1	2480	Some	F	equiaxed	5 & 7	<0.05	
6-3	211	Some	F	equiaxed	7	<0.05	
6-5	2060	Considerable	F	equiaxed (e), elongated (point)	6 (c)	<0.05	
7-2	1498	Some	F	equiaxed elongated (point)	6	<0.05	
7-3	1474	Many	F	equiaxed elongated (head)	4,6	0.05	Banded structure, Neumann bands in head
7-4	113	Many	F	elongated		<0.05	
7-5	1266	Many	F	elongated		<0.05	
8-1	2308	Many	F	equiaxed	2	<0.05	
8-4	893	Many	F	equiaxed	2,6	<0.05	Banded structure
9-1	2637	Many	F	equiaxed, (e)	4,6	<0.05	Banded structure, Neumann bands in head
9-4	2706	Many	F	equiaxed	7&5 (c),(d)	<0.05	Banded structure

a) F - ferrite, P - pearlite
b) Approximate carbon content estimated metallographically
c) Fine grains (No. 8, 9) at head's surface
d) Different grain size in head and point than in shank
e) Elongated grains at head's edge
f) High carbon streak (P+F) in head and at the head's surface

5. TECHNOLOGY OF IRON OBJECTS

5.1 Relationship Between Structure and Technology

It was mentioned before that the main phases of slowly cooled iron and steel are ferrite and pearlite. Ferrite is a very soft and ductile phase of nearly pure iron with less than 0.05%C. Pearlite is a lammelar aggregate of ferrite and cementite (Fe_3C) which contains about 0.8% carbon, and is much harder then ferrite. The more carbon (up to 0.8%) and the higher rate of cooling, the more pearlite and less ferrite is formed, and consequently the harder and less ductile is the material.

Hot working is a mechanical treatment resulting in plastic deformation of metal above the recrystallization temperature. Hot working of iron is usually carried out above 1000°C. The ferrite grains which although deformed in forging are no longer elongated because the temperature at which hot working has been done was significantly high to permit the structure, except the slag stringers, to recrystallize. In hot working operation, the factors that determining the final grain size will be the temperature at which deformation is completed and the rate of cooling from this temperature. Similarly in annealing, the final grain size will be determined by the temperature at which the object is heated, how long it is heated and the rate of cooling from this temperature. Where there are no structural changes resulting from transformations at lower temperatures, the higher the finishing (or annealing) temperature the coarser will be the final grain size. Overheating during annealing, or heating for too long a period at a high temperature will cause grain growth. Slow cooling also will tend to coarsen the structure as compared with that obtained by faster cooling from the same temperature.

Cold work involves working metal below the recrystallization temperature, which is for iron about 450°C and for steel about 550°C. As a matter of fact, most cold work is done at or about room temperature. Cold working increases strength and hardness of the material. The higher is the degree of deformation, the greater is the distortion of structure (the grains are more elongated) and the stronger is the effect of cold working on mechanical properties of iron.

5.2 Technology and Hardness of Iron Objects

Type of material, hardness and technology of the individual iron objects is given in Table 3. The technology of the modified artifacts is graphically illustrated in Fig. 10. The examined objects are arranged below into three groups characterized by common structure and technology.

A. Cold worked wrought iron and steel objects

wrought iron:	1-2, 2-2, 4-1, 7-4, 7-5
steel:	1-1, 2-4, 3-4

B. Hot worked wrought iron objects with cold working applied to part of the object

head:	3-1, 3-2, 7-3
head's edge:	6-5, 9-1
point:	6-5, 7-2
shank surface:	5-4

C. Hot worked wrought iron objects
wrought iron: 4-4, 5-3, 5-4, 6-1, 6-3, 8-1, 8-4, 9-1, 9-4

The objects which were modified by cold working (i.e. Group A with elongated grains) were originally hot worked, evidence of which is shown in objects 1-1 and 3-4 containing some areas with equiaxed grains. The objects in Group B, with equiaxed grains and some areas with elongated grains, were partially modified by cold working.

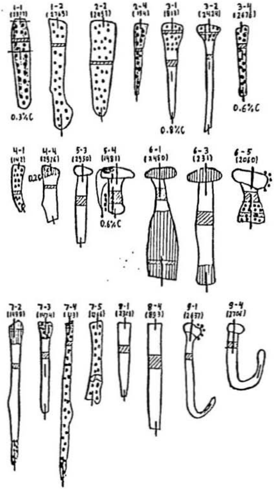
With few exceptions, there is no evidence that the objects in Group C (with equiaxed grains only) were modified by hot working or cold working. The exceptions are significant. The three clearly modified objects are 6-1, 6-3 and 7-2. This means that hammering was carried out in this case at high temperatures by hot working.

The presence of medium grain size in these three nails suggests that hot working was finished at temperatures close to or not exceeding much 1000°C, followed by moderately fast cooling in air. A similar conclusion can be drawn about the original hot working temperature of all objects containing medium grain size. The objects with coarse grains were obviously overheated (3-1, 5-3, 7-3, 8-1, 8-4 and 9-1); in this case hot working was finished at a very high temperature. Actually, the two nail shafts 8-1 and 8-4 may have been deliberately heated to a temperature probably exceeding 1200°C, prior to the heads removal. It was not possible to determine directly how these two and many other objects were cut, because corrosion obliterated the cut surface and its structure.

TABLE 3. Material, technology and hardness of iron objects from Boyd's Cove, Newfoundland

Code No.	Prov. No.	ARTIFACT	MATERIAL	TECHNOLOGY AND HARDNESS(*) Modified	HB	Original	HB
1-1	2377	Metal strip	Steel (0.3%C)	Cold worked	158	Hot worked	-
1-2	2763	Metal strip	Wrought iron	Cold worked	168	Hot worked (?)	-
2-2	2493	Plate (?)	Wrought iron	Cold worked, cut	166	Hot worked (?)	-
2-4	154	Plate (?)	Steel (0.8%C)	Cold worked, cut	-	Hot worked (?)	-
3-1	813	Nail w. flatt. head	Wrought iron (high - P)	Head cold worked	150	Hot worked	127
3-2	2473	Nail w. flatt. head	Wrought iron	Head cold worked	174	Hot worked	106
3-4	2676	Nail w. flatt. point	Steel (0.6%C)	Cold worked	180 (250)	Hot worked	-
4-1	142	Bar fragment	Wrought iron	Cold worked, cut	246	Hot worked (?)	-
4-4	2926	Metal strip	Wrought iron	Cut	-	Hot worked	171
5-3	2950	Truncated nail	Wrought iron	Cut	-	Hot worked	110 (154)
5-4	1481	Truncated nail	Wrought iron	Cold worked at surface	-	Hot worked, fagoted	141 (101)
6-1	2480	Nail w. flatt. point	Wrought iron	Head and point hot worked	116	Hot worked	99
6-3	231	Nail w. flatt. point	Wrought iron	Head and point hot worked	114	Hot worked	97
6-5	2060	Nail w. flatt. point	Wrought iron	Point & head's edge cold worked	173	Hot worked	134 (106)
7-2	1499	Modif. nail shaft	Wrought iron	Head side hot worked, cut Point cold worked	107	Hot worked	-
7-3	1474	Modif. nail shaft	Wrought iron (high - P)	Head side cold worked, cut	146	Hot worked	132 (102)
7-4	113	Modif. nail shaft	Wrought iron	Cold worked, cut	194	Hot worked (?)	-
[illegible]	[illegible]	Metal strip, [illegible]	Wrought iron	Cold worked, cut	155	Hot worked (?)	-
8-1	2708	Nail shaft	Wrought iron	Head removed	-	Hot worked	172
8-4	[illegible]	Nail shaft	Wrought iron	Head removed	-	Hot worked	151
9-1	1632	Clinched nail	Wrought iron (high - P)	Head's edge cold worked	-	Hot worked	170
9-4	2706	Clinched nail	Wrought iron (high - P)		-	Hot worked	122 (105)

*In brackets hardness values for head or point



Location of sections

Revolved section superimposed on the side view of the object

MATERIAL

Wrought iron (hot worked)

Steel (hot worked)

METAL WORKING OPERATION

Cold worked

Hot worked

Fig. 10 Technology of iron objects and location of sections taken for metallographic examination.

The effect of type of material and the metal working operation on the hardness (HB) of the iron objects is shown below.

	Hot worked	Cold worked
Wrought iron	97-141 (114 avg.)	146-194 (165 avg.)
Steel (0.6%C)	170-180 (175 avg.)	180-250 (215 avg.)

The large variations in hardness are basicly due to the different degrees of deformation caused by cold working and hot working. The hardness of steel objects is higher than that of wrought iron objects by about 50-60 HB due to the presence of carbon. Also cold working hardened considerably the material. The cold worked objects are harder than the hot worked objects by about 40-50 HB. For some unexplained reason the hardness of iron objects 4-4, 5-3, 8-1, 8-4 and 9-1 (about 150-170 HB) exceeds significantly the hardness range of the hot worked objects, and the hardness of object 4-1 (246 HB) is much higher than that of the cold worked objects.

6. CONCLUSIONS

6.1 Out of 22 examined objects 19 are made of wrought iron, 3 of steel (1-1, 2-4 & 3-4) and 1 of faggoted iron (5-4).

6.2 The structure of wrought iron objects consists of virtually carbon free ferrite grains, mostly of medium size, and slag stringers. Elongated ferrite grains occur in 12 objects while equiaxed ferrite grains in 10 objects. The structure of the high carbon steel artifacts with 0.6-0.8%C (2-4 & 3-4) is that of elongated pearlite with grain boundary ferrite and none or very little slag inclusions. The structure of the medium carbon steel object with 0.3%C (1-1) consists of elongated ferrite and pockets of pearlite. The faggoted nail 5-4 is made of strips of wrought iron and high carbon steel (0.6%C).

6.3 In total, 12 wrought iron objects and 3 steel objects were cold worked, and 9 wrought iron objects were hot worked.
Among these, five wrought iron and three steel artifacts were modified completely by cold working (1-2, 2-2, 4-1, 7-4, 7-5 and 1-1, 2-4, 3-4 respectively). Many other objects were only partially modified; four of them were reworked by cold working (3-1, 3-2, 6-5 & 7-3), two by hot working (6-1 & 6-3), and one appears to be modified both by cold working and hot working (7-2).

6.4 In most artifacts hot working was finished at temperature range 1000°C-1100°C, followed by moderately fast cooling in air. Several objects were hot worked at a very high temperature and cooled very slowly, perhaps in a forge (3-1, 5-3, 7-3, 8-1, 8-4 & 9-1). The two nail shafts 8-1 & 8-4 may have been deliberately heated to a very high temperature, probably exceeding 1200°C, prior to the head's removal.

6.5 Cold working hardened considerably the material yielding average hardness of 165 HB and 215 HB for wrought iron and steel, respectively, comparing with 114 HB and 175 HB for hot worked objects.

6.6 No heat treatment had been given resulting in hardening of metal due to carburization or quenching, except such as would naturally accompany forging and air cooling of iron objects. Primary carburization (taking place during smelting) was observed in iron nail 5-4. The secondary carburization, observed in objects 5-4 & 6-5, was accidental, as their surface was most likely carburized in the forge while in contact with hot charcoal.

6.7 Evidence suggests that the Boethuk Indians were familiar with hot working, but predominantly hammered iron at ordinary temperatures. The fact that only three objects were modified by heating prior to hammering suggests that working hot metal was an operation too cumbersome for them to carry it out frequently. It would be advantageous to use cold working over hot working, if the Boethuk were aware of the hardening and strengthening effect of cold working on old iron.

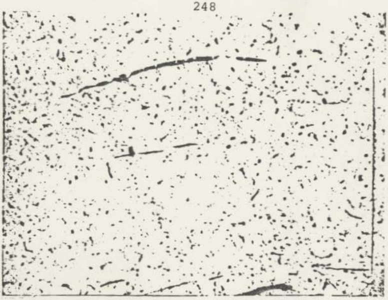


Fig. 11. As polished (Not etched) x 100
Some slag inclusions.

Fig. 12. As polished (Not etched) x 100
Considerable number of slag inclusions.

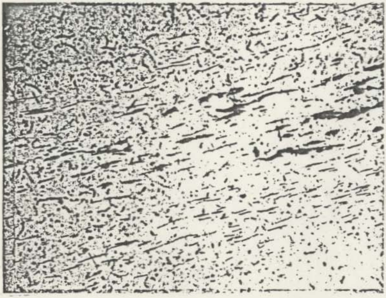


Fig. 13. As polished (Not etched) x 100
Many slag inclusions.

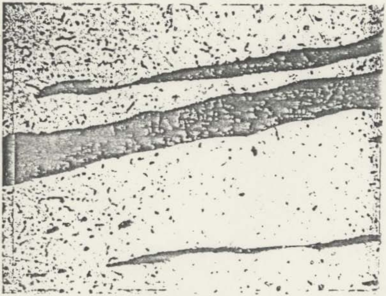


Fig. 14. As polished (Not etched) x 300
Duplex structure of slag inclusions: mixture of FeO (light) and SiO_2 (dark).

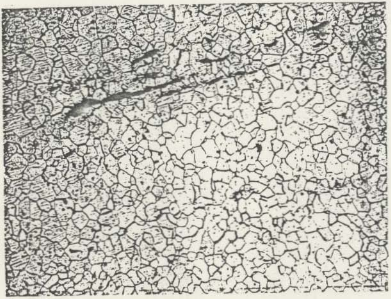


Fig. 15. 4% Nital x 100
Structure of hot worked wrought iron: small equiaxed ferrite grains (ASTM No. 7).

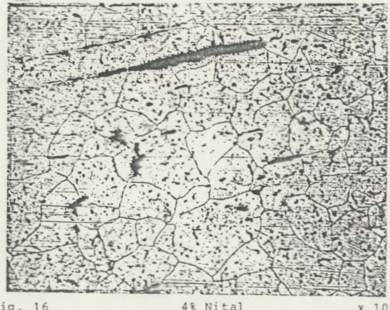


Fig. 16 4% Nital x 100
Structure of hot worked wrought iron: medium size equiaxed ferrite grains (ASTM No. 5).

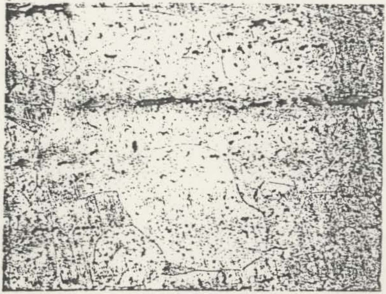


Fig. 17 4% Nital x 100
Structure of hot worked wrought iron: coarse equiaxed ferrite grains (ASTM No. 2).

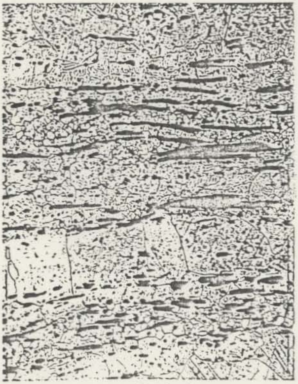


Fig. 18. 4% Nital x 100
Banded structure of wrought iron: bands of fine (P-poor) and coarse (P-rich) ferrite grains.

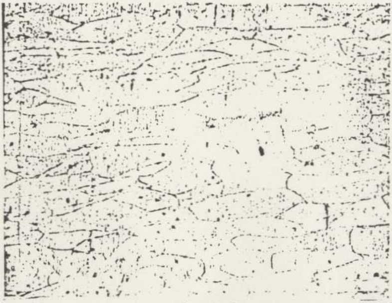


Fig. 19. 4% Nital x 300
Structure of cold worked wrought iron: lightly elongated ferrite grains.

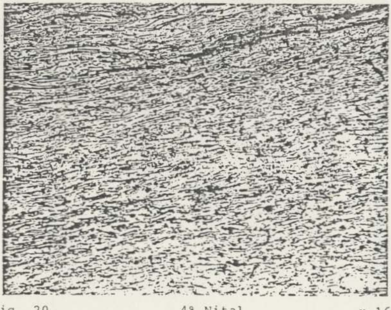


Fig. 20. 4% Nital x 160
Structure of cold worked wrought iron: heavily elongated ferrite grains.

Fig. 21. 4% Nital x 160
Structure of wrought iron nail head resulting from a hammer blow: equiaxed ferrite grains crossed with Neumann bands.

Fig. 22. 4% Nital x 300
Structure of cold worked medium carbon steel (0.3%C): elongated grains of ferrite (light) and pearlite (dark) in object 1-1.

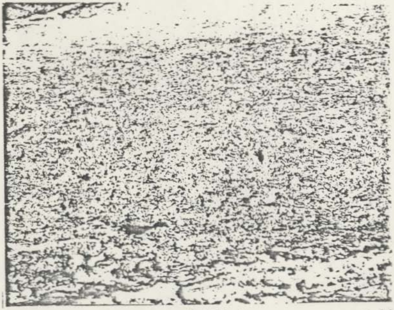


Fig. 23. 4% Nital x 100
Structure of cold worked high carbon steel (0.8%C): elongated pearlite grains in nail 2-4.

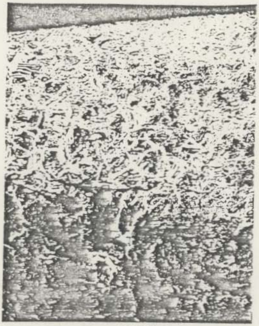


Fig. 24. 4% Nital x 100
Structure of nail point 2-4 at decarburized surface: pearlite and grain boundry ferrite followed by pearlite only.

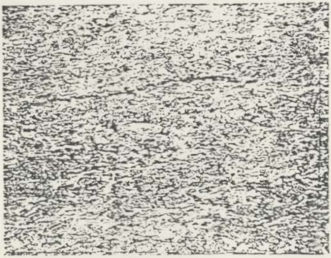


Fig. 25. 4% Nital x 300
Structure of cold worked high carbon steel (0.6%C): elongated grains of pearlite (dark) and pockets of ferrite (light).