TECHNOLOGICAL CHANGE IN THE FRASER RIVER SALMON CANNING INDUSTRY,
1871 - 1912

by

DUNCAN A. STACEY

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Department of HISTORY

The University of British Columbia
2075 Wesbrook Place
Vancouver, Canada
V6T 1W5

Date MAY 1977
ABSTRACT

British Columbia's salmon industry is currently one of the province's major sources of income. Its development from a primitive fishery to a highly organized industrial operation has had many phases, one of the most significant occurring in the late 19th and early 20th centuries. In this period several technological developments freed the industry from expensive and unreliable manual labour and laid the basis for the modern industry's organization.

This study investigates the innovations made in fishing, packing, and canning machinery and shows how intimately related these developments were to each other. A central point in this thesis is the argument that the industry's development at this time was not due to the introduction of a major invention (the "great man" theory applied to machines) but rather to a series of interlocking, mutually supporting innovations which tended to occur in clusters. Another point is that these innovations were called forth by chronic labour shortages which afflicted the province in its early history. Some space is also given to the effects of technology on the workers and canners of the period.

Whenever possible primary source material has been used, including company records, letters and other papers of the early canners, early newspaper and periodical accounts, government reports and regulations of the time, and interviews with pioneers of the fishing industry. Secondary sources have, as much as possible, been restricted to clarification or supplementation of the original material.
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My major acknowledgements, however, must rest with the members of the British Columbia fishing industry, especially those of the Canadian Fishing Company, who taught me the practical end of my studies. These men are so numerous that it would be impossible to list them all, but I would like to mention the crews of the Cape Scott, the Cape Pine, the Cape Flattery, and the Cape Dorset, especially Ronald Robertson, Sam Burich, Charlie Coffin, Jerry Dobrilla, Herb Hockaday, John Klaboe, Harold Tipper, and the shipyard cannery personnel such as George Olsen, Harold Britten, and Bill Ross.
INTRODUCTION

This thesis will investigate technological change in the British Columbia salmon canning industry between the years 1871 and 1912 and will use the Fraser River industry as a test case. The object of this study is to contribute to investigations into canned salmon and lumber, the export commodities which were cornerstones of the region's economic development in the late nineteenth century. When such research has been done, the path will be clear for a critical study of the theory of regional economic development. As Professor Careless has observed, there is much more to the early development of British Columbia than the affairs of provincial governments or the vicissitudes of public men.

Studying technological change, one finds two types of industries, the leaders, those which invent technology, and the followers, those which adopt it. The Fraser River salmon canning industry was a follower.

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1 The term "export commodity" is more descriptive of the canning industry than "staple" or "extractive resource" because the latter terms usually refer to the products of purely extractive industries such as coal. See Douglas North, "Location Theory and Regional Economic Growth," Journal of Political Economy, LXIII (June 1955), 247.

2 "Economic development" is used rather than "economic growth" as the latter refers to increased output whereas the former term implies both more output and changes in the technical and institutional arrangements, i.e. technological change.


industry as all its technology was imported from Europe or eastern North America. Only one machine, the butchering machine, was invented specifically for the west coast canneries and here again the Fraser River and British Columbia salmon industry was a follower, since the successful model of the butchering machine, the "Iron Chink", was developed by the Columbia River salmon industry. Given these circumstances, the central issue of this thesis will be innovation, or the adoption of technology rather than its invention.

Salmon canning machinery was adapted from the vegetable and meat canning industries of eastern North America and Europe. The original source of early salmon canning technology was Britain where Crosse and Blackwell established the world's first salmon canning factory in Cork, Ireland. The technique of fish canning was copied by eastern North Americans (E. May, The Canning Clan [New York: The Macmillan Co., 1938], p. 435). The canning of fish, especially cod, was pioneered in North America by Ezra Daggett of New York in 1819 (May, p. 7). A Canadian named Tristram Halliday was canning salmon at St. John, New Brunswick, as early as 1839 (May, p. 12). The cradle of the North American canning industry was the fruit and vegetable industry of Baltimore, the early process being especially applicable to this class of products as they require a lower degree of heat to preserve them than fish products do. However, the diffusion of the basic canning techniques to fishery products was aided by the fact that the original industry in the period 1820-1845 was confined largely to cities where fish and oyster canning was carried on (Arthur Hunt, "Canning and Preserving Fruits, Vegetables, Fish, and Oysters," Manufacturers, Part III: Special Reports on Selected Industries, United States, Twelfth Census of the United States, Taken in the Year 1900 [Washington: U.S. Census Office, 1902], Vol. IX, 480, 492). In the case of the Fraser River salmon industry a perfect example of how canning technology was diffused from the eastern vegetable industry to the western salmon industry is evident in the case of the Schaake machine works of New Westminster. Henry Schaake, one of the most progressive canning machinery manufacturers during the early 1900's originally worked in Baltimore on fruit and vegetable canning machinery. He came to New Westminster via San Francisco (Pacific Fisherman, annual edition, 1903, p. 52).

Other types of butchering machines were used in the Fraser's canning process, but they were soon replaced by the Iron Chink (see pages 56-62).
Sustaining technological change in a follower industry is not simply a matter of importing "new" machines or processes. If technology is to be successfully implanted in new territory, many aspects of the new setting, ranging from market opportunities to the essential back-up skills in a wide arc of support functions, must be favourable. In brief the conditions which must be met are as follows: there must be a surplus of some resource, there must be technology to develop the resource to the level of an exportable surplus; there must be a source of capital, there must be a market, and the exportable surplus must be conveniently located on a trade route. In the 1860's the Fraser River met all but one of these conditions. Salmon was embarrassingly abundant. Capital was available from Victoria and

7 Innovations are the application of inventions to the productive process. It is the application of inventions that determines the rate of investment and growth (D. Landes, "Factor Cost and Demand: Determinants of Economic Growth," *Business History*, VII [1965], 21). It can be argued that invention is a function of the state of the art and innovation is a function of the state of the market; the development of the Fraser River salmon canning industry was a function of the market demand of the British industrial worker for high protein fish products (Jonathan Hughes, *Industrialization and Economic History* [New York: McGraw Hill Book Company, 1970], p. 44).

8 Saul, p. vii, n. 4. "New" in the sense that these machines had not been applied to the Fraser River but were in use in other regions such as eastern North America and Europe.


San Francisco commission agents and banks.\textsuperscript{11} The industrial worker of Britain provided a ready market.\textsuperscript{12} The Fraser River was linked by steamers and coastal sailing vessels to the Victoria-San Francisco-Liverpool trade route. All that was missing was the technology necessary to transform the salmon resource into a base for a canning industry capable of exporting its product.

Before the introduction of canning, the Fraser River salmon fishery was conducted almost exclusively for the small local fresh fish market. Attempts to raise this fishery to an export level by packing salmon in barrels met with only limited success.\textsuperscript{13} With the appearance of the necessary technology and permanent canneries in the 1870's, the problem of preserving salmon for transport to distant markets was solved. All the conditions described above had been met, and the salmon staple became, by definition, an export commodity.


\textsuperscript{11} Prior to 1889 and the advent of limited companies, the Fraser River industry's organization was characterized by low levels of industrial concentration, small firms run by individuals or partners, and by a high incidence of local proprietorship. After the initial investment, the canning proprietors gained fixed capital by re-investing the profits made in the industry. Long run operating capital, which was especially important to the industry because the salmon market had an eighteen month cycle from the time the tinplate was ordered from England until the season's pack was sold, was supplied by commission agents (Ralston, "The 1900 Strike," p. 18). These agents provided canning and fishing supplies and a distribution system to the market as well as capital.

\textsuperscript{12} The rapid increase of the British labourers' real wages in the era of the so-called "Great Depression" accounted for their consumption of millions of cans of food which a generation earlier would have been
The exact date of the establishment of this permanent commercial canning industry is hard to determine. In 1867, James Syme experimented with canning at his saltery on the Fraser. Although he exported a dozen, two-pound cans to Australia,14 his was not a permanent commercial venture. Between 1871 and 187315 small canneries appeared on the river on a more permanent basis and by 1874 four canneries produced for export purposes.16 There appear to be three reasons for the gap between 1867 and 1871, when no canneries were established despite the fact that the technology was available. One reason is that it was a time of economic recession, so little capital was available for such ventures. In addition, Britain, the area's major source of capital, was directing its money into the Columbia River fishery rather than the Fraser.17 Thirdly, considered a luxury quite beyond their means. Between 1860 and 1877, real wages increased by twenty-five percent; between 1877 and 1891 they increased five percent; and from 1891 to 1899 they rose another five to ten percent (A. L. Bowley, Wages in the United Kingdom in the 19th Century (Cambridge: Cambridge University Press, 1900), p. 63). See also: S. B. Saul, The Myth of the Great Depression, 1873-1896 (London: Macmillan and Co. Ltd., 1969), p. 31; and John Burnett, Plenty and Want (Harmondsworth, Middlesex, England: Penguin Books Ltd., 1968), pp. 124-125.


14 Columbian, May 9, 1868, p. 2.

15 Although secondary sources claim that a cannery (Annieville) started in 1870, there is no evidence to support this. Annieville was a saltery in 1870 (Mainland Guardian, June 18, 1870, p. 3). In 1871, however, Annieville exported nearly 50,000 pounds of canned salmon (Mainland Guardian, June 20, 1871, p. 3; Colonist, November 2, 1871, p. 3). Most fisheries originally canned in conjunction with salteries prior to the 1880's (Canada, Report of the Inspector of Fisheries for British Columbia, 1876, Canada, S.P., 1877, no. 5, appendix 21, p. 340). For example, in 1876 Ewen and Company produced 300 barrels and 3,125 cases, but by 1882 they turned out 20,000 cases and only 500 barrels.
it was difficult to obtain labour and appliances in this early period.\textsuperscript{18} It is safe to say, therefore, that a permanent canning industry, based on an export market, started between 1871 and 1874.\textsuperscript{19}

The time period of 1871-1912 and the geographical area of the Fraser River have been chosen as the limits for this study for specific reasons. The years 1871-1912 encompass the "pre-modern\textsuperscript{20}" period of the canning line. With the introduction of butchering machines in 1903 and the sanitary can and double seamer, which made manual soldering obsolete, in 1912, the basis for the modern, mechanized high-speed canning line was


\textsuperscript{16}\textit{Colonist}, April 28, 1874, p. 2.

\textsuperscript{17}Ralston, "Patterns of Trade and Investment," p. 41. This assumption is based on the fact that in 1874 there was a desire on the part of Fraser River canners to guide English capital into the Fraser rather than the Columbia. During that year Crosse and Blackwell of England sent 30,000 pounds sterling to be invested in the Columbia (\textit{Colonist}, April 28, 1874, p. 2).

\textsuperscript{18}Labour and appliances were most easily and more cheaply obtained on the Columbia than on the Fraser (\textit{Colonist}, April 28, 1874, p. 2).

\textsuperscript{19}An indication that the economic importance of the Fraser's salmon resource was recognized as early as the 1870's is that the first federal fisheries regulations for the river were applied in 1876 (Canada Gazette, IX [May 13, 1876], 1500).

\textsuperscript{20}A canning line is modern if its machines actually replace the manual processes rather than supplement them. Between 1870 and 1914 the most striking technological development of industrialization appeared to be in the development of machines to replace a man's hand or implements in undertaking some function such as canning (Habakkuk and Postan, VI, chapter 7; North, p. 694).
complete. Before these innovations, however, the Fraser River salmon industry was characterized by decentralized industrial organization, by utilization of only two of the five species of salmon, by extensive hand labour in the canning line, and by limited mobility in the fishing fleet. The technology of the fishing fleet centered around sail and steam; canning machines were generally aids to the hand process rather than automatic manufacturing devices. In the period between 1901 and 1905, several major changes in the industry started the development toward modern processing. The technology of the gasoline motor began to replace sail and steam and allowed the gillnet fleet a greater mobility. It also made possible the establishment of a powered purse seine fishery to catch the lesser species of salmon. The application of the butchering machine and the solderless can system made complete automation of the canning line possible. In addition, the formation of the B. C. Packers Association was an effective step toward centralization in the industry. The period 1871-1912 therefore covers the most important adoptions made in the industry.

The Fraser River was selected for study because innovation in this region was less restricted by government regulations than other major salmon areas which developed later. In addition, the sockeye, the

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21 With the exceptions of the B. C. Canning Company in 1889 and the Anglo-British Columbia Company in 1891, both of which failed to centralize the industry due to the large number of new entries in the 1890's (David Reid, "Company Mergers in the Fraser River Salmon Canning Industry 1885-1902," Canadian Historical Review, LVI [1975]).

22 Before the 1900's only the sockeye and coho salmon were exportable as the British market would accept only the red fish. "The present run is composed of what are known as sockeyes--the true
most important commercial species in the Fraser's industry at the time covered by this thesis, follows a specific migration pattern. The peculiar characteristics of this species (Oncorhynchus nerka) are therefore fundamental to the growth pattern of the Fraser's canning industry. These characteristics include a short season with sharp peaks of intensive fishing effort between the first week of July and the first week of August and a wide variation between one year and the next in the number of sockeye returning to spawn. The yearly variation is based on a four year cycle. This cycle comprises one dominant year, which in the 19th and early 20th centuries came the year after leap years, (i.e., 1873, 1877, 1881, 1885, 1889, 1893, 1897, 1901, 1905, 1909, 1913) followed by a subdominant year and two "off" years. The dominant year has many times the return of the smallest, or "off", years and the subdominant year has a lesser return than the dominant year but larger ones than the off years. Thus a fairly predictable source of salmon and a relatively unfettered industry on the Fraser make it easier to see how and why the canners used their technological skills to benefit from the resource.

There are at least two ways to study technological change. The traditional approach argues that technological change in the form of specific machines and processes is the determining factor in economic advance. Such an approach would seem to be the "great man" theory of commercial fish" (Mainland Guardian, July 13, 1878, p. 3). This preference was due in large part to the fact that the first pink salmon shipped to England were badly packed and lacked the firmness and oil content by which the British consumer learned to judge the quality of salmon.

history applied to things rather than to persons. Recently, however, Robert Fogel has argued that the most important application of his study on railroads and American economic growth is that "no single innovation was vital for economic development during the nineteenth century." Paul David supports this approach, arguing that "the appearance of isolated 'great innovations' is less consequential for economic progress than the rate at which clusters of interlocking, mutually supporting techniques can be brought into use." Studies of the Fraser's salmon industry have generally followed the traditional approach in the sense that they considered the industry's sectors--fishing, packing, and canning--in relative isolation to each other. They also tend to be preoccupied with the canning sector and see that process and the innovations within it such as the butchering machine or the steam retort as the sole factors in the industry's technological change. This is misleading. The canning process was a by-product of new industrial methods that permitted the rolling out of very thin uniform sheets of metal. The steam retort was merely the adaption

(hereafter referred to as EcHR), XIX (1966), second series, 647.


27Only two major works on the B.C. salmon industry are relevant to the study of the Fraser River, the theses of Keith Ralston and Joseph Lawrence. Although Ralston centres his study on labour relations,
of ship's boilers, which were in turn the result of new industrial processes in the metal and engineering industries. Only in the case of the butchering machine is the traditional approach more valid. It was the only machine invented specifically for the salmon industry; it revolutionized the canning sector and resulted in unprecedented mechanization. But even here the traditional approach ignores the limitations on this invention. Because all machines in the canning process are designed for the same capacity so that they can work in unison, any machine, including the butchering machine, depends for its capacity on the one that precedes or follows it. Machines on a canning line are also dependent for their capacity on the fishing fleet to provide a steady supply of salmon. In the early 1900's, when the Iron Chink was introduced, the reliability of such a supply began to depend on new forms of fishing technology such as mechanized seiners.

This study will therefore investigate the development of clusters of technology in the Fraser's salmon industry in an attempt to show the validity of this approach. It will divide the period under study into two parts and examine the different natures of the technological changes in each. In the 1871-1903 period, technological advance rested on several improvements in manual technology, but the "machines" remained aids to the hand process. The 1903-1912 period saw the development of automatic machines which replaced the hand methods.

his first chapter deals with the early development of the industry. Lawrence's work is of a descriptive nature and essentially follows the traditional approach by developing the industry's sectors separately. Ralston sees canning as part of a wider industrial process, as a by-product of new processes that permitted the rolling out of very thin uniform sheets of metal (Ralston, "Patterns of Trade and Investment," p. 38).
Chapter 1

THE MANUAL CANNING ERA: 1871-1903

The Fraser's salmon pack increased from 9,847 cases in 1876 to 837,489 cases in 1905. Much of this increase was due to an increase in the number of producers and in the length of seasonal operations rather than to technological innovation. Between 1876 and 1901 the number of canneries increased from three to forty-nine, with most of the newcomers entering the market between 1892 and 1902. Consolidations reduced this number to forty by 1905. Not all of the increased production, however, can be credited to the addition of more canning lines and more crews. Although primary evidence of technological innovation in the cannery is fragmentary, enough proof can be presented to show that it was a significant factor in expanding the industry's productive capacity in the period between 1871 and 1903.

Between 1871 and 1903 the canning processes were essentially manual. The "machines" in use at the canneries were aids to these hand processes rather than automatic manufacturing devices. Canning equipment at one cannery in this early period consisted of "... 1 screw press, 1 set cast iron top dies, 1 set of cast iron bottom dies, 1 pair

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2Canada, S.P., 1889, no. 8, p. 243. It must be remembered that instead of fishing for five or six weeks as they did in former years (before 1888) the fishing extended over nearly as many months.
squearing shears, 1 pair rotary shears, 1 pair bench shears, 1 pair hand shears or snips . . . 1 forging hammer, 1 tinner's hammer, 1 set punches for making stovepipe . . . ." The fish were manually butchered, manually filled into cans, and the cans were manually soldered. The cans were then boiled in a kettle and painted with a mixture of red lead, turpentine, and linseed oil.


4 This is the major characteristic of the Fraser River salmon canning industry's technology before 1903.

5 Originally these dies were purchased from San Francisco and New York, but after 1892 the New Westminster Foundry produced dies superior to the American ones. Henderson's British Columbia Gazetteer and Directory for 1892 (Victoria and Vancouver: Henderson Publishing Company, 1892), p. 1037.


7 "It is not unusual for a Chinaman to clean as many as a thousand fish a day" (H. Gowen, "Salmon Fishing and Canning on the Fraser," The Canadian Magazine, December 1893, p. 163). "An exceptionally fast worker was reported to be able to clean fish at the rate of 2,000 fish in a ten hour shift" (Victoria Colonist [hereafter cited as Colonist], July 26, 1881, p. 3).

8 The speed of fillers was estimated at a dozen cans every four minutes" (Alfred Carmichael, "Account of a Season's Work at a Salmon Cannery; Windsor Cannery, Aberdeen, Skeena," Provincial Archives of British Columbia Manuscript, p. 7). Another source estimated the speed from 1,200 to 1,400 cans in a ten hour shift ("Our Salmon and Salmon Canneries," The Resources of British Columbia, vol. I [December 1883], p. 42).

These hand processes were generally recognized as the major bottleneck of the industry. One of the chief limits on the canning process was the necessity of making cans by a series of operations which involved a large amount of hand labour. The bulk of this labour was supplied by the Chinese on a contract system. Several of the leading Fraser River canners testified to the importance of the Chinese workmen: "...it may safely be affirmed that the industry could not have been prosecuted without the aid of Chinese labour." In the earliest canneries each can was cut by hand out of sheet tinplate, formed, and soldered. By 1890 a number of machines had been introduced to punch out body pieces, tops, and bottoms and to apply solder, but these were still aids to the hand process. Not until 1897 was an economically viable automatic can making machine introduced by the Automatic Can Factory of New Westminster. Even when such a machine was available many processes and white labour was hired to be the foremen, mechanics, bookkeepers, and fishermen.

10 Indian Labour concentrated on the catching, cleaning, and filling processes and white labour was hired to be the foremen, mechanics, bookkeepers, and fishermen.


12 H. Keith Ralston, "The 1900 Strike" p. 7. See also, Canada, Royal Commission on Chinese Immigration, "Chinamen make the cans ....", Canada, S.P., 1885, p. 365.

13 John Cobb, Pacific Salmon Fisheries (4th ed; Washington:
canners still preferred to make their own cans, believing that it was no more expensive and knowing that it gave a longer season's work to the Chinese crews they needed for processing the salmon. In 1902 the Chinese were still employed in considerable numbers in making the cans because this gave them longer employment and the canner was thus assured of having them ready when the cannery started to put up its pack. Before 1902 machine made cans accounted for no more than one-tenth of the cans used on the Fraser.

With the automatic can maker, however, it was possible to quickly replenish a cannery's stock of cans. Before its introduction, the canneries often ran out of tins during the season because of poor planning or a large run of fish. It was, however, also inadvisable to have too many cans on hand as they were liable to rust before they could be used in the next season.
Prior to 1877 the appliances for canning were crude and under-developed. It was probably in this year that the first major innovation, the steam retort, was introduced. The retort is, in essence, a large pressure cooker. This machine facilitated the canning process and materially reduced spoilage due to faulty cooking. With the rapid application of this device a new era began in canning. The product could be heated at temperatures higher than that of boiling water salted with calcium chloride. The higher temperature increased the speed of the cooking process over the old boiling water method. The retort also decreased the bursting of cans, a major problem in the cooking process under the old system, by maintaining a pressure outside as well as inside the can. It also eliminated another problem as calcium chloride caused dangerous rusting. In addition the large horizontal salmon retort was a major labour saving device. It not only took a larger charge but was fed by trucks running on rails directly into the retort so that the trays of cans could be handled without hoists or other power.

are compelled to close down until a new supply of cans is made" (New Westminster Mainland Guardian [hereafter cited as Mainland Guardian], August 17, 1889, p. 3).

In his graduating essay Professor Lawrence says that the retort first appeared in 1878 (J. C. Lawrence, "An Historical Account of the Early Salmon Canning Industry in British Columbia 1870-1900," unpublished graduating essay, University of British Columbia, 1951, p. 32), but an 1877 newspaper item seems to describe a retort: "... cooking by steam forced through iron pipes placed in a tank" (Mainland Guardian, August 17, 1877, p. 3). In addition, the 1905 B. C. Fisheries Commission states that in 1877 "... they started the steam canneries. Before that they had just the ordinary canneries with boilers" (Canada, British Columbia Fishery Commission, "Evidence," 1905-1906, Canada, S.P., 1908, p. 93).

By 1881 the Fraser River Company was the only cannery in the region which still boiled the canned fish in huge tanks (Colonist, July 26, 1881, p. 2).
Almost every important piece of processing machinery was stimulated by the introduction of the retort. The first process to be improved was soldering. Soldering machines appeared in the late 1870's; five out of the seven canneries had these machines by 1879. Evidence of the initial effectiveness of these machines is, however, contradictory. They did reduce the amount of labour needed in the cannery as each machine could produce 3,000 cans in a ten hour day as compared to 1,000 cans per ten hour day under the old manual system. Further proof of their effectiveness is that the Chinese solderers objected to their introduction because they made work scarce for them. But other evidence shows that soldering machines did not work well until four or five years after their introduction. In addition, most canners found that manual soldering produced far fewer faulty cans than machine soldering. It can, therefore, be concluded that although soldering machines were introduced in the late 1870's, they were not completely accepted until the mid-1880's.


22 After being filled, "The cans pass to the crimping and solder machines where they are put into a sort of hopper and pass around a wheel that crimps the lid in place, then by an ingenious device they pass through acid, then through a solder bath and away from the machine down an incline plane of about 50 feet. This ingenious contrivance was invented by J. Spratt, Esquire, of the Albion Iron Works, Victoria" ("Our Salmon and Salmon Canneries," p. 42).

23 *Colonist*, July 26, 1881, p. 3.

24 "The successful use of the new mechanical contrivances soldering
During the early 1880's major innovations were introduced in the filling, salting, and cutting processes and in the movement of cans through the cannery. Although introduced in 1881, filling machines were not generally adopted on the Fraser prior to 1902 because the hand filled product was far neater and commanded a better market price.

A salting machine, for adding the required amount of salt to each can after it was filled, was used by 1881 at Finlayson's Cannery by the B. C. Packing Company and probably by other companies. The gang knife was also apparently first used on the Fraser in 1881. This machine, operated by a hand lever, was a large knife with eight blades arranged so that they cut the fish into the exact length of a can. The gang knife and filling machines will tend to cheapen production while lessening the dependence upon manual labour during the past season so severely felt" (Canada, S.P., 1882, no. 6, pp. 202, 218).

25 Colonist, February 12, 1882, p. 3.
26 Colonist, July 30, 1881, p. 3.
27 Colonist, July 26, 1881, p. 3.
30 See footnote 23. The saving by these machines in the cost of manipulation of the cans was estimated at 30%.
32 Colonist, July 26, 1881, p. 3.
was important because it was the first innovation directed at relieving the bottleneck in the cutting stage. The final innovation of 1881 was the use of conveyor belts to speed up the line. But, although these machines were noted in 1881 they were not in general use. The Inspector of Fisheries predicted, however, that they would be generally adapted in the coming season of 1882.

There is contradictory evidence concerning the origins of these early canning innovations. Local sources credit Joseph Spratt of the Albion Iron Works in Victoria with the invention of a soldering machine, but the Fisheries Report for B.C. claims that they were adapted to the Fraser's canneries from Columbia River models. Apart from the chain solderer, the only other canning invention credited to a British Columbian in the 1880's was a can filling protector, so it seems that the bulk of

33"Again to cutting tables, where muscular Chinese work the arms of machines that cut two salmon at one fell sweep into pieces convenient for tinning" ("Our Salmon and Salmon Canneries," p. 42).

34Colonist, July 30, 1881, p. 3.

35"... cans ... placed, after being filled, on a travelling platform worked by an endless chain are successfully presented to the soldering tool and pass out complete without the intervention of hand labour" (Canada, S.P., 1882, no. 5, appendix 6, p. 202).

36Ibid., p. 218.

37"Our Salmon and Salmon Canneries," p. 42. Confusion over who invented the solderer is due to the fact that there are several models of this machine. For instance, there was a patent held by a Mr. Johnson for a solderer that processed 3,000 cans per day (Colonist, July 28, 1881, p. 3) and one held by Joseph Spratt for the chain solderer which with six hands processed 35,000 cans (Colonist, July 30, 1881, p. 3).
the Fraser's new machines were indeed copied from American models. This evidence is reinforced by the fact of the leadership on the west coast in this period of the Columbia salmon industry. There were three reasons for the cluster of innovations between 1877 and the early 1880's: extensive capital investment, a major innovation, and serious labour shortages. During 1877 there was a major extension of capital investment in the Fraser's salmon industry. The introduction of the retort sped up the cooking process and thereby necessitated increased production by the other canning processes—cutting, soldering, filling. Labour shortages, a constant problem in the fishing industry, were especially bad during the early 1880's when the boom in C.P.R. construction absorbed much of the Province's manpower. These labour shortages could only have reinforced the demand for labour-saving innovations.

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38 This machine was advertised to produce a vast saving to canners by preventing soiling of the can surface during the filling stage, thus making unnecessary the wiping of the can after it was filled. It also decreased the number of cans leaking because scales adhered to the can prior to the soldering of the top, a serious cause of spoilage which plagued the early canners (Mainland Guardian, August 11, 1883, p. 2).

39 "Aggregate expenditures for labour and supplies cost over a quarter of a million dollars and probably exceeds the disbursement of the old established canners of any previous years nearly tenfold" (Canada, S.P., 1878, no. 17, p. 287).

40 "The canneries were not worked up to their full capacity owing to the deficiency of labour arising from the increased demand for railway and other purposes" (Canada, S.P., 1882, no. 6, p. 202).

41 Another serious labour shortage in 1889 resulted in the canneries packing less fish than they could have. It was estimated that an additional 15,000,000 one pound cans could have been put up if enough labour had been available (Canada, S.P., 1890, no. 17, p. 247).
Between 1883 and the early 1890's there is, however, little evidence of substantial technological change in the canneries. Poor market conditions, due to a glut of salmon on the British market between 1883 and 1885, severely dampened innovation as capital sources dried up. Commission houses, the industry's major source of capital in this period, discouraged canners from packing by curtailing their advances.

With the end of the market glut in the late 1880's and the appearance of a new and more effective method of mobilizing capital, the limited company, the Fraser River industry entered a period of rapid expansion. Between 1889 and 1901 the number of canneries rose from 16 to 49 and total production from 303,875 cases to 962,682. By 1902 the

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42 Before the coming of the limited companies in the 1890's the commercial practice on the Pacific coast was for commission merchants to make advances in the form of overdrawn accounts on goods in transit. These merchants also provided cannery supplies and a distribution system to the markets (Ralston, "The 1900 Strike," p. 18). For example, in 1882 the commission house of Stahlschmidt and Ward advertised "liberal advances made on consignments" (Henderson's B. C. Directory, 1882, [no page numbers]). Even the Bank of British Columbia engaged in this form of lending (Victor Ross, "The Bank of B.C.," A History of the Canadian Bank of Commerce, I [Toronto: Oxford University Press, 1920], 309-314).

43 Mainland Guardian, June 27, 1885, p. 3. Although this refers to the San Francisco houses and their dealings with the Columbia River, there is little doubt that the Victoria houses followed suit in relation to the Fraser River as both areas responded directly to the British Market.

44 The first of these companies, British Columbia Canning Company, was formed by the established Fraser River operators, Findlay, Durham, and Brodie in 1889. By 1891 limited companies such as Anglo British Columbia and the Victoria Canning Company controlled over 60% of the Fraser's sockeye pack (David Reid, The Development of the Fraser River Salmon Canning Industry 1882-1913 [Vancouver, B.C.: Department of the Environment, 1973] p. 2).

45 Cobb, p. 579.
industry was dominated by large corporations\textsuperscript{47} which exhibited a high degree of concentration and decreased radically the importance of local capital, especially that of commission merchants.

Even though canning innovation was made in the years 1885 to 1902, it was far less rapid than in the earlier period. It seems to have been mainly concerned with the refinement of the technology introduced in the earlier years. This fact supports the thesis that technology appears in clusters of interlocking mutually supporting techniques that are initiated by a major innovation, in this case the steam retort, rather than in a series of isolated major innovations.\textsuperscript{48} A lengthy description of the Fraser River canning process in the year 1889 confirms this argument. The only change from the previous technology was the use of a more sophisticated gang knife.\textsuperscript{49}

\textsuperscript{46}In 1902 the B. C. Packers Association was formed. This limited company alone absorbed 29 of the existing canneries and 22 existing firms, including the Victoria Canning Company, and in its first year of operation controlled over 50\% of the Fraser's sockeye pack (Reid, pp. 1-2).

\textsuperscript{47}By 1902 these corporations were the B. C. Packers, backed by a consortium of eastern Canadian financial interests and ABC, backed in the United Kingdom.

\textsuperscript{48}It would appear that the "isolated great innovation" theory of technological change has some validity if one considers the steam retort as a key (or "great") innovation which initiated the cluster of technological change in the canneries between 1877 and 1882. It was not a new principle, however, "isolated" from the general stream of technological development of the day. It was merely an application of marine boilers to a stationary position.

\textsuperscript{49}"The next lays it [the salmon] upon a semi-circular machine where it is cut into three or four pieces, the exact length of the can by means of a set of large revolving knives which are operated by a crank. As the knife turns back an elevator consisting of an iron plate throws
In 1891 a new method appeared for packing salmon for the English market. Salmon were put up in half pound tins rather than the traditional one pound can, which was subsequently discarded. The economic advantages of the half pound tins were twofold. It involved just as much labour to put up the smaller cans as the pound cans, but in a season when fish were scarce the extra work was offset by the higher price obtained for the smaller cans. Also the smaller tins did not need to be boiled or retorted as long as the pound cans so more cases could be processed per day.

Some of these refinements of machinery developed in this period were exhibited at the New Westminster Exhibition of 1898—a machine that capped and soldered tins in one motion, a power cutter that cut up the fish, and others that filled the cans and sent them to the capping machine. Contemporary advertisements for the Schaeke Machine Works of

the pieces on another table, where they are sliced again. . . ." (Vancouver Daily World, August 28, 1889, p. 1). This quote shows again that it was merely an aid to the hand process rather than an automatic manufacturing device. For further descriptions of the gang knife see Carmichael, "A Season's Work," British Columbia Fishery Commission, "Report and Minutes of Evidence," 1892, Canada, S.P., 1893, no. 10c, p. 13.

Laidlaw and Bon Accord were the first to use this style of tin which was packed 96 to the case so that the case would equal the old ones with 48 one pound tins (Colonist, July 29, 1891, p. 4). In 1893 T. E. Ladner of the A. B. C. Company noted that only a few canneries were using the half pound tins; thus he intended to control the market on them ("Correspondence from Canoe Pass Cannery, 1892-1896," University of British Columbia Special Collections manuscript, p. 109).

"Correspondence from Canoe Pass Cannery," p. 4. For the year 1901: "Profits on tails less than others in the following order. Pound flats—profit 1 sh to 1/6, half pound flats 2/6-3/6, ovals 3/6 and upwards" (H. Doyle, "Letter to Jarvis, May 8, 1902," H. Doyle Papers, University of British Columbia Special Collections).
New Westminster give further evidence of this evolution:

Machines and designers of automatic canning machinery: dies, pressers for cutting out can tops and bottoms, shears, crimping machines, solder machine, power fish cutter, filling machines, Kellington washers, Des Brisay topper, Maunula spiral solder machine, Cosen's Exhauster and Tester, R. D. Hume's can making machine, Cosen's Lye washing machine, Swenson Oval Can Topper.

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52 "Correspondence from Canoe Pass Cannery," p. 4. Before the early 1890's the cooking process involved double cooking, once in a vat of boiling water for 30 minutes, then in a retort for one hour.


54 This machine, I believe, was a steam powered version of the gang knife (Columbian, July 12, 1897, p. 3).

55 One source of this machine was the Astoria Foundry which supplied a filling machine to Findlay, Durham and Brodie in 1893 ("Correspondence from Canoe Pass Cannery," p. 89).


57 Schaake moved his machine shop from San Francisco to New Westminster in 1897-1898 and soon became one of the most progressive manufacturers in British Columbia. His career is a perfect example of how salmon canning machinery was adapted from the vegetable canning processes of eastern North America as he had originally worked on canning machinery in Baltimore (Pacific Fisherman's Annual, 1903, p. 52).

58 Originally these machines were operated with a foot lever and held the can top in place pending soldering (William Wilcox, "The Fisheries of the Pacific Coast," Report of the Commissioners for the Year Ending June 30, 1893, United States Commission of Fish and Fisheries, XIX [Washington: Government Printing Office, 1895], 585). Whether the machine advertised by Schaake was manually or steam powered is unknown.

59 These machines were simply improved models of the earlier types.

60 J. Kellington was a machinist who worked for Schaake (Henderson's
Information on the extent of the actual application of these machines is, however, very limited. Both a power cutter and can washing machine were used in the Cleeve cannery during 1897 and did save a good deal of time and labour. This cannery also used three wooden and three iron retorts arranged in an arc on a "railway roundhouse" scheme which was a new departure in the canning process. But one cannery cannot be taken as the norm.

A general overall view of the effect of mechanization at the turn of the century is available from several sources. According to the Royal Commission of 1902 on Chinese and Japanese immigration, machinery was in

61 Des Brisay was an engineer and manager for the Cleeve Canning Company (Henderson's Directory, 1897-1900).

62 Cosen was either a machinist and/or foreman of Ewen and Company's cannery. As models of canning machinery are credited to men such as Kellington, Des Brisay, and Cosen, it is evident that although the Fraser River canning industry was by no means a technological leader, it did contribute innovations to canning technology.

63 This machine was patented in 1893 (U.S., Annual Report of the Commissioner of Patents, 1893 [Washington: Government Printing Office, 1894], p. 180) and introduced into British Columbia in 1896 when R. D. Hume made an arrangement with the major machinery producer in 19th century British Columbia, the Albion Iron Works of Victoria, to manufacture these machines. Tin plate was fed into the machine, cut, flanged, and curved around a cylinder. The can then passed into the soldering apparatus in which a reel held the wire solder and an automatic cutter chopped off the required amount (Colonist, May 2, 1896, p. 5).

64 Columbian, July 12, 1897, p. 3.

65 loc. cit. Railway tracks leading into retorts but not on a roundhouse system were used on the Fraser at English and Co.'s cannery as early as 1881 (Colonist, July 30, 1881, p. 3).
general use and had drastically reduced the cannery labour input. 67

One washing or wiping machine with at most three people could process up to two thousand cases every day whereas the old manual system demanded twenty to thirty hand washers. 68 Two hands with a capping machine put up 1,500 to 2,000 cases per day; under the old system this process involved twenty labourers. The fish cutting machine saved the labour of five men on 1,500 cases per day. The labour of fifteen to twenty or more hands was saved by the application of an automatic cooking process, a tester, and an automatic washer. Two men did as much work with a soldering machine as 75 men working by hand would have done some years previously. 69 One final innovation on the canning line before 1900 was the introduction of the steam box 70 to the cooking process. This box eliminated the old system of double cooking, in which cans were boiled in kettles for 45 minutes before being vented and resealed for the second cooking in the retort. 71 Under the steam box process, cans were passed back and forth through a box for only 7 or 8

66 Canada, Royal Commission on Chinese and Japanese Immigration, 1902, Canada, S.P., 1902, no. 54a.

67 "All the available labour saving machinery known to the trade is in general use by the canner and has reduced the Chinese labour by more than one half, but they state that its introduction has not lessened the cost per case for Chinese labour" (ibid., p. 165). As Chinese labourers' wages were relatively constant prior to 1902, the canners' claim that mechanization did not lessen the cost per case for Chinese labour is dubious.

68 Ibid., p. 137.

69 Ibid., p. 154.
minutes to exhaust the air in the can. As it took less time to cook the fish, the entire cooking process was speeded up. The 1902 British Columbia Packers Canneries (Northern) Report also gives evidence on mechanization. The presence of steam powered cappers, washers (for cans, not fish), power knives, and steam boxes shows that these items were in general use on the Fraser at that time, since the northern canneries were usually slower in adopting innovations than were the southern canneries. The washing and cleaning of fish was, however, one section of the canning line which still presented a serious bottleneck, and this problem was not resolved until the introduction of butchering machines in 1903-1906.

The statistics, though limited, support the above argument that there was substantial technological change during the era of manual canning (before 1902), and that such technology was essentially labour saving in nature. In 1877 average production per day ranged from 240 cases with a 130-150 man crew to 300-450 cases with a crew of 150-300. By 1883 average daily production had risen to 1,000 cases with an average crew of 120-140. Thus between 1877 and 1883 average daily production per

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70Steam boxes were not used prior to the early 1890's (Herbert Gowen, "Salmon Fishing and Canning on the Fraser," The Canadian Magazine, Dec. 1893, p. 163).

71Columbian, August 28, 1889, p. 1.

72Gladstone, p. 34. Further information was provided in an interview with Harold Britten of the Canadian Fishing Company, Vancouver, B.C.

73Not until 1913 was a vacuum machine introduced which eventually replaced the steam box. This machine exhausted the cans and sealed them with the sanitary or solderless can (Pacific Fisherman, August 1952, p. 42).
cannery had more than doubled with the same or less manpower input. By 1893 average daily production had again risen but it is uncertain whether this was attributable to labour saving technology. Between this date and the early 1900's there is no doubt as to the effect of technology. Although average daily production remained constant, the average number of cannery crew decreased from 120-150 to 84 (see Table I).

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74 "B. C. Packers Canneries Report," November 1902, Doyle Papers, box 11, file 12, see Mill Bay, Lowe Inlet, and Smith Inlet notes.

75 The cappers were steam powered because Doyle notes that "the capper wants to be shifted so as to give it a better draft for the carrying off of steam" (ibid., Lowe Sound notes).

76 "In equipment the cannery is sadly lacking: no capper, washer or power knife and kettles instead of steam boxes for the first cooking" (ibid., Mill Bay report).

77 Canada, Royal Commission on Chinese and Japanese Immigration, 1902, Canada, S.P., 1902, no. 54a, p. 137. The whole problem of this bottleneck will be discussed in detail in Chapter 4, but the canner's concern with this problem at the turn of the century must be emphasized.

78 As B. C. was a newly developing region with a very small population it is little wonder that technological change was essentially labour saving in nature.
TABLE I
CANNERY STATISTICS FOR THE YEARS 1877, 1883, 1893, and 1898-1905

<table>
<thead>
<tr>
<th></th>
<th>Finlayson and Lane</th>
<th>English and Co.</th>
<th>Ewen &amp; Wise</th>
<th>Holbrook &amp; Co.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1877 Capacity per day (cases)</td>
<td>300-500</td>
<td>450</td>
<td>240</td>
<td>230-240</td>
</tr>
<tr>
<td>Cannery crew</td>
<td>150</td>
<td>300</td>
<td>150</td>
<td>130</td>
</tr>
<tr>
<td>No. fishboats</td>
<td>18-19*</td>
<td>22-23*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No. fishermen</td>
<td>75</td>
<td>90</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total employees</td>
<td>225</td>
<td>390</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1883

<table>
<thead>
<tr>
<th></th>
<th>Delta Cannery</th>
<th>Ewen &amp; Richmond Cannery</th>
<th>Coquitlam Cannery</th>
<th>Wadham's Cannery</th>
<th>Rivers Inlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity per day (cases)</td>
<td>1000*</td>
<td>1000</td>
<td>600</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>Cannery crew</td>
<td>150 (plus 20 others)</td>
<td>140-160*</td>
<td>-</td>
<td>360</td>
<td>-</td>
</tr>
<tr>
<td>No. fishboats</td>
<td>40 (plus contract boats)</td>
<td>35-40</td>
<td>-</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>No. fishermen</td>
<td>160</td>
<td>140-160*</td>
<td>-</td>
<td>120*</td>
<td>-</td>
</tr>
<tr>
<td>Total employees</td>
<td>330</td>
<td>300</td>
<td>-</td>
<td>175-250</td>
<td>245</td>
</tr>
</tbody>
</table>

1893

<table>
<thead>
<tr>
<th></th>
<th>Delta Cannery</th>
<th>Ewen &amp; Richmond Cannery</th>
<th>Coquitlam Cannery</th>
<th>Wadham's Cannery</th>
<th>Rivers Inlet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity per day (cases)</td>
<td>1200</td>
<td>84 (plus 10 steamboat and camp men)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cannery crew</td>
<td>84</td>
<td>60</td>
<td></td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>No. fishboats</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. fishermen</td>
<td>140</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total employees</td>
<td>234</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average production of 1200 cases per day (during a large run).

Average for all canneries on the Fraser for these eight years.
Starred figures are estimates. For example, the number of fishermen is four times the number of boats. Each boat had a puller and a hauler, or two men on both daily shifts.

Although the data is fragmentary, it is the most complete found for the early years.

Mainland Guardian, August 18, 1877, p. 3. The bigger labour force of this cannery was probably due to the cannery's being on different levels.

Ibid., August 11, 1877, p. 3.

Colonist, July 29, 1877, p. 3.

Statistics for 1883 are found in "Our Salmon and Salmon Canneries," pp. 42-44.

Columbian, July 29, 1893.

Canada, Dominion Fisheries Commission for British Columbia, "Report and Recommendations," 1905-1907 (Ottawa: Government Printing Bureau, 1908), pp. 22-24. After 1897 canneries started to use more than one line; these estimates, however, are based on one canning line per cannery.
Chapter 2

THE OAR AND SAIL POWERED GILLNET FISHERY

Having dealt with technological change in the canneries, it is now essential to study the corresponding change in the two other sectors of the industry, the fishing and tenderboat sectors. Other studies of the Fraser River industry have virtually ignored this topic, but an examination of the changes in these sectors is essential for a comprehensive understanding of technological change and its interlocking characteristics. It is impossible to study any sector of the industry in isolation; the attempt to do so results in conclusions which misrepresent the historical evidence.

Fraser River canneries relied solely on the gillnet, or ensnarement, fishery for their supply of salmon. It appears that gillnets were not employed aboriginally; the native people used entrapment, weirs, spearing, and dipnetting techniques. These methods were too slow and too unreliable to ensure a sufficient catch for continuous cannery operations. In addition the centre of this fishery was in the lower Fraser canyon, too distant from New Westminster, the original centre of the canning industry, to guarantee the catch being suitable for canning when it arrived in New Westminster.

It has been accepted as fact that Alexander Ewen introduced the

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1"There is but one mode of capture of salmon by whites, that is by drift nets gillnets . . . Traps and weirs have been tried without any great success and financially proved a failure" (The Inland Sentinel, July 29, 1880).
gillnet to the Fraser in 1864. However, as the Hudson's Bay Company was experimenting with different types of nets at Fort Langley as early as 1829, it is entirely possible that some long-forgotten Hudson's Bay employee actually initiated the use of this net on the Fraser River.

Three things contributed to the dominance of the gillnet in the commercial salmon fishery. The major factor was the physical characteristic of the Fraser during the sockeye season. The river's opaque waters enabled the gillnet to be effectively used either during daylight or at night. The second was the conservation regulations which discouraged and in most cases banned encirclement, or seining, and entrapment, or traps.


3 Henry Doyle, "Rise and Decline of the Pacific Salmon Fisheries," University of British Columbia Special Collections manuscript, vol. I, p. 10.


5 "Fort Langley Journal," International Pacific Salmon Fisheries Commission, New Westminster, manuscript, July 20, 1829. Although there is no evidence that the natives aboriginally used the gillnet on the Fraser, gillnets spun from Fraser River hemp were used in the early 1860's in the bays and harbours of southern B. C. Thus the Indians in all probability used gillnets on the Fraser before Ewen's arrival (John Lord, The Naturalist in Vancouver Island and British Columbia, I [London: Richard Bentley, 1866], 62-63).

6 Drag seines were never important on the Fraser, but some of the Fraser River canneries used them during the late 1880's in Mud, Semiamho, and Cowichan Bays before they were banned in 1890 (Canada, Statutes of Canada, 1891, vol I, p. lxxvii; Canada, S.P., 1889, no. 8, p. 244; Canada, S.P., 1888, no. 8, p. 255).

7 A trap was tried on the Fraser in 1878, but as traps were illegal
The third was that the Fraser area has protected waters in which relatively small, low cost vessels (compared to trap and seine vessels) can operate. The inexpensiveness of the original gillnet vessel or skiff was especially important in the early years when capital supplies were meager. The need to save on cost led, however, to a concentration on relatively high cost, low production methods in the salmon fishery.

Fundamentally gillnets consist of a web netting, loosely suspended between a lead line on the bottom and a cork line on the top. These nets can be fished either by anchoring them as set nets or by allowing them to drift with the tide or current as drift nets. The set net was illegal in British Columbia, but not in the states of the Pacific coast. The effectiveness of this type of gear depends on sufficient silt in the river to obscure the net. In the early spring the Fraser is comparatively clear, so that in daytime the gillnets can be more or less plainly seen by the salmon. Fishing is therefore carried on during the night. Sediment appears in the river later in the season and is at its greatest intensity during the months of June, July and August, after which the river begins to clear again. In opaque waters, the net may be used effectively either day or night and it is during this season that the great sockeye run, on which the early canneries chiefly depended, takes place. This gear is not only used in the river itself but beyond its mouth where the discoloured water extends for several miles in all directions. The area of effective gillnet grounds stretches from Point Roberts to Point Grey to a distance of at least five or six miles offshore.

before 1894, it was removed by order of the Department of Fisheries (Canada, British Columbia Fishery Commission, "Report and Minutes of Evidence," 1892, Canada, S.P., 1893, no. 10c, p. 739).
The total range or maximum mobility of the early Fraser River gillnet fleet extended from this offshore limit to a few miles above New Westminster. The restriction of fishing above New Westminster had nothing to do with the silt content of the river. It was rather that this area had few good drifting places during the sockeye season. In addition there was less certainty of a sailing breeze upstream than below New Westminster, a fact which was especially important when the gillnet vessel relied solely on oar and sail power.

The actual practice of gillnetting was conducted in a "reach" or "drift", a stretch of water fairly uniform in depth and free of snags or sharp ledges which could catch the lower portion of the net, especially the lead line, and tear the mesh or cause the net to be lost. In setting the net, usually an hour before high water slack, the boat puller rowed across the current while the fisherman paid out the net. When two thirds of the net was out the boat was turned downstream at nearly right angles to her former course so that the net, when set, approximated the shape of the letter "L". The boat drifted with the net until an hour after the turn of the tide or until the end of the drift was reached. The net was then hauled over a wooden roller on the stern and the catch was removed. This procedure was repeated if the tide was not too strong and if there were not too many boats working the

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8 During this time the salmon head upstream.

9 Prior to gillnetters being mechanized, each boat had a two man crew—the puller rowed the vessel and the fisherman dealt with the net.

10 Cobb, p. 478.
The original Fraser River gillnet, used exclusively until the introduction of the hard twine net in the 1890's, was loosely laid, double knotted, and made of soft twine. Its twine was made with the very best flax but since it was loosely laid it had a very coarse appearance when compared to the eastern North American hard laid variety of gillnet. Nets of the Fraser River construction, although not suited for clear waters, were better adapted to the circumstances of the Fraser, that is, large catches of heavy fish and the murky waters during the salmon season. Before net knitting machines capable of producing the double knot were introduced in the late 1880's, all gillnets were hand knitted, mostly by Indian women. The first evidence of machine-made gillnet mesh on the Fraser is in 1888. The total cost of a gillnet (mesh, lead line, and corkline) was between $120 and $150, or one dollar per fathom. The cork or float line was of hemp and the floats were made


11 Flax was used instead of cotton because it is much stronger and deteriorates less quickly when used in a river fishery. Unlike cotton, the holding strength of flax is greater when it is wet than when it is dry (Doyle, "Rise and Decline," I, pp. 12-13). The major source of gillnet twine was Britain (Columbian, July 11, 1896, p. 1). The key to Britain's superiority in the supply of twine was that she possessed machines capable of knitting the double knot mesh and was able to keep other nations from becoming competitive in this field (Doyle, "Rise and Decline," pp. 81-82).

12 "Our Salmon and Salmon Canneries," p. 41; Doyle, "Rise and Decline," p. 81.

of cedar, although it is possible in some cases that tin cans were used. Although a net float factory was not established until 1899,\textsuperscript{16} the local lumber mills on the Fraser produced lathed cedar floats.\textsuperscript{17} Early gillnet leads were simply attached to the bottom line, not woven into the lay of the rope like modern leadlines.

Between 1871 and the early 1900's there was very little change in the dimensions of the gillnet except for net depths. In the early 1880's conservation measures limited the mesh size of sockeye nets to 4 7/8 inches and the maximum length was fixed at 150 fathoms in 1888.\textsuperscript{18} As net depths were not regulated until 1908,\textsuperscript{19} however, nets became deeper and deeper. Prior to this regulation net depths increased from 27 to 30 meshes in 1883\textsuperscript{20} to 30 to 60 meshes in 1892\textsuperscript{21} and 75 to 100 or more meshes in 1900.\textsuperscript{22} Before being regulated by law net depths were set by custom which was in turn governed by the depth of the major drifts.\textsuperscript{23}

\textsuperscript{15}"Our Salmon and Salmon Canneries," p. 42. "After one month's constant fishing it is then thrown aside as useless."

\textsuperscript{16}\textit{Columbian}, December 30, 1899, p. 3.

\textsuperscript{17}In 1885 the Royal City Planing Mills of New Westminster advertised net floats (\textit{Columbian}, December 30, 1885, p. 1).


\textsuperscript{19}In 1908 conservation measures limited net depth to 60 meshes (ibid.).

\textsuperscript{20}"Our Salmon and Salmon Canneries," p. 42.

\textsuperscript{21}\textit{Canada, B. C. Fishery Commission}, 1892, Canada, S.P., 1893, no. 10c, p. 430. On the sandheads depth was 30-40 meshes (ibid., p. 84). Deeper nets (50-60 meshes) were used further up river, however, and even in the channel down at the mouth (ibid., pp. 13, 21, 84).
The boats in the first commercial fisheries on the Fraser were probably flatbottomed skiffs. They were used as early as 1870 and they continued to be in general use as long as fishing stayed in the river itself. Their cost throughout the period dropped, probably as a result of mass production techniques. There were slight variations in skiffs on the upper and lower reaches of the river fishery; boats on the lower river were more heavily built and extensively rigged as protection against open water conditions in the river mouth. These skiffs, commonly known as Fraser River skiffs, were generally twenty-foot, flat-bottomed, double-enders with big flares to the side and quite a round bottom fore and aft.

Since the production of a cannery rose with the number of boats fishing, it is little wonder that the fishing grounds in the Fraser

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22 Rounsefell, p. 708. The deep nets were used in the Gulf fishery, outside the river, as such depths were not practical in the river. "There are snags in the river ... you cannot fish very deep nets" (Canada, B.C. Fishery Commission, 1892, Canada, S.P., 1893, no. 10c, p. 8).

23 In reference to net depth, "It depends on the depth of the water" (ibid., p. 70).

24 "Ordered the construction of four boats and a large number of net and 2-3 thousand barrels" (Mainland Guardian, June 18, 1870, p. 3). "Great preparations are being made for the fishing season making nets, building and painting skiffs" (ibid., June 22, 1872, p. 4).

25 Initially skiffs cost $46, but by the 1880's they dropped to as low as $31. Canada, Department of Fisheries Report for B.C., Canada, S.P., various issues 1877-1888.


experienced overcrowding by the late 1880's. Between 1872 and 1888 the number of canneries increased from three to twelve and there was increased productivity on each canning line as well. As early as 1881 the principal fishing was being done at the river's mouth and the sandheads. In 1884 over 400 boats fished on the river and by 1888 serious overcrowding was reported.

In response to fishing pressure on the Fraser River the federal government introduced fishing license limitations between 1889 and 1892. During 1889, 1890, and 1891 the number of licenses was limited to 500 with an average of 20 licenses per cannery. In early 1892, however, in response to strenuous protest from canners and fishermen alike, all limitations on the number of boats were lifted. Licenses were then given to all bona fide fishermen who were British subjects.

Two long range effects resulted from removal of license limitations:

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28 Colonist, July 26, 1881, p. 3. By 1882 the number of canneries on the lower river was greater than those on the upper river. This downstream movement was a result of increased fishing activity on the lower river.

29 Canada, Report of the Department of Fisheries, 1883, Canada, S.P., 1885, no. 9, appendix 7, p. 262.

30 "If all the canneries are in operation, I do not understand where the room for the increase of nets is to come from. At the regulation distance apart the number of nets fished this year would extend 85 miles, while there is only about 70 miles of fishing ground" (Canada, S.P., 1889, p. 244).

31 Canada, S.P., 1890, no. 17, p. xii.

the traditional fishing grounds were overcrowded and a change took place in the type of license ownership. Removal of limitations contributed to the overcrowding of the inside grounds and resulted in many fishermen moving out into the open waters of the Gulf. In 1894, only two years after the removal of license limitation, the number of fishing units numbered 1426, surpassing the pre-limitation peak of 1055 by nearly 150%. A limit of 20 boat licenses per cannery, which was dropped to ten in 1898, reinforced this trend toward non-cannery licenses which had begun in the 1880's. The change in the type of license changed the employer-fisherman relationship from one based on a daily wage and company-owned gear to one in which fishermen owned their own gear and operated on a contract or share system. The dominant wage relationship in effect before the late 1880's rapidly gave way to the contract relationship. Following the last year of license limitation fishermen held 270 licenses and the canners had only 508. By 1894 the total number of licenses was over 200 more than in 1893 and double the number of four or five years previous. As the greatest increase was in the number of free fishermen's licenses, such licenses were dominant by 1894.

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33 Lax handling of applications made evasion of the British citizenship clause very easy (Ralston, "The 1900 Strike," p. 79).


This situation of overcrowded fishing within the river resulted in the fishery being pushed into the unprotected waters of the Gulf of Georgia, which required a change in boat and net design. By 1891 the fishery extended to the edge of the clear Gulf waters, which was as far into the Gulf as possible with its existing net technology. A new type of gillnet, less visible in clear water and thus better suited to the Gulf was therefore introduced in 1892. This was the hard-laid design, constructed of oiled, hard laid sturgeon twine. Although by no means new to North America, it was first introduced on the Fraser by Gilbert Robertson of the Alliance Cannery. Not only did the hard twine net increase the range of the fishery, it also allowed for more fishing time. Hard twine did not bunch up and become entangled as easily as a soft twine net; it kept its shape and being oiled could be handled without the danger of tangles. Less time was therefore spent in untangling and repairing the net, permitting more fishing time.

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36 In 1887 only 109 of 467 licenses were non-cannery (Canada, S.P., 1889, no. 8, p. 243).

37 Canada, S.P., 1893, no. 10a, p. 158.


39 Columbian, July 11, 1894, p. 4. By far the majority of free fishermen were whites or Japanese as the Indians preferred the old wage relationship (Columbian, July 9, 1897, p. 4).

40 Rounsefell, p. 708.


42 Ibid.
The ever increasing intensity of the Gulf fishery in the early 1890's showed the unsuitability to open waters of the original Fraser River gillnet skiff, which was reported to split in two in the heavy seas of the Gulf.\(^44\) Between 1889 and 1892 a new vessel, the Columbia River boat, was therefore introduced into the fishery. This vessel was an open, carvel built, centerboard craft, sharp forward and aft. The ends were shaped alike, it was moderately concave below the water line, and it had a rather full convex line above the water. It had a shallow keel with little or no rake to the stern and stern post, both of which were straight, with the exception of a rounded forefoot. The floor was long and low with a round bilge and was flared slightly at the top. It was decked for two or three feet at each end and had a washboard extending along both sides. A coaming of two or three inches high ran around the inner edge of the washboards and the decked spaces of the bow and stern, making the open part of the boat an oval. It had four thwarts with three rowlocks on each side, each with a single tholepin. A single mast, upon which was set a spritsail, was stepped well forward. Oars were carried and used when there was no wind or when working the net.\(^45\) The Canadian Fisherman described the gillnet

\(^{43}\) Ibid.

\(^{44}\) "While fishing on the Gulf in pretty rough water their boat, an ordinary flat bottomed affair, was struck by a wave and split in twain" (Columbian, August 8, 1896, p. 39).

\(^{45}\) J. W. Collins, The Fishing Vessels and Boats of the Pacific Coast, Bulletin of the U. S. Fish Commission (Washington: Government Printing Office, 1892), p. 39. The dimensions of this boat, which are a trifle larger than the average, are as follows: length over all, 25 3/4 feet; beam 6 3/4 feet; depth, 2 feet; height amidships, gunwhale to bottom of keel, 2 1/2 feet; height at ends, 3 feet; mast length, 16 1/4 feet; oar
boat of the early 1900's thus: "The boat is a strongly built round bottom
sailing boat, 30 feet long, 6 1/2 foot beam with a 6 foot centre board.
On either side of the centre board are the fish tanks capable of holding
two and a half tons of fish line weight. The sails are a jib and an
ordinary sloop rigged main sail."\(^{46}\)

Although such boats were commonly referred to as Columbia River
boats the name is misleading because another boat built for the Fraser
River salmon fishery, the Collingwood boat, had a similar, if not
identical, design.\(^{47}\) In all probability, the Columbia River boat was in
fact the local West Coast name for the Collingwood boat,\(^ {48}\) which had been
evolved on the Great Lakes by a William Watts. It was transplanted to the
Fraser by Watts' son, Capt. William Watts, who established a boatyard in
Vancouver in 1888\(^ {49}\) to construct gillnet boats for the Fraser River
canneries.\(^ {50}\) Three years later another shipwright, Andy Wallace, who had
also worked for William Watts in eastern Canada, moved to Vancouver and

length, 12 feet; cost ready to use, $400; number of men in crew, 2.

\(^{46}\) Canadian Fisherman, July 1917, p. 292.

\(^{47}\) Yachting, November 1940, pp. 35-37, 74-77.

\(^{48}\) J. W. Collins claimed that the first Columbia River boat for use
on the Columbia was built in 1869 at San Francisco (Collins, p. 38). However, as William Watts built Collingwood boats as early as the 1850's
(Yachting, Nov. 1940, p. 36) this design may have diffused to
San Francisco where it became known as the Columbia River boat or it may
have had a parallel development in the United States. Since the Columbia
River boat was used earlier on the Columbia than on the Fraser and prior
to 1899 migratory fishermen annually came north from the Sacramento and
Columbia to fish the Fraser, the name "Columbia River boat" probably came
from these migrants.

\(^{49}\) Yachting, Nov. 1940, p. 37.
shared gillnet boat building contracts with Capt. Watts before establishing his own yard in 1894.\textsuperscript{51}

Initially Columbia River boats were constructed by white shipwrights; between 1895 and 1897 the Wallace Shipyards of Vancouver alone built from 600 to 800 of them.\textsuperscript{52} Between 1896 and 1901, however, about 50\% of the manufacture of fishing boats passed into the hands of local Japanese boatbuilders.\textsuperscript{53} There were two basic reasons for the rapid inroads made by the Japanese in this trade. The first was that non-Japanese boatbuilders who did not mechanize their yards could not compete with the low cost labour provided by the Japanese.\textsuperscript{54} In Wallace's shipyard the wage rates ranged from $1.25 to $4 for a nine hour day, whereas Japanese offered to work for Wallace at 10\textcent and 11\textcent per hour or 90\textcent to 99\textcent per day.\textsuperscript{55} Wallace successfully competed with the Japanese by applying labour saving devices such as a solid boat frame\textsuperscript{56} and woodworking machinery.\textsuperscript{57} The second reason for Japanese inroads was their entering building contracts\textsuperscript{58} with the canneries. They not only

\begin{itemize}
\item \textsuperscript{50} Ibid.
\item \textsuperscript{51} Marshall, I, 17.
\item \textsuperscript{52} D. Wallace, interview, June 1973.
\item \textsuperscript{53} Canada, Royal Commission on Chinese and Japanese Immigration, 1902, "Report," Canada, S.P., 1902, p. 358.
\item \textsuperscript{54} Ibid., p. 357.
\item \textsuperscript{55} Ibid., p. 358.
\item \textsuperscript{56} The boats were built bottom up over this frame (\textit{Yachting}, p. 37).
\end{itemize}
contracted to build boats but also guaranteed to furnish the canners with men to fish these boats while white shipwrights refused to engage in fishing.\textsuperscript{59} This guarantee became increasingly important in the 1890's with the rapid increase in the demand for fishermen. Between 1891 and 1899 the numbers of fishermen rose from 1,000 to 5,444. In 1902 Alexander Ewen, a leading canner, stated that "the trouble is to get the fish and the people to work. That is the great difficulty."\textsuperscript{60}

The Columbia River gillnet boat was well established by 1892.\textsuperscript{61} By 1896 the combination of this boat and the hard twine gillnet had enabled the Gulf fishery to extend in an arc into the clear waters from Garry Point to Point Roberts to a distance of five or six miles out. By 1905 the dominance of the Columbia River boat was indisputable.\textsuperscript{63} Statistics in the Doyle papers would suggest that this design was in fact dominant by 1901,\textsuperscript{64} but in fact skiffes still played a major role on the Fraser in that year. Rounsefell maintains that the adoption of the

\begin{itemize}
\item \textsuperscript{57}Wallace claimed that his yard could do work about 15\% cheaper by machinery and that no one building by hand could compete with machinery (Canada, Royal Commission on Chinese and Japanese Immigration, Canada, S.P., 1902, p. 358).
\item \textsuperscript{58}Only 3\% of the gillnet boats were not built on the contract system (ibid.).
\item \textsuperscript{59}Ibid., p. 359.
\item \textsuperscript{60}Ibid., p. 136.
\item \textsuperscript{61}"Many boats of a larger and more seaworthy class than formerly used are being employed in the salmon fishery. The boats fish far outside the river and in all weather" (Canada, S.P., 1893, no. 10a, p. 158).
\item \textsuperscript{62}Speaking of the sockeye in the Gulf, the \textit{Columbian} reports:
\end{itemize}
Columbia River boat was all but complete by 1903. He bases this observation on the fact that Japanese and white fishermen, the majority of fishermen by the late 1890's, rapidly adopted the new design whereas Indians did not, and to prove this point he shows that only 477 of the 3,096 licenses in 1903 belonged to Indians. Other statistics for 1901 show that there were approximately 1,257 skiffs and 1,891 Columbia River boats which makes it doubtful that the adoption of this design was "all but complete" only two years later. The Fraser River skiff was therefore still important in the river fishery until at least 1903.

Prior to 1903 the only other innovation in the fishing boat was the introduction of a wooden net roller, commonly called a dead roller because it was not mechanized, in the stern. On the Columbia River boat the rudder was removable so that the roller could be put in its place to ease the strain of hauling in the net. Because of the simplicity of this device its introduction was probably very early, but no date can be given.

"There they are reported in great number and though it is difficult to net them in clear water, some of the canneries averaged 70 to the boat yesterday" (Columbian, August 4, 1896, p. 4).

"This alteration in the length of gillnet in the Gulf was necessitated by the general use outside the river of the large Columbia River boat which will hold twice the quantity of fish" (Pacific Fisherman, June 1905, p. 21).

The Star Cannery (Steveston) had 59 boats and 11 skiffs; the Fraser River and Vancouver canneries, no skiffs (Doyle, "Papers," box 3, IIIc). Although only three canneries are given, they are an excellent gauge as they represent the English Bay, and the lower and upper Fraser fishing areas.

Rounsefell, p. 708.
Even with these innovations the fishery began to display a pattern which has characterized the salmon fishery over the years: a continuous decrease in productivity per fishing vessel in the face of technological advance. After 1893 the catch per unit of effort decreased on a four year average. Coupled with this decrease was an increase in the cost per unit. The original Fraser River skiff cost between $25 and $35, whereas the Columbia River boat cost $75 to $150; the outside nets were bigger, and thus more expensive, than the inside nets.  

Unlike cannery innovation, technological changes in the fishing fleet in this period were not primarily labour saving because two men were still needed to operate the Columbia River boats. Only the later application of gasoline motors to the gillnet fleet made it possible to reduce a gillnetter's crew to one man.

66 With the influx of Japanese fishermen in the early 1890's the native fishermen were rapidly pushed out of the fishing sector. This was a major cause of racial tension and accounts for the Indians supporting the whites during fishing strikes (Ralston, "The 1900 Strike," pp. vii-176).  

67 Letter to J. P. Babcock, September 30, 1901, B. C. Dept. of Fisheries manuscript, B. C. Provincial Archives, box 17.  

68 Cobb, p. 478. Interview with Donald Watson and draft for an article on marine development of Richmond, at Richmond Arts Center.  


70 Two aspects of this technology were, however, labour saving. The hard twine gillnet tangled less than its predecessor which meant less time was spent untangling nets. The design of the Columbia River boat allowed more time spent on the grounds.
Chapter 3

EARLY TENDERBOATS

Another aspect of technological change in the salmon fishery was the introduction of the steam powered tenderboat to transport fish from the fishing grounds to the cannery. Such vessels were not employed in the first years of the fishery;\(^1\) the earliest evidence of their use is in 1877.\(^2\) Initially these vessels were of two types—freighters or tugs. The freighter carried fish in boxes on the deck or in the hold and the tugs towed the fish in scows.\(^3\) Both these types of tenders collected salmon directly from the fishing boats on the grounds. By 1878 the importance of tenders is indisputable.\(^4\)

A basic change in the method of collecting salmon occurred between 1877 and 1881. At first tenders had collected salmon directly from the fishing boats, but by 1881\(^5\) fish camps were used as bases. Each camp was composed of fishermen's living accommodations and net racks for repairing nets. They were either built on floats or on shore.\(^6\)

\(^1\)This is because there was no need for tenders—the fishing fleet worked drifts located very near if not at the cannery.

\(^2\)The Leonora and the Leviathan collected fish from English and Company boats on the Fraser and brought them to the cannery. Both these vessels used screw propulsion (Colonist, July 29, 1877, p. 3).

\(^3\)The Leonora was freighter and the Leviathan a tug (Canada, Department of Marine and Fisheries, "Annual Report of Steamboat Inspections for British Columbia," 1877, Canada, S.P., 1878, no. 1, p. 55).

\(^4\)"A multitude of large and small steamers are employed by various canneries to bring up their fish" (Mainland Guardian, July 10, 1878, p. 3).
At the commencement of a season these camps were established at favourable fishing points along the river, each camp having native fishermen and net men under the charge of a white man. Four men were needed to man each boat as fishing was conducted in two twelve hour shifts. At the camp the catch was unloaded into scows which were picked up twice a day by tenders and towed to the canneries for canning.

The fish camp and scow system was far superior to the original freighter and system of collecting fish, especially in turnabout time. The freighter had to wait to load and unload, whereas the tug simply exchanged an empty scow for a loaded one. Thus steam tugs could service a greater fishing area in less time per unit as compared to the freighter. Tenders also increased the mobility of the gillnet fleet before its mechanization by towing fishing boats to and from the fishing grounds. This was necessary when one area of the river proved to have poor fishing

5"Every cannery had a steamboat connected with it, and twice a day these steamboats visited the camps to collect fish" (Colonist, July 26, 1881, p. 2).

6Initially camps were either a shore station or were built on floats. The floating variety were far superior and soon superceded the shore station because the shore station could only service one section of the river while the floating variety could be towed to where the best fishing was throughout the season.

7Colonist, July 26, 1881, p. 2. "Our Salmon and Salmon Canning," p. 42.

8Colonist, July 26, 1881, p. 2.

9Mechanized gillnet boats appeared in the early 1900's. Pioneers set the date between 1902 and 1905 (interviews with D. Watson, J. Easthope, and N. Stevens). The Department of Fisheries does not even mention them until 1909, but as the Pacific Fisherman states: "For the first time gasoline engines [inboards] in fishing boats will be tried,
and the boats needed to move quickly to a better location. Although
the freighter tender could provide the same service it was at a greater
cost than the steam tug. The tug's advantage over the freighter was
not only economic; they were far better suited to towing scows and
boats. Steam tugs replaced the freighter tender because they could
transport salmon at the lowest cost consistent with the state of late
19th century technology.

Between the early 1880's and the 1900's the tenderboat sector of
the industry gained steadily in importance. In 1881, this sector
accounted for 4 to 8% of the Fraser salmon fishery's fixed capital, and
by 1890 it was 10%. Although by 1905 the percentage was down to
9.2%, this does not mean that tenders decreased in importance; by 1905
they serviced 75% more fishing boats than in 1890. The importance of ten-
ders is emphasized by the Columbian in 1896: "Few people are aware of
the magnitude of the business done in connection with our fisheries.
Here is a list of steamers [26 tenders] employed to carry salmon from
fishing camps and other points along the river to the particular cannery
to which they are attached . . . 7 [additional American] steamers are used
over 30 boats on the River" (Pacific Fisherman, V [July 1907], 27), one
can date their introduction by 1907.

10 "Because of a poor run in 1880, the fishery near the mouth of the
Fraser was a failure, and fish tugs towed the fishing boats to other
points near New Westminster" (Colonist, August 11, 1880, p. 3).

11 Steam tugs carried a smaller crew than the freighters and so
labour costs were also less.

12 See Table II, p. 50.
to carry salmon from the traps at Point Roberts and other points in the Gulf to various canneries on the river."

13 See Table II, p. 50.
14 See Table II, p. 50.
TABLE II

CAPITAL INVESTED\textsuperscript{a} PER CANNERY IN OPERATION ON THE FRASER FOR THE YEARS 1881\textsuperscript{b}, 1890\textsuperscript{c}, and 1905\textsuperscript{d}

<table>
<thead>
<tr>
<th>Year</th>
<th>Shore Installations</th>
<th>Fishing boats and nets</th>
<th>Steamboats and flatboats</th>
</tr>
</thead>
<tbody>
<tr>
<td>1881</td>
<td>$17,102</td>
<td>5,263</td>
<td>1,146</td>
</tr>
<tr>
<td>1890</td>
<td>$25,000</td>
<td>2,000</td>
<td>9,000</td>
</tr>
<tr>
<td>1905</td>
<td>$30,000</td>
<td>15,922</td>
<td>5,000</td>
</tr>
</tbody>
</table>

\textsuperscript{a}The percentage increases in the primary sector of the industry compared to the secondary can only enforce the importance of the primary sector in the development of the industry.


\textsuperscript{c}Canada, British Columbia Fishery Commission, "Minutes," Canada, S.P., 1893, no. 10c, p. 367.

THE TRANSITION FROM MANUAL TO MECHANIZED CANNING

Between 1903 and 1913 the technology of Fraser River salmon canning changed from primarily manual processes to primarily mechanized ones. In the canneries hand butchering gangs gave way to butchering machines, manually soldered cans began to be replaced by the mechanized solderless, or sanitary, can, and all other sections of the canning line experienced varying forms of mechanization. Technological change became no longer essentially an aid to the hand processes; it mechanized these processes. In the fishing fleet engines replaced oars and sails and mechanized seiners supplemented the gillnetters. The steam engine of the tenderboat tug was replaced by gasoline-powered collectors.

During the 1903-1913 period the capital and organization of the industry became dominated by large corporations having a high degree of concentration.\(^1\) Between the peak cycle sockeye years of 1901 and 1905 there was a rapid centralization of plant. In 1901, 49 canneries operated on the Fraser River, but by 1905 this number had decreased to 38, four of which were new entrants.\(^2\) Most of this centralization was a result of the formation of the British Columbia Packers' Association (hereafter referred to as BCP) which absorbed 29 of the existing canneries in May of 1902.

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\(^1\)Reid, p. 2.

\(^2\)Only one of these new entrants survived to can in the next cycle.
Consolidation of plant appears to have been a major objective of the B.C.P. Association. When the Company is formed the canneries on the Fraser will not be operated every season, the idea being to cut the canneries down to about one-third and double the plants. The machinery and equipment of those closed down will be taken to others . . . the work will be less costly and the output will be regulated by the price maintained. As seen by its architects in 1902, this consolidation was to have four advantages. It would decrease cannery labour, the price of fish, insurance costs, and the operating costs of canneries. To an industry suffering from overcapitalization, from labour scarcity, especially among cannery employees, from high insurance rates due to the problems of fire, particularly in the Steveston area where the canneries were closely crowded together, and from increasing fish prices, such objectives were essential. By the first peak year after the formation of the BCP Association, this company had decreased its operating canneries on the Fraser from twenty-nine to fifteen. Four of these canneries operated more than one canning line: Imperial had four lines, and Currie McWilliams, Brunswick No. 2, and Terra Nova each had two lines. Equipment for these additional lines was obtained mainly from canneries which were closed down between 1903 and 1905. By closing down a certain proportion and removing their machinery to the year of 1909. This poor survival rate of new entrants after 1901 could only have strengthened the power of the major company, B.C. Packers, in relation to the Anglo British Columbia Packing Company which was formed in 1891. Between 1893 and 1896, 22 new canneries were established on the Fraser, none of which were owned by ABC.

3 Letter to A. Jarvis, May 8, 1902, Doyle Papers, box 11, file 12.
plants operated, the packing capacity can thus be increased with only the expense of installation of machinery already on hand." For example, in 1903 the machinery from London and Brunswick No. 1 at Steveston was transferred to Imperial Cannery and at Currie McWilliams, the machinery and plant was taken from the Delta and Fisherman's Canneries. The advantages of more than one line per cannery were many. By centralizing plant "the tension upon the labour market during the height of a season's run should be considerably relieved by adoption of more machinery and equipment in enlarged plants and with much less labour for the same production." Plants with two or more lines did not have to stop and change cappers when a change was made in the style of the can. This gave these canneries an advantage because salmon could be canned without loss of production time as happened with a one line cannery.

4Colonist, March 26, 1902, p. 3.
5Letter to A. Jarvis, p. 7.
6"BCP Association General Manager Report, July 17, 1905," Doyle Papers.
7Ibid.
9Province, February 26, 1903, p. 1.
10"Additions to Canneries," 1903, Doyle Papers, box 6, file 12.
11Letter to A. Jarvis, Doyle Papers, p. 7.
The savings incurred from each cannery that was closed down were estimated as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>White labour exclusive of managers</td>
<td>$3,500</td>
</tr>
<tr>
<td>Tug for season (tenderboat)</td>
<td>750</td>
</tr>
<tr>
<td>Savings of 5% on purchasing supplies</td>
<td>690</td>
</tr>
<tr>
<td>Savings of 5% on commissions, freight, insurance,</td>
<td>2,000</td>
</tr>
<tr>
<td>etc. on selling price of $4.00 per case</td>
<td></td>
</tr>
<tr>
<td>Incidentals</td>
<td>900</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$7,840</strong></td>
</tr>
</tbody>
</table>

By closing down plants the efficiency of the remaining plants could also be increased. In a number of cases, production in existing plants was not hindered by a lack of capacity but by a lack of equipment and by slowness in moving the pack to obtain room. Machinery from abandoned plants was removed to operating plants and surplus buildings were either sold or used as storage warehouses for operating plants, thus alleviating a major problem prior to centralization—storage space for processed cans awaiting shipment.

Reduction of the price of fish was the second stated objective. Between the big years of 1897 and 1901, the price of salmon per case rose from an average cost of 90 cents to $1.50. As David Reid suggests, monopsony power—a market situation where one buyer controls the demand from a large number of sellers—of fish prices and cannery labour was an objective of BCP, but it is questionable to maintain that it was the major objective. The desire for greater efficiency and reduced costs in the canning process could have been equally compelling. Keith Ralston

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12 Ibid.

argues that, "company merger was the instrument closest at hand of the cannerymen, and it promised good results in the increased efficiency of a unified management, in saving through large-scale purchases, and in economics in production, all of which would make the industry more profitable by reducing the cost per case of canned salmon."\textsuperscript{16}

Significantly, Henry Doyle, in promoting the formation of the BCP Association argued not for monopsony power but for centralization in the canning process. He stated that a major objective should be "to cut down the canneries in operation from their present number to a sufficient number to handle the same pack profitably and economically."\textsuperscript{17}

There was no change in the price of fish between the peak seasons of 1901 and 1905. If the objective of the BCP Association was gaining monopsony in the fish market and the power to cut fish prices it had failed. The centralization of plant, however, was very successful --by 1905 fifteen plants nearly equalled the productive capacity of the twenty-nine purchased by BCP in 1902, even with the labour shortage that year.\textsuperscript{18}

\textsuperscript{14}For example, Imperial and Brunswick No. I were united into a single cannery plant and Haigh Cannery became this plant's storage area (Doyle, "Rise and Decline of the Pacific Salmon Fisheries," p. 217).

\textsuperscript{15}Doyle, "Report on B. C. Salmon Industry," p. 6. See also Reid, p. 12.

\textsuperscript{16}Ralston, "The 1900 Strike," p. 172.

\textsuperscript{17}Doyle, "Report on B. C. Salmon Industry," p. 3.

\textsuperscript{18}Canada, Dominion Fisheries Commission for British Columbia, 1905-1907, p. 23.
Between 1903 and 1913 there was rapid and unprecedented mechanization in the canning sector, especially after 1905. The basic instruments in this rapid mechanization were mechanized butchering machines and the sanitary can, both of which helped to break down the traditional bottlenecks on the canning line and to alleviate serious labour shortages. "The shortage of cannery labour has been conducive to the invention and adaption of the most useful labour saving device, viz The Iron Chink." The effect of labour shortages prior to the introduction of the Iron Chink is emphasized in the Fisheries Report of 1905: "Though had the necessary labour in the canneries been obtainable, the 1901 pack [the record year] might have been not only equaled but exceeded." The machines were steam or electrically powered and were not mere aids to the hand process. "Recently, indeed, each successive year has seen some important improvements, but the installation of machinery this year [1907] is in advance of that of any other season. It may now be claimed that after the fish leaves the boat from which it is captured, all handling of it ends then and there."22

The labour shortages in the peak years of the early 1900's--1905, 1906, 1909--were due to the fact that Oriental labourers were fewer than during former years and that they were demanding better wages. After 1901 cannery labour, which was almost exclusively Chinese contract labour, became increasingly difficult to obtain. To a large degree

19"Review of the Salmon Industry, Season of 1906, the Year in B.C.," Pacific Fisherman, V (February 1907), 15.

20Canada, S.P., 1906-07, no. 22, appendix 2, p. 29
these labour shortages were traceable to the exclusion of Chinese immigrants. In 1905, the first peak year after the increase in the head tax to $500, the Pacific Fisherman reported that "Chinese labour for the canneries is constantly growing more scarce. I [a Chinese labour contractor] have found it necessary to hire Japanese and other labour along with the Chinese in order to make up our gang for the different cannerymen." In 1901, Chinese cannery labourers had received from $35 to $50 per month for an average of 10 hours per day.

21 "Canning machines: steam boiler, retort, weighing machine, wiping machine, capping machine, a steam engine to drive the same. Also soldering machine and crimper plus can making machinery" (Alert Bay Cannery notes, Doyle Papers, box 6, file 11). See also fn. 17 and 18.

22 Canada, Dominion Fisheries Commission for B.C., 1905-7, p. 13.

24 Pacific Fisherman, V (February, 1907), 5. Exclusion of the Chinese in B.C. was accomplished by placing an immigration head tax of $500 on all Chinamen during 1903. Originally (in 1885) this tax was set at $50 and was increased to $100 in 1900, but these amounts proved too low to be an effective barrier. British Columbia tried to pass total exclusion acts, but these were disallowed by the Federal Government which did, however, pass head taxes as a result of continued pressure from the province. The success of the $500 head tax was questionable. It did keep Chinese immigration to a nominal figure for several years. The total number paying the tax from January 1, 1904 (when it came into effect) until June 30, 1907 was 121. During the following year, however, the figure rose to 1,482 (Canada, Department of Labour Report, Canada, S.P., 1909, no. 17, p. 95).

25 Pacific Fisherman, Annual edition, 1905, p. 9. As early as 1903 the publication noted that "Chinamen are getting scarcer every year, especially expert Chinamen and as a result Chinese contractors have to pay more for these every season" (Pacific Fisherman, I [August 1903], 7).

26 Canada Labour Gazette, I (1900-1901), 353.
By 1906, Chinese working in the canneries who had previously been paid from $40 to $48 asked for as high as $65 per month. Cannerymen reported during that season that the cost of packing fish would be greater than for some years past because of high prices for fish, higher wages for cannery workers, and general increases in the cost of material. In the peak years of 1905 and 1909, the Fraser River canneries were unable to pack to capacity because of the scarcity of Chinese. During these years it was reported that not only was there a shortage of cannery labour, but that the Chinese held out for larger advances than the contract bosses were willing to give.

These labour shortages and the resulting increased costs were conducive to innovation; as labour costs increased the relative cost of mechanization decreased. It was no mere coincidence that the Iron Chink was installed in the Fraser River canneries immediately after the first major cannery labour shortage of the period in 1905. Just as important to innovation was the type of labour scarcity, that of skilled cannery labour: "... not only was the supply short in quantity but distinctly inferior in quality." When the Iron Chink and sanitary can replaced the hand processes in butchering and soldering, they alleviated not merely labour shortage but the most important shortage, that of skilled labour in the butchering and can-sealing stages of the canning line. Thus innovation after 1903 can be viewed as a response to the shortage of

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27 Ibid., p. 51. By 1908 Chinese contract cannery labour received no less than $65 per month according to a Victoria contractor (Canada, Department of Labour Report, 1909, Canada, S.P., 1909, no. 17, p. 105).

28 Ibid., p. 151.
cannery labour, a shortage viewed by contemporaries as one of the most serious difficulties facing the salmon industry.  

Prior to the introduction of butchering machines, the speed of the line depended on the capacity of the gangs to produce butchered fish, and there was little point in mechanizing other stages of the canning line, even where the technology was already developed.

The Smith Butchering Machine, which came to be known as the "Iron Chink" because it replaced Oriental butchering gangs, thus revolutionized salmon canning. Even when first introduced in 1906, the Iron Chink could process 60 to 75 fish per minute with the aid of three men. The butchering gangs it replaced were composed of about thirty men, each of whom processed about 1,500 to 2,000 fish in a ten hour day. Unlike other machines in the cannery, it was not a modification of equipment used in the vegetable and meat processing industries of eastern North America and Europe but was the only machine designed specifically for the salmon cannery. Invented by E. A. Smith of Seattle in 1903, it was patented on August 8, 1905.

Although Smith's butchering machine became the most widely used, it was not the first of its kind. In the United States alone 21 patents were granted between 1856 and 1905 for similar devices. The first patent

29 Province, September 18, 1909, p. 1.

30 Pacific Fisherman, IV (September 1906), 18.

31 Canada, Dominion Fisheries Commission for B.C., 1905-07, p. 17.

32 Columbian, October 4, 1899, p. 2.
on the West Coast was granted to the Vancouver firm of Letson and Burpee in 1900. In 1903, a "Kellington" machine, made by the Schaake Machine Works of New Westminster, was used by BCP at their Cleeve Cannery on the Fraser; in 1905 BCP purchased three more for other plants. Another B.C. firm, Letson and Burpee, produced the "Farmer" machine used by the Pacific American Fisheries at Fairhaven in Bellingham, Washington. Although the Pacific Fisherman claimed that fish cleaning machines other than the Iron Chink were utter failures, to the cost of the cannerymen who had reduced their force of Chinese butchers trusting these machines to do

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34 Bitting, p. 810.

35 "Fish Cleaning Machines, References for Smith Investigation, Nov. 25, 1905," Shiels Papers, Western Washington State College Geography Archives manuscript, box 2. Prototypes of the Smith and Letson and Burpee machines were both developed at the Fairhaven Cannery of the Pacific American Fisheries near Bellingham and so it is doubtful that their development was isolated from one another, especially as Smith hired a lawyer in 1905 to investigate patents covering parts of his machine in other butchering machines such as Letson and Burpee's, Kellington's, and Hughlett's. The development of butchering machines lends support to the theory that the process of innovation is not heroic; the invention credited to an individual such as Mr. Smith is rather systematic, or the culmination of successive increments such as the developments of butchering machines by Kellington, Letson, Burpee, and Hughlett (Robert Baldwin and Gerald Meier, *Economic Development* [New York: John Wiley and Sons, Inc., 1959], p. 159).

36 *Pacific Fisherman*, Annual Edition, 1903, p. 52. It should be noted that the first butchering machines were used solely in BCP plants which reinforces the proposition that the company's objective was to centralize plant with the aid of technology. Two Fraser canners, James Munn and A. Ewen were involved with this machine's development (Shiels Papers, loc. cit.).

37 *Pacific Fisherman*, III (June 1905), 23.
the work, it is unlikely that BCP would have added three more to their plants if their original one had been completely unsuccessful. Smith's Iron Chink was introduced to the Fraser in 1906 by B.C. Canning Company Limited. The BCP first used it in 1907, in addition to their Kellington machines.

Like the other machines, the first Iron Chink processed the fish only after the heads and tails had been removed, and in fact required more labour than some of the other machines to do this—the Kellington machine used only one third the labour needed by the Iron Chink. By 1907 (model #1908), however, the Iron Chink was modified so that it cleaned the entire fish automatically; after this innovation there was no question as to its superiority to other butchering machines.

Apart from being a faster and cheaper way to butcher fish, the Iron Chink eased the pressure of labour shortages for the canners. It also increased the profit per fish by decreasing the waste and giving a consistent quality of butchering. "Under the old method of hand cleaning much of the fish which was good was sliced off when the fins were removed. When hundreds of thousands of salmon are being cleaned even the smallest amount of waste is quite an item of loss." Henry Doyle estimated that the saving of fish by the use of the Iron Chink was "about half a fish to the case over hand labour."

38 Pacific Fisherman, I (May 1903), 20.
39 Pacific Fisherman, V (February 1907), 53.
40 Pacific Fisherman, IV (May 1906), 13.
41 Pacific Fisherman, V (February 1907), 54.
The Iron Chink also provides a key to the centralization of plant. Even the early model of Iron Chink could provide enough butchered fish to supply two, and in some cases, three canning lines. This meant that each cannery could have at least two lines instead of the traditional one. The mechanized butchering process also used far less cannery floor space than the manual system and the freed space was used to increase the number of canning lines and/or to provide sorely needed storage space in existing canneries.


Iron Chink Machine," Doyle Papers, box 5, folder 7. For every 24 cases mechanically cleaned an extra case was produced as compared to manual cleaning. "It is also well known that the capacity of the packing plant of a cannery is always that of the butchering and because the packing part is almost perfect, being nearly all operated mechanically, and it only means running a few more hours in order to increase the pack and as the operators of the various machines have no manual labour to perform to any great extent, they can stand up to the press of work no matter if they are worked six or seven hours overtime. And also in working these men overtime, while they may get tired, the hundred and twenty cans a minute continually pass over the line and the quality of work does not suffer. Whereas, the butcher, as soon as you press him into long hours, fails both as to speed and quality of work performed and the waste of the necessary oil immediately commences, the result being dry, tasteless, salmon"

Province, August 15, 1906, p. 5).

Interview with Buster Mackenzie and Bill Ross. Today the Canisco plant at Prince Rupert has 7 canning lines fed by 4 Iron Chinks and on some occasions not all the Chinks work. To evaluate the productive capacity of the Iron Chink or any butchering machine in relation to a canning line one must know which species of salmon is being butchered when discussing the number of fish a machine can clean. On an average it takes 19 cleaned pink salmon or 12 cleaned sockeye to produce one case of the finished product. This difference is a result of the weight of these species in the round, i.e. uncleaned. Pinks weight 4 to 5 pounds whereas sockeye weigh 6 to 7 pounds. Unless otherwise stated a case of salmon will refer to sockeye as this was the major specie canned before 1913. If sixty sockeye are cleaned per minute the Iron Chink can produce enough fish to fill five cases; if an equal number of pinks are cleaned only 3.15 cases are produced per minute. It took three men to operate an Iron Chink and the
Another innovation on the Fraser in this period was the application of electricity as a source of power and light. "The Company [B.C. Electric Railway Company] has already [1905] received applications for the supply of current to motors in seven of the largest canneries. Motors are not intended to supply the entire power for the canning machinery. They will be used to run the more important and delicately adjusted parts of the canning machinery where uniform speed is necessary." The adoption of non-steam sources of power was in fact very slow and piecemeal. Steam was needed for the cooking and for steam blowers which cleaned the cans. Any kind of engine would be used in addition to a steam boiler. Consequently it was cheaper and more practical to use a steam engine. A small one of from 20 to 50 horsepower was all that was required. Cannerymen used various makes of engines and seemed to have had no special favorite. The exact date of the adoption of electric power is unknown,

productivity per man hour of these Iron Chink attendants was 100 cases of sockeye; a manual butcher could produce only 14.8 cases of sockeye per hour. A man using an Iron Chink increased butchering productivity by over 700%. Thus the canners' preference for sockeye was not only market derived; canny labour costs per case of sockeye were less than those of pink salmon. Since more pinks than sockeye had to be caught to fill a case, fishing costs could also be reduced if sockeye were the chief canning species (interviews with Mr. Bill Ross of Stirling Shipyard and Mr. Buster MacKenzie of Phoenix Plant. Both men are ex-cannery managers of the Canadian Fishing Company. January 1977). Following this reasoning the natural resource economists' idea that lesser grades of a product are developed due to market demand should be challenged by looking at the state of technology available at any given period. For example, pink salmon are considered the least desirable specie of salmon from a technological point of view, not because of their quality or colour, but because their size makes them the least economic to process.

45 Province, July 4, 1905, p. 1. Electric power supplied by steam powered generators was used prior to 1905 by a number of Fraser River canneries.

46 Pacific Fisherman, IV (August 1906), 13.
but in 1902-1903 BCP installed General Electric Company electric plants in three major canneries, Imperial, Currie McWilliams, and Brunswick No. 2 at Canoe Pass. 47

The modern canning line was in sight, but was not in place until 1912 with the use of the sanitary can and the double seamer which eliminated soldering of can lids. 48 Here again is an example of interlocking technological change, the successful development of the sanitary can rested on the innovation of a double seaming machine. Neither machine was invented for salmon canning, but for the canning process in general. In the sanitary can a flexible cement or a washer of flexible material is placed automatically within the flanged rim of the top when the can is manufactured. After the can is filled, it is passed through an exhauster—a flat, steam-tight box. This partially cooks the fish and the fish and the air in the can expand. The cover is placed on as it emerges from the exhauster, the ends of the can draw inward as the contents cool, and the can seals. 49 Although the sanitary, or solderless, can had long been used in Europe and to some small extent in the East, the first evidence of interest in it on the West Coast was in an editorial in the Pacific Fisherman in 1905 about an advertisement of the Maxs Ams Machine Co. of New York: "... a new can making machine which turns out what they term

47 "Rough Notes, 1902-1903," Doyle Papers, box 11, file 12.
48 Pacific Fisherman, August 1952, p. 6. "... sanitary can first appeared in salmon canning in 1905 but was not widely used until 1912 with the introduction of the 'double seamer'."
49 Pacific Fisherman, X (February 1912), 36.
the sanitary solderless sealed cans." The first experiments with the sanitary salmon cans were tried on the Columbia around 1908 and in Bellingham in 1908 when 547 cases were put up. These early attempts were abandoned because of the inability to get machines which were sufficiently fast to "make a pack".

The combination lock and lap seam, which ensured the success of the sanitary can, was practically the same as the lock seam formerly employed on the automatic body machines for soldered cans, but each end was lapped and soldered for a short distance to facilitate the double seaming of the ends onto the can bodies. This double seaming could not be done without danger of breaking the tin if the lock seam extended the whole length of the can body. This lock and lap seaming machine, developed by the American Can Company, resulted in this company obtaining a virtual monopoly of sanitary can making machines. The only other major sanitary can producer was the E. W. Bliss Co. of the United States and France.

While the development of the "lock and lap" seam body machine and flanger—the flanger was also built by the American Can Company to turn the edge or flange of the can over to facilitate the double seaming of the ends to the bodies—occurred in the East, Axel Johnson of San Francisco invented and patented a double seamer, or closing machine, for the sanitary can which was automatic and of sufficient speed to interest the packers in sealing filled cans. The combination of these various machines into one line solved the problem of manufacturing and sealing the sanitary can.

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50 Pacific Fisherman, III (September 1905), 33.

51 Pacific Fisherman, X (February 1912), 34, 36.
The results of using this can were phenomenal both in the volume of output and in the quality. The percentage of "leaks" and "do-overs" was reduced to a minimum. The Chinese experts who formerly operated solder machines, mended leaks, and did the venting and stopping were no longer necessary in the canning process.\(^{53}\) A minimum of "leakers" were produced at a cost of 30-35\% less labour in the sealing process as compared to soldered cans. The first cooking, with its subsequent venting and stopping, was no longer required to prevent the cans from bursting in the retorts.

Although the solderless canning line appeared successfully in the western States during 1910, it did not make its debut on the Fraser until 1913 when the ABC, BC Canning Co. and M. Des Brisay employed such lines along with their soldering lines.\(^{54}\) The reasons for the introduction of sanitary canning lines were similar to those behind the Iron Chink. The canners, plagued by labour shortages and related increases in labour costs, sought ways to decrease the labour input.

Apart from the leading or "major" innovations such as the butchering machine and the sanitary can, other processes of the canning line experienced varying degrees of mechanization. After the application of the Iron Chink the major bottlenecks occurred in the stages which followed the butchering machine: filling, salting, weighing, and sealing.\(^{55}\) The bottleneck in the sealing sector was resolved as we have seen by the sanitary can system, but prior to this there were innovations to further

\(^{52}\) Pacific Fisherman, XI (December 1913), 30-31.

\(^{53}\) Ibid.
mechanize the soldered can process. Soldering machines were refined and can topping\(^{56}\) and stopping off machines\(^{57}\) were developed.

Various machines were developed for filling. The Fulton filler, brought out in 1902 by Letson and Burpee and further refined in 1911, processed around 60 cans per minute.\(^{58}\) Others were the Astoria Iron Works' Filler, built under contract by the Victoria Machinery depot, which processed 65 cans per minute\(^ {59}\) and an unknown make which filled 120 cans per minute.\(^ {60}\)

Weighing and salting were mechanized for the first time during this period. A can salting machine invented by W. Demont of Blaine was a great improvement over the old method of hand salting.\(^ {61}\) In the old method, empty cans were placed on a tray under a board which had small holes directly over the cans. A thin board was inserted, forming the bottom

\(^{54}\) Pacific Fisherman, XI (January 1913), 37.

\(^{55}\) The final stage of the canning line, the cooking sector, experienced no bottleneck after the application of the steam retort in the late 1870's.

\(^{56}\) Pacific Fisherman, III (July 1905), 38; III (February 1905), 16.

\(^{57}\) Pacific Fisherman, II (February 1904), 4. The machine automatically soldered vent holds.

\(^{58}\) Pacific Fisherman, IX (August 1911), 12; I (January 1903), 12. It was claimed that this machine replaced 15-20 hand fillers.

\(^{59}\) Pacific Fisherman, XI (January 1913), 31.

\(^{60}\) Pacific Fisherman, V (May 1907), 29.

\(^{61}\) Pacific Fisherman, I (May 1903), 9.
of the holes. Salt was then scraped over the top until the holes were filled, the thin inserted board was drawn out, and the salt fell into the can. With the salting machine a measured quantity of salt was deposited into each can by a hopper system. This machine was driven by the can filler and was presumably timed to salt each can as it was processed by the filler.\textsuperscript{62} Weighing was also mechanized after 1903. The machines used were the Perkins, the Smith, and the Herzog, produced by Schaake. The most successful of these appears to have been the Smith weigher, which, when perfected, weighed 48 cans per minute.\textsuperscript{63}

Although the butchering machine revolutionized the canning sector and resulted in unprecedented mechanization, this does not automatically lead to the conclusion that this single invention resulted in the great advances in the Fraser River canneries. Butchering was one of many processes to be mechanized to approximately the same capacity and designed to work in unison. Without the proceeding and subsequent innovations in other stages of the canning line, the invention of the Iron Chink would have had only a limited effect.

The mechanization and centralization led to economies of scale at the canneries. "Simplicity of plant and machine design and the narrow range of commodity types manufactured in the fish canning industry" results in canners being "susceptible to large scale methods and to concentration of control if other conditions are favourable."\textsuperscript{64} but these

\textsuperscript{62} Pacific Fisherman, II (February 1904), 4.

\textsuperscript{63} Pacific Fisherman, VIII (September 1910), 17.

\textsuperscript{64} Gregory and Barnes, p. 118.
other conditions tend to set limits to large scale organization in this industry. Experience indicates that the optimum technological unit is relatively small and increased output usually results merely in the duplication of like-sized plants.

Given these conditions, economies of scale do result in an optimum technological unit of four to five lines per plant. Though BCP Association's centralization of plant in the early 1900's was below the present optimum technological unit—Currie McWilliams, Brunswick No. 2, and Terra Nova each added one line and Imperial added only two to three lines—economies of scale were a major, if not the major, objective of such centralization. "Up to a certain point (which was not reached on an average if at all prior to 1913) a larger scale of operations and closing of marginal plants clearly brought improvements in the early years."

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65 Ibid., p. 113. 1. Size of fish runs in any one area; 2. the effectiveness of competition in fishing; 3. the need for immediate processing near the point where fish are caught. Brine refrigeration or refrigerated salt water revolutionized the salmon and herring fishery of the 1960's by removing the necessity of immediate processing. For example, Canfisco's brine vessel Cape Scott transported fish from Alaska to Vancouver prior to processing. Harold Britten, the cannery manager for Canfisco's home plant, sees brine refrigeration as the major technological innovation since the early 1900's.

66 Ibid., p. 113. Many managers believe that a four to five line plant is most effective for maximum per man output over a time.

67 Ibid., p. 118.
Chapter 5

EARLY MECHANIZATION OF THE SALMON FISHING FLEET

The gasoline motor was to the salmon fleet what the Iron Chink was to the canneries. It\(^1\) revolutionized the gillnet fishery, made the purse seine fishery economic, and called forth a new type of tenderboat.

The gasoline engine was first applied to the gillnet boat in the early 1900's.\(^2\) Pioneers on the Fraser River set the date of the first gasoline powered salmon vessels between 1902 and 1905,\(^3\) but as the Department of Fisheries reports do not mention this type of vessel until 1907,\(^4\) they could have been of little economic importance before that year. The only design change needed in the oar and sail-powered Columbia River gillnet boat for gasoline engined operation was to adapt the stern to take a propeller.\(^5\)

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1. The other type of internal combustion engine, the diesel, was of little importance until after 1913 ("Diesel Revolution, 1913-1922," Pacific Fisherman, August 1952, p. 9).

2. "Fifteen years ago the gasoline powered boat was a curiosity" (Pacific Fisherman Yearbook, 1915, p. 19).


4. Canada, Department of Fisheries Report, 1907-08, Canada, S.P., 1909, no. 22, appendix 11, p. 223. Another source also states that in 1907 "for the first time gasoline engines in the fishing boats will be tried, over 30 boats on the River," Pacific Fisherman, V (July 1907), 27. According to the Daily Colonist, however, "Engines in Fishing Boats: A great number of the fishing boats are being fitted with gasoline engines for motive power. It is thought that the opening of the sockeye season will see over half of the boats on the river equipped with power," (Colonist, May 21, 1907). This proved to be an exaggeration.

Engine-driven Fraser River gillnetters were commonly referred to as the "mosquito fleet". They were small "double enders", adapted from Columbia River boats, and ranged from twenty-five to thirty-two feet in length. A small house in the bow replaced the pup tent made from the sail as the crew shelter on the grounds. 6

The gasoline engine was only slowly adapted. Fishermen were skeptical of its utility and staying quality—early engines were lightly built and frequently broke down. Initially most engine parts were available only from the East, which meant long delays for repairs. 7 With the establishment of local repair shops such as SchaaKe Machine Company, Easthope and Sons, Canadian Fairbanks, Letson and Burpee Ltd., and Henry Darling, all present by 1907, 8 and the development of stronger engines, the use of the gasoline motor rapidly increased. 9 By 1910 gasoline powered gillnetters comprised fifty percent of the Fraser's fleet and by 1913 over eighty percent were mechanized. 10 Early engines were of the

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6 Ibid.

7 Pacific Fisherman Yearbook, 1915, p. 19. "... many of them were condemned and thrown out when the fault lay not with the engine but with the engineer" (Pacific Fisherman, January 1919, p. 55).

8 Henderson's Vancouver Directory, 1907, various advertisements.


10 Canada, S.P., 1912, no. 12; 1914, no. 11. Mechanization was retarded in northern B.C. (north of Cape Caution) where after 1911 powered gillnetters were illegal. This prohibition was a result of the companies not wanting to invest capital in powered gillnetters as in the northern area the majority of boats were company owned, not independently owned as on the Fraser (Vancouver Province, July 12, 1917, p. 14).
three to five horsepower variety and made six to seven knots. According to local pioneers most of these engines were two cycle and were produced by Easthope and Sons, Cowie, and Vivian in British Columbia or by Frisby and Hyannis in the United States or by Toronto Junction Engines in eastern Canada.

The rapid adoption of engines after 1907 was a result of competition for the resource. When one gillnetter successfully used an engine, competition forced other fishermen to follow suit if they intended to stay in business. Mechanized gillnetters had a distinct advantage over oar and sail powered vessels in the river fishery. The mechanized gillnetter could make more sets since it could move more quickly upriver to start a new drift. The gasoline engine also enabled the fishery to increase the fishing area by working further offshore. It increased fishing time since it took less time to travel to and from the grounds and vessels could fish in rougher weather. Engines also eliminated the backbreaking labour of manning the oars.

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12 Joe Easthope, Tape 31, side 2, Richmond Arts Centre, Richmond, B.C. These engines cost between $150 and $175.


14 Pacific Fisherman, IV (June 1906), 9; V (May 1907), 23.

15 "Tide, wind and sea which would interfere with the old style of fishing seldom troubles the modern motor boat fisherman" (Canadian Fisherman, February 1914, pp. 44-45).

16 "With the motor doing the hard work for him, he can twirl the
The gasoline motor was probably the most important factor in the development of the purse seine fishery. The purse seine used the principle of encirclement and was used mainly for the "schooling" species of salmon, chums and pinks. Unlike sockeye, red springs, and cohoes which travel at various depths, chums and pink salmon school at or near the surface and so encirclement, or seining, was used instead of ensnarement, or gillnetting, as for the other species. The beginning of the seine fishery marked a new concentration on the previously ignored "lesser" species by the Fraser River canners. A feature of the 1911 season was that all five varieties of salmon were utilized for canning to a greater extent than ever before. Prior to 1911 sockeye was the main species exploited. Red Spring and Coho were also in demand in the early years, but essentially to supplement the sockeye pack. Between 1902 and

wheel or keep a hand on the tiller and rest up after the labour of fishing" (ibid., p. 45).

17 The purse seine should not be confused with the earlier beach seines used in the late 1880's and again in the early 1900's. Such seines were set only from the shore and their design differed radically from the purse seine. Although beach seines were banned in B.C. prior to 1906, special licenses were issued in 1900 for five beach seines to be used on the West Coast of Vancouver Island. These special licenses were issued with the hope that such seines would intercept the salmon before their arrival at the American traps. This experiment failed because the fish in some years passed too far offshore to be caught by beach seines (Canada, S.P., 1902, no. 9, p. 173). See also, "The History of Western Seining," National Fisherman, September 1971, p. 3-c.

18 "Owing to the increased demand for the product the cheaper varieties of fish which only latterly have been used even sparingly were canned in all districts" (British Columbia, S.P., 1912, p. N 49).

19 "Sockeye salmon have always been the chief object of the fishery and have commanded the best price" Canada, Report of Special Fishery Commission, 1917 (Ottawa: King's Printer, 1918), p. 7.
1910 seventy-eight percent of the pack was sockeye, but between 1911 and 1917, sockeye accounted for only forty-two percent of the pack.\textsuperscript{21} Increases in the pack after 1911 were due chiefly to the use of pink and chum salmon.\textsuperscript{22}

The early purse seines were essentially a webbing of tarred cotton with a lead line and cork, or float line, measuring 175 to 225 fathoms in length. Brass rings were hung at regular intervals along the lead line by means of "bridles". A purse line was then passed through these rings. Salmon purse seining was introduced to Puget Sound in the 1880's.\textsuperscript{23} It was carried out from two large flat bottomed scows equipped with little more than a hand-powered purse line winch. At the beginning of each season a steam tender towed the scows to the grounds where a large skiff manned by eight oarsmen pulled the scows from place to place to set the net.

The tenderboat was a vital part of this early purse seining technology. It towed the gear to and from the grounds and transported the haul to the canneries. This early method of propulsion limited purse seining to a few miles around each fish camp, but it was an improvement in terms of mobility over the beach seine system. The purse seine was also

\textsuperscript{20}"Only since 1911 have the canners been prepared to take pinks and chums in any quantity" (ibid.).


\textsuperscript{22}Ibid.

\textsuperscript{23}The purse seine had been used extensively on the East Coast since the 1860's ("History of Western Seining," pp. 1-c, 3-c). Purse seining was and is the major technique used in the herring fishery.
far more efficient at trapping fish than the beach seine. 24

As in the case of the gillnet fleet, the introduction of the gasoline engine rapidly increased the mobility of the seine fleet. Unlike the gillnet fishery, however, before 1913 the engine not only propelled the seiner but also ran a winch with a horizontal niggerhead to haul in the purse line. 25 These dual functions resulted in savings in both time and labour. The time of a set dropped by fifty percent; half an hour was all that was needed as compared to an hour under the manual system and mechanization cut the seine crew from ten men to six. 26

Powered seiners 27 used a different fishing technique: "The scows were discarded and the net moved from the skiff to the powered vessel. The end of the net was now made fast to the skiff which acted as a buoy and the seiner ran a circle setting the net and returning to the skiff. Both ends of the net were then brought aboard, the net pursed and finally hauled or 'dried up' so the fish could be removed." 28

The typical early seiner was a small open boat decked foreward with a small house over the engine. It had no crew quarters. Hulls were very beamy to take heavy cargoes and the strain of pulling in the nets--the beam was twenty-five percent of the length. Engines could only be five to twelve horsepower 29 because they took up the same space as a

24Ibid.

25Pacific Fisherman, IV (August 1906), 10.

26Pacific Fisherman, III (August 1905), 12.

27The first gasoline seine boat used in the northwest was the Pioneer, built in 1902 ("The History of Western Seining," p. 3-c).
modern 100 horsepower engine. The net was stored aft on a "table" or platform.

Although the earliest seiners had only handpowered purse winches, these were soon mechanized to eliminate the heavy work of pursing by hand. The purse winch was connected to the main engine with a line shaft. Seiners mechanized in this way could make twice the number of sets in a day.

The British Columbia seine fleet began to develop rapidly after 1911 to exploit the Swiftsure Bank in the Straits of Juan de Fuca. Between the salmon seasons of 1911 and 1912, the number of seiners in this fishery rose from 22 to 100. These seiners were open water boats known as deep sea seineboats. They differed from the early seiners in that they were larger, heavier, had more power, crew quarters, and were fully decked. The Swiftsure Bank seine fishery was another attempt by the Fraser River canning industry to intercept the salmon runs before they got to the Americans.

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28 Ibid., pp. 3-c, 4-c.

29 *Pacific Fisherman*, VI (November 1908), 19.

30 These powered purse winches were in use by 1907 (*Pacific Fisherman*, V [May 1907], 24).

31 "Fishing did not begin on a large scale until 1911 when extensive power boats enabled troller and purse seiners to operate in comparative safety on the off shore banks" (British Columbia, Sessional Papers, 1913, p. I 14). Troll fish were caught specifically for the fresh fish market, and were thus of little importance to the canning industry.

32 The total was probably over 125. Ibid.
Although there is insufficient data to measure increases in efficiency brought about by the adaption of engines, such an increase existed and should be noted. The B. C. Sessional Papers emphasize this initial increase: "decreasing catch, not withstanding increased efficiency in fishing methods." This quote applies strictly to the gillnet fishery, as the seine fishery did not initially experience a decreasing catch because it fished for pink and chum salmon which had hitherto been unexploited in any real measure.

The internal combustion engine had a two-fold effect on the steam tenderboat fleet. Mechanization of the gillnetter decreased the steam tender's importance in that fishery since steam tenders no longer transported the bulk of the gillnet fleet's catch to the canneries. On the river, small gasoline powered gillnet collectors, actually gillnet boats with an open or closed hold filling the whole stern aft of the house began to replace the tug and scow method of transporting fish.

With the move of salmon seining out into the Strait of Juan de Fuca, tenders provided an essential transportation link to the Fraser River canneries. Transportation of salmon from these new grounds by

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33 Rounsefell and Keleg, p. 729; Canadian Fisherman, February 1915, p. 61.

34 See above, p. 69, fn. 17.

35 I use the word "initial" because the free entry characteristic of the salmon fishery results in economic rent, due to increased efficiency, eventually being removed as additional fishermen enter the new geographic or technological area of exploitation. In the case of Swiftsure Bank exploitation was both geographic and technological.

the tug and scow system, however, was exceedingly expensive. As the distance increased, perishability of the catch became a matter of concern to the canners and a new type of tender, the diesel powered packer, was introduced. This vessel had its own holds with pen and shelf boards to prevent the crushing of the salmon that took place in an open scow. As its hold was covered, ice could be used economically, which was not possible in an open scow. Packers were rare before diesel motors because existing gasoline engines were uneconomical for such large vessels.

The reason for the eventual replacement of steam tenders was basically economic. The internal combustion engine was smaller than the steam engine, occupying less cargo space and requiring less labour than the equivalent steam engine. It is also quicker and easier to start than the steam engine and quick starting is especially necessary in tenders which make a number of starts and stops in their daily work.

37 "When the seiners are full they head for the nearest cannery tender. These tenders, some of them motor boats and some of them steam, are usually waiting off the fishing bank with scows alongside" (Canadian Fisherman, February 1915, p. 60).


39 Pioneer tendermen emphasize the amount of time wasted while an engine room crew worked up steam so that a tender could get underway (interviews with George Martinolich and N. Stevens).
CONCLUSION

This study shows that technological change in the 1871-1912 era in the canning, fishing, and tender sectors of the Fraser River salmon industry took the form of a leading innovation reinforced by a cluster of supporting techniques. It supports the theory that the key factor in innovation is the rate at which clusters of interlocking, mutually supporting techniques can be brought into the production process. All "major" innovations in the salmon industry were in essence by-products of new industrial methods and techniques of the metal and engineering industries of the industrialized world.

The study shows that on a canning line where each part of the line relies for its productive capacity on the process which precedes or follows it, the economic effect of a great innovation such as the retort can only be measured by the ability of the rest of the line to keep pace. The effect of an isolated innovation is very limited unless further innovation facilitates increased production. The "great" innovation is therefore really a "leading" innovation forcing changes to take advantage of its higher potential output.

This study also shows that improved technology on the canning line was in turn supported by innovations in the fishing sector and the tender sector. If technological change had been restricted to the canneries alone the industry would have had shortages of raw material. The productivity of the canneries was therefore directly related to the ability of the fishing and tender sectors to increase their productivity. Yet even without technological change in the canneries such increased productivity would have been essential to supply the increase between 1871
and 1901 in the number of canneries.

Technological changes of the late 1870's and early 1880's serve as an example of a pattern which occurs throughout the growth of the industry. The introduction of a leading innovation such as the steam retort is followed by a cluster of supporting innovations such as the gang knife, the soldering machine, and the conveyor belt. These cannery innovations increased the capacity of each cannery. This increase, combined with an increase in the number of canneries, requires greater production in the fishing sector. In response to this latest demand tenders and fish camps provide the fleet with greater mobility. The new system makes possible the total use of the inside fishing grounds. Then fishing pressure in these traditional waters spurs further innovation in the fishing sector—the Columbia River boat and the hard twine gillnet—to extend the fishery into outside or Gulf waters.

There are two distinct periods of technological change, 1878-1902 and 1903-1913. In the former, technological change rests essentially on innovations, leading and supporting, which supplement manual processes. After 1903, however, technological change actually replaces hand processes. Leading innovations in both periods are initiated on the canning line. They take place in a time of serious scarcity and higher wages for labour, which in turn decrease their relative cost.

Finally, the experience of the Fraser River salmon fishing industry does not support the isolated innovation theory of technological change. It shows that, if the theory has any validity, it is in regarding such innovations as neither great nor isolated, but merely as leading innovations.
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