
REPORT

—OF THE—

FISHERIES COMMISSIONER FOR BRITISH COLUMBIA

FOR THE YEAR 1902.

JOHN PEASE BABCOCK, Commissioner.

REPORT

FISHERIES COMMISSION FOR BRITISH COLUMBIA

FOR THE YEAR 1902

BY THE FISHERIES COMMISSIONERS



SALMON FISHING FLEET, OFF THE MOUTH OF THE FRASER RIVER, IN THE GULF OF GEORGIA.

FISHERIES COMMISSIONER'S REPORT FOR 1902.

*To Honourable D. M. Eberts,
Attorney-General.*

SIR,—I have the honour to submit the following report of my observations and work during the past season. My aim has been to make myself familiar with the conditions affecting the great salmon fisheries of the Province, and particularly with the conditions existing upon the spawning grounds of the Fraser River, that I might, as soon as possible, determine upon a comprehensive system for salmon propagation in the Province, for which purpose I was appointed. During the fishing season of 1902 I passed over a large proportion of the salmon-fishing waters of the Province, as well as the adjacent American waters of the Sound, that I might obtain a personal knowledge of the workings of the regulations and fishing methods of each district. The greater portion of the summer and all of the fall was devoted to studying the fishing and spawning waters of the Fraser River. In the early part of the fishing season of 1902 I visited Rivers Inlet, the Skeena and Naas Rivers; passed up the Skeena River to Lakelse River, and thence to Lakelse Lake and its main tributary, Sockeye River.

In the following notes I have endeavoured to set forth, in as brief a manner as possible, the conditions affecting the salmon fisheries of the Province, as I viewed them in 1901 and 1902. The spawning season is so short, and the spawning waters of the Province are so extensive and widely separated, that they cannot be thoroughly and intelligently covered in one or two seasons.

A part of October and November, 1901, was devoted to the investigation of a limited portion of the spawning grounds of the Fraser River. During the entire sockeye spawning season of 1902 I devoted as much time to the examination of the extensive spawning grounds of the Fraser and Thompson Rivers as the limited season would permit. At all the points visited in 1901, spawning fish were seen in great numbers, while during the past season but few were seen, and at some places none at all. If the size of the run of fish in the Fraser for a given year is dependent upon the abundance of fish upon the spawning grounds during the spawning period four years previous, as the canners and fishermen claim, and as the records manifestly demonstrate, and as I believe, the run in 1905 will be large, and the run in 1906 small. Certainly, natural propagation was at its maximum in 1901 and at its minimum in 1902. My impressions, formed from observing the abundance of fish upon the spawning grounds of the Fraser River in 1901, have been materially modified by my observations during the past season, and I am now strongly led to conclude that the seasons and regulations for the catching of sockeye, that proved so effective in allowing them to reach the spawning grounds in 1901, were altogether inadequate to produce the same result in 1902. Anyone who witnessed the great number of fish on the spawning grounds of the Fraser and Thompson Rivers in 1901, and their scarcity in 1902, cannot help being impressed with this conclusion.

The placing of restrictions upon salmon fishing is justifiable only upon the ground that they are necessary in order to allow enough fish each year to reach the spawning grounds to insure their perpetuation. To be effective in this regard, regulations governing fishing on a river should be framed so as to conform to the conditions which exist upon that particular stream.

It has been demonstrated that every fourth year there is an abundant run of sockeye salmon (*O. nerka*) in the Fraser River, and that in the year immediately following there is a poor run. No regulations that cover every season alike can be made that will adequately meet the remarkably varying conditions known to exist on the Fraser. There should be seasons and regulations provided for the river applicable to the years that are known as those of abundance, and other and more restrictive ones provided for the years of the poor runs. Our fishermen should be permitted to take only that portion of the run which is in excess of the number necessary to the perpetuation of their species. The present regulations for the Fraser do not accomplish the object of their enactment. Those in force in 1901 were shown to be sufficiently effective, and no further restrictions should be placed upon fishing in that stream in the known years of abundance. It was demonstrated in 1902 that these regulations did not produce the desired result, so it is evident that more stringent restrictions should be enforced during the years of poor runs.

If these conclusions and deductions meet with your approval, permit me to recommend that you urge upon those vested with the power of making the fishery regulations the importance and necessity for their amendment in this regard.

Unfortunately, there is a divided jurisdiction on the fishing grounds of the Fraser river. The American fishing grounds on Puget Sound must be considered a part of the Fraser River district, as the sockeye captured there were bred in and are endeavouring to return to that river. This divided authority prevents, at least for the present time, the making of suitable protective laws which justly affect the fishery interests on both sides of the line. There are almost no restrictions placed upon fishing on the American side of the inland sea, while we have a 36-hour weekly close season in the gulf and in the river channels, do not permit fishing until July 1st, and confine our fishermen to the use of gill nets alone. The Americans have no close season for the salt waters of the Sound, and permit the use of all kinds of fixed contrivances for taking fish, including drag and purse nets. The Americans have certain restrictions within defined limits of the mouths of rivers, and in the rivers themselves, but none of these regulations give any protection whatever to the salmon seeking the Fraser.

The Dominion alone gives them protection. The injustice of this is acknowledged on both sides of the line, and joint action may in time be taken to pass regulations which shall be mutually effective. There is grave danger, however, that before that time is reached the present vast wealth of the Fraser fisheries will be sadly depleted.

It is not clear how regulations that will equally protect the fish in both the British and American waters can be brought about. There is certainly a great necessity for equalising the regulations affecting the sockeye salmon. A weekly close season applicable to the American waters of the Sound is much to be desired. If a 36-hour weekly close season, beginning on Thursday at 6 p.m., and extending to Saturday, 6 a.m., were adopted on that side of the line, the fish that passed through their waters during that time would be protected in our waters by the present 36-hour weekly close season which begins at 6 a.m. on Saturday and extends to 6 p.m. on Sunday, and would solve the question and insure an increase of fish on the spawning grounds. The benefits to be derived from such joint action are so great that the wisdom of their adoption should appeal to the great interests on both sides of the Sound. During the last four years there has been a general consolidation of the canning interests in both Washington and British Columbia. The American interests are now very largely centered in two or three big companies, and there is considerable unity of action between the companies operating in British Columbia. These interests are controlled and managed by men of commercial prominence, to whom the wisdom of joint action to preserve this great fishery should strongly appeal. Is there not, then, a likelihood that if this matter were presented to

them by the proper official authorities it would result in the American interest taking steps to have such enactments made by the Legislature of the State of Washington as above suggested. Surely the benefits to be derived from such action are so great, and the arguments in its favour so strong, as to warrant a well directed effort for their accomplishment.

MOVEMENTS OF SOCKEYE SALMON FROM THE SEA TOWARD FRASER RIVER.

All of the sockeye which enter the Fraser come in from the sea through Juan de Fuca Strait. There seems to be no evidence that any portion of the sockeye run comes from the north through Johnstone Strait. If any do come from that direction their presence would be clearly indicated in the narrow channel, by their habit of travelling in more or less compact schools close to the surface, and their advance being marked by leaping from the water. The sockeye which come in through Juan de Fuca Strait strike the south-west coast of Vancouver Island, between Port San Juan and Sherringham Point, and appear to come from the open sea to the north-west. An examination of some of the sockeye which have been captured in the straits, discloses the fact that their stomachs are contracted and devoid of food, which indicates that they have come a considerable distance from their feeding grounds, which place is unknown. The run which comes in through the strait appears to have no relation to the runs of the smaller specimens of fish which enter the small streams of the west coast of Vancouver Island, and the State of Washington, from May to October. Nor does there seem to be any movement of fish along the American shore of Juan de Fuca Strait, which would also seem to indicate that their ocean feeding ground lies to the north of the strait.

The first fish of this annual movement of sockeye are usually reported from Sherringham or Otter Points. After the season advances their presence is, at times, disclosed as far west as Port San Juan. From Sherringham Point, along the Vancouver side of the strait east, their movement is clearly defined as they pass close in shore. They come in rapidly with the flood tides, at times close to the surface, and break water frequently. On the ebbing of the tide they disappear. Occasionally, in years of abundance, they may be seen on the ebb, circling in the eddies at Sherringham and Otter Points, and at Beachy Head. Their presence at any of these points on an ebb tide was not noticed this year. With the change from ebb to flood they return, at times in vast successive schools, and the run continues for days at a time. During the last days of July and the first two weeks of August, in years of large runs, they show themselves plainly, a racing, leaping, blueish-silver mass in the clear and rapid-moving waters. Passing Beachy Head they hold close to Race Rocks, and pass to the north-east as far as Discovery Island, and thence east towards Rosario Strait. Men who have studied their movements at these places state that the first of the run, after passing Race Rocks, move to the east, heading for Rosario, and that many of these runs pass to the south of the traps at the salmon banks on the southern end of San Juan Island, while the later runs are freely taken at these banks, and in the purse nets and traps to the north of them.

The state of the tides and weather conditions have a marked effect upon their movements. With strong westerly winds and flood tides they pass more directly towards Rosario. On bright windless days they strike the shores of San Juan Island further to the north, and many continue through the Strait of Haro to the gulf. Such appeared to be their routes during the days of my observations in last July and August. On July 29th, I located a school in the vicinity of Race Rocks, which turned to the north and made for Discovery Island, beyond which place I could not follow them. On the same day Mr. Schultz, the manager of the great lime kiln at Roach Harbour on San Juan Island, noticed a vast school, possibly a mile in length, passing outside the traps at Mosquito Pass towards the shores of Sidney Island. None were taken in the traps at Mosquito Point on that tide. The school was not traced further.

It may have entered the Gulf of Georgia by the channels to the south of Saturna Island, or may have continued to the north and entered the gulf by way of Active Pass, or Plumper's Pass, as it is locally misnamed.

It is impossible at this time to determine what proportion of the runs passes through Haro, and what proportion through Rosario Straits. Unquestionably, the movements of the fish in these channels vary with different years, being influenced by their number, and by the winds and tides. In the years of small runs the fish usually follow these two channels, while in the years of the big runs they are found not only in Haro and Rosario Straits, but in all the lesser passage-ways between the islands. It is generally believed the greater movement is through Rosario Strait every year, which belief appears to be well founded by reason of the numbers captured there. It is my opinion that the greatest movement is through Rosario, for the reason that the largest proportion of the fresh waters from the Fraser River flows towards the sea through that channel. With the ebbing of the tide the waters from Howe Sound and the eastern part of the gulf are directed south, and sweep with them the discoloured fresh water from the mouth of the Fraser, past Point Roberts, and on between Lummi and Orcas Islands, through Rosario. As the waters rush from Rosario they are turned north-westward and are driven towards Vancouver Island by the strong ebb tide, which comes from the extensive inland sea to the south.

That the movements of the fish are influenced by the presence of this body of fresh water in this strait seems to be warranted by the known effect such water has upon their movements in other sections.

The schools which pass into the gulf either through Rosario or Haro Straits do not appear to make directly for the mouth of the Fraser. They rather seem to circle around the outer edge of the waters of the gulf, which are discoloured by the silt brought down by the Fraser. At flood tide this discoloured area extends to Valdes Island on the west, and to Bowen's Island, at the outlet of Howe Sound. Passing around and through the edge of this silt-discoloured area, the sockeye strike towards the shore of the Mainland near Point Atkinson, and then turning south past Point Grey, enter the river through two of its various channels. This route is traced by the movements of the first schools. As the run progresses, and school follows school, the fish are found throughout this area of discoloured water, and are taken by means of gill nets. Many experienced fishermen assert that by taking advantage of this early movement they make better catches at the first of the season off Point Atkinson and Point Grey than can be made off the sand-heads. This circling of the salmon in the gulf, and the fact of their being caught to the north of the mouth of the Fraser, is probably the only foundation for the existing belief that a portion of the run enters the gulf through Johnstone Strait.

FISHING METHODS IN BRITISH COLUMBIA AND AMERICAN WATERS.

The seasons and the methods in use for the capture of salmon in the Provincial and American waters through which they pass to reach the Fraser River are entirely dissimilar. In the former they are closely restricted; in the latter they are virtually unlimited.

In Provincial waters the Dominion regulations provide that "no nets other than drift (gill) nets shall be used for the catching of salmon," and their use is confined to "tidal waters." "Nets for the catching of 'quinnat' or 'spring' salmon shall only be used from the first day of March to the thirty-first day of October * * * and the meshes of such nets shall not be less than seven inches in extension measure."

"The meshes of nets for catching salmon, other than quinnat or spring salmon, in tidal waters shall not be less than $5\frac{3}{4}$ inches, and shall only be used between the first day of July in each year and the 31st day of January following." It is further provided that "no one shall



SOCKEYE SALMON FROM THE FRASER RIVER.

fish for salmon from Saturday morning at six o'clock until the following Sunday afternoon at six o'clock, except in the rivers and waters of the Province of British Columbia north of 54th parallel of latitude" (where a different weekly closed season exists). "No nets shall exceed in length three hundred yards." The licence fee for each net is \$10.

In the American waters of Puget Sound, which is defined by the laws of the State of Washington as being "all that portion of the tidal waters emptying into the Straits of Fuca and the bays, inlets, streams and estuaries thereof," the restrictions placed upon the catching of salmon apply only to the distances between traps or pound nets, and the depth of water in which they may be placed. Every known appliance in the way of traps, pounds, purse, drag, drift and set nets may be used. There are no close seasons which affect the run of fish seeking the Fraser.

The scale of licence fees in the State of Washington applies to all fishermen and fishing apparatus, which fees are collected annually. Drag nets pay from \$2.50 to \$30 each, according to length. First-class purse nets pay \$50, and second-class \$25. Traps pay \$50 each; those "that fish at both ends" (*i. e.*, have pots at each end), pay \$100, and in addition \$1.00 per 1,000 for all salmon taken therein. During the past season there were 305 trap, 84 purse net, 353 gill net, 361 set net, and 92 drag net licences issued by the Fish Commissioner of the State of Washington for use in Puget Sound.

It will be seen, therefore, that while the American methods for catching salmon in the Sound, so far as those running to the Fraser River are concerned, are unrestricted, the fishermen of the Province are confined to the use of gill nets only, which cannot be successfully used outside the discoloured waters of the Gulf of Georgia, because the fish can easily see them in the clear waters of the Straits, and either pass under or around them. The Provincial fishermen are also restricted to a limited open season, and by a weekly closed period of 36 hours.

Under such conditions it is not surprising that the fishery interests of the Province should protest against regulations which place them at such manifest disadvantage with their American neighbours, and seek the adoption of the trap-net methods of the Americans.

USE OF TRAPS AND PURSE NETS JUSTIFIABLE AND NECESSARY.

Ever since the establishment of traps for the capture of salmon in the American waters of the Sound there has been more or less discussion upon the advisability of permitting their use in the waters of the Province. With the increase in the number and effectiveness of these fixed contrivances in American waters the movement in favour of their use on this side of the line has grown in strength. Ever since 1895 it has been demonstrated that by this improved and scientific method the Americans catch the greater portion of the fish *en route* to the Fraser River, and, therefore, great pressure is being brought to bear upon the authorities to amend the regulations so as to permit the use of traps in the waters of the Province.

In the discussion of this question it has been pointed out on the one hand that the use of traps is a destructive method of catching fish; that too great a portion of the run is taken; that their use will exterminate the fish, and will deprive the fishermen of employment, because the cost of traps is so great that only men of means could own and operate them. On the other hand it is said that the use of traps is more scientific, more economical and the more easily regulated method of catching fish; that by no other method can they be taken in clear waters; that in the clear waters of the straits and sounds the fish are in better condition for use; that the fish taken are not killed until removed from the traps; that they can be held for a week or ten days without injury to their canning qualities; that when the packing capacity of the canneries has been reached the traps can be closed; that fish taken in gill nets

are killed or fatally injured in being removed from them ; that their catch cannot be regulated, and at times is in excess of the capacity of the canneries ; that there is an ever increasing scarcity of labourers in the packing establishments ; that the men who are now engaged in the hazardous and labourious business of fishing would find ready and equally remunerative employment in the canneries and in connection with the trap fishing.

Clearly there is much to be said on both sides of this pressing question. Independent, however, of the many arguments *pro* and *con*, I believe that the use of traps, purse and drag nets for the capture of salmon on the south-west coast of Vancouver Island is justifiable, because the main portion of the Fraser River run of sockeye salmon which comes in from the sea, strikes the coast of the Island east of Port San Juan, and advances close in shore through the straits to Race Rocks, thence easterly into American waters, and the fish are there captured in vast numbers by means of traps, purse and drag nets. I also believe that by the use of traps and purse nets on the south-west coast of Vancouver Island a good portion of this run, which now passes from our waters into American waters, could be captured. I believe, from personal observation and investigation, in a season like the past, that the greater part, if not all, of the fish that strike the south-east end of San Juan Island and the waters to the south, and which direct their course for the Fraser River through Rosario Strait, are captured by the American traps and purse nets, and consequently never regain British Columbia waters. To me, it is not a question as to whether the capture of these fish in Provincial waters by means of traps will endanger the perpetuation of them. In my opinion the question as to whether trap fishing is or is not a destructive method of catching fish is not one that confronts the Government at this time. It is not a theory, but a condition that must be met. At the present time the Americans are, by means of traps and purse nets, catching the very fish which should be taken by our fishermen while passing through our waters in the strait, and south of Discovery Island. During the past season, as has been shown, the State of Washington issued 305 trap, 84 purse net and 92 drag net licences for the capture of these salmon, while under the Dominion regulations our fishermen were confined to the use of gill nets, which are not suited to successful use in the clear waters through which the fish pass before entering the American waters. If the use of traps endangers the perpetuation of our Fraser River salmon fishery, then the Americans will soon have accomplished the extinction of these fish, and will have reaped the benefit. For the above reasons I believe that the use of traps in San Juan de Fuca Strait, and south of Discovery Island, is justifiable.

If traps are permitted to be used in the waters south of Discovery Island, the use of purse nets should also be sanctioned, as very few of our fishermen are financially able to place traps. They are expensive contrivances and beyond the reach of most of our fishermen. Purse nets, the use of which has become quite general and very successful on the American side, are not nearly so expensive as traps. It takes ten men to operate the kind of purse net in general use, so that our fishermen could, by combining, enter the business and compete with the Americans who use the traps.

I am not, however, at this time prepared to advocate the use of traps in any of the waters of the Province that are unaffected by the use of American traps. In our own channels north of Discovery Island, where the fish are moving towards the gulf and where they are not liable to encounter American traps, I do not believe the use of traps is advisable. In my judgment their use, for the present at any rate, should be confined to that part of the coast of Vancouver Island which lies to the south and west of Discovery Island. Many people desire to place traps on the east coast of Discovery Island, and on the islands facing the gulf. And while it is true that the Americans have traps on the west and north sides of San Juan Island, and in the channel north of that island leading to the gulf, it appears also to be true that the greater



YALE, FRASER RIVER—HEAD OF NAVIGATION.

portion of the sockeye that reach the gulf and Fraser River pass through Haro Strait and its northern channels. There is sufficient evidence to show that many of the salmon that pass north from Discovery Island through the Straits of Haro travel in the open channels to the west of the American Islands, and, by avoiding the traps placed there, reach the gulf. I believe that the placing of traps on the shores of the Provincial islands bordering upon the Strait of Haro would intercept the fish that now pass to the Fraser through the gulf without being intercepted by American traps.

If these deductions regarding the movements and capture of the sockeye salmon after they pass north of Discovery Island be conceded, it certainly follows that at this time the Government would not be warranted in permitting the placing of traps north of Discovery Island for the interception of those fish which are now but slightly endangered by American traps. Would it not be wise, considering the magnitude of the interests at stake, to proceed slowly, and note the effect of the use of traps on Vancouver Island upon the run in our own and American waters? By confining the use of traps and purse nets to the waters south of Discovery Island I believe that the business of our fishermen, who now use gill nets in the gulf and Fraser River, will not be materially affected.

It will take some years to demonstrate the effect and value of the use of traps in Juan de Fuca Strait. If it shall be shown that traps and purse nets can be successfully used in these waters, many changes in the present conditions will have to be effected. By moving deliberately in these matters the fishermen and the vested interests will be better protected. Those interested will be given time thereby to study and adapt the business to the changed conditions which will follow the use of traps.

In conclusion, permit me strongly to urge upon your attention my opinion that the use of traps or purse nets in northern waters, such as Rivers Inlet, the Skeena and the Naas Rivers, would be little less than disastrous to many of the interests there. The salmon fishing grounds of these northern waters are limited, the present methods of taking fish are adequate, and the vested interests are prosperous under existing conditions. The effect of American traps is not a factor in considering the movements and capture of the fish in the north. There are no international controversies over the control and management of the fisheries on the Skeena and Naas Rivers and Rivers Inlet. So long as special and exclusive rights are denied to all fishermen in the north, the various interests there should prosper.

To summarise, the use of traps and purse nets on the shore of Juan de Fuca Strait and the waters to the south of Discovery Island are justifiable, and made necessary by the methods in use in the American waters of Puget Sound. The use of traps and purse nets should be confined for the present to the waters south of Discovery Island. Traps and purse nets should not be permitted in northern waters.

THE FRASER RIVER AS A SPAWNING GROUND.

The greatest salmon river of British Columbia is the Fraser, which drains the major portion of the southern section of the Province. Starting from Yellowhead Pass, in the Rocky Mountains, at the 53rd parallel, north latitude, it runs north-west between that parallel and the Selkirk range of mountains to the 54th parallel, where it receives the waters from Stuart and Tecla Lakes, and turning south passes through the western part of the great plateau between the Gold Range and Coast Range, receiving the waters of the Nechaco, Blackwater, Quesnel and Chilco Rivers as it proceeds towards its junction with the Thompson, the largest of its tributaries, and then rushes through the great canyon of the Coast Range to receive the waters of the Harrison, the Pitt, and other numerous but less important streams, as its mighty volume wends its way through the rich agricultural delta which has formed at its mouth, and

empties into the salt waters of the Gulf of Georgia. Its chief tributaries are usually the overflow from the large lake system of that water-shed, and in the main form the outlet of, or pass through, a lake of importance. The length of its direct channel is approximately 800 miles. Ocean-going ships load from the docks above its mouth, and light draft steamers traverse its waters a distance of 90 miles. Throughout its length the water of the Fraser is discoloured from the erosion of the yellow and white soil from the snow-capped mountains which encompass it; the temperature is low in its northerly and easterly courses, where it is covered with ice and snow throughout the winter. Its waters are sought by the five varieties of salmon common alone to the Pacific. Of these the sockeye is the most numerous and valuable, their numbers far exceeding all the others combined. The time of the run of this salmon is from May to September. Mr. Alaxander Ewen, the pioneer canner on the Fraser, states that one year he took over ten thousand of them in May, and that there always was a run of them in that month, and that he believes there still is, but owing to the use of the small ($5\frac{3}{4}$ inch) mesh net being prohibited previous to July 1st, it passes unnoticed, not being taken in the large mesh nets used for the purpose of catching spring salmon.

The "spring" or "quinnat" salmon runs from March to August. The run is said to be at its height in June. They are large fish, and the size of their run does not vary in number as it does with the sockeye and humpback. The coho, or silver salmon, as this fish is called in all waters outside of the Province, runs in the river during September and October. A few specimens are occasionally taken during the sockeye season, which are by many fishermen called "bastard sockeye." The dog salmon run in October and November. The humpback run only every other year, and then usually accompany the last of the sockeye.

The regulations governing the methods of taking these fish and the close seasons, have already been commented upon in these pages, and require no further mention.

The following table showing the catch of the sockeye in the Fraser by weeks, together with the number of boats, and the nationality of the men engaged in the fishing, is a comprehensive statement concerning the season just closed, and may be considered as showing the average running time of the sockeye. I am indebted to Mr. W. D. Burdis, of Vancouver. Secretary of the Fraser River Cannery Association, for this most instructive table, which he compiled from the records of all the canning establishments in the Fraser River District.

Week ending	Number of boats manned by			Boats nationality of fishermen not given.	Total number of boats.	Number of Sockeye caught.
	White men.	Indians.	Japanese.			
July 19th	246	103	79	66	494	26,267
July 26th	695	412	560	128	1,795	133,526
August 2nd	796	534	919	178	2,427	404,075
August 9th	819	551	922	169	2,461	1,566,984
August 16th	912	597	923	169	2,601	524,561
August 25th	569	387	689	148	1,793	292,920
Total number of Sockeye delivered to Cannery						2,948,333

From the earliest records there has been a recognised periodicity in the run of sockeye in the Fraser; there are years of abundance and years of scarcity, which reach the maximum every fourth year, and the minimum in the year immediately following.

The appended table presents a record of the salmon-pack of the Fraser River district since the beginning of canning operations. It expresses clearly the history of the industry and demonstrates more forcibly than words the irregularity and periodicity of the runs.

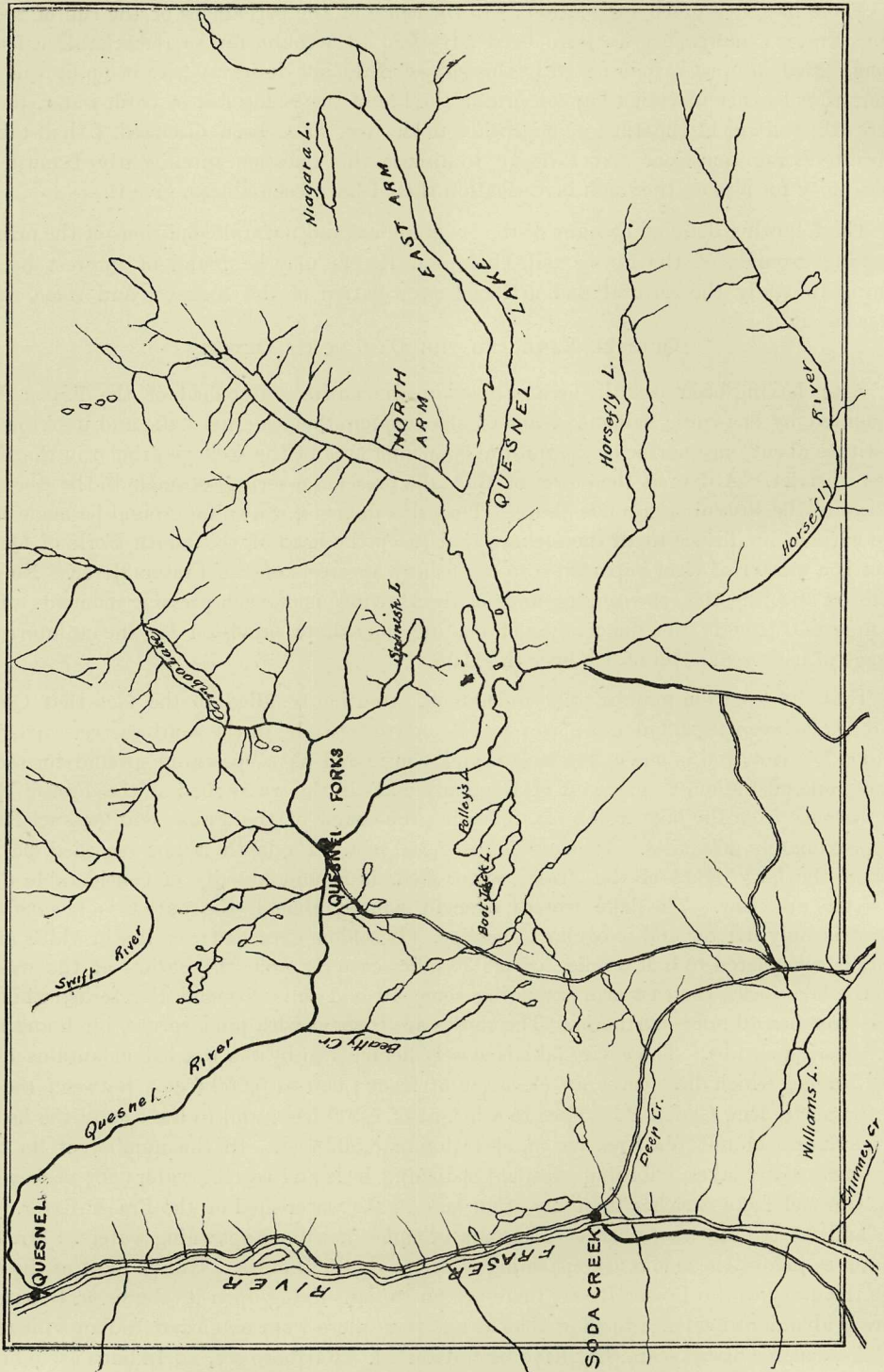
There has been much speculation as to the cause of the periodicity of the run of sockeye in the Fraser; many theories have been advanced to account for so remarkable a feature. Though great interest is manifested in this subject I do not desire to take it up at this time. Later, after further investigation concerning the life of the young fish in fresh water, the rate of growth, and age at the time of migration to the sea, have been disclosed, I shall take up this interesting question. As I desire to discuss this question intelligently I must have opportunity for a more thorough investigation than I have been able to give it.

The following detailed account of the geographical and natural conditions of the principal spawning grounds of the Fraser and Thompson Rivers may be found of interest by those wishing to study the natural and artificial propagation of the sockeye, and some way of increasing it.

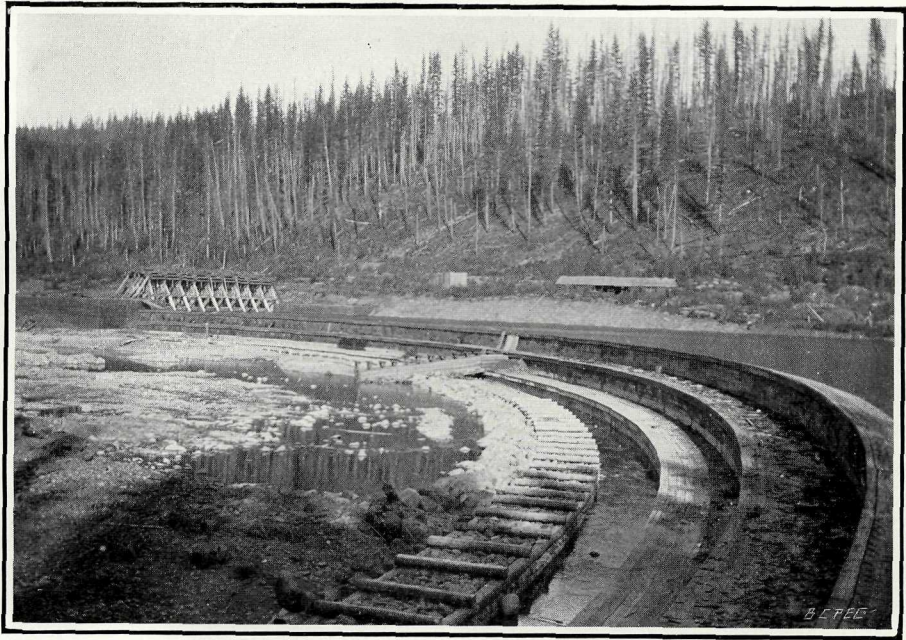
QUESNEL LAKE AND THE DAM AT ITS OUTLET.

After having been over the greater part of the entire water-shed of the Fraser River frequented by spawning salmon, I am of the opinion that Quesnel Lake and its tributaries constitute about one-quarter of the natural spawning area of the sockeye salmon in the Fraser River District. A dam at the outlet of this lake presents a serious obstacle to the passage of sockeye to the spawning grounds above. That this immense spawning ground be made accessible without hindrance to all the sockeye that reach the head of the South Fork of Quesnel River is a matter of vital importance to the fishery interests of the Fraser River. No other condition affecting the spawning grounds of the Province is of such pressing moment. I cannot urge too strongly the importance of making immediate provision for the uninterrupted passage of next year's run of fish over this dam.

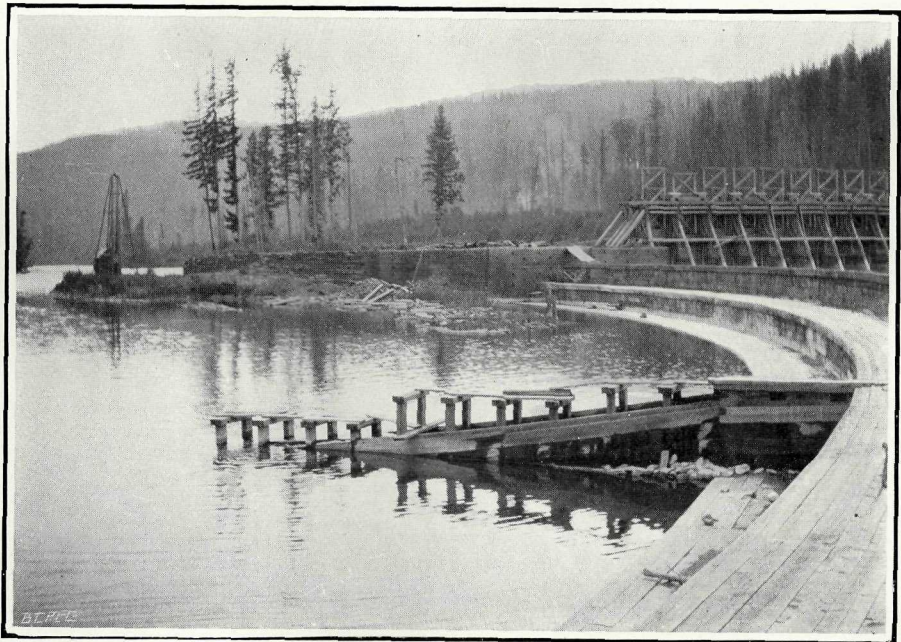
That the situation may be fully understood, attention is called to the fact that Quesnel Lake lies between the 52nd and 53rd parallels, north latitude, in the south-eastern part of the Cariboo District, and is one of the largest and, considered as a spawning ground for sockeye salmon, one of the most important of the many lakes in the water-shed of the Fraser River. The distance from the lake to the sea, following the course of the Fraser and Quesnel Rivers, is approximately 500 miles. Its elevation is 2,250 feet. Its depth is not recorded, but, like most of the large lakes of the Fraser water-shed, it is undoubtedly of considerable depth. Its waters are clear. The lake freezes over in winter, though the outlet is always open. It is strikingly narrow and irregular in outline. It seldom exceeds two miles in width, and at points is constricted to half a mile. Some 30 miles easterly from the outlet, at the westerly end, the lake forks, the east arm extending some 40 odd miles beyond the forks, while the other stretches 40 miles northerly. The shores are covered with pine, spruce, birch and many berry-bearing shrubs. The entire lake is closely hemmed in by the wooded mountains of the Gold Range, which here have an elevation of from 4,000 to 5,000 feet. Between the east and the north arm, Ogden Peak rises to a height of 7,500 feet; and to the east of the head of the north arm Mount Watt reaches an elevation of 8,500 feet. In the number of its tributary streams and lakes, affording excellent spawning beds and rearing-waters for sockeye salmon, Quesnel Lake is richer than any other lake in the water-shed of the Fraser River. The lake and its tributaries embrace thousands of miles of salmon-spawning waters. Mr. J. B. Hobson estimates the amount of spawning water to be 1,000 miles. Unlike most of the other lakes tributary to the Fraser River, there are no Indians living upon its shores or tributaries. There is abundant evidence to show that at one time there were extensive Indian villages on the lake, but for many years they have been deserted. Furthermore, no Indians come here to cure salmon, which is a factor of considerable importance to a spawning-bed in the years of the poor runs.



SKETCH MAP, QUESNEL LAKE.



THE QUESNEL DAM.
(Gates closed.)



THE QUESNEL DAM.
Showing present fishway, which has an opening through the dam of only
eleven inches by ten inches.

Of the tributaries, the Horsefly River, which enters the lake from the south some 18 miles from the westerly end, is the largest and most important, as it drains a considerable section to the south, has many fine tributary spawning streams, besides receiving the waters of the Horsefly and Stillwater Lakes, both of which are of consequence. At the head of the east arm there are several tributary streams, the largest of which comes from a small lake lying directly north of the arm called Niagara Lake. The north arm receives the waters of innumerable streams, some of which come from small lakes, and all of which are of great benefit to the spawning salmon. The quinnat or "spring salmon," as they are locally called, and the sockeye are the only salmon that are reported as resorting to the lake. I saw there only the sea-run of sockeye. The lake and its tributaries abound with trout and charr.

THE DAM.

There is a dam in the westerly end of Quesnel Lake, at the point where the south fork of the Quesnel River heads, which is a serious barrier to the free passage of the immense run of sockeye salmon that annually seek to enter the lake and its numerous tributaries at that point, to spawn. This dam was constructed by the Golden River Quesnel Company, Limited, under the provisions of an Act passed by the Provincial Legislature in 1881, which was amended in 1888, 1895, and again in 1898. It was constructed for the purpose of shutting off, in the fall of the year, the waters of the lake, to permit mining for gold in the river bed and on its banks below. The dam was completed in 1898, and the gates closed on September 11th of that year. The waters being entirely shut off, the bed of the river was exposed for miles below. Mining operations were conducted for a part of two years, since which time the gates have been open. The mining operations not proving successful, the original company became insolvent, and its properties were acquired and are now held by the English debenture holders. The value of the dam is prospective only. It is built on the segment of a circle, having a radius of 460 feet, is 18 feet high, and from abutment to abutment is 763 feet long. At the north end of the dam is a raceway, which is 124 feet wide and 430 feet in length, with a grade of 6 inches. At the head of the raceway there are nine 12-foot discharge gates. The ordinary overflow of the lake is entirely carried off through this raceway. The water varies in depth according to the season, and never has a velocity of less than 12 or 14 feet per second. At the time of my visit there were about 5 feet of water in it. No sockeye ever pass through this raceway; they enter it in great numbers, but after working against the swift waters for a few rods are forced back into the pool below.

THE FISHWAY.

Located near the centre of the dam is a small fishway or ladder, which was constructed, after the dam was built, upon plans furnished to Mr. Joseph Hunter, C.E., the designer and builder of the dam, by the Department of Marine and Fisheries, to which plans Mr. Hunter made such alterations as he deemed necessary to secure the safety of the dam. The fishway is fed by an opening through the dam, 11 inches by 10 inches. It delivers its waters into the shallow, currentless, semicircular basin in front of the dam, some considerable distance (about 1,000 feet) from the lower end of the raceway. The fishway has a width of 4 feet, with a length of 72 feet, and there is a fall of 1 foot in 7 in the last 49 feet. There are 9 stops or riffles. Appended hereto is a sketch-plan of the fishway, furnished by Mr. Hunter; also a photograph which I took at the time of my visit. At the time the dam was built no provision was made for a fishway, as it was thought the salmon would have no difficulty in passing through the raceway when the gates were open, and that during the time the gates were closed there would not be sufficient water in the bed of the river to permit the salmon to approach within several miles of it. When it was found that the sockeye could not pass through the raceway, the present ladder was constructed.

SALMON.

The "spring" salmon and the sockeye are the only salmon that are reported as coming to the lake. The coho, the humpback and dog salmon are stated to be unknown here. I saw only the sea-run of the sockeye. The "spring" salmon reach the outlet of the lake in September, and, being more powerful than the sockeye, it is said the majority have no difficulty in passing through the raceway. I could obtain no estimate of the size of the run of "spring" salmon at this point, but it is not believed to be extensive.

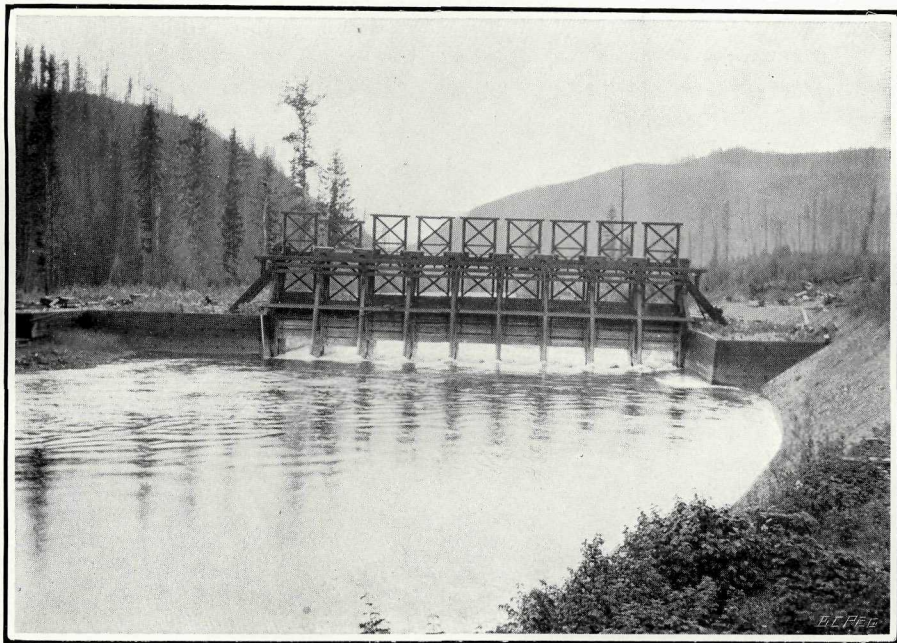
The sockeye usually reach the dam in August. In 1899 their arrival was noted on August 24th. In 1901 the first arrived during the last week of August and continued to run in vast numbers until the latter part of October. In 1902 they were first reported on August 5th, the earliest ever known, and at the time of my arrival, on August 17th, there were many thousands massed in the pool at the end of the raceway and in the eddies at either side. They were large, strong fish, running in weight from five to ten pounds. Despite their journey of 500 miles through the rapid waters of the Fraser and Quesnel Rivers, in which they had climbed 2,250 feet since leaving the sea, they were free from all marks or scars. Some were dark in colour, though many still retained traces of the bluish-green colouring of the back, and the silvery sides, that so distinguish them in salt water; while others, noticeably the males, were highly coloured, many having begun to take on the vermilion that marks their spawning period and their death. The fish which I examined were taken with a gaff by a Chinaman who was curing his winter's supply. They were firm, and there were no signs of the fungus-covered blotches that are so noticeable on spawning fish. The eggs and milt were hard. If permitted to pass the dam, these fish would have gone to the limits of the watershed before spawning. While the school was massed at the foot of the raceway, a few were seen motionless in the shallow, currentless backwater in front of the circular part of the dam, which is to the east and some distance from the present channel. There was a continuous movement of fish from the pool into the raceway. A few passed up 50 to 100 feet before being swept back by the swift current. The majority were forced back before they had gone 10 feet. None passed through. There were none at the fishway. They did not seem to notice the gentle current which came from it.

Mr. William Fleet Robertson, Mineralogist of the Department of Mines, who visited the dam on the 9th and 10th of last September, reports having made a careful examination, and states that the fish were still massed in the pool below the raceway, and that large numbers were seen in the quiet waters below the dam. He saw none enter or leave the fishway.

Mr. Joseph Hunter, C. E., states that he was at the dam on September 24th last, and that there were few or no red fish below the dam at that time.

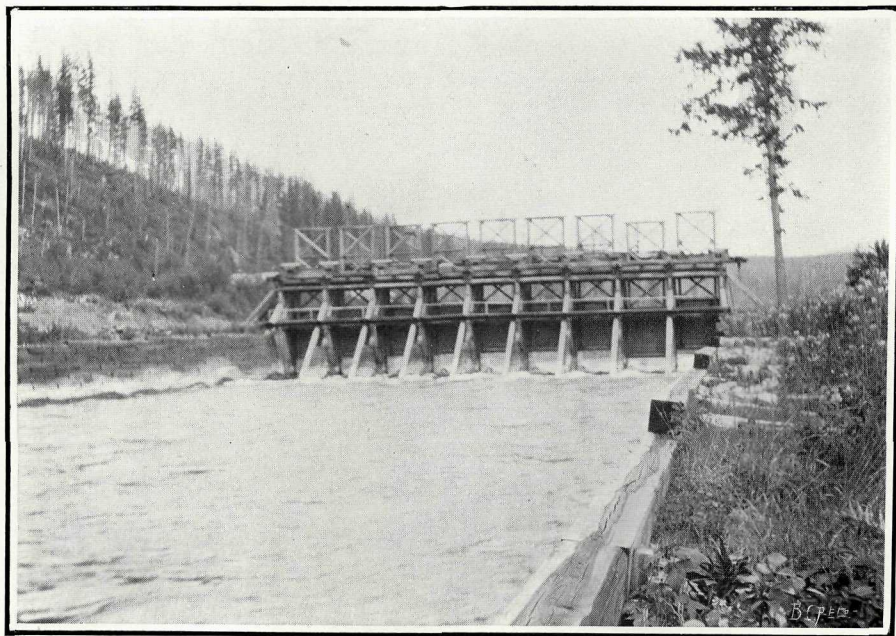
Mr. Thomas Drummond, C. E., of Quesnel Forks, wrote me in October: "The run this year passed the dam through the fishway, as far as I know from hearsay, in six days. The fish do not go through immediately upon arrival. They seem to hang about for quite a time and then rush through. In abundant runs, from three-fifths to four-fifths of the salmon pass; in an ordinary run almost all of them, except when the fishway is blocked."

Locally, there is considerable difference of opinion regarding the efficiency of the fishway. Mr. Thomas Drummond, C. E., and Mr. Winkley, of Quesnel Forks, state that when the ladder is freed from the gravel and other débris which accumulate in it each year at high water (which was done for the first time in 1901 and 1902), the fish have no difficulty in passing through, though they are delayed for some weeks before finding it; that in the years of the ordinary runs all the fish go through; that in the years of the big runs, like that of 1901, only three-fifths to four-fifths pass through. Mr. Drummond says that he sat on the dam many times in



RACEWAY AT QUESNEL DAM.

Looking into the head gates. The proposed fishway to enter through the two gates to the left.



RACEWAY AT QUESNEL DAM.

Looking from the lower end towards the gates. The proposed fishway to pass inside raceway, parallel with and 25 feet from wall to the right.

1901 and timed the fish going through the opening above the dam, and that from 25 to 50 per minute passed through and entered the lake. Mr. Drummond thinks the enlargement of the ladder would be of great benefit to the fish. In the opinion of Mr. J. B. Hobson, Manager of the Consolidated Cariboo Mining Company, whose principal property is located a few miles below the dam, the fishway is entirely too small. He states that at times during the season of 1901 he visited the dam and saw that only a few fish passed through the fishway, and he says that many thousands of tons were destroyed below the dam that year. Mr. Hobson also says that previous to the construction of the dam vast numbers of salmon annually passed through Quesnel Lake into the Horsefly River, but that since the dam was built no salmon have been seen there until last year, and then only a few. He also states that many of the fish detained at the dam spawn in the shallow basin below. The beds there, however, are so limited in area, and are so covered with dead fish at the end of a big season's run, that the eggs deposited there are killed by the rotting mass.

Mr. W. D. Mathews, of Toronto, who visited the dam with Mr. T. G. Brough, of the same place, at the time of the salmon run in 1901, wrote me as follows:—"I was induced to visit this particular place because of reports regarding the great quantity of salmon held there. I was very much surprised, and regarded the sight as most unusual. There was an immense number of salmon struggling evidently with the effort to find a passageway to continue their journey into the lake. A fish ladder had been constructed at one side of the dam, but its size was out of all proportion to the number struggling for admittance. There were positively acres of fish, and I do not hesitate to say that their numbers were hundreds of thousands. We tried to take photographs. Unfortunately, they did not develop. Had we succeeded, they would have been most convincing as to the necessity of improving this fishway."

Mr. A. J. Patenaude, of Harper's Camp, who has resided on the Horsefly River for many years, writing of the dam and the fishway, says: "The sockeye formerly reached the Horsefly River in the latter part of August and the beginning of September. The run of 1901 reached here the last of September and was confined to about 500 fish, while in former years, from 1893 to 1897, one might almost have walked on them. In 1898, 1899 and 1900, there were no sockeye here at all, though there were thousands at the dam. I do not think that one fish in a thousand ever gets through the dam. As to the fish-ladder, it is useless."

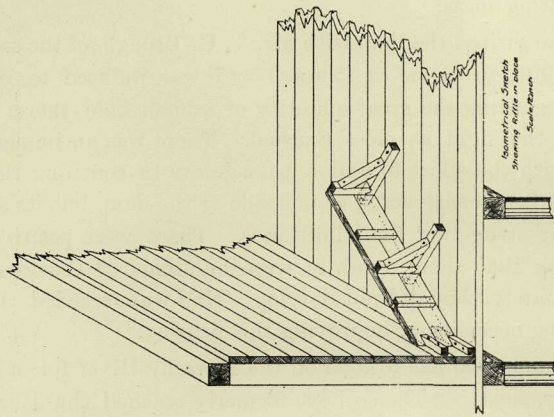
A miner on the Horsefly River, who has lived on the lake for years, states that previous to the construction of the dam the shores of the lake and its tributaries ran red with the vast schools of spawning salmon, but that since its construction he had seen no sockeye above it until the season of 1901, and then only a few.

I was told by several local observers, whose names I did not secure, that the majority of the fish that reach the dam die there, and their dead bodies line the banks of the river for miles below it.

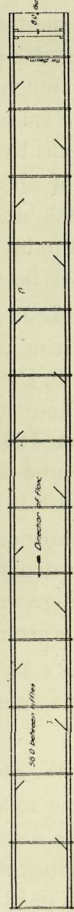
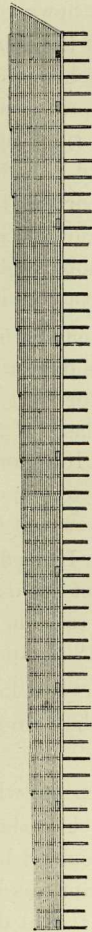
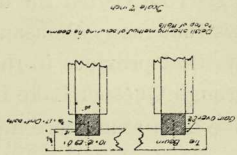
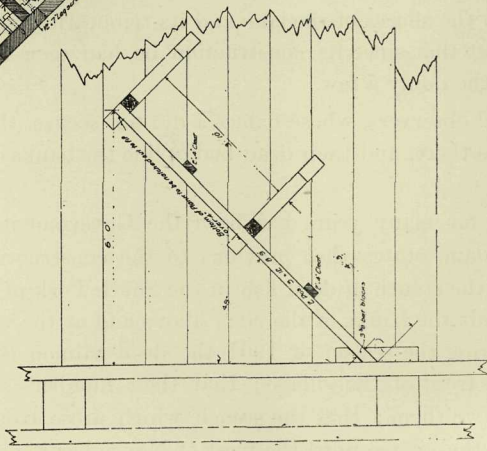
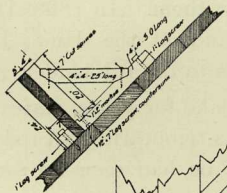
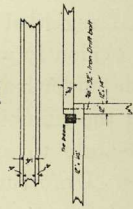
Mr. W. Stephenson, who for many years has been the Government Agent at Quesnel Forks, nine miles below the dam, states that previous to the construction of the dam the village was never troubled by the stench of dead fish in the South Fork of the Quesnel River, but that since the dam was built the banks of the river above and at the village were annually lined with dead fish; that during the season of 1901 the dead salmon drifted in thousands upon the shores of the river in front of the village; that their numbers were so great as to defeat the efforts made to remove them; that the stench which arose from the rotting mass was a menace to the health of the village until the frost of November removed it.

My opinion is that the ladder is totally inadequate. A consideration of the fact that the opening through the dam is only 11 inches by 10 inches, and of the further fact that the fishway is only 4 feet wide, must, I think, convince any one familiar with fishways that it is too

PLAN OF PROPOSED MAIN FISH MAY
ON THE DAM AT QUEENSLAND I. A.M.C.



Asymmetrical Slantish
Shooting Riffle in above
Scale. Below.



Plan and Elevation of main fish may
Scale 1 inch to 1 foot

small to accommodate the passage of the number of fish found in so large a stream. The small opening into the dam does not allow enough water to pass into the shallow basin in front of the circular part of it to create a sufficient current, and is too far removed from the pool at the foot of the raceway, where the fish congregate, to attract their attention, and after weeks of delay spent in fighting the rapid waters of the raceway they die.

Nobody asserts or believes that the ladder is adequate in the years of the big runs, and even if it were conceded that it was effective in the years of a poor run like this year, the fact that the fish are detained here for several weeks before getting through, and never reach the higher spawning ground, is certainly a matter of sufficient importance to cause the fishery interests serious concern, and to warrant an expenditure sufficient to construct a ladder in the dam which will meet the requirements necessary to pass all the fish without delay.

Mr. Joseph Hunter, C. E., who designed and built the dam for the original company, is of the opinion that the present fishway cannot be enlarged without endangering the safety of the dam. A new fishway, therefore, must be constructed at some other point. The raceway offers the most suitable location.

I submit herewith the plans of a fishway which will, in my judgment, be the most effective. These plans were prepared by the Lands and Works Department from my designs. They call for the construction of a fishway inside the present raceway, by the building of a 7-foot partition wall 22 inches thick parallel with, and 25 feet from, the east wall, extending from the head-gates to the lower end; the placing of board riffles 2 feet high at an angle of 45 degrees to the side walls, and at a distance of 56 feet between each alternate one. A ladder of such a width will include two of the head gates. During the run of fish one gate is to remain closed. The open gate will permit 12 feet of water to enter the fishway, which being 25 feet wide will, with the aid of the riffle angles, give a broken current through which all the fish will have no difficulty in passing. The entrance to this ladder is to be at the point where the fish first find their passage obstructed.

I have submitted these plans to the agent of the debenture holders, and am told by him that he will make no objection to the Government performing the work.

There was in the Act authorising the building of the dam no provision for the construction and maintenance of a fishway. Nor was there at that time any law that compelled the owners of dams to construct and maintain fishways. The present fishway was built by the Company as an act of courtesy to the Department of Marine and Fisheries, which requested its construction. I am advised that there is no way by which the present owners of the dam can be compelled to construct a new fishway. Certainly it would take considerable time to successfully prosecute an action against them. As it is urgent that the ladder be built this coming spring, it would seem that the Government which authorised the dam to be constructed should make provision to meet the expense. As all the gates of the raceway will have to be temporarily closed to permit the building of the proposed fishway, the work must be done early this coming spring, at low water, if it is to be of service for the run of 1903.

I have, therefore, to urge upon your attention the importance of at once making provision for the letting of a contract for the construction of this fishway.

Independent of the destruction of fish at the dam there has been some discussion as to the damage its giving way at high water would entail in the Fraser River Valley. This discussion appears to have been caused by the fact that the present owners of the dam do not maintain a regular watchman there to see that the logs and drift that accumulate at the boom and gates are promptly removed. It is said that if at high water the gates should become blocked by driftwood there is danger of the dam giving way, thereby releasing a volume of water estimated at about 200 square miles, with a depth of about 14 to 16 feet.

It is estimated that the fall in Quesnel River from the lake to Quesnel Forks is about 50 feet per mile for a distance of 7 miles. From Quesnel Forks the main Quesnel River has a fall of $8\frac{1}{2}$ feet per mile for a distance of 60 miles. From the mouth of Quesnel River down, the Fraser River has a fall of about 4 feet to the mile for a distance of about 200 miles to Lillooet. From Lillooet the grade of the Fraser is about $5\frac{3}{10}$ feet per mile for a distance of about 100 miles down to Hope. From Hope the fall is 150 feet in the 100 miles to the mouth of the river.

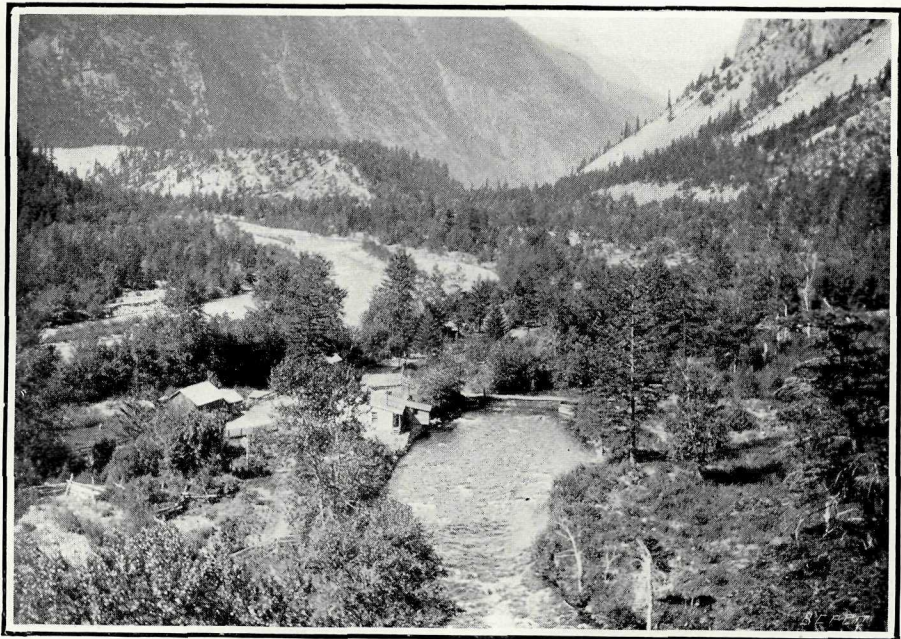
It is stated that if the Quesnel Dam were to break away at any time during the high water stage of the Fraser River, when the water is also at its greatest height in the lake, every bridge from Quesnel Lake down to the Gulf of Georgia, together with every dyke, cannery and habitation close to the present high water mark of the river would be swept away. It is also stated that the dam is built on piles driven into the gravel bed to a depth of from 3 to 9 feet, and is not one which will stand a heavy flow of water over its crest, and that its safety depends upon keeping the gates open and clear of drift, and the dam, generally, in good repair. On the other hand, the Company asserts that the dam has resisted, and will resist, a large volume of water coming over its crest; that it is built of cement encased in heavy timbers upon a bed-rock foundation, and that there is no possibility of its being swept away, even if the gates should become blocked. The question is only raised here so that the cannery interests may be informed of the situation, and not as affecting the spawning grounds, for the removal of the dam would be of the greatest benefit to the running fish, and would solve a problem that must always be of great concern to the salmon interests of the Fraser River.

No hatchery system for the watershed of the Fraser can be said to be complete that does not include one for the Quesnel District. It has already been shown that the lake and its tributaries comprise an important part of the spawning section of the Fraser. An excellent opportunity is presented for a hatchery on the Quesnel when the Province shall be in a position to build and operate additional hatcheries on the Fraser—the eggs to be obtained at the dam. The shallow, currentless waters in front of the circular portion of the dam offer excellent facilities for impounding the fish, and the hatchery could be located on one of the adjacent tributary streams of the lake. Previous to the selection of a hatchery site, an examination should be made of the streams during the winter in order to determine the constancy of the water supply. The winters in the neighbourhood of Quesnel Lake are very severe, and it must be established beyond doubt that the water supply to the hatchery will not freeze. If a hatchery is to be built it would be cheaper to construct a building of logs than to transport lumber to the site.

There is a natural fall of about 20 feet in the North Fork of the Quesnel River that prevents the salmon from entering Cariboo Lake and its several tributaries. Mr. Thomas Drummond, C. E., of Quesnel Forks, is of the opinion that this natural obstruction could be removed, or a fishway blasted in the rocks on one side, which, if done, would open up this lake region to the fish which annually congregate at the foot of the falls, and whose progress is obstructed by it; and that this work could be accomplished by the expenditure of \$1,200. This matter has been presented to the Dominion authorities, and it is stated that they have decided to do the work. It is certainly worth while to make the attempt, but there is so much greater need of a ladder at the dam in the South Fork of the Quesnel River that attention should first be given to that.

SETON AND ANDERSON LAKES.

Seton and Anderson Lakes, following the courses of the streams which drain them, are some 200 miles above the mouth of the Fraser River. These lakes afford spawning grounds for the sockeye, which are only second in importance to those of Quesnel Lake, in the Fraser River District north of the Thompson River. They are the first lakes the fish enter which pass the great canyon and continue up the Fraser River proper. The waters of these



LAKE CREEK.
The Hatchery Site, near Seton Lake.



SETON LAKE.
Looking towards the outlet, from the Mission.

lakes chiefly come from the melting snows of the great range of coast mountains to the south. The rainfall on this water-shed is slight. The waters begin to rise in May, and reach their maximum height in August, when the outlet stream is some three feet higher than the normal winter stage. Lake Creek, the outlet of Seton Lake, empties into Cayoosh Creek, a tributary of the Fraser, 45 miles north of the latter's junction with the Thompson, and one mile south of the town of Lillooet, which is three miles from the lake. Seton Lake, the first of this chain of lakes, is 17 miles in length, and has an average width of one mile. Its waters are remarkably clear, of great but unknown depth, and have a temperature ranging from 42 to 60 degrees. From the outlet the lake extends almost due east and west for a distance of 15 miles, and then turns directly to the south. The continuous range of mountains on either side has an elevation of from 3,000 to 6,000 feet. The north range is barren of timber, while there is a growth of inferior spruce on the south range. Seton Lake has but one tributary, Portage Creek, which conveys the waters of Anderson Lake, which lies one and a quarter miles to the south, into it. This connecting stream has a fall of 60 feet, and offers an excellent spawning bed for salmon throughout its gravelled length of a mile and a half. It has a good-sized tributary coming from the range of mountains to the west, at the mouth of which there is an excellent hatchery site.

Anderson Lake is apparently an extension of Seton Lake, which it closely resembles, and from which it appears to have been divided by a great landslide from the eastern range of mountains. It is sixteen miles long, and of an average width of one mile. Several small tributaries enter on its west side, none of which are of importance as spawning grounds, as falls prevent the salmon which spawn at the mouths of all of them from passing further. Anderson Creek, which comes into the lake at its southern extremity, is a large, rapid stream of some ten miles in length, in which there is a descent of four hundred feet. The channel is filled with boulders and log jams, and the bottom is gravelly. The creek has its source in Summit Lake, a circular body of water a mile in diameter, which lies at an elevation of 1,450 feet. This little lake, the waters of which are chalky white from the cataract stream which comes from the great mountain to the south, is the extreme head of the Seton-Anderson Lake region. A part of the vanguard of the sockeye which enter Seton Lake comes here to deposit its eggs. They can go no further.

The main spawning ground of Seton and Anderson Lakes is found in Lake, Portage and Anderson Creeks. There is reliable evidence to show that in the great run of 1901 many of the salmon spawned in portions of the lakes. The sockeye pass into Seton Lake from August to October. Local observers in October, 1901, were positive that the sockeye run every year in great abundance, that there were some fluctuations in the size of these runs, but that in the history of the region there had never been a year when the run was not of such magnitude as to make the dead fish offensive to residents along the creek and to those a considerable distance away. I visited the neighbourhood in the latter part of October, 1901. The fish had then been running for two months, and the air was fetid from the dead fish which covered the beds and lined the banks of Cayoosh Lake and Portage Creek, and portions of the shores of Seton and Anderson Lakes, yet the streams ran red with spawning fish. It was an interesting though offensive sight, the like of which I had never witnessed. The run of sockeye into Seton Lake this past season was the poorest ever known. The whites and Indians all say that this was the first and only season that they have failed to run in abundance. In the last week of July and the first week of August there were many thousands of firm, bright silver and green coloured sockeye observed passing through Lake and Portage Creeks. None of these fish were red, and none spawned in Lake Creek. In September there was no run. In October only a few ran, which, while red, passed from Lake Creek into Seton Lake.

In the early part of September, 1902, I found sockeye spawning in the waters of Anderson Creek. This was the only stream in the District where I found any. They were evidently the remnant of the July and August run that had entered Seton Lake. I say the remnant of the run, because the Indians from the village on Portage Creek and at the head of Anderson Lake had taken a large proportion of them as they passed. It would be interesting to know at what time this run of fish entered the Fraser River, because, considering the journey of two hundred miles from the mouth of the Fraser to Seton Lake, and the dates of their arrival at the lake, it would appear that they must have entered the mouth of the river previous to, or soon after, the fishing season for sockeye, July 1st.

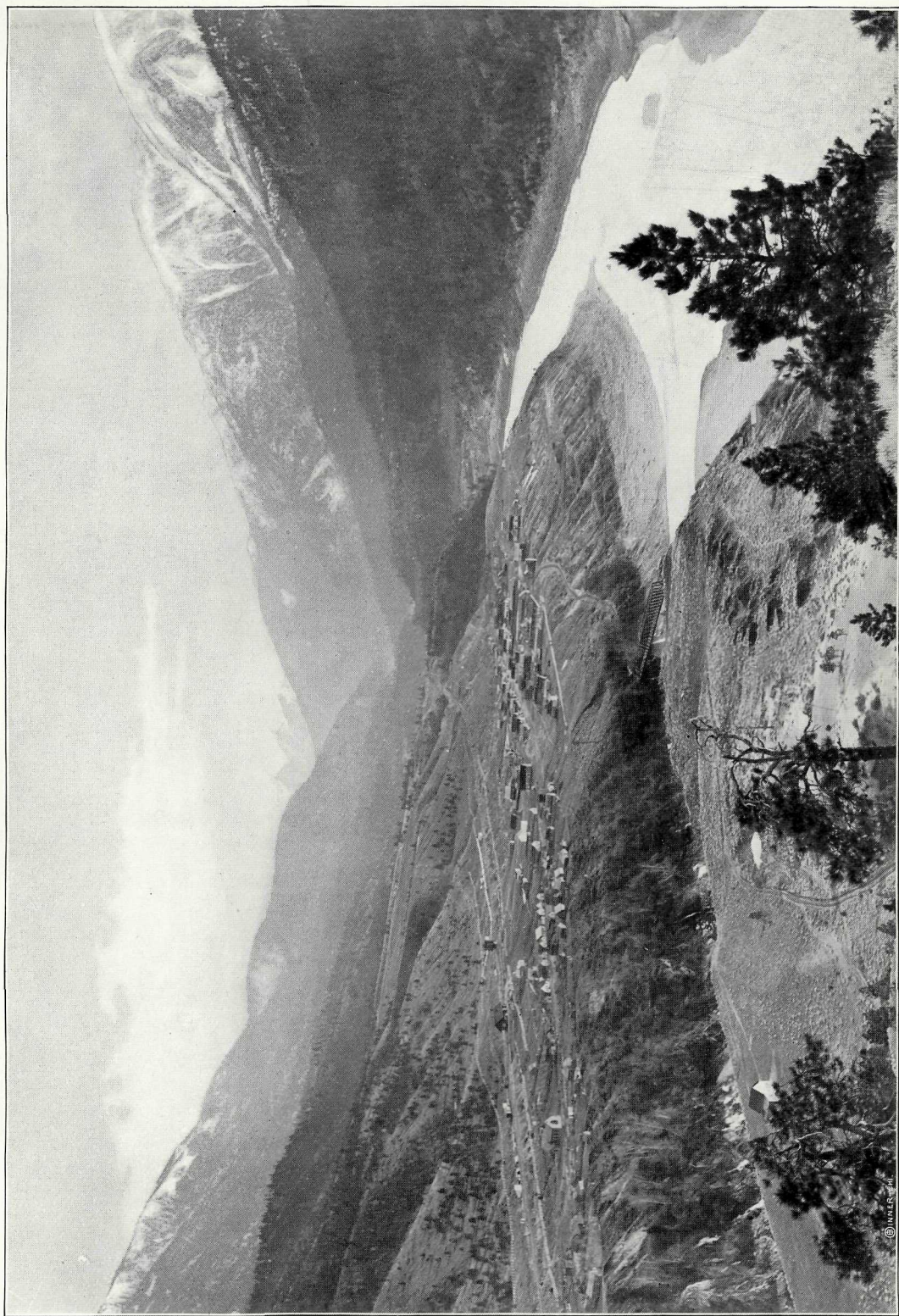
I was unable to make any personal investigations regarding the movements of the young salmon in Seton or Anderson Lake. Mr. John Dunlop, who resides on Lake Creek, half a mile from Seton Lake, at my request, carefully observed the movements of the young sockeye in the creek, and took specimens of various sizes of them as they passed down stream. The smallest were secured from the lower end of his irrigation ditch, and averaged $1\frac{1}{8}$ inches in length. It is doubtful what became of the immense schools of these small fish which were noticeable in all the shallower waters. Mr. Dunlop had no means for determining their movements. As to the movement of the larger size, there is no doubt but that they were passing out of the lake in schools headed down stream. The specimens forwarded me were of uniform size, varying from $3\frac{3}{4}$ inches to $4\frac{1}{8}$ inches in length. They were plump, of a silvery white colour below the lateral line, and dark green above. From their size and condition it was evident that they had been in the lake for one year at least. They were probably the product of the ova deposited in the fall of 1900, and the smaller size of those spawned in the fall of 1901.

The Evermann, or permanently small form of the sockeye salmon, is found in Seton Lake in October, and in Anderson Lake in November. Their presence there at other times has not been recorded. These small fish annually appear in great numbers in Seton Lake, about the middle of October, at that time rising to the surface of the water with the abdomen so distended with gas that they are held there, where they struggle for a few days and die. Their fins are frayed and covered with fungus, the tail in many specimens being entirely gone. They are of a dark, muddy colour, and show dark spots on the back, and never show any of the brilliant red colour which so distinguishes the larger variety. They average about 8 inches in length and weigh only a few ounces. At times the surface of the lake is practically covered with their remains. The Indians term them "oneesh" and gather them in great quantities by means of scoop nets when they first come to the surface. Nothing regarding their spawning habits is known. They never enter the creeks, so far as reported. I saw none save in the lake proper. These fish are common to both Seton and Anderson Lakes, but come to the surface of the latter some three or four weeks later than the former.

In addition to the sockeye, a few quinnat enter the lake in the spring, and a few coho in October and November. Large sized trout, of the steelhead and mykiss varieties, are found in the lake, as well as the Dolly Varden (charr), and the burbot, or "Ling," as it is locally termed, which also grows to a large size, in many instances from ten to fifteen pounds. During the salmon spawning season the trout and Dolly Varden are seen in great numbers on the spawning beds, and their consumption of the newly expressed eggs must be very great.

SETON LAKE HATCHERY.

During the year I made repeated visits to Seton Lake, for the purpose of determining the best site for a salmon hatchery. Of the many good sites on Lake Creek I selected one on the north side, about half a mile from the outlet of the lake. The controlling factor in the final



JUNCTION OF FRASER AND THOMPSON RIVERS AT LYTTON, B. C.

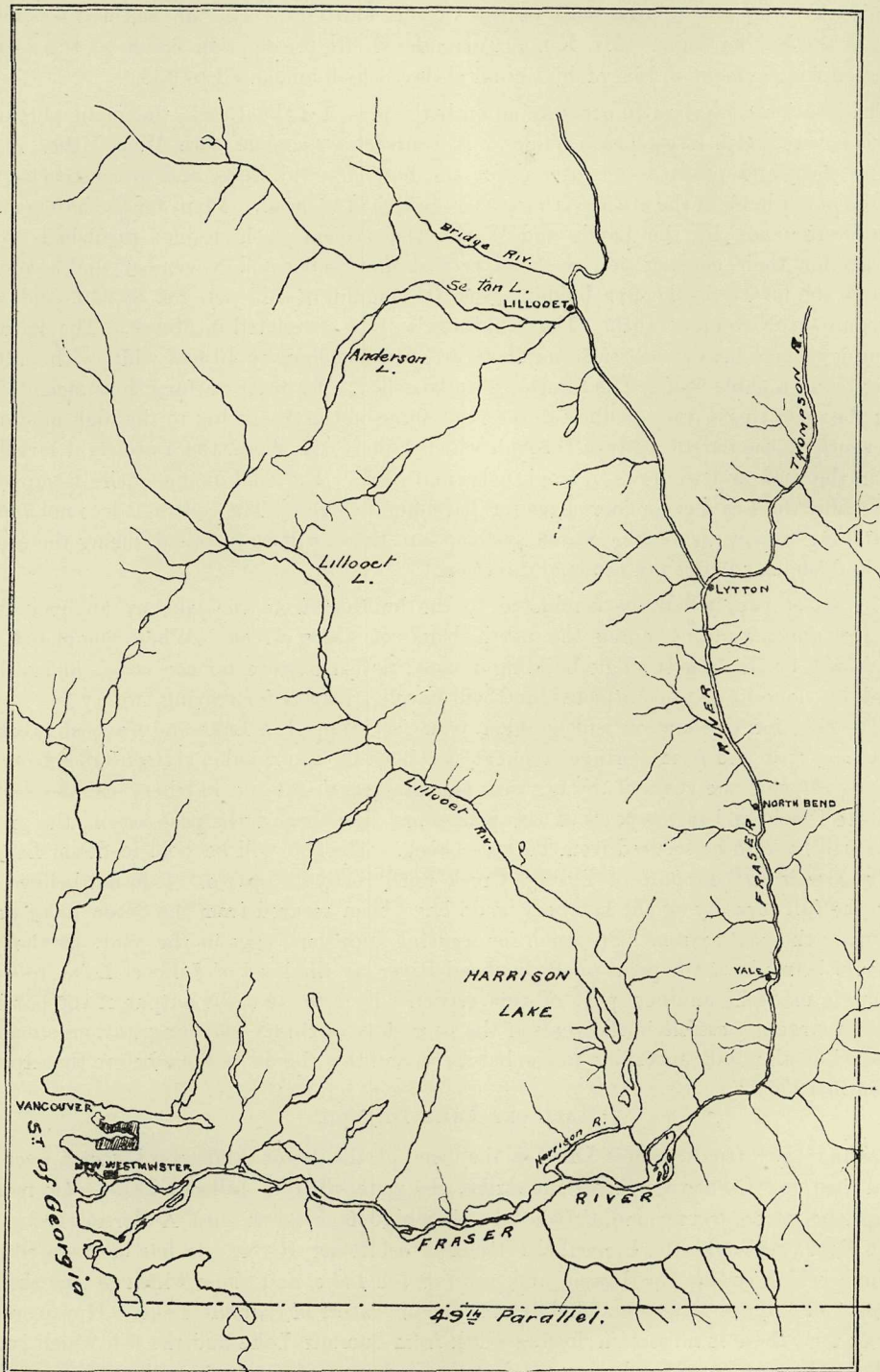
determination was the relative cost of the various locations. The site selected was locally known as the Kinder claim. Mr. Kinder surrendered his pre-emption claim to the Department upon the payment to him of his actual outlay, which amounted to \$33.

The location comprises 40 acres, lying on both sides of Lake Creek, the main portion of which is covered with large spruce timber. A contract was made with Wm. Miller, of Lillooet, to clear and prepare the ground for the hatchery buildings, and to construct a road along the north bank of the creek to the waggon bridge at its head. Plans for the hatchery and cottage were made by the Lands and Works Department upon designs furnished by me. Proposals for their construction were advertised in October and November, and a contract was let to the lowest of the five bidders, Wm. G. Duguid, of Lillooet, for \$6,945, and work was begun on November 15th. The buildings will be completed in March. The hatchery building is to be a heavy wooden frame structure, 210 feet long by 40 feet wide, with walls 10 feet high, and a gable roof. The interior is to be ceiled. In order to furnish sufficient light during the operating season, as the sun does not shine on the site owing to the high mountains to the south of the narrow canyon through which Lake Creek flows, there are eight large skylights in the roof, and windows in front, sides and back. The roof being entirely supported by the walls, there is a clear floor space for hatching troughs. The contract does not include the hatching apparatus or the water system, but these will be installed during the coming spring and summer under my personal direction.

The water supply will be conducted to the building from the lake by an open flume 1,400 feet long, running along the north bank of Lake Creek. When completed, the hatchery will be the largest single building devoted to fish culture on the coast, and will be excelled by none in its appointments, and will have a capacity for rearing twenty-five million fry. The eggs for this station will be taken from fish trapped in Lake and Cayoosh creeks at the hatchery site, and from Portage creek at the head of Seton Lake, sixteen miles from the hatchery. During the years of the big runs enough eggs to fill the hatchery can be secured from Lake Creek, and in the years of the poor runs, like that of the past season, the greater number will have to be secured from Portage Creek. The fish will be held in Seton Lake by means of a weir at the mouth of Portage Creek until ready to spawn. I do not believe that eggs to the full capacity of the hatchery could have been secured from the Seton Lake watershed during the past season. Provision for securing additional eggs in the years of the poor run should be made at the point on Birkenhead River at the head of Lillooet Lake, to which reference is made in another part of this report. In order that the output of the hatchery shall be as large as possible in the years of the poor runs, auxiliary spawning stations should be established at all points accessible to the hatchery, and this should be done before the expected poor run in 1906.

LILLOOET LAKE DISTRICT.

Passing south from Summit Lake, at the head of the Seton-Anderson District, over the original road to "Golden Cariboo," one strikes the water-shed of Lillooet Lake. On most of the maps the waters from Summit Lake are shown to flow north into Anderson Lake, and through Pool Creek and the Birkenhead River into Lillooet River. It has been stated that the salmon which go up the Fraser and enter Seton Lake, and those which go up through Harrison and Lillooet Rivers and Lakes meet in the waters of Summit Lake. However, as a matter of fact, there is no stream flowing south from Summit Lake and the fish which run up the Lillooet River cannot reach Summit Lake on account of a narrow ridge ninety feet in elevation separating them. In seasons of abundance the fish in this section spawn within a mile or so of each other. Going down from the divide the road runs for a short distance along Pool Creek to the point where it empties into Birkenhead River, which stream rises in the



SKETCH MAP OF SETON, LILLOOET and HARRISON LAKES.

mountains to the north-west. This river is locally confused with Pool Creek, and even on some of the Government maps is given the name of Pool Creek, and on others, Blackwater River, evidently named after the small lake at its source. Officially, however, it is given the name of Birkenhead. Proceeding down this river by the road which runs along its eastern bank, a good opportunity is given for observing the red spawning sockeye, which are plainly seen in its many clear pools and gravelled stretches. I saw them there on September 7th and 9th, 1902.

The Birkenhead River empties into the north channel of the Lillooet River a short distance below the large Indian village which is located upon the grass-covered delta known as Pemberton Meadows, four miles from the head of Lillooet Lake. Lillooet River has its source in the snow-clad mountains of the Coast Range to the north of Lillooet Lake. It is a large stream and at its lower end rather sluggish. Its waters are coloured by a chalky silt. The Soquamish River is its largest tributary. About five miles before Lillooet River enters Lillooet Lake it divides into two branches, which encircle Pemberton Meadows. The south branch is much the larger. The sockeye which come up through the lake run in both channels. The waters are so discoloured by silt as to make it impossible to judge the numbers running in either channel. The presence of fish is disclosed only by their breaking water. The Indians catch them with small nets fastened to the banks, and confine their fishing mainly to the north channel, in the vicinity of the clear water at the mouth of the Birkenhead, where they are easily taken by means of gaffs and spears. The favourable conditions of bend and currents existing at the junction of the Birkenhead with the north channel leaves but little doubt that the sockeye that run in the north channel turn into the Birkenhead. I saw none in the Lillooet above the junction, and the Indians use no nets above that point. There are some 250 Indians at Pemberton Meadows in the fall who obtain their main supply of salmon from the Birkenhead. In a season of a poor run, and low water, like the past season, they take a large proportion of the run at this point. Large trout were noticed on most of the spawning grounds, which were destroying large numbers of eggs.

There were a good many fish being smoked in the sheds at the village of Pemberton Meadows during the time of my visit, September 7th to 9th, and the Indians were still catching them, both at the mouth of the Birkenhead River and at Fish Camp, some miles up stream. There is an excellent hatchery site on the Birkenhead River near the mouth of Owl Creek, a small tributary which enters it a few miles from its mouth. Though the Owl Creek site possesses many advantages, there are other points that should be examined before a site is selected in this vicinity. There is an abundance of fine cedar in this neighbourhood from which a hatchery could be built. The Indians at the Meadows have demonstrated that they are adepts at building log houses and barns of extensive proportions, and could be utilised for the purpose of building such a hatchery. They also could be employed in the operation of the hatchery.

Lillooet Lake is eighteen miles long, is quite narrow, is enclosed by steep mountains, and is about the size of Seton Lake. Its elevation is only 620 feet. Its waters are discoloured at the upper end by the muddy waters of Lillooet River. There are several small tributaries which are not of importance and which the Indians say are not frequented by salmon. At the south-eastern end the lake empties through a channel one and one-half miles long into a small lake, about six miles in length, called Tenas Lake, or "Little Lillooet," as it was better known in the early days. From Tenas Lake the mountains again close in and the waters rush through a narrow canyon for 29½ miles into Harrison Lake. This stream, which is still called Lillooet River, is rapid, particularly the last five or six miles, having a fall of 550 feet. Until recent years the Indians ran this river with canoes, but now they pack over the old road to Port Douglas, at the mouth of the river.

The Indians at Pemberton Meadows are as thrifty and intelligent as any on the coast, and I gave much credence to their statements. They say there is always a run of sockeye in August and September, and that occasionally there is a run as late as October. They stated that the run this year was the poorest they had known, and that they had not been able to cure more than a third of the usual amount. Many of their smoke houses were empty.

The quinnat run from June to September. The coho run in October, and is said to be small. There were numerous trout upon the spawning beds, some which were several pounds in weight.

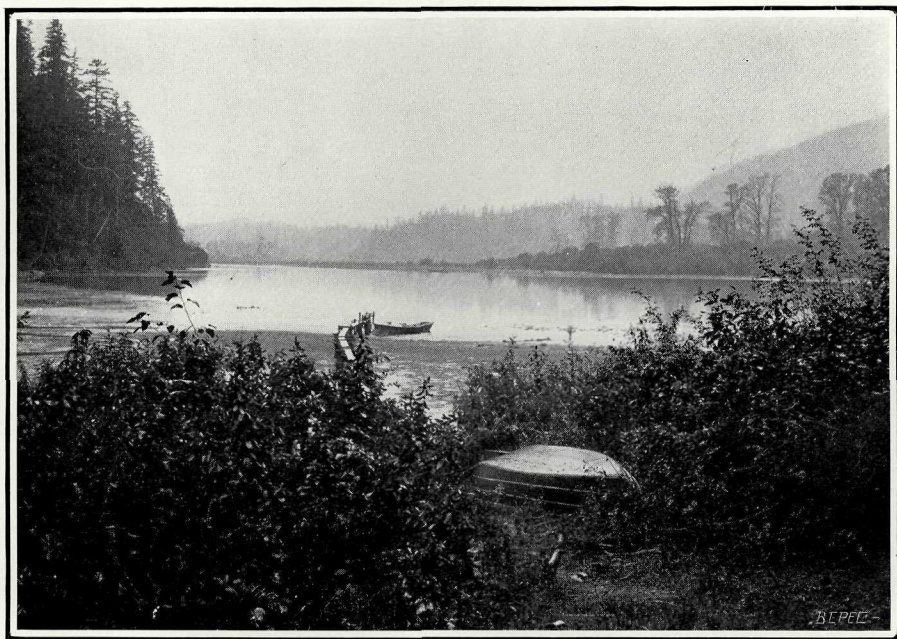
HARRISON LAKE.

Harrison Lake, which receives the waters from Lillooet Lake and River, and also the waters from the west side of the high mountain range which forms the west bank of the Fraser River, and the east side of the range between the lake and the gulf coast, has an elevation of only 71 feet, is about 40 miles in length, and lies in a basin extending slightly west of north. The rainfall on its water-shed averages more than 80 inches per year. The mountains on both sides rise abruptly to a considerable elevation, many of them at the head of the lake are snow-clad throughout the year, and all are densely covered with a heavy growth of spruce, cedar, the big-leafed maple and the white birch. The waters of the lake are clear and of an equable temperature, and empty through the Harrison River into the Fraser less than a hundred miles above where the latter empties into the Gulf.

Harrison Lake receives a number of small streams on its eastern side where the salmon of all five varieties spawn. The greater proportion of the early runs pass from the lake into the Lillooet River, proceeding thence to the more extensive spawning grounds of the Lillooet Lake District. To the east Silver Creek empties into the lake three miles from the outlet, and is the largest and most important of its tributaries, except Lillooet River. It takes its name from its silvery waters. A delta of considerable size has been formed at its mouth, through which it now has two channels, each of which is entered by the early run of sockeye and other spawning salmon. Four miles from its mouth is a fall over which the sockeye cannot pass. Their spawning grounds in this stream are therefore limited to the channels below the falls, and to Canyon Creek, which enters Silver Creek some two miles below the falls. The upper portion of these channels is wide, and the gravel bottom offers most excellent spawning beds. Silver Creek, however, like the other tributaries of the Harrison, is subject to freshets.

There is an excellent hatchery site at the mouth of Canyon Creek, and the last of the early run of sockeye spawn here in considerable numbers in August and September. At the time of my examination, October 25th, 1901, there were no living sockeye in these streams, but the dead bodies of a considerable number were seen. A few spawning coho were noticed in the creek, and also dog salmon at its mouth. The Dominion Government placed a weir in Silver Creek in August, 1902, and took nearly two and a half million sockeye eggs, which were transferred to the hatchery near New Westminster.

Harrison River, the outlet of the lake, is a wide and rather shallow stream, and empties into the Fraser River. A considerable number of the late run of salmon spawn in this river at the end of the season, but the majority of the late run of sockeye which enter the Harrison pass into Morris Creek and Morris Lake, which latter is a small lagoon-like body of water lying west of the river, and some four miles from Harrison Lake. None of the early run of sockeye enter Morris Creek. Morris Creek and lake are insignificant bodies of water, but as a spawning ground for the late run of sockeye, and, from the standpoint of artificial propagation, they constitute one of the most important and valuable points on the Fraser. The Dominion Government has operated a spawning station here since 1885, and, with the exception of the



MORRIS LAKE.
Looking towards the outlet.



THE HATCHERY SITE ON LAKELSE RIVER.

year 1900, has never failed to take eggs. All the salmon eggs taken by the Dominion in this Province up to 1901 were secured at this station. It is well known that the last of the run of sockeye which come into the Fraser or other big streams spawn in waters closer to the mouth of the river than the first of the run does. The regularity of the run at Morris Creek and Morris Lake results from the fact that the fish that enter the creek come from the Fraser River after the regular sockeye fishing season is closed. This certainly was the case in 1902. It does not, however, follow, as some critics of the hatchery operations in the Province contend, that the fry propagated from this late run of fish produce only late-run fish, and that if we are to increase the early run we must hatch the eggs of the early-run fish. I have already shown that the early runs go to the extreme head of the watershed and spawn there in August and September. The eggs and fry in these headwaters are longer in developing, because the water is much colder than it is nearer the sea. The eggs naturally deposited in Morris Creek would produce swimming fish as soon, if not sooner, than eggs deposited at Quesnel, Shuswap, or Adams Lakes, and the water in Morris Creek and the Harrison being warm, the young fish would develop faster, and having a shorter distance to travel would reach the sea at the same time, if not in advance of the fry from the upper lake region. If the fry of the late run do enter the sea earlier they would, being better fed, advance faster, and be quite as likely to return to the river in the early part of the season as in the latter part. It is generally believed that the fish bred in a given watershed, such as the Fraser, return to it upon reaching maturity, and there is considerable evidence to warrant it. It has not, however, been settled, and probably never will be, that the fish bred in a given tributary of a large river seek only that tributary to spawn.

SHUSWAP LAKES.

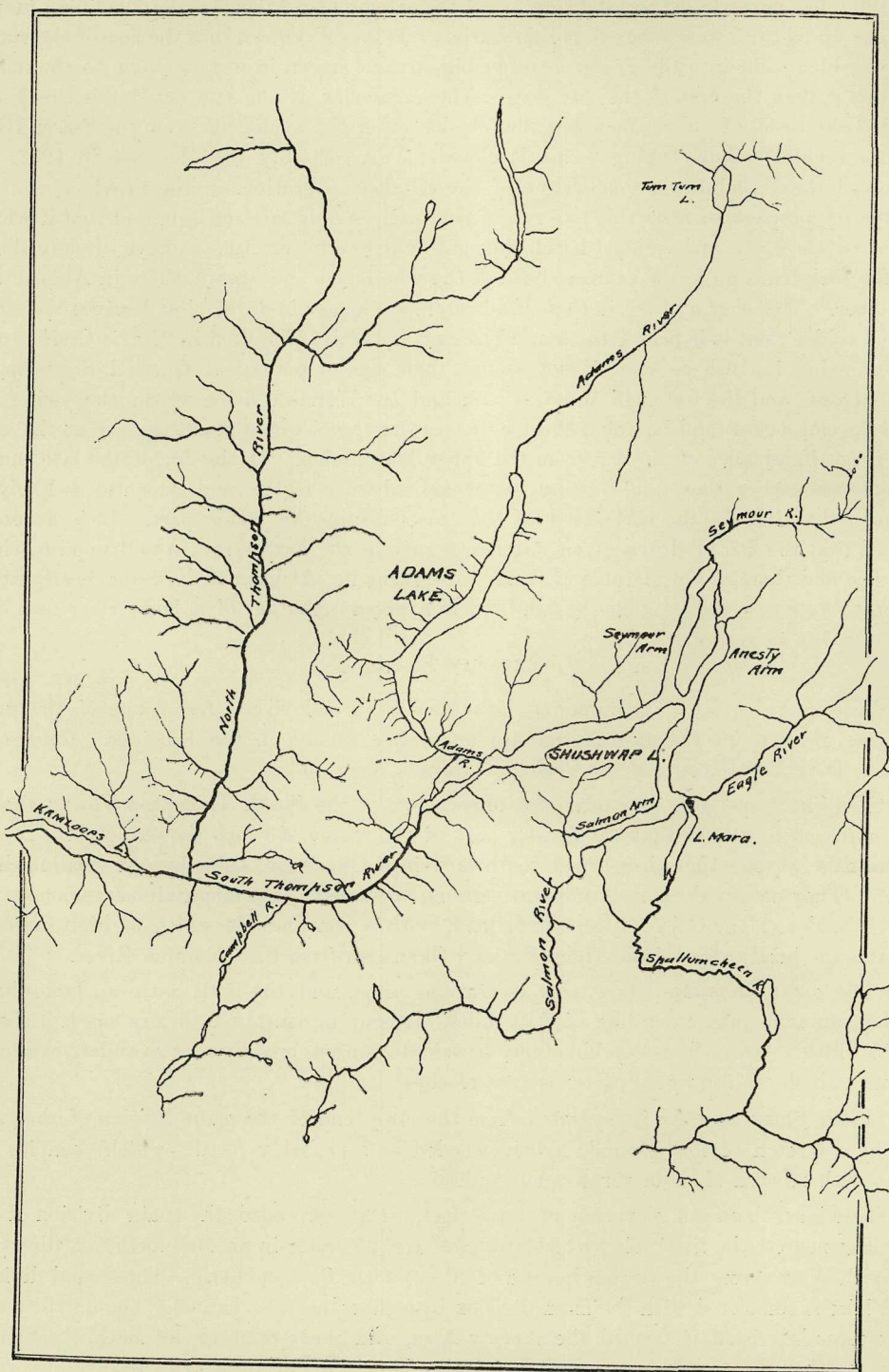
Shuswap Lake, with its numerous tributary lakes and rivers, forms one of the great spawning grounds for the sockeye, quinnat and coho salmon in the Province. George M. Dawson, D.S., F.G.D., etc., of the Geological Survey, says:—

“The Shuswap Lakes now form the upper part of the South Thompson Valley, though there is reason to believe that the greater part of the region of which they at present receive the drainage at one time discharged southward into Okanagan Lake by the Spallumcheen Valley. They occupy deep and comparatively narrow valleys in a mountainous region on the western border of the Gold Range, which here, with a considerable width of high summits, separates the headwaters of the Thompson and Okanagan from the Columbia River.

“The great Shuswap Lake, with its various arms, and the little Shuswap Lakes have, together, an aggregate coast line of 210 miles, without measuring into any bay less than a mile in width. Great Shuswap Lake may be said to consist broadly of two rudely-paralleled portions, which are connected by transverse reaches.

“Little Shuswap Lake is separated from the lower end of the main division of the great lakes by a stretch of low ground, lightly wooded and probably fertile, which occupies the valley, with an area of about three square miles.”

These lakes have an elevation of 1,160 feet. Dawson called the main division of the great lake nearest the little lake, which stretches for 25 miles in an east-north-east direction, the South-West Arm; the stretch beyond of 20 miles, the Seymour Arm. The second division of the lake is connected with the main division by a short, narrow channel. The north stretch of the second division is termed the Anesty Arm, and the stretch to the south, the Salmon Arm; together these arms are more than 40 miles long. All of these arms receive important streams. The South-West Arm of the Great Shuswap receives the waters of Adams River a few miles north of the neck which separates it from Little Shuswap. This rapid-moving river has its source in Tum Tum Lake, some 100 miles above. After leaving Tum Tum Lake it



SKETCH MAP OF SHUSWAP AND ADAMS LAKES.

courses rapidly for 70 miles and enters Adams Lake, which is some 50 miles in length. At this point the hills again close in and the river flows 7 miles further and empties into the Great Shuswap. In this last-described stretch it has a fall of 300 odd feet. In addition to the Adams River at its head, Adams Lake has several other important tributaries entering from each side, several of which offer excellent hatchery sites. At the time the sockeye turn from Shuswap Lake into Adams River they appear to be green fish some weeks removed from spawning. The ripe sockeye (those about to deposit their spawn) pass by the mouth of the Adams and go in great numbers to ascend Scotch Creek and the streams beyond. Scotch Creek empties into the lake on the same side as the Adams River, and a few miles north of it. Of the smaller streams tributary to the Shuswap, it is believed that Scotch Creek is more frequented by sockeye than any other. The Dominion Government placed weirs in this creek in 1901, and took 10,000,000 eggs, which were placed in the hatchery at Granite Creek. The attendants assert that, under favourable conditions, an unlimited number of eggs could have been taken there that year. Weirs were again placed in Scotch Creek in 1902, but, owing to unforeseen difficulties, the sockeye which run freely into the creek escaped, and no eggs were secured. Scotch Creek impressed me as being one of the best locations for securing eggs in the Shuswap section. The natural conditions in this stream are favourable to the easy trapping of fish. To work this stream to the best advantage, a hatchery should be placed near the mouth of the Adams River, where suitable sites are offered. At the head of the Seymour Arm the Shuswap receives the waters from Seymour River. There was a considerable run of sockeye to this important tributary in 1902. Its bed is of a soft, sandy nature, and the stream being subject to sudden freshets it is difficult to maintain a weir to hold the fish. I was unable to go up this stream any considerable distance, but was told that there was a fall some distance up where the fish could be readily held and a hatchery erected. The Dominion Government attempted to take sockeye eggs at the mouth of Seymour River in 1902, but failed to hold the run which came in August.

The Anesty Arm (as the northern half of the eastern division is called) receives several tributaries, none of which are believed to be sought by the sockeye in great numbers. Traps can easily be placed in these streams. The fish that enter them are ripe.

Eagle River, which enters Shuswap Lake from the east at Sicamous, is a large stream up which the sockeye run as far as Valley Lake in considerable numbers. The maintenance of weirs near the mouth of this stream is difficult. They can best be worked near the lakes at its source. Sockeye run here in August; coho in September and October.

The Spalluncheon River enters Shuswap, through Mara Lake, just south of Eagle River. This river has two lakes near its source that are frequented, I was told, by sockeye in the years of big runs. The Salmon Arm of Shuswap Lake receives the waters of Salmon River. This river drains the country lying to the south. The last four miles of its course is through a low-lying, agricultural section. Like the lower end of Eagle River, the bed of the Salmon River is soft and sandy, and has no rocks or gravel. The stream is, however, frequented by sockeye in the years of abundance. The soft nature of the bed and banks of Salmon River make the placing of weirs and trapping of salmon difficult and uncertain.

The Dominion Government built and operated a hatchery at the mouth of Granite Creek, a small tributary of the Salmon Arm of Shuswap Lake in 1901, the capacity of which is ten millions. The eggs were secured at Scotch Creek and were transferred by boat to the hatchery sixty-five miles away. Ten million sockeye eggs were placed in the building in August, 1901, but owing to some difficulty in the water supply there was a considerable loss, and the output of fry is given at six millions. There were no sockeye eggs secured at any point in Shuswap

Lake in 1902. The hatchery, however, was operated with eggs secured from Morris Creek, to which reference has heretofore been made. It is a matter of regret that this hatchery was not more centrally located.

The first run of sockeye was observed entering Shuswap Lake on August 8th, 1902. They usually reach the lake during the first week in August. They appear to run during August and the early part of September of each year. The runs vary in numbers as in other sections, but the run there in 1902 appeared to be larger than that at any other point I visited during August and September. I made two trips to this section in 1902, and although I visited the lake in 1901, it was so late in the season that no personal comparison with the run this year could be made. There is no question but that the run in 1902 was small, but there is reason to believe that the first run was larger than in any other lake section of the Fraser-Thompson District.

I was unable to obtain any reliable evidence regarding the movements of young sockeye from this region. In Scotch Creek and Seymour River I noticed many trout on all the beds with the spawning salmon.

RIVERS INLET.

Rivers Inlet, situated on the northern coast opposite Fitzhugh Sound, is the third most important salmon-fishing water of the Province.

Salmon canning has been carried on there since 1882, at which time the British Columbia Canning Company erected the first cannery and packed 5,635 cases of sockeye salmon. The Wannuck Packing Company began operations in 1884. There was no pack in 1885. These two canneries have been operated every year since then. Beginning with the year 1886, the pack of 15,000 cases increased yearly till in 1894 it reached 39,351 cases. In 1895 another cannery was erected, another in 1896, and two more in 1897, since which time all have been operated until this year, when by a combination only five were operated. The pack was greatest in 1896, when 107,408 cases were packed; and another exceptional pack of 104,711 cases in 1898 was made. In both of these years the pack at Rivers Inlet was greater than that on the Skeena River.

The average yearly pack for the last ten years has been 66,915 cases. The sockeye is the principal fish packed. So few cases of spring and coho have been packed in recent years that they do not figure particularly in the value of the fishery. During the past season the Japanese fishermen took a considerable number of dog salmon. Humpbacks are never numerous. The coho run in September, but there has been little done with them as yet. As the value of these fish for canning purposes becomes better appreciated they may be taken in larger numbers than at present, though it has not yet been demonstrated that their run at Rivers Inlet is sufficiently numerous to be worth while.

The sockeye season begins on July 1st, and the run usually lasts until August 10th, though in some years they ran as late as August 15th. The height of the run is expected between July 10th and 20th. The fish appear to come in shore from the north, and are usually found at Schooner Passage and the south entrance at the same time. The majority of the fish come in through the south entrance, and most of the outside fishing is done there, though there are always a considerable number of boats fishing in Schooner Passage. The Inlet extends into the mountainous coast for 20 miles. The water at the mouth of the Inlet is usually clear, but as the middle of the Inlet is approached it becomes muddy. This discoloured water comes from the Wannuck River, which takes its source in Oweekayno Lake, three miles from the head of the Inlet.

Fishing is confined to the waters of the Inlet. The tides are strong and rise from 16 to 20 feet. The fishing is, however, not confined to any particular state of the tide, as is the

case on the Skeena River. Most of the fish are taken at night. Bright, sunny days with brisk winds produce the best fishing weather. On rainy days the fish are said to travel deeper than in fine weather, and are less apt to strike the nets. Floods in the Wannuck River, which bring down the discoloured waters, are welcomed by the fishermen, as being conducive to large catches of fish. It is said that there was an abundance of fish in 1901, but owing to unfavourable weather the catch that year was poor.

The nets used are usually from 40 to 45 meshes deep and 200 fathoms long. Deeper nets have been tried, with the hope of taking the "deep run fish" during unfavourable weather, but they did not prove effective, and were abandoned. The canners charge up a loss of 25 per cent. per annum on the value of the nets used.

The Inlet is free from reefs and snags and is of great depth. A sufficiently heavy sea as to prevent fishing is seldom seen, though, occasionally, at the south entrance, some considerable loss of gear from rough water is experienced.

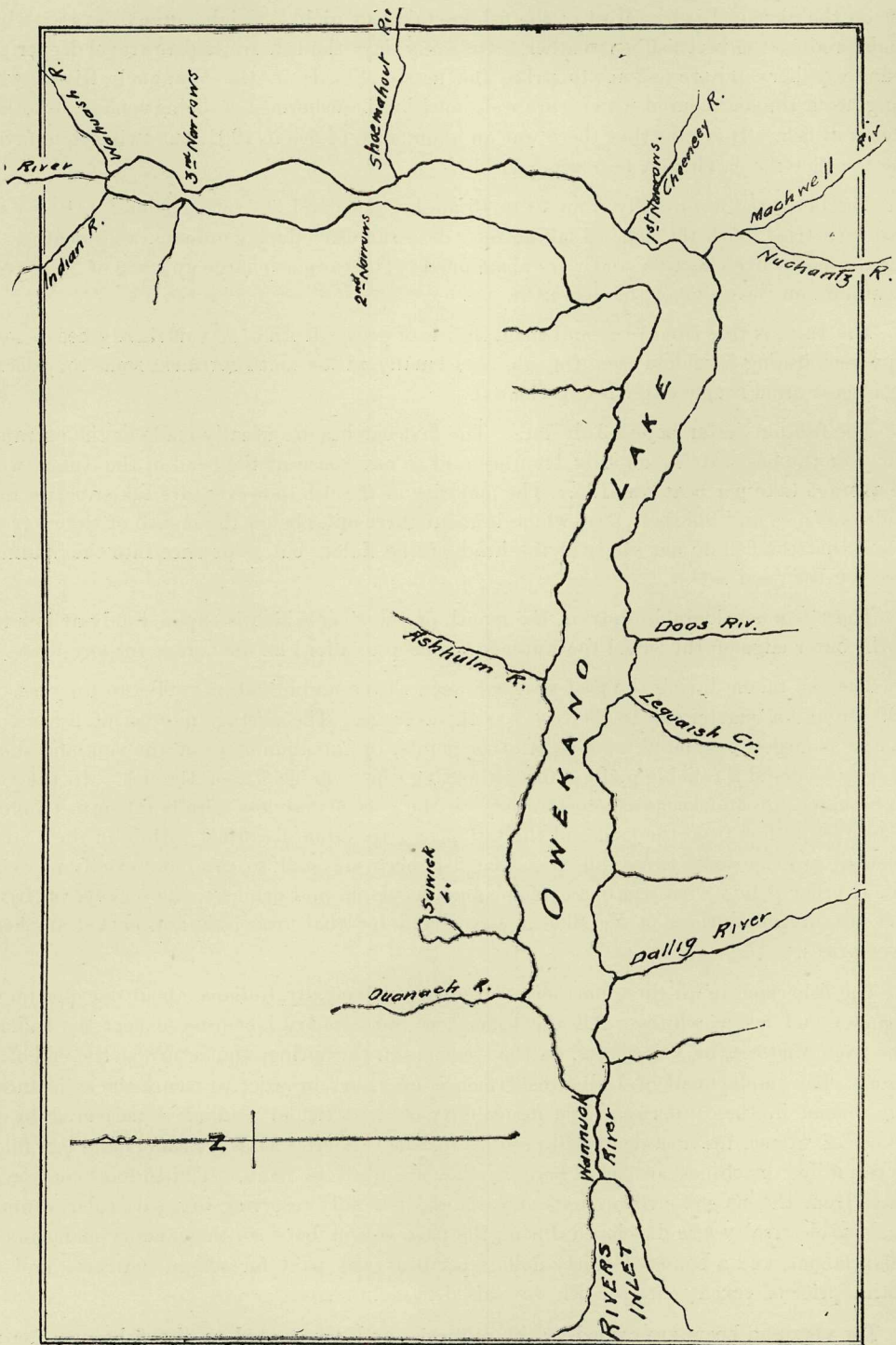
The fishing season begins July 1st. The first catches are usually made at the entrances. This year the best catches on July 1st were said to have been at the head of the Inlet, where the average take per boat was 185. The majority of the fish, however, are taken between the inside entrance and Shotbolt Bay, which is about three miles below the mouth of the river. It is said that the fish do not linger at the head of the Inlet, but go at once into the Wannuck River on the flood tide.

There is a considerable shoal at the mouth of the river which is exposed only at low tide. At the outer edge of this shoal the water is too deep to afford an anchorage for any boats.

The fish taken during the past year averaged eleven and a half or twelve to the case. In 1899 ten and a quarter fish to the case was the average. The average number of fish used to the case is largely regulated here, as at other points, by the abundance of the run, and should not be considered a reliable method for estimating the average size of the fish. In the years of abundance greater waste is experienced, for the reason that less care is taken in trimming the heads and fins from the fish, and the tail pieces are often discarded; while in the years of the small run the waste is minimised. The fish here are said to run more evenly in weight than at other points. In regard to colour, amount of oil, and firmness, the sockeye of Rivers Inlet are inferior to those of the Skeena River, and for that reason do not market at Skeena River prices.

The fishermen in all these northern waters are principally Indians, about one-quarter are Japanese, and a few whites. All the fishermen and cannery labourers (except the Indians) come from Victoria, or Vancouver, on the steamers in the spring, and return at the end of the season. The employment of Indian fishermen is necessary in order to secure the assistance of their women in the canneries. The desirability of a particular Indian is measured by the number of women his household will produce for the canneries as fish cleaners and can fillers. No can-filling machines are used here, so they are filled by hand. The Indians come every season from the neighbouring coasts and islands, generally resorting to a particular cannery. Considerable rivalry was developed during the past season between the cannery managers for Indian labour, and a bonus of thirty dollars per boat was paid for season contracts, and the existing price of seven cents per fish was raised to eight cents.

The nets and boats are owned by the canneries and are rented to the fishermen for the season at a rental of one-third the season's catch. The boats used are flat-bottomed skiffs and suffer less damage from the rocky shores of the inlet than the more expensive Columbia River boat, and are more suited to these waters, as the fishing is largely carried on inside.



SKETCH MAP, OWEEKAYNO LAKE, RIVERS INLET.
(This map was furnished by Mr. H. Bell-Irving)

There were 599 boats engaged in fishing at Rivers Inlet this past season, as against 466 in 1901, and 578 in 1900. The number of boats and nets used there is out of all proportion to the extent of fishing water and the amount of fish caught. The catch has not been proportionally increased by the use of more boats. At present the earnings of the fishermen are too small. By the use of less boats their earnings would be increased and the catch would not be proportionally decreased. At any rate, a decrease in the pack would be fully compensated for by the lessening of expenses.

It is to the interest of the canners and the native fishermen of the district alike that a less number of boats be employed. I am assured that those interested will voluntarily reduce the number next season. If this is not done, the interests of the fish demand a longer weekly close season than at present obtains, and the fishermen an increase in price for catching them.

The sockeye which enter Rivers Inlet are *en route* to Oweekayno Lake and its tributary waters to spawn. The Wannuck River, at the head of the inlet, is the only stream of fresh water entering the arm that is frequented by sockeye. It is a wide and rather shallow river of about three miles in length, extending from the head of tide water to the lake. The lake, from its outlet, extends some 22 miles easterly, and then, making a rather abrupt turn through a narrow channel, extends to the north for some 20 miles further.

The lake, like the inlet, is surrounded by high, precipitous mountains, has an elevation of only 25 feet above the sea, is of unknown depth, and appears to have been originally a continuation of the inlet that has been cut off from it by an immense slide from the mountain range on the north. Its waters are never clear, and in the early summer are greatly discoloured with the muddy water which comes from its two main tributaries, the Markwell and Shoemhout Rivers. The mountains which surround the lake extend in a continuous line on the north side, and are broken only at the end of the easterly arm, where the Markwell and Nuhantz Rivers drain what appears to be a long and rather narrow valley. These mountains are heavily timbered and are snow-capped throughout the year. Glaciers can be seen in the range to the south. The annual rainfall of this section is exceedingly heavy, probably equal to that of the Lower Skeena, in consequence of which its tributaries are subject to frequent freshets, a matter of importance in considering the value of the spawning streams for hatchery purposes.

The four tributaries of the lower half of the lake afford the salmon excellent spawning grounds, the best having gravelly bottoms, and being generally clear of drifting sands. In the north arm there are four streams of importance. These northern streams are frequented by the first of the run. Sockeye may be found in all of the tributaries in August and September. I visited the lake in November, 1901, after the sockeye spawning season was over. I saw only a limited number of coho in the streams, but the remains of sockeye were noticeable in most of them, and there were smoked salmon in all the Indian sheds and houses. In addition to that, the waters at the mouths of some of the streams, notably Genesee Creek, just above the first narrows, were offensive to the smell, and the beaches there were covered with the bones of dead fish. There will be no difficulty in obtaining a suitable and, compared with the Skeena, an inexpensive location for a hatchery. Probably the best location, considering accessibility and inexpensive water supply, is found at the mouth of the Dallig River, as was pointed out by Mr. John T. Williams, in a report made to the Inspector of Fisheries in 1901. The Dallig is only two miles from the outlet of the lake, where is situated the largest Indian village on the lake, and from which the main hatchery force could be secured. Lumber for the building can be obtained from the saw-mill at the head of Rivers Inlet, and can be transported to the hatchery site at less expense than the material for a log building could be

gotten out. Eggs can be obtained from the Dallig, as well as from most of the streams within 20 miles of it. The best spawning stations are found on the smaller streams, as the fish can be held there with greater certainty, there being less danger from freshets.

The importance of building an extensive hatchery on Oweekayno Lake is manifest. The spawning grounds are comparatively limited, much less extensive than those of the Skeena, and the number of fish annually taken from Rivers Inlet warrant an extensive hatchery plant.

A hatchery of twenty million capacity can be equipped on Oweekayno Lake for \$10,000, and operated to its full capacity for \$6,000 per year.

THE SKEENA RIVER.

Of the Provincial northern coast salmon waters the most important and extensive is the Skeena River. It is second only to the Fraser. Canning began there in 1877 with a pack of 3,000 cases. In 1887, with five canneries running, the pack was 58,592, and ten years later there were eight canneries operated, with a total pack of 65,905. The pack reached its highest limit in 1902, with 154,875 cases. The accompanying block-table exhibits in concise form the history of the canning industry on the Skeena.

The fishing grounds of the Skeena District extend from a point on the river some twelve miles above the village of Port Essington to Chatham Sound. From Port Essington to De Horsey Island the river may be described as an estuary. The tides rise to a height of twenty feet. At low water the greater portion of the extensive sand flats of this basin are exposed. The main channel runs along the north shore. At De Horsey Island the waters divide and pass through either the North Skeena Passage or the Southern Passage. The North Passage is very narrow throughout its length of six miles, and terminates to the north of Smith Island. The South Passage, which is the main entrance, passes to the south of De Horsey Island, and to the north and south of Kennedy Island. The channel to the north of Kennedy Island terminates in Malacca Passage, as the southern end of Chatham Sound is called. The fishing in the Sound is largely confined to the waters south of Rachael Island, but in some seasons is extended out towards Brown Passage, through which the sockeye appear to enter from the open sea, though a portion of the run is known to come in through Edey Passage, to the north of Porcher Island. The first catches are usually made in the vicinity of Rachael Island. As the season progresses the water is covered with boats, from Port Essington to the Sound. Previous to the introduction of the Columbia River pattern of boats the fishing was confined largely to the inside channels. With the advent of the round-bottom boats and the increasing demand for salmon, the men have advanced further out to meet the incoming fish, so that the season is longer and appears to be earlier than formerly. Fishing in the inside channels is regulated by the tides. The nets are cast at high tide, and drift out with the ebb. When "the drift" has been covered, or the "snagging grounds" reached, the nets are hauled in and the boats return to the home station on the flood tide. The canners maintain receiving stations at many points, where the fishermen deliver fish to be transferred to the cannery by tugs and steamers which ply back and forth. By this method each cannery has boats fishing upon every drift of the extensive fishing grounds. For outside fishing brisk westerly winds, which bring clear skies, are most desired. On bright, clear days the fish travel closer to the surface and are more easily caught by the nets. Once the fish pass into the shallow, inside channels, where the discoloured water of the river conceals the nets, the effect of weather conditions is not so marked as it is farther out. Previous to 1897 the boats used on the Skeena were of the flat-bottom variety, at which time the round-bottom model known as "Columbia River boats" were introduced, whose superiority for the outside fishing was at once demonstrated, and resulted in their general adoption since 1899. Most of the boats and

nets used are the property of the canneries, and are rented to the fishermen on the customary one-third basis. Where fishermen provide their own boats they are allowed two dollars per week as rental. In cases where fishermen own both boat and net they are paid nine cents each for sockeye, and twenty-seven cents each for spring salmon, instead of the usual prices of seven cents and twenty-five cents paid for fish caught by cannery boats and nets. The nets used for catching sockeye are the regulation machine-made web-net, made of six or eight strand thread of $5\frac{3}{4}$ -inch meshes, and from 40 to 60 meshes deep, and 200 fathoms long. These nets last from one to four years. In this vicinity a greater loss is occasioned by snags than in any other section of the Province. The canners usually charge to profit and loss 35 per cent. per annum of their value, to cover the season's losses.

Fishing for sockeye begins in the latter part of June, and ends about the middle of August. The main part of the run is looked for early in July.

There do not appear to be any marked periodic fluctuations in the run of sockeye in the Skeena. They are considered better fish than those taken in Rivers Inlet, as they contain more oil and are of a better colour, though they do not bring quite as good a price in the market as the Fraser River fish.

The spring or quinnat salmon run begins in May and ends about the first week in July. Like in the Fraser River, these fish vary considerably in colour. The white and pale pink-tinted fish predominate, which lessens the value of these fish. Some of the canners use seven and a half-inch to ten-inch mesh nets (called "spring salmon" nets) in May and June and the early part of July, for the purpose of taking the early run of these fish. This part of the run is stated to more nearly approach the standard red colour. The canners do not accept the white-coloured spring fish. When offered for delivery to the cannery, the receiving clerk slashes the fish near the head and tail to examine its colour, and if it be white the fish is rejected. The proportion of white-flesh fish is stated to be about one-third of those taken, and one-third is said to be pink, while the remaining one-third is the desirable deep red colour of the first quality.

The coho salmon runs in August and September, and the dog salmon in September, October and November. Up to the present time little effort has been made to catch large numbers of either of these fish, but with the increasing demand for these grades their value may be more fully recognised, as the runs of both varieties is stated to be large.

The Skeena River is, after the Fraser, the largest in the Province. It carries to the sea the waters of an extensive mountainous area, on the coast slope of which the rain and snowfall is over 100 inches a year. Its principal source is at the Babine Lake. It is believed at one time to have drained Stuart, Tecla and Quesnel Lakes, whose waters now flow into the Fraser River. From Port Essington, at its mouth, to the little settlement of Hazelton, a distance of 180 miles, the river is navigable by powerful stern-wheel steamboats during the greater part of the summer. Some 90 miles above its mouth the river rushes with great force through a narrow canyon, which renders navigation impossible during the season of extreme high water. During the winter months the river is frozen over and the greater portion of the watershed is buried under snow and ice. South of Hazelton the valley of the Skeena varies in width from one to four miles. Precipitous mountains of considerable elevation rise on either side, the summits of some of which are perpetually covered with ice and snow, and the lower elevations with a dense and exceedingly valuable growth of timber.

Owing to the flood which was running in the Skeena at the time of my visit (June, 1902) I was unable to make a survey of it or its many large and important tributaries. I succeeded only in reaching the mouth of Lakelse or Trout River, some 60 miles up its lower stretch, and passed up the latter stream 12 miles to Lakelse Lake at its head, and made a careful survey of that watershed.

The Dominion Government began the construction of a salmon hatchery on Lakelse River in 1901, and completed and operated it in 1902. I visited the hatchery and was hospitably entertained over night by Mr. Whitwell, the Superintendent. It is built at the mouth of Clearwater Creek, the only tributary of the Lakelse River, and undoubtedly occupies the best situation, in regard to its accessibility, water supply and nearness to the spawning grounds, to be found along the lower stretch of the Skeena.

The hatchery water supply is taken from Clearwater Creek. The fish from which the ova are obtained are trapped at the mouth of Sockeye River, the main tributary of Lakelse Lake, only eight miles from the hatchery. The hatchery building is a substantial wooden structure a story and a half high, 72 feet long by 24 feet wide, and was constructed from materials brought from Port Essington. The quarters of the employees are in the upper story. The interior of the hatchery is equipped with fifty hatching troughs, each 16 feet long, 10 inches wide and 5 inches deep. It is stated that the hatchery has a capacity of rearing 4,000,000 of fry.

Lakelse River and Lake afforded me an opportunity of seeing the greatest number of trout I have ever seen in any lake or stream.

Climatic conditions on the lower Skeena render the successful operation of a hatchery difficult and expensive. Before I can determine upon the establishment of a comprehensive system of salmon propagation for the Skeena River I must make a thorough survey of its entire watershed, which I hope to undertake at an early date.

While I visited the Naas River, Lowe Inlet, Alert Bay, and other minor salmon-fishing and canning points of the northern Provincial coast section, my time was too limited to permit more than a cursory examination while passing on the steamer.

The salmon pack during the past ten years, at these points, is given in the accompanying table, which clearly shows the relative importance of these minor fishing stations.

	1893.	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
Alert Bay.	3,700	2,000	5,100	2,840	8,602	8,500	3,470	9,182	4,629	10,806
Lowe Inlet.	8,724	8,315	8,681	10,395	10,666	10,312	10,142	10,834	6,451	7,538
Naas River	15,190	19,587	19,550	14,649	20,874	18,953	19,443	18,238	14,790	23,218
Namu	3,393	.....	3,000	3,987	4,357	.....	7,200	10,106	11,460*	4,966*

* Namu and Kimsquit.

Respectfully submitted,

JOHN PEASE BABCOCK,
Fisheries Commissioner.

Victoria, December 1st., 1902.

VICTORIA, B. C.:

Printed by RICHARD WOLFENDEN, Printer to the King's Most Excellent Majesty.
1903.

THE PACK, BY CANNERIES, OF BRITISH COLUMBIA SALMON, SEASON OF
1902, AND A DESCRIPTION OF THE PACK.

— 0 —
FURNISHED THE DEPARTMENT BY THE FRASER RIVER CANNERS' ASSOCIATION.

FRASER RIVER.

	Sockeyes.	Spring and Fall.	Totals.	Grand Totals.
British Columbia Packers' Association—				
Albion Cannery	9,389		9,389	
Atlas "	5,028		5,028	
Anglo-American "	6,088	1,658	7,746	
Alliance "	3,636		3,636	
Acme "	4,006		4,006	
Brunswick No. 1 "	10,057	13,994	24,051	
" No. 2 "	7,830		7,830	
Canadian Pacific "	8,117	9	8,126	
Currie & McWilliams "	9,428	1,286	10,714	
Colonial "	4,281		4,281	
Celtic "	3,947		3,947	
Cleeve "	8,208	232	8,440	
Delta "	7,863		7,863	
Dinsmore Island "	5,446	17	5,463	
Ewens "	14,301		14,301	
Greenwood "	4,527		4,527	
Hume "	4,496		4,496	
Imperial "	4,756		4,756	
Pacific Coast "	6,815	2	6,817	
Provincial "	3,407		3,407	
Terra Nova "	8,405	1,257	9,662	
Westminster Pckg. Co. "	8,382		8,382	
				166,868
Anglo-British Columbia Packing Co., Ltd.—				
Britannia Cannery	6,030		6,030	
British America "	5,515	2,871	8,386	
B. C. Packing Co. "	2,680		2,680	
Canoe Pass "	3,420		3,420	
Phoenix "	6,658		6,658	
Wadhams "	5,408		5,408	
				32,582
United Canneries of B. C., Ltd.—				
English Bay Cannery	7,500		7,500	
Gulf of Georgia "	15,537		15,537	
Scottish-Canadian "	14,520		14,520	
				37,557
Canadian Canning Co., Ltd.—				
Fraser River Cannery	7,228	1,398	8,626	
Star "	11,421		11,421	
Vancouver "	6,266		6,266	
				26,313
J. H. Todd & Sons—				
Beaver Cannery	7,269	1,428	8,697	
Richmond "	5,990		5,990	
				14,687
British Columbia Canning Co., Ltd.—				
Deas Island Cannery	7,236	325	7,561	
National Packing Co., Ltd.—				
Eagle Harbour Cannery	4,801	2,525	7,326	
Great Northern Cannery—				
Great Northern Cannery	7,194	417	7,611	
Federation Brand Sal. Cg. Co. Ltd.—				
Lighthouse Cannery	4,241	3,562	7,803	
St. Mungo Canning Co., Ltd.—				
St. Mungo Cannery	11,127	2,347	13,474	
C. S. Windsor—				
Industrial Cannery	5,023	290	5,313	
	293,477	33,618		327,095

The Pack, by Canneries, of British Columbia Salmon, Season of 1902, and
a description of the Pack.—*Continued.*

NORTHERN PACK.

	Sockeyes.	Spring and Fall.	Totals.	Grand Totals.
SKEENA RIVER—				
B. C. Packers' Association—				
Balmoral Cannery.....	5,885	1,604		
Cunningham's ".....	12,399	5,427		
Standard ".....	8,286	3,691		
			37,292	
Anglo-British Columbia Packing Co., Ltd.—				
B. A. & N. Pacific Cannery.....	33,385	5,778	39,163	
J. H. Todd & Sons—				
Inverness Cannery.....	13,227	3,855	17,082	
B. C. Canning Co., Ltd.—				
Aberdeen Cannery.....	11,990	5,580	17,570	
Carlisle Canning Co., Ltd.—				
Carlisle Cannery.....	10,380	1,182	11,562	
Wallace Bros., Ltd.—				
Claxton Cannery.....	12,158	5,408	17,566	
P. Hermon—				
Hermon's Cannery.....	7,500	3,230	10,730	
J. Turnbull—				
Turnbull's Cannery.....	2,467	1,443	3,910	
				154,875
RIVER'S INLET—				
B. C. Packers' Association—				
Brunswick Cannery.....	14,223	179	14,402	
Wadhams ".....	18,595	127	18,722	
Wannuck ".....	9,062	618	9,680	
				42,804
Anglo-British Columbia Pkg. Co., Ltd.—				
Good Hope Cannery.....	12,000	382	12,382	
B. C. Canning Co., Ltd.—				
R. I. & Victoria Canneries.....	14,939	173	15,112	
				70,298
NAAS RIVER—				
Federation Brand S. C. Co., Ltd.—				
Mill Bay Cannery.....	11,519	819	12,338	
Naas Harbour ".....	9,434	1,446	10,880	
				23,218
LOWE INLET—				
B. C. Packers' Association—				
Lowe Inlet Cannery.....	5,701	1,837		7,538
CHINA HAT—				
B. C. Packers' Association—				
Princess Royal Cannery.....	2,642	966		3,608
DEAN CHANNEL—				
R. Draney—				
Kinsquit Cannery.....	6,491	1,416		7,907
NAMU HARBOUR—				
R. Draney—				
Namu Cannery.....	2,019	2,947		4,966
BELLA COOLA—				
B. C. Packers' Association—				
Bella Coola Cannery.....	2,685	2,182		4,867
SMITH'S INLET—				
Wm. Hickey Canning Co.—				
Hickey Cannery.....	5,200			5,200
ALERT BAY—				
B. C. Packers' Association—				
Alert Bay Cannery.....	1,772	9,034		10,806
WEST COAST VANCOUVER ISLAND—				
Clayoquot Sound Fishing & Trading Co., Ltd.—				
Clayoquot Cannery.....	4,000	1,604		5,604
	237,959	60,928		298,887

The Pack, by Canneries, of British Columbia Salmon, Season of 1902, and a description of the Pack.—*Concluded.*

PACK BY DISTRICTS, PREVIOUS YEARS.

	1901.	1900.	1899.	1898.	1897.	1896.	1895.
	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.
Fraser River	990,252	316,522	510,383	256,101	860,459	356,984	400,368
Skeena River	126,092	128,529	108,026	81,234	65,905	100,140	67,707
Naas River	14,790	18,238	19,443	18,953	20,847	14,649	19,550
Lowe Inlet	6,451	10,834	10,142	10,312	10,666	10,395	8,681
China Hat	5,500	4,138	.....	.....	.....	.....	.....
Rivers Inlet	66,840	75,413	71,079	104,711	40,207	107,468	58,579
Bella Coola	4,158	4,849	.....	.....	.....	.....	.....
Namu and Kimsquit	11,460	10,106	7,200	.....	4,357	3,987	3,000
Alert Bay	4,629	9,182	3,470	8,500	8,602	2,840	5,100
West Coast, V. Island	5,984	7,602	2,694	4,350	4,434	5,107	3,320
	1,236,156	585,413	732,437	484,161	1,015,477	601,570	566,395

SHIPMENTS IN DETAIL, PREVIOUS YEARS.

	1901.	1900.	1899.	1898.	1897.	1896.	1895.
	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.	Cases.
England—							
London direct	206,344	51,095	150,670	79,598	325,966	182,253	96,459
" overland	19,236	16,143	5,733	5,687	4,957	9,076	.....
Liverpool direct	576,065	257,848	365,151	242,437	407,738	322,364	256,301
" overland	46,831	60,090	26,128	8,050	38,373	11,405	.....
Overland, previous y ^{rs} .....	.....	.....	.....	.....	.....	.....	65,647
Via other ports	3,350	3,802	.....	19,862	.....	.....	29,590
Eastern Canada	131,875	79,171	114,736	87,881	130,815	51,041	79,289
Australia	38,022	25,903	41,518	9,644	28,579	11,609	8,832
Other destinations	13,538	56,237	4,246	439	226	2,128	.....
Local sales	19,956	20,309	11,945	1,183	4,823	3,844	4,326
Stock on hand	180,939	20,815	12,079	29,380	74,000	7,850	25,952
Lost .....	.....	.....	231	.....	.....	.....	.....
	1,236,156	585,413	732,437	484,161	1,015,477	601,570	566,395

VICTORIA, B. C.:

Printed by RICHARD WOLFENDEN, Printer to the King's Most Excellent Majesty.

1903.

TABLE
SHOWING THE SALMON PACKED ON FRASER RIVER
1876 TO 1902
 ILLUSTRATIVE OF THE PERIODIC FLUCTUATIONS IN THE
 MOVEMENTS OF SALMON IN THAT RIVER

Year	Cases
1876	
1877	
1878	
1879	
1880	
1881	
1882	
1883	
1884	
1885	
1886	
1887	
1888	
1889	
1890	
1891	
1892	
1893	
1894	
1895	
1896	
1897	
1898	
1899	
1900	
1901	
1902	

9,847 64,387 106,101 50,490 42,165 142,516 199,204 109,701 38,437 89,619 99,177 130,088 76,616 303,875 241,889 176,954 79,715 487,797 383,987 395,984 396,984 990,459 256,101 490,485 316,523 990,252 327,095

1,000,000
 975,000
 950,000
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 225,000
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 175,000
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 125,000
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 25,000