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A STORY OF THE FRASER RIVER'S GREAT SOCKEYE RUNS
AND THEIR LOSS.

Being part of a local history written for my
neighbors of the Shuswaps.

D. S. Mitchell

(Manuscript 1925.)

The Nursery of the Fraser River's Big Sockeye Runs.

The Home of the Richest Colored Tribe of Sockeye Salmon.

East from Vancouver 283 miles on the Canadian Pacific Railway, lies the little town of Chase, where the long Shuswap Lakes shallowing in the Thompson Valley to the west, overflow the rim, as source of the Shoopem-hat-kwa, the Shuswap River, or South Thompson.

Onward 36 miles further west, this flowing water meets, and mingles with the Sin-po-at-kwa, North River, or North Thompson, at the bright town of Kamloops - from Kam-a-loo-la-pa, point between the rivers.

Another 60 miles to the west and south and this Thompson River, at Tl-kam-sheen, or Lytton, gives its waters to the Fraser.

The Shuswap's several lakes and arms make a combined length of 106 miles, by about two and a quarter miles wide.

The deepest sounding taken has been 555 feet.

Overflowing to them again are Mabel Lake 22 and Adams Lake 45 miles long, with many smaller lakes.

Adams Lake or Hstilt-at-kwa is walled by great cliffs, and mountains that rise 7,390 feet high. Its greatest sounding has been 1,054 feet deep, or reaching to 310 feet of sea level, 200 miles back from the sea. Adam or Atom was a name given Pukamoos, a Shuswap nobleman and warrior of whose clan it was the stronghold.

There are 611 small creeks flowing towards the Shuswap Lakes, entering by 64 streams, 8 of which are of considerable size.

During high water in June and July, one may navigate over 318 miles of lakes and rivers, all wonderfully beautiful, a fairy land that no language can describe, and no mind or memory can retain.

These lakes stretch and bend between ranges of high mountains, that are broken by steep rocky ravines, and narrow glens, each contributing its creek, tumbling in cascades from pool to pool, or winding through marshes and willow bottoms with numerous beaver dams, from smaller lakes nestling among the wooded hills at higher altitudes.

At the ends of these greater lakes, the gigantic furrows in which they lie, continue as important and fertile valleys, each with its winding river, and some navigable for a time each season.

These great lakes lie like miles of mirror duplicating the fire-draped mountains in reflection, while leaping trout break through and spread out widening water rings on which the mirror mountains quiver, then a ripple spreads with a rising breeze and soon the lakes may be torn with chasing, white crested billows.

Before the sun sets on the Great Shuswap, it is a dreamland of soft tints, on mountains that melt into the distance, and sky reflected in golden sheen, upon the farring water. Then the golden rose fades from the snow-capped peaks of Sa-how-ya, the dark shadowy blues creep over, and one's soul reaches forth, to call to great mother Nature, in some wild, beautiful song,

Oh Mother dear
How fair thy breast,
unscarred by ruthless human greed,
in tune with Thee, one longs to rest,
the yearning soul to feed.

This beautiful region was the ancestral home of the Soc-whap-mgh Indians, a kindly intelligent people, with a language as resourceful as Greek.

When I first beheld it over thirty years ago, spring 1889, the lake was dotted with their canoes, calmly gliding about, or creeping across the fainting distance. Little clouds of flimsy blue smoke indicated the many camps, where canoes lay pulled ashore, and at night campfires twinkled in the woods, and thickets along the water's edge, where the air was fragrant with the perfume of *vagnera racemosa*.

The night was noisy with calling loons, and the chirring of grebes, and merganzers, not intermittent - a continuous babble of bird voices.

In the wide shallows at the end of the different arms, great numbers of blue herons waded, indifferent to the Indians approach.

Swans were nesting at Canoe, then Puk-a-meechum, the place of the white swans' nests. All along the 200 miles of lake shore, mink were in incredible numbers. They seemed to have organized into colonies.

I have watched a troop of a dozen or so evidently following one leader, glide off the rocks into the water, and swimming along the shore, meet another similar troop, with which it would engage in what seemed a pitched battle, squealing, and struggling in the water. In a few minutes they would swim apart and climb on the rocks again, to rest for about two minutes, then following their

leader, return to the water to renew the attack.

Many naturalists who have studied the mink, never watched them in an untrapped wild, that offered food for any numbers.

Otters were everywhere, and so numerous at the Rock Bluff, at Kualt, a great squawfish spawning bed; that Granite Peak, the mountain behind, was called Tsil-hats-ellh, the great otter's house.

It was no solitude, this great Eden, before every precipace golden eagles were circling on the wing; and on the big cotton-woods and firs along the shores, white headed eagles sat, not in pairs but by half dozens; while hovering ospreys dived to pluck the squawfish, sucker or ling, from these great wide ribbons of sky-reflecting blue, that take up some 300 square miles of this region. Every storm-blasted fir, broken off at about 80 or 100 feet from the ground served as a column supporting an osprey's or a white headed eagle's nest.

Formerly there was much semi-open country on the hills, showing great detail of cliff and gorge, now curtained over by the solid green of an almost impenetrable thicket of small firs, which has taken possession, for in those days the Indians ran fires at intervals of a few years, over the grassy slopes to check the encroachment of the forest on the patches where the women dried berries on bulrush mats, for winter food, or gathered edible roots; and where the men might hunt bears, when they came out to eat the fresh young grass and herbage in the spring.

One didn't have to go over fifty yards from camp to get what grouse were needed.

Rabbits, porcupines, and lynx were everywhere.

Prairie chickens and blue grouse were as thick as grouse on a preserved, Scottish moor. Deer were in droves, and traveling caribou sometimes took days to pass.

The deer were so tame and inquisitive that they would almost surround one, fifty or more, and in spite of shouting, waving, or throwing of sticks or snowballs, refuse to move; dogs, or the sound of fire arms, and they were off.

The numerous Indians had powder horns slung against their sides, and carried long muzzle loading Hudson Bay muskets, ornamented with the brass dragon; while the boys played with bows and arrows.

They had Chiefs, councillors, and held Courts. Their tribal country had been sub-divided or apportioned among the different Indian families, as trapping, or hunting grounds: each family having

an allotted estate. The Sa-how-ya, or north east arm, had belonged to the Sinastin family. The Kowatnimb-at-lwa, from Sicomus to Mara, had belonged to the Eatl-noo-mat family. The Finn settlement at White Lake had belonged to Noohk-Kwiout. The Schwn-a-meen or Seymour Arm, had belonged to the families of Sil-sa-leitsa, and Silpachn, and so on.

(This Seymour River had its source in the mountains east of the Columbia River north from Revelstoke, and must not be mistaken for the Seymour Creek near Vancouver.)

In this way the toll of food was drawn evenly from all over the country, thus saving any one part from depletion.

In addition to their outlying estates, they had a house in an Indian town to which they brought their winter food.

Among them were several types. Some families were very handsome.

Life was so easy among such abundance of food and fur, that they lived as gentlemen of leisure, never killing more than was needed to keep all their people provided.

There was nothing solemn and silent among these Indians; vivacious, often garrulous; some were splendid narrators, and would hold a big campfire audience spell bound, a spell that kept leaking giggles until it burst with a chorus of laughter, for the yeast of humour was always working in the Pacific Indian.

With the larder supplied, he spent time on his knees, singing, and practising slik-amious, the game of hand, a social game of skill, in which two teams kneel in rows opposite to, and facing each other, with a long narrow fire between to give light.

In front of each team lies a long dry pole or split board, acting as a drum, upon which they beat time with short sticks or clubs. Each team during its innings sings the song of its tribe, beating perfect time upon their long board, or pole, upon which twenty or more sticks fall as one. With wonderful dexterity a player juggles with two pieces of bone, about two inches long, thicker than a pencil, and tapering towards the ends. One is plain, the other has a black band around the middle. The opposite team sit back on their heels, silently watching him. After considerable manipulation, all in time with the drumming and the song, and with an occasional yell, alike the hooch of a Highlander dancing a reel, he with an almost teasing gesture, signals the invitation to guess. A quick eyed expert in the opposite team, by sign, guesses the hand containing the banded bone. Every mistaken guess tallies a point for the in team, while with a correct guess the innings pass to the other side.

The players in a team throw the bones from one to another at intervals, thus giving all good players in a team a chance to display their skill. The first team to gain ten tally sticks, or points, gets the iktas, or goods that have been bet on the game.

These may consist of horses, saddles, muskets, blankets, dried salmon - anything.

Great enthusiasm was thrown into the game. The players though on their knees, dance with their bodies, in time with their big song, and the clash of their sticks on their long front board, fall like the clash of cymbals.

The population seemed to circulate around, visiting, giving presents of food, chatting, singing, feeding and playing. At night one could always find the game by the song, and know by the tune which tribe-men were having their innings.

An Indian could never go broke as long as another had anything to share.

Indians from the South used to bring horses, and all manner of goods, to trade, or play for dried salmon, the Indian's staff of life.

Ask a disconsolate old Indian who looks as if the sunshine had all left his life, if there is anything you can do for him? He will give you an anxious look and ask, "Have you any salmon?"

I bought one at Tappan lately, from a man who had fish shipped from the coast by express. An old Indian woman who passing, saw it, held up her hands, as if to Heaven, and cried out, "Salmon! Oh salmon!"

What memories of the days of plenty, that fish had awakened in the poor old woman's mind.

The Indian's dried sockeye salmon trade.

Salmon was the main Indian food, dried it was their money, as blankets used to be on the coast.

The Kweekwillie holes along the Thompson River are archeological evidence of a great population that had towns straggling for miles along the river banks.

A population living on salmon, and drying in sun, and smoke, great quantities for winter food, and for barter with the Indians to the south.

In the Autumn the trails were busy with mounted Indians, singing as they jogged along, or whooping as they galloped from one troop to another, while trains or processions of pack horses, toddling along under tremendous loads of baled, dried salmon, bit at the herbage along the way.

Behind them would come squaws, papooses, colts and cayuses, gay with colour, buckskin, beads and dyed horsehair.

Every little while came the pounding of more and more hoofs, along the ridges and benches, with more yelling, laughter and song.

It was the southward movement of great quantities of dried sockeye salmon, some of it for Indians over on the American side, whose forebears had traded in it, long before there was a boundary line, or white man in the country.

This trade was made possible by a treaty of peace, after the death of Wilpachan, and his brother. I will leave these tragic stories for another time; briefly, they were Shuswap renegades, whose wives were two of the King of Okanagan's daughters. Inveterate enemies of their own people, they led Okanagan raids into the Shuswap, keeping up a continuous state of war.

Knowing the country so well, these two brothers made independent raids, stealthily hunting scattered Shuswaps. They were terrible warriors, and taking a terrible vengeance for some real, or imagined wrong. Emboldened by so many such successes, they even brought their wives on these stealthy massacres, repairing the moccasins they wore out, and gathering food. They made one such trip too many, both were slain and their wives captured.

I may say here that chiefs are themselves subjects of some higher head to whom they owe allegiance. These Indian headmen, or patriarchs, bowed to no superior.

They knew nothing about foreign kings, thousands of miles away, claiming also theirs, a land they had never seen.

These so-called chiefs were King, like old King Cole, an ancient king of Kyle, or Colia, a district of Ayrshire in Scotland, where at Colesfield his grave is said to be.

The King of Soo-whap-mgh was a reasonable, intelligent man, as most Indians are when we understand them. Having originality and initiative, he ignored precedent, the barrier to progress.

The Council decided to return the women to their Father, the Okanagan or Sits-wat-nimh-King.

With a body guard of Shuswaps, and many gifts, the girls with an offer of peace, returned to the astonished Okanagans. The King

of the Sits-wat-nimh, and his councillors only needed the new idea. They adopted it, then, freed from the bondage of the old set custom, their vision went further.

In accepting the Shuswap's offer they proposed that it should also embrace other nations with whom they were at war in the Kootenays.

At a great council of these tribes, the treaty was made, and welded by warriors of each tribe taking wives from the other.

Then the old war trails became routes of social intercourse and trade.

Indians are natural born fighters. No Jap, or anyone else, has anything on the Indian there. If they were given to ambushes and surprises, the rugged nature of the country caused that, as among so much cover it was certain death to make an open attack, and the vengeance for which they used to stake their lives, as a duty, like the old Mosaic law, could seldom have been otherwise accomplished.

He would fight as long as he could rise to it, and when beyond that, he would sing his heroic death song, while consciousness and breath would last.

This peace which terminated war between these nations, did not put a stop to minor feuds between families, sometimes in the same tribe, like old family feuds in Scotland, that lasted even after the Union, like feuds still rankling in some Southern States, or the blood feuds common in the Balkans, recently overshadowed by the Great War.

There was still a lot of sniping. Overbearing conduct, or indifference to justice were unhealthy afflictions.

These injuries did not have to be strictly personal, for the Indian, like many whites, can feel the blow when it falls upon a friend.

Indians are very psychic, and a dead Indian's spirit could have the use of a living friend's arm, and bow.

The next generation of these native nations was interlaced by bonds of relationship.

Young Shuswaps traveling on visits to their relatives in the Kootenay, would hasten their steps on coming within hearing of the war drums, and the distant, rising song, and find with enthusiasm that they were just in time to accompany a big war party going over to the prairie to hunt buffalo, which meant fights.

All young men the world over love adventure and lament the obliteration of the wild. Old warriors too, with shrinking muscles, at the sound of the drums, would become boys again, and run into the dance. Their whirlwind fights of the past would awaken in their minds and advice from the younger men for them to stay at home, was resented as if it caused a wound. Amid the singing of the squaws they would depart.

By roaring cataracts, and raging torrents, through the great masses of mountains, clothed in deep forest, these human specks would wend their way.

The dark curtain of night would fall over the black mountains, and other twinkling worlds would come in view.

The great horned owl, toots his mighty horn, and flits on silent wings, till the tiny wren proclaims the morn, as to his mate he sings.

Then they arise, hideous in war paint, these sons of Mars, to continue their sinuous way to the lands of the Wheesp (buffalo). Survivors of these raids used to give me wonderfully realistic stories of their adventures, but we must not drift too far away from Shuswap.

The Salmon Trails.

It was only a twelve mile pack by Eagle Pass from sockeye salmon fisheries at Three Valley Lake, to the Columbia River, opposite where Revelstoke now stands.

From there it required little effort to take baled dry salmon by canoe, away through a great region lying on both sides of the International boundary line. They could drift much of the way only using the paddle enough to steer.

From Kum-tche-tche-tohin (Enderby) on the Shuswap River it was sixteen miles pack to Okanagan Lake. From Fish trap rapids on the Shuswap River to Okanagan Lake, twenty-two miles.

The great horse route from the South Thompson River to Okanagan Lake was thirty-six miles. From the head of Okanagan Lake another great water route lay open.

Another route, between the Shuswap Lakes and the upper Columbia River was by Schwn-a-meen, or Seymour, thirty miles.

In the dry belt, horses were more plentiful than canoes.

Individuals among Indians in the South owned hundreds, that would pay on the ranges for their feed all winter. Cayuses could be bought for two dollars and a half. (10 dried sock-eyes).

A few mounted Indians could keep long trains of these salmon packers moving on the trail.

Some of the dried salmon purchased, or won at the game of slik-a-mious in the Shuswaps; after reaching Colville would be relost at Ts-lalikum (Okanagan for same game) to Indians from the still farther south.

This gambling game took the place of the warpath, satisfying restlessness, and providing an outlet for energy and skill.

In the Indians' storehouses, dried sockeye salmon would keep in good condition for two years, if turned over once in the sun after one year.

It was eaten after being toasted on a pointed stick jabbed into the ground, and leaning forward by the fire.

The foregoing portrays the old conditions around the nursery of the Fraser River's great sockeye salmon runs, the home of the reddest fleshed tribe of sockeye salmon.

A large Indian population, of which there only now remains a remnant, using it as their staple food and their exchange in southern trade, the annual salmon harvest being the most important incident in the Northern Pacific Indian's life, while great numbers of otters, mink, eagles, herons, loons, merganzers, and grebes fed upon the ling, suckers, squawfish, etc. that ate the salmon eggs and fry.

The otters killed some salmon during the run, and trout that followed to eat the salmon spawn, but for the great part of the year they preyed on the fish that devoured the salmon fry. The otters up the streams lived on the trout that grew big and fat in the beaver dams. The beavers could not tolerate these otters, they having the annoying habit of coming up into a beaver lodge if they got a chance, to eat the shoulders off a captured trout on the beaver's bed, where they would leave the objectionable remains. To prevent this annoyance the beavers used to attack the otter and compel it to take its dinner to the bank.

There was a natural balance, that was broken, when the white-man came, and threw his rifle into it. He came, bang, bang, bang, at every living thing, not that he wanted it, but he wanted the satisfaction of showing himself that he could hit it.

After he had killed everything that could move near his camp, he set up his empty bottle on the beach and banged that, then moved camp - bang, bang, bang. A few white men soon spoiled the Indian's easy life for him, and reduced him to their own hard struggle for existence.

White trappers took possession of the Indian's allotted trapping grounds, and cleaned them out. The mink and otters were killed for their skins, and the eagles, ospreys, herons, loons, etc. perished as targets. As a consequence the coarse fish (ling, suckers, squawfish, etc.) eating the salmon eggs and fry, now increased enormously.

With the development of canning at the coast the salmon runs were now assailed at both ends.

Then came settlers who ran amok when they saw the salmon run, killing them for pleasure after they had their barrels full, and slaughtering them for fertilizer. Then came lumbermen's sluice dams.

The first white men to camp around these lakes were not wantonly destructive of the wild life. They killed just what they needed, as food for themselves, and anyone who might chance to come along. They were a hospitable lot of good, true, fellows and all good company, men who would go anywhere and who had gone through a lot.

D. G. MacPherson	Whitfield Chase
Ben MacDonald	William Fortune
Alexander McBryan	William Wallace
Henry Fraser	James Ross
Thomas & Jim Hatherly	Scotty Elliot
Charlie Seymour	Harry Mitchell
William McKargar	Carl Olsen
Dan MacGillivray	Billy Watson
Charley Maxwell	George Murdoch
Frank Anstey	John the Russian
Harry Fowler	Jack Haldane
Billy Henstrige	Tom Jones
Alf Elgood	Billy Boyce
Mabolm MacIntyre	Magnus Magnuson
John Forrest	John Rose

These men were not all here together, some came many years after others, but all over twenty-five years ago. Over thirty years now.

Some were nomads and wandered away, others settled by the railway which traverses the shore for about 37 miles, and not very many years ago one might row around the shores for 150 miles without meeting a white man.

There was no Misters or Dear Sirs in these days, it was Dear Ma, Dear Bill or Dear old Jim. Every one of them I remember with affection an affection that included others who came later, and some who lie under its deep waters.

The destruction was mostly wrought by visitors on holiday and some settlers who came later. As the country settled up, the demand on the spawning beds became very heavy. It was an unsatisfied demand, as the canners allowed so few to pass, during three years out of four, that the settlers could only lay in a supply once in four years, when they used their chances to satiety.

When the Indian struck at a salmon with his spear he got that salmon, and when he had enough he quit; not so the white men. They got after them with pitchforks, iron spikes, or pieces of thick telegraph wire fastened on poles, and with gaffs. After wounding several they would get one pinned to the bottom then lose it in trying to get it ashore. For each one that they got to the bank many got away with holes through them. For every ten they got, they injured a hundred that-escaped. I have seen fish dying that had been slashed open as if with long handled shovels, and others leaking ripe eggs through holes torn in their sides. A fish could not spawn after having a pitchfork through her.

Our European ancestors never left us a model of a good fish spear. The best they had devised was the crude leister, or barbed fork from which a fish could hardly be taken without cutting it in halves, an instrument which, if it struck the stony bottom, dulled or broke its points. The Indian salmon spear is evidence of great ingenuity; it can strike a hard bottom without injury and secures the salmon with little laceration. Its excellence shows not only great perception and reasoning powers but also the great importance of salmon to its Indian inventors, who also produced the snowshoe and wove water-tight baskets.

Kindred to the Incas, these most industrious and highly organized people in history, who reared the miracles in masonry at Machu Picchu, and Saosa huaman near Cuzco in Peru, and developed the tomato, the corn and potato, two of them human foods that in importance are only equalled by rice, and by the wheat developed in ancient Egypt, while our own forefathers, with stone axes and long pointed sticks, were hunting wild pigs in the swamps of Europe with the aid of domesticated wolves.

The Indian remnant are no longer gentlemen of leisure. Their time is spent attending funerals. Tuberculosis contracted from the whites, a disease they do not understand, is cutting them down and at each funeral there is a fresh distribution of the fatal germs.

Many of the old people are beggars who have buried their children and grand-children.

Haunted with worry at hearing that the white men are now demanding their reserves, they are confused among all the things they must not do.

"The white man did not come like an Indian, with a war cry, and paint upon his face. Sending presents ahead, he came as a

closhé tillikum, (Jargon, good friend) and when we knew, it was too late."

The Indians had been the victims of diplomacy, and presents, the symbol of friendship and good intent.

"But Indians never die, their spirits live in the mountains. Some Indians can see them, hyui, kakwa stik", (lots like the trees in the forest).

Some Indians still cling to their old beliefs in transmigration and reincarnation.

Indians not to blame for the loss of the salmon.

The Indians did not deplete the salmon.

Their barricades across streams were opened at the ends as soon as they had as many fish as the women could prepare for drying that day. They were opened, as the Indians said, to let the salmon go up stream to "mamkok papoose" (jargon for reproduce). (Correct Chinook, mamkok tenas).

I have gone to their barricades at all times, unexpectedly, and in the middle of the night and found that it was so.

When the Indian population was great, salmon were in abundance. It was after the Indians had become greatly reduced, that export commerce depleted the three smaller years of each four, and the dumping of the rock out of Hell's Gate tunnel bore, cut off the big quadrennial runs that had made the Fraser's fame.

Salmon abundant every year when first whites came to Shuswap.

When R. G. MacPherson rode up the South Thompson Valley many years ago the Indians were living in their kweekwily houses all along the banks. A notched tree served as a ladder to the roof, and another led from the wide chimney opening, or smoke hole, to the wide interior pit below.

The Indian dogs howled as he rode along and the heads of women popped up the chimneys or hatchways to see what ailed the dogs. There was a big Indian population then, and an abundance of salmon every year.

The kweekwily houses were comfortable and warm. There was a dry bank on which one could recline. They were large circular pits covered by a building of logs. The fire burned in the middle where women sewed, made baskets, and toasted salmon, and hunters told yarns, or played bone and sang.

The Sockeye run in the Shuswap as it used to be.

During the first week in August the van of the great Sockeye salmon run used to arrive in their old Shuswap Lake home that they had left three years before, as little one year olds, about three inches long. Now four years old, and having during their absence, feeding in the ocean, attained a length of about 26 inches, and a weight of about 7 pounds; full grown, sexually ripening, and led by a wonderfully devised and adjusted instinct, they returned to their native nursery of three hundred square miles of lakes, where they had spent their first year of life. They came back to spawn there once, and die as their parents had done four years before, leaving them to pass the sockeye life on to the next generation.

Among plants there are perennials that come up from the same old roots year after year, to flower and shed their seed, and there are annuals like the great wheat plants that ripen seeds but once and die, just as the Sockeye salmon do.

These sockeye have not eaten since they left the sea, they will never eat again. Nature has arranged it for them, their hunger for food has now gone forever. Before leaving the great ocean where there was such abundance, they fed heavily to build up rich fat upon themselves; that fat represents so much stored up energy and nourishment to carry them over their long journey home, hundreds of miles up stream, and to the time when their last eggs are deposited and fertilized in the gravel of their native creeks.

Each fish is a charged storage battery. Every leap, every struggle, every repeated failure to penetrate the weight of water falling over some obstruction, uses up so much of that energy producing fat. When ascending its native stream to spawn, the Pacific salmon you may say is wound up with fat, representing energy, nerve force, or life, and can only run as long as that fat lasts, like the car that stops when it comes to the last of the gasoline in the tank.

Nature has forbidden the spawning Pacific salmon to replenish its waning energy by taking food from its fresh water nursery, for their numbers were so great that they would have devoured and exterminated everything without getting enough.

Its stomach and digestive tract are now no use, even its scales can now be spared, they are absorbed into the skin to be transmuted into more nourishment, while the milts and eggs are ripening. The spawning completed, they have come to the end of their generation and die, just as the lampreys do.

Why did they go to the sea at all? It had to be arranged thus, these 300 square miles of lake could not have provided food for such tremendous numbers for four years, and for the three other sockeye families, of the same sockeye tribe, that would reproduce in the three following years. For one year only could each of the four families of a sockeye tribe draw upon their native lakes for food, and that, the year in which they would consume least.

Arriving in the Shuswap Lakes they would travel to the mouth of their parent stream, and there congregate in ever increasing numbers, sporting about, and occasionally coming up to turn over like dolphins on the surface of the water. From day to day their numbers would be reinforced by new arrivals.

Their scales had been absorbed before reaching their Shuswap home, showing the bright red skin, a most conspicuous color when they entered their native streams.

They were very wary on first coming. A camp at a stream's mouth would delay their entry, and Indians were careful that no slops of any kind, or offal should get into the river. With a keen sense of smell, they would stampede down stream at the scent of horses drinking in, or fording the stream above.

In the early grey of morning they would start the upward rush in great schools, like battalion following battalion, their bright skins making the river look red.

A Sockeye run on the Salmon River.

Many years ago I rowed in the moonlight up the Salmon River. About a mile from its mouth I tied the bow to a long stake that was driven in the bed of the stream. There was no sign of salmon. I unrolled my blankets in the stern and went to sleep. Several times I awoke to listen and look around, there was no sound but the faint gurgle of the passing water around the bow.

In the grey of early morning I was aroused by a commotion, and found the river full of sockeye running up stream. I put in an oar and felt that the river was half fish. The increasing light soon showed that it was red from bank to bank.

Then a stampede or panic occurred, and salmon came surging down, but the river was so full of ascending fish that they blockaded and made a great flat wriggling dam. So jammed were they that they crowded out, and were pushed up the sloping banks out of water. Where the banks steepened, these struggling, flapping fish were rolled down onto the backs of the fish in the river bed below, into the mass of which they would again sink.

The boat was on fish, on a red, flapping, squirming mass.

The fish lower down stream, suffocating for oxygen had turned and were rushing back to the lake to breathe fresh water through their gills, and the mass subsided. They rushed down stream creating a great noise, like the roar of a storm, or the noise of thousands of wild ducks rising from a lake, and followed down stream by a succession of waves. The river was quiet again, flowing by the stake fourteen inches below the wet high water mark reached a few minutes before. Not a fish was in sight.

In about twenty minutes or so they came back, filling the river again from bank to bank. Lightly clad Indians then appeared along the wooded banks, with their long, slender shafted fish spears, to take as many fish as the women could prepare in one day for drying, while the men would be erecting more drying racks.

I took aboard the few fish I needed and unhitched from the stake. I could not row, the oars only came down on sockeye backs, so taking an oar to push with on a bank, and use as a paddle, I worked down and out of the river.

Some people may think this unbelievable; let them come to Salmon River and ask the settlers, not necessarily those who lived there at the time of which I write, but any settlers who came there as recently as 1909 the last big salmon run to reach these spawning beds. When they tell you of having seen sockeye salmon so thick in the river that one could walk across on their backs, they have reference to these jams, and at the commencement of the run, when the fish were liable to panic and stampede. I never heard of anything attempting to cross. They would have sunk and smothered in the seething, slippery mass.

The Fraser was the greatest Salmon river in the world.

Every fourth year the Shuswap region gave it the great excess that made its fame. These salmon runs were one of the Wonders of the World, and their loss has been one of the World's Greatest Disasters. These now lost salmon runs were everywhere described as "inexhaustible".

Every stream was full of spawning fish. Little creeks or drains, too narrow for a salmon to turn in, and too shallow to cover the salmons' backs, were used to the utmost.

People may think that there might have been too many salmon, and that the last of the run must have disturbed and destroyed the eggs of the first, but Nature was still protecting, rather than checking their numbers. When a stream was fully seeded, later coming salmon seemed to know, and leaving it undisturbed they sought another spawning ground along the gravelly lake shores.

Lake spawning sockeye.

The lake spawners that used the shore from the mouth of

Scotch Creek eastwards, were the same type of red fleshed sockeye that used the creek, and undoubtedly a part of the same tribe, that had adapted themselves to the circumstances.

I don't claim that all lake spawning sockeye tribes originated in this way, and will refer to these instincts later under the heading of "kikinauch or land-locked sockeye".

Order in entering streams.

The first salmon to enter the streams were those that had farthest to go to reach the native gravel where they had been hatched. Those that had been hatched nearest the outlet, entered latest.

Grizzly salmon fishers.

The grizzlies came down to the river banks to enjoy their salmon feast, and taking up positions on drift wood jams, or other suitable places, would deftly pitch salmon from the water, over onto the banks.

Skoomocheish (the name applied to the grizzly by the Shuswaps, on account of the way his hair bristles up, when quivering with rage, he stands erect to challenge) is very fond of salmon, but doesn't like the bones. He just bites out that part of the head that contains the brains, then lays the fish in a row along some fallen tree or log, to decompose. When fully ripe he daintily licks the putrid flesh from the skeletons.

Salmon pair off, and excavate nests.

The male salmon were the first to reach their destination; as females arrived they paired off, and made hollows in the gravel as nests, where they voided, fertilized, and buried their eggs. The hollow was not the nest, the eggs being caught or rolled by the current into the gravel mound on the down stream side of the excavated hollow.

Salmon as food, before and after spawning.

Salmon would reach their native streams in the Shuswap two weeks or more before they were ready to spawn - fat, rich and full of oil.

From a big pan of baked salmon, trout and whitefish, one who knew would choose the sockeye salmon. After spawning, the salmon were unfit as food. With the ebb of all vitality, which goes with the last ova, the Pacific salmon are dying flesh, already sown with nature's bacterial agents of disintegration and transmutation.

Though grizzlies like their salmon high, I have not noticed that they ever ate these fish that had died naturally after spawning.

Natural death of the Pacific salmon.

After spawning they made no effort to return to the sea. With tails almost worn away, and skin no longer exuding slime, hardening as if only the fibre of their contracting flesh remained, blotched with patches of white fungus that kept extending over their skin, a fungus or white mould that grows on dead animal tissue in water, they would lie in some still spot with just the gills moving, or were carried unresisting by the current, to be left stranded on some driftwood pile, or carried by the stream back to the lake, where the waves would wash them ashore, and pile them up in long bars, banks, or mounds, extending around the beaches.

The atmosphere was heavy with the stench through which flew gulls that had followed up the river over 300 miles from the Fraser's mouth, to feast upon the dead salmon's eyes.

The salmon's water shroud.

For the dead fish lying in the water, nature had provided an antiseptic shroud. A saprophytic fungus that grows like a white cottony mould over dead animal matter in streams. It is Nature's provision to prevent poisoning of the water, by changing the products of animal decomposition into its own vegetable growth. It grows over dead fish in water like a dense white fur, which becomes brown by catching passing mud, thus covering them with an every thickening mat, or dense felt of fungus bound silt. Nothing can escape from the dead fish, but to the roots of this cottony, mud entrapping mould.

The great stench came, not from the fish in water, but from those on the driftwood jams, and piled in banks along the shores. Their fluids drained to the water, and near the outlet of the lower Adams River I have seen this fungus growing on the stones, six to eight inches long, waving in the current like white silky hair, to take from the passing water the contamination coming from the jams.

At the end of a great Sukai salmon run.

Thousands of tons of dead salmon available as manure for the fields lay banked around the shores, too offensive to be used.

Had these big runs not been knocked out by increasing the difficulty of passage to the spawning beds in 1913, through casting into the Fraser River Canyon the blasted rock out of Hell's Gate tunnel, and from several rock cuts during 1912 and 1913, the great quantities of spent fish left dead after big salmon runs could now have been saved for agricultural use by mixing with pulverized gypsum, or sulphate of lime, from the great

deposit on the Salmon River, now reached by the Government railway between Kamloops and Vernon. The mixing plant could have followed the shores on a scow. A good combination would have been produced, as gypsum having an affinity for ammonia would have saved the manurial properties of the fish, in addition to its own beneficial action in releasing potash locked up insoluble in the soil.

If these great runs are ever built up again, a floating plant for grinding and mixing the spent fish with dry absorbent plaster will be necessary, to safeguard the health of the people who have settled around these shores. After big runs the mouths of streams were hardly approachable for the stench; for miles beyond the deep bars of dead salmon, the shores were strewn.

On the 14th of December, 1905, we steamed through the awful stench into the wide bay at the mouth of the Lower Adams River. With mouths tightly closed we communicated only by signals. The shore was banked with a wide, deep, double bar of putrid salmon, extending around the bay until it faded out of view in the distance. The parallel furrow in this bar of dead spent salmon, marked the interval between the two separate storms, that had piled on the beach these spawned out fish, swept by the current out of one of the three mouths of the Lower Adams River, while the level of the lake was gradually falling. The difference between the lakes high water in June, and low water in mid winter being from 11 to 14 feet. The lake bottom, where visible near shore, was paved with dead fish.

We dropped a stern anchor, and crossing the slippery, putrid mound of rotting fish, in hip rubber boots, passed a bow line to a big cottonwood tree ashore.

The Indians had all cleared out from the reserve. The water in the connecting channel between the Great and Little Shuswap Lakes was not fit to use, boiling only aroused the flavor. We kept our fire on, in case of sudden storm, and filled our boiler there.

On leaving we found our anchor rope slippery with slime like a thin jelly.

Our journey back with a tow was fifty-two miles, interrupted half way by sheltering in a bay over night. On the following day we would smell the Eagle River when passing five miles away with the wind right.

During this journey since leaving Adams River we had filled the boiler many times, but on our arrival at Kualt, people who came aboard, got right off again, owing to the stench of dead fish coming with the steam from our pipes.

We could not detect it ourselves then, and our engineer told them "At Adams River the stench is so strong, that ye can lean against it."

"Salmoned" dogs.

One of the many things yet to learn about salmon is why in some districts their raw flesh poisons dogs, while in others they thrive and fatten on it.

Along the Umpqua River, Douglas Country, in western Oregon all salmon offal is burned lest the dogs get it. There, salmon flesh is as poisonous to dogs, as the loco weed in only certain districts is poisonous to horses.

In some cases the effect of salmon on dogs is almost sudden, depending some believe on the part of the fish eaten. In other cases death is said to follow a period of acidosis, which condition consumes the calcium or lime salts of the body; with tenderness, pain, wasting of ligaments, and gathering in the joints.

Are the Indians right when they attribute the Grizzlies preference for putrid salmon to a dislike for bones? What effect has putrescence on trichinae?

Trichinae of pork and trichinae of salmon.

Trichina spiralis is a small parasitic worm occurring in the pig, rat, man, etc.

The sexual forms are found in the intestine. The male is about one-sixteenth of an inch long, the female twice as large. The female brings forth many young that bore through into the body cavity or blood-vessels, and work their way to the muscle, fibers in which they grow. On attaining full growth they coil themselves spirally, surrounded in the muscle by a thin skin which becomes a calcareous or lime encrusted cyst, in which they remain passive to await the devouring of their host's flesh by some other creature, "as when the pig eats the rat, and the man eats the pig."

In the alimentary canal of the new host the cysts are dissolved, and the worms then set free, rapidly develop and breed, the numerous young migrating to the muscles of the new host.

The condition is called Trichinosis.

For the first week the symptom is a feverish state, after which time the muscles become tender and painful to the touch, hard and swollen, their movements painful or even impossible. In some cases there may be locking of the muscles, and even jaws, diarrhoea, and death from exhaustion, or pneumonia may occur in

four or five weeks after eating the infected flesh.

Trichinae in Salmon.

Trichinae found in some salmon are about three quarters of an inch long. They have reached the cyst stage before the salmon enters the river to spawn, and are found coiled up in yellowish encrusted cavities in the salmon's flesh.

As Pacific salmon do not eat after entering fresh water, we know that the parents of these worms are ingested in the ocean, and as I examined salmon from a cannery that secured its fish before they entered fresh water, I had evidence of their encystment before leaving the sea.

Finding such trichinae in sockeye shows that these salmon feeding upon small crustaceans floating in the deep sea water, and sand eels, also take larger fare, and that they themselves are devoured by creatures that do not masticate their food very finely.

I have seen symptoms of trichinosis like an epidemic among Indians during a big salmon run while they were taking treatment for inflammatory rheumatism.

There is no danger from trichinae in canned salmon, but if half cooked there is. I hope that foregoing shall not create a prejudice in anyone against salmon. All fish are infested with parasites. The delicious sable fish has them, the halibut and all. All trout are afflicted with their own special types.

Looking over a collection of tapeworms one may tell at a glance the species of fish to which each belonged.

The porcupine, bear, wolf, all animals, wild or domestic have them. The insects have them. If certain crickets drown in the creek, small white worms may emerge from one, and develop into the long hair worms that country boys believe come from leaving horse hairs in water. The pesky mosquito gets them so badly that they sometimes finish her. It is the female that bites you.

The glorious salmon is freer than the trout. Going to salt water rids him of external fresh water parasites, coming back to fresh water cleans off the salt water kind.

Worms an inch long have been found in a fresh egg of the domestic hen.

Anyone who eats ham and bacon may as well eat fish.

If you don't like the idea, your only escape is to become a nominal vegetarian and confine your meat diet to the worms in fruit and vegetables. You will have the satisfaction of knowing that the worms that feed on vegetation cannot survive the gastric juices to invade your tissues, and even then you might go wrong on your water cress, for under certain conditions (perhaps remote) water cress may communicate liver fluke, or sheep liver rot.

The Liver Fluke, referred to in the foregoing.
(Its Life History)

The flat oval liver fluke is about an inch long and half an inch wide. It lives in the liver and bile ducts of some sheep and other animals that browse on low damp land by the margins of ponds and brooks. Their eggs keep passing away with the droppings of the animal.

If they fall on moist ground, the shell opens after some weeks and a minute creature emerges that can swim about in water on the ground, but dies in a few hours time if it has not found the little fresh water snail *Limneus truncatulus*. It enters the snail's lung and changes to a sporocyst, producing eggs which develop without previous fertilization into another form called rediae.

These migrate from the lung to the liver of the snail where they pass through several generations of similar rediae, eventually they bring forth cercaria with a long swimming tail. It leaves the snail and swims to grass, where, on a stem it becomes encysted to await the plant being eaten by some animal, when the cyst will be dissolved, and the cercaria becomes a living fluke established in the liver. Of course a fish may swallow the watersnail while the fluke is in the sporocyst or rediae stage

Don't be turned against fish.

You are absolutely protected by good cooking. We should draw as much of our food as we can from the sea. The great plains are being overcropped, or mined of their agricultural fertility, this fertility gravitates to the great industrial centres then passes to the ocean depths.

No seems thinking of the future. Schemes to conserve fertility, or considerations to benefit the generations to come, would be pushed aside and tramped under foot. Do your own best, and encourage fishing all you can; the people need plenty of it.

Fish is an excellent brain food, only equalled by these valuable by-products of the flour mills rich in phosphates that are discarded by the people, and disposed of in the market as pig food.

The Loco weed referred to in the foregoing.

In mentioning the salmon poisoning of dogs as confined to certain localities, I compared it to the poisoning of horses in the west with loco weed, the name given the several plants that cause loco disease, the commonest of which is the purple flowered, or wooly loco weed, *Astragalus mellissimus*, *Osecytropis Lamberti*, and the most deadly *Hernii Aragalus spicatus*.

It is the root that does the damage, and as horses and sheep are very close eaters, they get it. The animals become doped, almost deaf and blind, staggering about in terrible fear of ordinary objects, smelling for their deadly drug. So impaired becomes their vision that they will walk up against a tree. On approaching, and placing your hand on one, it will leap in an agony of fright. After a lingering period of emaciation they die.

The plants are perennials about a foot high, bearing their flowers in racemes. A common variety has cream colored flowers. Harmless in some districts, and poisonous only, it is believed, where there is barium in the soil. Barium is a yellow metallic powder present in a white heavy rock which is used as an adulterant in white lead for paint.

The oxide is an alkaline earth resembling caustic lime. In the manufacture of fireworks the nitrate and chloride are used to produce the green flame.

Most barium salts are exceedingly poisonous.

As it is in some localities with animals on land, so is it in certain localities or lakes, with fish.

There are many causes for lakes being barren, most of these are readily visible, and many may be remedied, they are also obscure causes that defeat attempts to use some lakes as fish nurseries.

The young Salmon begins to hatch.

About the end of October the first eggs deposited in the gravel were beginning to hatch. The little embryos squirming around in the shells of tough skin, which are sufficiently transparent to show the eyes of the little fish.

Here in this earliest stage some of these little fish had already become acquainted with a parasite that had developed in company with them, right in the same salmon egg.

These white worms are about the thickness of a horse hair, and if straightened out might measure an inch.

They are however closely curled, and appear as a flattened spiral, between the embryo and the enclosing skin of the egg. The curl is frequently so close and regular that they sometimes resemble a small chain. Occasionally two worms are found in one salmon egg. They do not necessarily kill the embryo, as an egg will hatch out both a living fish and a worm.

These worms seem to feed and grow on the albuminous lubricant in which the little salmon is cushioned within the skin or shell. They are not common in salmon eggs, probably only one egg in a hundred thousand contains these worms.

I have found in creek mud, worms identical in appearance. Concealment in gravel saves the salmon eggs from hungry fish that would devour them all. It does not save them though from the many varieties of smaller creatures that crawl among the stones.

The gravel of a creek when carefully examined becomes revealed as an astonishing menagerie, and a poor place for salmon eggs. That is why Nature provided the Shuswap sockeye with an average of 3,000 or an increase of 1,500 per unit.

Hatcheries are to prevent the great loss, and turn to advantage Nature's provision, supplied to meet it. Shuswap sockeye have 50% more eggs than coast sockeye; to permit this increase in number, the eggs are of smaller size.

In having the eggs in the gravel of a stream, the only good gained is when the parent fish place them there themselves, thus communicating to the eggs, or keeping unimpaired the inherent instinct to do likewise in turn.

Artificially placing eggs, in the gravel of a stream, is no short cut to increase, it means only two or three salmon survivors from about 2,000 eggs.

Adventures of the little salmon.

Once free from the egg skin, and sheltering in the crevices between and behind stones, the little fish begins a life of terrible adventure. Prowling leeches, and leeches concealed beneath the stones reach for them.

Air breathing water beetles with poisonous beaks, bringing a film of air on their bodies, sufficient to last for a time, swim down to grapple the little salmon and suck its blood. Giant water bugs, that after a stubborn wrestle can kill a four inch trout, grab for them. The little salmon's life is a succession of hair-breadth escapes, his environment is one of tragedy. On every side his sisters and brothers are seized, or snatched away.

The fresh water ling, *Lota maculosa*, requires three thousand of them for one meal, the sucker hundreds, the squawfish and trout dozens.

He may flee for safety into a wonderful cavern, only to discover too late that it is the gaping mouth of a ling; or crouching in a deep crevice between rocks, he is surely safe now, but a great shadow looms over him, and he is whirled up in a sudden suction vortex into the interior of a sucker.

What of all the water insects, blood sucking worms, crustaceans, water snakes that devour hundreds in quick succession, fish and birds before he tries to get back home in four years' time, and finds that man has made it almost impossible with nets. His four years' adventures would fill a great book. No tropical jungle has dangers or terrors to compare with those of a creek or pond.

The scale being small they are little noticed by human mountains of flesh, but in diversity and complexity the creatures of the pond are far more wonderful than the mammals.

What amazing stunts they can perform. What wonders the little salmon behold. Along come ogres in miniature that not satisfied with the speed of their six legs, among the obstacles and entanglements of the pond, have been equipped to propel themselves about in a rapid succession of glides, by taking in water, and forcing it out in jets behind; but one does not have to go to a pond to witness marvelous accomplishments--the female flea that is said to be able to pull fifteen hundred times her own weight, and jump three hundred times her own height, was aptly described by a foreigner who, trying to tell of having spent a very restless night asked, "Yet you call dese leddle yumping tings? Ch! you know vot I mean, ven you put your finger on them they are not there."

Many different salmon.

Leaving out the Steelhead, a species related to the Atlantic salmon that need not die after spawning once, there are five species of Pacific Salmon that spawn once and die.

- (1) *Oncorhynchus tshawytscha*. The spring salmon, quinnat, chinook, tye, or king: kuk-asho of the Shuswaps.
- (2) *Oncorhynchus kisutch*, the Coho salmon, silver salmon, hoopid skewitz, quisutsch, bielaya ryba, of the Alaska Russians, s-hiex of the Shuswaps, and after they have absorbed their silvery scales in the Interior of B. C. black salmon, a name often misleading, as they are sometimes dark red or livered colored, dark blue or golden russet, and black only when in shallow water they have been exposed to strong sunlight, a condition that makes the yellow sucker or any fish black. Translucent salmon

fry from a dark hatchery when placed in a sunlit pond, will become dark in one day, nature having endowed them with the ability to make dark paint in the skin to shield them from the violet rays of light.

- (3) *Oncorhynchus gorbusha*, the Humpback salmon, honeck, of the lower Fraser (Whannock) haddo, holia, s-hany of the Shuswaps, "pinks" of commerce.
- (4) *Oncorhynchus keta*, the Dog salmon, calico salmon, hayo, lekai, the "chum" of commerce, spawns only near the Coast, and is unknown at the Shuswaps. In experiment some eggs from this species were hatched out in the Interior. The fry swelled up and when the yolk sack had become absorbed they burst.

We don't know whether altitude had anything to do with it. The elevation was 1,160 feet above sea level, perhaps they are adapted to deeper water and greater pressure than the others, and may thus be deterred from ascending inland.

- (5) *Oncorhynchus nerka*. The sockeye salmon, suk-ai, sawkeye, sau-qui, blueback salmon, red salmon, red fish, kraenaya ryba of the North Pacific Russians, and s-klelitn of the shuswaps.

There is a small landlocked variety of sockeye known as the little redfish, Kennerly's salmon, or walla, kikiny of the Interior of B. C., Kokanee trout of the Revelstoke market, and kikinauch of the Shuswaps.

Different sockeye salmon.

There are different tribes, strains, or races of Sockeye salmon. If Europeans, Africans and Mongolians are different races, then there are different races of sockeyes.

The many races of sockeye salmon differ in size, spawning habits, and in color of flesh and skin. Their flesh varied in color from white, through different shades of yellow and pink, to the intensely rich salmon red of two Fraser River tribes, one of which became extinct about 1906, the other now on the verge of extinction.

Hatchery figures do not sub-divide their sockeye eggs or fry according to strains or quality. The millions of sockeye eggs in a hatchery may bring forth sockeye with soap colored flesh, or sockeye of a valuable strain with flesh of rich salmon pink.

The richest color was found only in the Fraser River, and since 1906, only in one, of the many different tribes of Fraser River sockeye salmon.

As all searun sockeyes have absorbed their silvery scales before reaching the Shuswap Lakes, the difference between these sockeye tribes showed first in skin color, and was so great that a novice could hardly believe them to be of the same species.

The sockeye spawning season in the Shuswaps used to last four months, from the second week in August (about the 8th) until the second week in December at the lower end of the lakes. Three or four different tribes of sockeye might in succession use the same stream. The bulk of the run came in two great divisions. The first division composed of red skinned fish with red flesh, the second or smaller, green skinned fish, with pale flesh.

Some streams only received fish from the first division; others from both divisions, with an interval between, in which case the second division fish had no trace of red in either skin or flesh. On other spawning beds the two divisions overlapped, the second division fish grading in flesh from white to pale red, with skin irregularly blotched or mottled a smoky red and green, or red and grey.

One interested would in time notice that each of these great divisions could again be sub-divided, that the red fleshed fish spawning in one stream would in skin color shade from red to white on the belly, while at another stream skin color would shade from red to black or dark grey on the belly. To practised eyes the fish of each stream could be recognized in a mixed lot.

The great bulk came in these two divisions, and in addition to them, there were sockeye tribes of great distinction. The first division appeared early in August, the second about the middle of October.

After the red fleshed sockeye of the first division were all spawned out and dead, and the second division of white fleshed sockeye were also finished at the upper end of the lakes, in November came the richest colored of all salmon.

These beautiful sockeye were small, barely reaching four pounds in weight, as against the six and seven pounds of the first, great red fleshed division, but what they lacked in weight they more than made up for in richness of flesh color. They were last seen on the spawning beds in 1906.

The largest sized sockeyes of all were a tribe of magnificent plum colored fish. These were last seen in 1903. We had never weighed any of these, but they were quite noticeably larger than the salmon we know weighed 7 pounds. They were also a late fish, coming when the run seemed over at some streams.

Landlocked Sockeye

Known in western U. S. as Little Redfish, Kennerly's salmon or Walla. There are at least two varieties of landlocked sockeye in the Shuswap region, the Kikinauch, and Kikinawhealt.

Sockeye that spent their full life in fresh water could not be expected to attain the size of those four-year old sea-run sockeye that had spent from twenty-four to twenty-eight months in the ocean, where fish growth is more rapid, or the smaller number of five year old sockeyes that had fed in salt water from thirty-six to forty months. Sea-run sockeye males four and five years old taken in the Shuswaps, weigh six and seven pounds; while three-year old sea-run sockeye males only weigh from $1\frac{1}{2}$ pounds to 1 pound 15 ounces. The 6 pound sockeye male makes from 4 to $4\frac{3}{4}$ pounds of his weight in one, his fourth year.

The landlocked or Lake sockeye die as the sea-run sockeye do, after spawning.

Two sizes of landlocked or Lake Sockeye

As would be expected both of the landlocked sockeyes are small. To distinguish them we use the Indian names Kikinauch, the larger variety, and Kikinawhealt, the smaller. The difference noted between these two, are size, color, shade of eggs and slight difference in spawning season in the same waters.

We have only observed Kikinawhealt in Adams lake. They are not as numerous as Kikinauch.

Kikinauch.

Here in the Interior of B. C. it is known as kikiny, on the Revelstoke market as kokanee trout, among the Indians they are also known as little salmon. They only weigh about half a pound and measure ten or twelve inches.

Entering the streams bright silver with dark green head, they on absorbing the scales become: the males, smoky pink, the females blue.

Kikinauch has been a great harvest fish of the Interior, conveniently procurable at small lakes, many of which are distant from the sea-run sockeye spawning beds.

Kikinawhealt

Kikinawhealt, which was named canary fish by the Tappen hatchery staff, is smaller than Kikinauch, and after the absorption of the scales is yellow. They are not so numerous as Kikinauch and don't ascend to spawn until the Kikinauch have been spawning for some time.

Their eggs are of a different shade. Although Adams is one of our deepest lakes, reaching 1,054 feet, I believe that Kikinawhealt is adapted to even smaller and shallower lakes than Kikinauch.

Color of Fish

There seem to be two opposite influences affecting the color of fish, both protective. One, the tendency to take on color of the bottom, as a protection against being noticed by fish hawks; the other the development of pigmentation in shallow sunlit water, as a protection against the actinic rays of light.

The yellow of Kikinawhealt would suggest that this color variety had been developed in some small lakes within a limestone formation, with shores and shallows of lime carbonate or marl, and with Ospreys or fish hawks gliding above. They may be emigrants from higher lakes and might lose their identity and become absorbed by the Kikinauch but for annual fresh arrivals. A trapper's mention of the yellow trout of a high unnamed lake might be a clue.

The variation in lake sockeye may be used to advantage when stocking lakes, by selecting that variety best adapted to certain environments, thus saving the newly planted fish from these discomforts and dangers, to meet which the variation had been produced.

The lake Sockeye does not eat salmon eggs. They only come on the spawning beds to propagate, and have ceased to feed when the several species of sea-run salmon come up to spawn.

If to the slower growth attributable to life in fresh water, be added the drain of shedding so much tape worm that keeps intercepting their nourishment, a double reason is found for the landlocked or Lake Sockeye being much smaller than the migratory or sea-run fish.

They interbreed

Towards the close of the sea-run of sockeye, many of these ocean females arrived late, after the ocean males were all dead, and it was a common thing to see males of the miniature landlocked Sockeye paired up with the large sea-run females. These little landlocked sockeye were never seen paired up with belated spring salmon, cohos, or humpbacks.

Among the sea-run sockeye are both stream and lakeshore spawners, among the landlocked sockeye are both stream and lakeshore spawners.

With no structural difference, with a difference only in size, color, etc., that may be accounted for by natural causes, it is to be expected that progeny would result from these matings of small landlocked males with large sea-run females.

It is likely that of the progeny of such a mating, those that go to the sea, gain the sea run size, while those that remain in the lakes reach only the size of sockeye salmon that come under the name of Kikinauch.

We have never found tapeworms in sea-run sockeye, but the small landlocked sockeye, like all the trout in these lakes, are full of them. Trout fry from worm infested Shuswap Lake parents, when placed in a hitherto fishless lake, grow rapidly to an enormous size. This may not be altogether owing to the abundance of the food supply. May it not be owing to these trout being free from the tapeworms that infested their parents.

The landlocked Sockeye is a subject for important
research and experiments.

Several experiments should be tried. Eyed Kikinauch eggs should be planted in some small stream flowing into one of the fishless lakes, to find out if freed from the parasites that infested their parents, they would attain a greater size, as trout do.

Fry from sea-run sockeye ova, fertilized by landlocked sockeye milt, should be planted in another fishless lake. Landlocked sockeye ova fertilized by sea-run sockeye milt in another.

Sea-run sockeye fry should be planted in a small screened lake and kept there to note their reduction in size at breeding age. Landlocked sockeye fry, one year old, should if possible be planted in some small coast lake stream that sockeye do not now ascend to find if they would return from the sea of greater or sea-run size.

Importance of Kikinauch

The Kikinauch, or landlocked sockeye, is of great importance to the Interior of B. C. It could provide a harvest of fish food in a useful size just before winter sets in. A harvest that could not be cut off from the people of the Interior by the fishermen and canners of the Coast, or by American traps.

They can be dried in smoke without having to be split up, just like the red herring on the market. The Indians used to dry them as late as October and November, without withdrawing the entrails. There is nothing in their entrails when they come inshore, or ascend the streams to spawn, except starving tapeworms.

When thoroughly dried they are translucent, more so than flint. (As fresh fish they used to be on the market as "kokanee trout". White men near the international boundary used to ship them to markets on the U.S.A., salted in barrels. The ranchers of the Nicola and Okanagan used to salt them down for winter food.

In the Nicola during the irrigating season they used to perish on the land in countless numbers, by coming down irrigating ditches, and were considered a nuisance, on account of the resulting stench. They are still numerous in some sections, but cannot be for long. From some districts they have entirely disappeared.

Coming in shore to spawn they are thoroughly exterminated with seine nets. Their only chance to spawn is in creeks blocked with rubbish full of snags, logs, and brush, where nets cannot be used, where spearing is difficult, and where they get shelter not only from their enemies, but from the strong light that aids the rapid growth of fungus on their abraded skins. This fungus aided by light grows so rapidly that it envelopes the eyes of the fish. I have seen both Kikinauch and sea-run salmon full of eggs, but stone blind, the eyes not visible, being completely curtained over with this fungus. Trout rid themselves of the fungus by returning to deep black water, in the shadows beneath some northern slope, where in the gloom, their abrasions have a chance to heal.

Different spawning habits of sockeye tribes.

Some sockeye tribes spawned in streams that had no lakes on their course, but flowing to lakes where the water coming from glaciers was so cold that one could hardly hold the bared arm in it for more than a few seconds.

Others spawned in running, clear soft water that had passed through lakes. Some spawned only in the still, soft, temperate water, along the gravelly shores of the lakes, and would pass the mouths of streams offering long stretches of unoccupied spawning bed, to spawn on their native lake shore beyond. Others again spawned in the outlets from lakes.

The outlet of a lake appeals very strongly to the instinct of spawning sockeye; and a subject to consider is, the origin of the sockeyes' instinctive spawning choice. Is it a habit enforced by the necessity of environment, that became an instinct?

Environment or necessity produces the idea or thought, thought directs action, action repeated becomes a habit, habit continued becomes an instinct, transmissible through heredity.

Why are some tribes of Sockeye shore spawners?

An instinct that may be evidence of the sea-run Sockeyes' derivation from the Kikinauch or Lake Sockeye.

In the Chuswap Lakes some Kikinauch will spawn along the shore, while there is still room in a nearby creek, so do some tribes of sea-run sockeye.

Many Kikinauch have no other choice, as at some of the spring fed mountain lakes which they inhabit, the outlet streams that are torrents in spring, are waterless in the fall when these fish spawn.

Others of these spring fed mountain lakes have outlet streams flowing more or less all the year round, and many of their Kikinauch spawn in the outlets. Some tribes of sea-run sockeye choose as spawning beds the outlets from lakes.

Tribes of sea-run sukai will also pass the mouth of a flowing stream offering miles of an unseeded spawning bed, to spawn along the lake shore just beyond. This habit was forced upon Kikinauch, or the Lake Sockeyes, in the high landlocked lakes, and the presence of this same instinct in the migratory sea-run Sockeyes appears as an inheritance from Kikinauch or Lake Sockeye ancestry.

Sockeye Emigrants.

In many high mountainous lakes there is but one species of trout, in others it may be Kikinauch in place of trout.

The large predaceous fish, such as freshwater ling, and the charrs, that prey upon smaller trout and kikinauch, being absent, these high lakes would become over crowded, but for emigration, shed to lakes on lower levels.

Emigration is a relief from further dwarfing of a narrow environment, with insufficient food for a greater number.

These lakes below already have their population of that species, breeding, and at balance with their foes. An annual influx from higher lakes may tend to further emigrations which must arrive at the sea, with its wide environment and tendency to greater growth.

Why were the sockeye runs as much greater than the other, were these overflowing mountain reservoirs of sockeye life a source?

The first salmon.

I am not saying that the salmon originated in these mountain lakes. Our lakes are very modern, when considering the awful depth of time. Their age goes back only to the glacial periods, when they resulted from the uneven distribution of glacial debris.

The earliest fossil remains of salmon are found in the upper Cretaceous rocks that accumulated as sediments on the sea floor, as immensity of time ago.

They branched off from the Ganoids, or gristle framed fishes, growing towards the salmon type of bone skeletoned fish long ages before evolving life on this planet had advanced to fashion warm blooded mammals, that suckle, after giving birth to living young.

The only mammals yet were small marsupials, like Ornithorhynchus or Duck-bill, and the Echidna or Spiny Ant-eater of Australia.

Examples of marsupials the earliest representatives of warm blooded mammals, when the Talon family branched off from the Canoids.

The Duckbill.

An animal living along creeks, and digging burrows about fifty feet long in the banks, these have an entrance under water, and one on land. The burrow ends in a small chamber where the duckbill lays her eggs, and rears her young. Their oval, flat bodies are coated with dense fur, able to keep from the skin both water and earth. With the short, flat, broad tail they are twenty inches long.

The male has horny spurs on his hind feet, connected with poison glands.

They have no visible external ears. The eyes are small. The snout is flat, broad, and hairless covered by a dark horny beak, like the bill of a duck. The legs are short with webbed feet, the long web on the front feet folding back, to uncover the five powerful claws for burrow digging. It has cheek pouches in which it collects the food sifted out of the mud with its bill, the food being chewed afterwards between horny plates, two pairs on each jaw.

The young have teeth in both jaws, but these disappear at an early age for plates.

The eggs are about three quarters of an inch in length, without lime in the shell, and hatch immediately after being laid. The young are naked and blind, with short fleshy bills. As the mother has no teats they lap up the milk from a bare patch of skin through which the milk oozes.

In the nest they roll up into little balls like the hedgehogs of Europe. They are shy and move about mostly at night.

The Spiny Ant-eater.

Five-toed, and three-toed, burrowing animals. They are covered with a mixture of short spines and stiff hairs.

The head ends in a bare beak-like snout, resembling the bill of a bird, and without teeth. They feed on ants which they pick up with their long hollow tongues.

Nature's arrangement to save her sockeye
salmon from extinction.

It was an admirable plan of Nature's to save her Sockeye salmon from extinction by any disaster such as a great slide, a great drought, or a great frost.

To exterminate the sockeye the blow would have to fall on four successive years, or last for four years.

If, before the advent of white men, family A had been completely wiped out, it would have received a new start four years later, with the percentage of 5 year old fish from family D, that had been hatched the year before the disaster fell.

In addition to insuring the Fraser's salmon from extinction under ordinary possibilities, this 20 year circulation of blood through all four families of a sockeye tribe, kept the type even. If allowed the opportunity it would also have brought all four families to a numerical balance.

If the four families had been equally strong, there would have been a complete fusion of blood during each hundred years. Nature was working to bring the four families to equal strength.

However, the conditions were not ordinary, the effects of Nature were being persistently defeated by man. Canning soon consumed the weakest families D and C, and was finishing up B.

The reinforcements, or new starts, that Nature's plan was sending from A to B, from B to C, and wished to send from C and D, to save these families from extinction, were also canned. Family B was now only the reinforcement of 5 year olds from A.

If anything happened to wipe out the great reservoir A, it could now get no start again by 5 year olds from D.

The blow fell on A in 1913, and in 1914 it destroyed A's 5 year olds. It thus caught both the 4 year olds, and 5 year olds, the progeny of 1909, the last big run on the spawning beds of Fraser River Sockeye.

All that now remained to rebuild these four families were 1917's run, the progeny from escapes of 1913, that missed the disaster by getting up the Fraser canyon while the flood of water was high enough to enable them to surmount the obstructions. These should have been all saved from propagation.

In them the hope of perpetuation for the Fraser's red sockeye lay. There were enough to promise that perpetuation, if given a chance but they were canned, and the few that did reach the spawning beds in 1917 were speared.

No worse to kill salmon of the spawning beds
than in the Straits.

Killing sockeye for food on the spawning beds is not a bit worse than killing them in the Straits of Juan de Fuca. Some people who believe it right to kill them in the Straits, are shocked at such an "outrageous crime" as killing them on the spawning beds.

It all amounts to the same thing as far as perpetuation of the salmon is concerned, the difference only lies in the people for which they are killed. Every sockeye killed in the Straits, or the lower Fraser, means one less to spawn on the beds, the only difference is that these killed on, or near the beds are for B.C. stomachs, while those killed in the commercial belts are for foreign stomachs and purses.

In the order of their numerical weakness, the three families D, C, and B, rapidly vanished before the thoroughness of coast fishing which left little opportunity for the growing unfavorable conditions that accompany settlement on and near the spawning beds, to play much of a part in bringing them to extinction.

The evidence indicating over fishing as the main cause of so few fish reaching the spawning beds in the B, C, and D, years, was the net mark. These breeding fish had one, two or three lines imprinted on the skin, and encircling their bodies, showing how often they had escaped through nets, the mesh of which had broken. One season we did not get a single fish on the Shuswap spawning beds that did not have one or more of these well defined encircling marks.

Improved methods in taking salmon at the coast, with a growing knowledge of their movements, was cutting the hatchery at Tapscott off from a breeding supply.

A comparison between the years 1906 and 1910, both of which were in family B, will illustrate the rate of depletion.

Scotch Creek, Sockeye salmon eggs

1906	-	4,704,000.	1910	-	1,263,500
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Anstey River, Sockeye salmon eggs

1906	-	<u>1,539,000</u>	1910	-	<u>298,300</u>
		6,243,000			1,561,800

The depletion of other species was just as rapid.

In 1910 only 9 Cohoes, all males, came to Granite Creek.

Humpbacks or pinks were on the increase, and extending their range, but had entirely disappeared in 1913 owing to the blockades.

It was possible for the whole school or sept, heading for some particular stream to fail in reaching their destination, while some of those coming to another nearby might by some accident or remote chance at the Coast, get past.

As males come before the females, the school of males for some stream might be trapped, and the females escape, and vice versa.

American traps and B. C. canners did not and could not exterminate the Fraser River Sockeye Salmon.

The American, and Canadian canners cleaned up the Fraser's sockeye families D, and C and had cut B down to its five year olds from A. They could not have exterminated the Fraser River Sockeye salmon though, for when only family A remained, the canners would be faced with the necessity for storing nets and traps, and protecting plants through four years for one season's use.

In this very unevenness of the Fraser River's four sockeye families lay the safety of that reddest of sockeye tribes. Investment was not going to multiply in an industry that would only produce a dividend once in four years, with the risk of protecting nets from rot.

The Sockeye of the Fraser were impregnable to the fishermen and canners while they were all in one family, and that as strong as A.

They are now practically exterminated; 1913 didn't quite accomplish it, the fry that were turned out carried the promise of perpetuation, but canning in 1917 did it.

The blow had been so severe that these Sockeye canned on the Fraser in 1917 were worth thousands of dollars each for breeding purposes.

The Fraser's "Big Run" were Shuswap sukaior sockeye.

In speaking of the Shuswap region as the nursery and home of the Fraser River's lost, big, sukaio-runs, I am neither careless, nor forgetful of the regions of Quesnel, Chilcotin, and others of the upper Fraser River.

At the town of Lytton, or the Forks, the clear water of the Shuswap River, or Thompson, meets the silty water of the upper Fraser.

The big suckai runs of the Fraser coincide with the tremendous runs of spawning sukai in the Shuswap region, marked as Family A, on the chart.

Family B was good, marked at about one fifth the volume of Family A, Family C, not so good, only about one twenty-fifth the volume of Family A, and Family D, the poorest of all on the Shuswaps.

We know from old records that the upper Fraser's poorest years, that almost amounted to total blanks, coincided with the Shuswap region's family B, which were good runs on the Shuswap.

As years coinciding with the Shuswap's good, or B years, were the upper Fraser's worst, then the upper Fraser's best years would coincide with the Shuswap's C, or second poorest years, and not coincide with the Lower Fraser's big runs.

The loss of the Great Sockeye Runs

When we learned that another railway was to parallel the C.P.R. from Kamloops to the Coast, our thought at once turned on the sockeye runs. Would they be dumping great quantities of sand along the edge while the salmon were ascending, filling the gills of many with sharp grit and blasting over bluffs?

We were soon reassured on the last by learning from a newspaper that the Department of Indian Affairs had engineers on the ground with the Indians, surveying and mapping out these places where no rock must be thrown in the river. This was done to protect the ancient fishing places of the Indians.

Unfortunately no claim had been put forward by the Indians for Hell's Gate, a place where the salmon always had difficulty, about 185 miles down the river from the hatchery. The Indian family that had used Hell's Gate had probably died out.

It was an ideal place from a contractor's point of view for the disposal of the rock taken out in boring Hell's Gate Tunnel. He had no doubt taken that into consideration when figuring on the job.

It was the rock out of the tunnel that blotted out the great runs of sockeye salmon to the Fraser River, after the volume of passing water had become reduced with the advance of the season.

The great floods of water coming from the glaciers and snow-fields of the Interior, raise the Shuswap Lakes, (106 miles long, by 2½ mile), from 11 to 14 feet above their low water mark. The highest water is in June.

When the Sockeye reach the Shuswap, the lake level is falling and the amount of water passing through the Fraser canyon is gradually becoming reduced.

The Sockeye with the big flow of water were getting past Hell's Gate but with the reducing flow the passage was becoming increasingly difficult. Before the run was more than started it was shut off.

The females were the first to fail in getting through.

All barrels in the Interior, had been scrubbed and aired, and all the salt had been bought up in expectation of the big run.

New comers were told by neighbors of the wonderful sight, and advised to send for barrels. They would be able to walk across the rivers on the backs of fish.

When the fish didn't come there were complications. Reputations for veracity became badly distorted, protests, redeclarations, and calling for witnesses, only added to the contempt.

They were all blankety, blanked economizers of the truth. It was said "the Hatchery people, or the Indians must surely have the river blocked", and a party was sent down the Salmon River, to tear out any barricades and let the fish up. They returned with the news that they could find neither barricades nor fish.

After a while news came of the blockades at Hell's Gate Tunnel and other places, and after the people had for some time been lamenting about the great loss, and saying that the C.N.R. should be made to pay for it, news came that a slide had now been brought down.

The severity of the railway construction blow on
the spawning beds during 1913.

Few females among those that got up.

There were very few females among the Sockeye that got past Hell's Gate before the water fell.

The Salmon River, a run which I described in the foregoing, was a total blank in 1913. Not a sockeye, coho, or pink salmon spawned in it.

It was estimated that about one thousand sockeye entered, but these were all speared by settlers below a sawmill dam.

At Eagle River about six hundred sockeyes entered, but of these about one hundred would be females.

Anstey River had been red with sockeye in 1909, but in 1913 an old settler with his sons rowed there and back, 86 miles, with their barrel and salt, and only found eight fish in the whole river. At Seymour River and Sil-sa-leitaa Creek, settlers were equally disappointed.

In 1913 I only found one dead sockeye, a male, on the shore of Skwa-am Bay at Adams Lake, where, after former big runs, the bar of dead spawned out salmon used to go a wagon load to every five feet.

Scotch Creek, Lower Adams River, and Little River were the only streams where a fair supply of breeding fish arrived. Of those that ascended Scotch Creek, many of the females were so exhausted that they were brought back dead with a flood, quite hard, having died without ripening to spawn.

The Lower Adams River sockeye were of the pale fleshed tribe. In former years this river was blocked at intervals with great jams of uprooted trees and drift, on which great quantities of dead, spawned out fish used to remain. These drift wood jams acted like sieves for dead fish drifting down stream, but through which ascending fish used to pass without any difficulty, for if there is a hole big enough for a sockeye to pass through they will find it.

A log jam never stopped living sockeye. The flowing water keeps channels scoured out underneath. These great jams used to catch a lot of the dead fish drifting back, and in that way prevented great quantities from being swept out by the current.

In 1913 there were no jams in the river, they having been all cleaned out by a logging company. Six days a week a great flood was let loose from a dam above, to sweep out saw logs, and it swept out everything else. 1913

When the run was over in 1913, I walked around the shores of the bay where the great bar of dead, spawned out fish used to pollute the air after former big runs. The dead salmon thinly strewn, and not being in contact with each other, were drying out, with the heads and tails curling upwards, through drying more rapidly on the upper side.

I estimated that the quantity there was only one/two hundredths (1/200) of the quantity there, after former big runs. I counted them, males and females. They came only two females to each thirteen males, (or 1 to 6½) this again multiplies the difference, but what was worse, the females that I examined hadn't spawned, no doubt owing to the operation of the logging company's sluice dam.

The blow fell not only on sockeye; it caught everything, and completely exterminated the tremendous run of humpbacks or pinks to the upper country.

The five year old progeny from family A's 1909 run, that Nature's system had retained an extra year in the ocean to come as the reinforcement to family B, came under the blow in 1914.

If salmon fishing had closed down on the Fraser River, after that rock was removed, and the hatchery system been replaced by assistance based on the knowledge and experience collected up to date, we would now have been well on towards having four good sockeye runs in four years.

The quantity of sockeye canned on the Fraser in 1917 shows that a good promise for the future was sacrificed. They were worth thousands of dollars each.

In 1917 some escaped the nets, quite a few reached Scotch Creek, several boat loads. It was a dry season. Scotch Creek was so low that half a mile from its mouth the people set a dyke of stepping stones across and speared most of them.

Killing a sockeye in the Straits did just as much harm as killing one in Scotch Creek. They were worth thousands of dollars each in the Straits. Great prices are paid for individual stallions and bulls for breeding purposes. The Fraser's sockeye were the reddest, and therefore the best.

In 1913 it became evident that some interest was at work to suppress the truth about the great loss. A fishery man from the American side came to investigate its extent and report. Before leaving the Shuswap Lakes he told me that he could see the big runs were lost, but after returning I understand reported that there was no cause for alarm.

I have seen a good many big fourth year runs on the Fraser River, and can measure the extent of the loss. In 1889 I saw the big run on the lower Fraser, in 1893 I was surveying on the lower Fraser, from Pitt River to Hope, moving from there to the Salmon River and Shuswap Lakes, where we surveyed until Xmas when the run was over. In 1897 I was prospecting on the Shuswap Lakes. 1901, 5, 9, and 13, I was in the service of the Department of Marine and Fisheries, working at Granite Creek Hatchery on the Shuswap Lakes, the home of the Fraser's big sockeye runs, and the brightest colored tribe of sockeye salmon.

The Fraser's Sockeye situation now.

There are now only priceless museum specimens of the rich colored Fraser River Sockeye left. These are worth millions of dollars for breeding purposes.

This condition did not come without warning. It was foreseen years ago, and the warning went out year after year without effect. People did not want to hear pessimistic prophecies. "If fish were becoming scarce, then it was up to the hatcheries to produce more."

A hatchery was supposed to be an institution where young salmon by some scientific process were manufactured out of gravel and hot water, and where the output was only limited by the boundaries of the gravel and water available.

The sockeye were not being allowed to get to the spawning beds in sufficient numbers to reproduce, and a hatchery can only hatch salmon, out of salmon eggs. The sockeye trying to reach their native spawning beds were assailed by a heavy combination of destructive conditions. Over-fishing at the coast was the main cause. Contributing factors were:

Settlements along the spawning beds.
The great increase at the spawning beds and in the lakes of predaceous, fry eating fish, owing to the slaughter of the fish hawks, that had kept these in check.
Hatcheries, as they are a crude and wasteful system of incubation.
Politics in several ways.
Lumbering, with loggers' sluice dams on the spawning streams.
Ignorance, and other causes, each would require a separate paper.

The first thing to do is to really try to find out how near extermination the Fraser's red Sockeye are, then stop salmon fishing on the Fraser.

Don't try to stock the Fraser River with sockeye from northern streams, that would only hasten the destruction of the north.

The same causes that destroyed the Fraser are closing in on the North today.

Other streams can never replace the red sockeye strain, of which they are now trying to can the last surviving specimens.

The Fraser should get up on her own legs. She could get up on twenty fish. She could even be stocked with fish that would not get into American traps, but not with the system in use today.

When the microscopic examination of sockeye scales showed that of the great numbers of young salmon that descend the rivers to the sea, only those return to spawn that had lived one year in their native fresh water lake before going down, the hatcheries of B. C.

become obsolete. (The 13% exception are Lower Fraser Sockeye, not the valuable rich red). Big hatcheries are as much out of date as a stone axe. I worked in one, from the time it was built, until it was shut down, and should know something about them.

Why spoil salmon eggs carrying them long distances to a great hatchery equipped with a half thought system that has destructive features, and then turn the young fish out to go to the sea and never come back?

Turn out fish that will be all in the class that may live to come back.

A system should never be satisfactory until all loss can be prevented. As the great bulk of young salmon hatched out naturally in the parent streams, as well as the hatchery fish, never come back from the sea, only those that stayed their first year in the lake returning, it may be seen that natural propagation can not now bring back the Fraser's sockeye runs.

We will return to this subject later.

I believe, of course, in the fish being allowed to spawn naturally, on improved or artificial spawning beds, with the view of preserving in them the spawning instinct. If all the eggs were taken from all the salmon by the artificial methods in use, for an uninterrupted succession of generations, the salmon would lose the spawning instinct.

Among poultry, take non-setting hens, or hens that sit for a few days and then desert the nest. Take highly bred incubator ducks, that evacuate the daily egg while swimming in the water. The egg drifts ashore to gratify some appreciative crow. These ducks would soon cease to exist if man did not attend to their propagation, by keeping them shut in during the morning, until they had deposited their eggs on the duck house floor, from where they are taken to the incubator, to develop amid the cosy comfort emanating from a kerosine lamp.

Now! in the case of these birds, natural propagation has not been so seriously interfered with as in the case of hatchery bred salmon. These birds have associated sexually in the joy of sunshine, on the full delights of their pond. It is their incubating and nursing instinct that has alone been denied exercise.

In nature the salmon pair. They select a suitable place, amid suitable conditions for propagation, where they dig a suitable nest in the gravel, over which they face the current side by side. The magnetic presence of each has its influence on the other. He is the warrior, and natural instinct has bid him fight the chair in defence of the eggs.

The female ejects a jet of eggs, the current carries them against the gravel mound, on the down stream side of the hollow. The male at once ejects a jet of milt which is heavier than the water and is instantly carried by the current again, or through this sieve or mound of gravel which has received the eggs. He then stirs gravel from the upper side of the hollow, and it is swept by the current against the up stream side of the mound or nest behind them, thus covering the eggs. This is repeated at intervals, until all her eggs have been deposited, many fertilized, and most covered. The process from start to finish covers days.

As the mound is raised, much of the lighter sand is swept away by the current, or fanned out by the tails of the fish, the heavier pebbles remain, offering crevices to receive the eggs rolled therein by the current.

In procuring eggs for hatcheries the natural instincts leading through the foregoing routine, are all ruthlessly violated. The fish are often trapped near the mouth of a stream, with a long journey still between them, and the goal they seek. In these traps they are held back to ripen, while anxiously striving for freedom to proceed. Drawn on by the imperative demands of instinct to reach a certain goal, amid the harmony of certain conditions from which they are debarred, they expend all possible energy in an incessant fight for liberty to gain these surroundings, suitable for the natural exercise of the procreative function.

During this imprisonment, full of terror, anxious worry, and despair, which should be a period of harmony, during which not only the ova, but the sexual instincts should ripen, the nervous system of the fish, so intimately bound with its sex on which that function depends, is doubly injured. First, by the discord of the surroundings, and secondly by violation of natural function while the fish is being tried, or partially stripped by the operators.

When the eggs within the lower part of the ovary have ripened and become detached, the fish is pursued by a dip net, snatched from its natural element, the water, and while struggling, suffocating, and approaching a state of coma, its eggs are forced from it by violence.

The delicate intimacy between the nervous system, and the organs of reproduction is broken. The eggs are expelled, without the aid of a delicately adjusted and highly sensitive organization created for that purpose. Neither has there been the exercise of pairing, the nest raising or egg covering instincts.

Added to the above violations of natural function are others, resulting from the employment of brutal men. Many operators fail to realize that they are handling creatures each endowed with a delicately adjusted nervous system. and not shovelling coal.

I have seen a man swinging the fish by the tails and beating them into insensibility against the pen, before stripping them of their spawn, "ripening the brutes" he called it.

Artificial or improved spawning-beds.

The preparation and operation of artificial spawning beds would in many places be a much less formidable problem than it appears. Many creeks have several channels, or old channels, (some have a network of them) from which the water could be shut off to permit improvement while not in use.

In a channel to be used, dams at the upper or diverging point could control the flow of water therein, preventing rise and fall, and thus saving the eggs from freezing owing to bars of gravel being left exposed by diminishing flow.

The channel used as a spawning bed should be gauged, and prepared in accordance with the lowest water supply in the stream during the period of incubation, the rise and fall being entirely confined to such channels as were fenced with gates to exclude breeding fish, and direct their entrance upon the ideal beds, improved and prepared, and with a never varying flow.

Trout could be excluded to let the salmon breed without their interruption.

Artificial propagation is necessary for stocking barren waters and for producing a larger supply of young fish, to meet the depleting drain of export commerce. It would be carried too far if all the members of the species were thus treated.

In conjunction with artificial propagation the spawning beds should receive attention, for on the spawning beds are retained and perpetuated the instincts governing procreation, and on these instincts depends the continuance of the species.

We can help Nature in many ways, and may be Nature's agents if our ideals are quite unselfish, but "we musn't get too fresh".

When it comes to interfering with the natural reproductive functions of a highly developed and sensitive organism, that has taken millions of years to evolve to its present state of perfection and adjustment, we must proceed with the utmost caution. One should engage in deep thinking, down to the very bottom, or as near as he is capable, before interfering with such of Nature's machinery.

Then, before proceeding, let him pause a few moments longer, to turn his mind to himself, a mite, on one, world cheese, deciding how far the plans of the Great Intelligence may be improved by him, or dispensed with entirely, to meet a hurry for bank figures among other mites.

It is wonderful how much of this cheese a few mites can spoil if the others let them.

The salmon's perpetuation is at stake whenever we tamper with their natural reproductive functions.

The directors should have long, actual practical experience in fish culture, with its opportunities for extended observation, and a wide scientific interest that collects the special knowledge from different avenues of research that may be of value, or applied in composing the deductions sought.

A quick decision without earnest investigation, and without exploring every avenue of related information, may look business-like, but result like throwing a monkey wrench into Nature's most intricate machinery.

The noise created in connection with it must not be mistaken for an increase in production.

Look back down the ages. How species have disappeared. Those that develop in one age, vanish in the next, as new species evolve, to disappear in turn.

The sinking and rising of continents has not done it all. Under slight climatic changes, if prolonged, species disappear that have reached the slowing down of their power of adaption. Look how native races almost die off before comparatively slight changes in food, clothing, and habits, and we think salmon can survive the repeated violation of the instincts upon which their survival depends.

The Indians who first met the whites, did not die off, but by old age, or bullets, etc., and it took some bullets. I have known them that travelled through the Rocky Mountains with holes in their chests, where big round Hudson Bay musket balls went in, and holes in their backs where they came out, with only moss as a dressing under a buckskin bandage.

The failure to survive took several generations to get under way. They are the grandchildren, and great grandchildren who are perishing.

The Britons perished like flies after the Roman conquest, and lamented their coming extinction, but the survivors developed a power of resistance to the newly introduced epidemics, and change of habit, a natural anti-toxin, and their descendants acquired some immunity to the fatal consequences.

There had been no race inferiority; conquerors and conquered were close kindred, there being no other two Aryan language groups that come so close as Celtic and Italic. The closest affinities being between Oscan and Gymraeg (the language of the Berton, Cornish and Welsh) and other between Goidelic or Gaelic (the language of the Irish, Manx, and Highland Scots) and the language of Latium.

(The original tribe that founded Rome was no doubt on its arrival in Italy, one of tall, fair, Goidel Kelts, that became reduced in stature through absorption of Ligurian blood, which gave them capacity for organization. The language of the kindred tribes that got departed from them in the Alps, and eventually reached Ireland would absorb Cruithne).

The almost dying off begins with a lack of vitality, leaving a race open to high mortality, before it gradually acquires the power of resistance to meet the new conditions.

For how many generations will the salmon know enough to come back from the sea, if not permitted to exercise these natural functions?

Is a thrill or vibration of fear or shock communicated to each individual egg, or to the spermatozoa, as the parent fish is taken from the water to be pressed or bled to death, for artificial propagation.

Oh! It is science, is it? It is ignorance of science. The most wonderful scientist is Nature, to whom we should look for our lessons.

Without exercise of function for so many generations, the fish won't know what to do, or do so imperfectly that the eggs will be all lost, unless man is on hand to catch them.

Will fear vibration, with reduced vitality, and consequent lost ambition, eventually deter them from coming hundred of miles to confusion?

Every visitor to a hatchery has seen freak fish. Little, newly hatched salmon with two heads or two tails, attached twins, and fish with three eyes.

In my collection there is one with three heads. The middle head having only one eye, on the top. Another common freak is just a living head attached to a nourishing yolk sack. When the yolk is all absorbed, the helpless head dies.

Only a small percentage of hatchery fish are freak, that is noticeably freak. No one knows yet if they are equally common among the progeny of fish that spawned naturally, although it might be easily enough found out.

One should expect a lot of abnormality to follow violation of natural law.

People will point to ponds and lakes where fish culture has been practised for a very long time.

Where fish come to be fed, they are taken in nets, at spawning time, stripped, and put back.

There are also tame carp in China, venerable forty pounders, 200 years old. These fish are pretty much like cage birds, that never knew the joy of freedom in the Garden of the Gods. There is a little shock and they cannot stray.

Some will bend where others break.

"Look at the wild birds then, captured in the fields, for sale in small cages in England, how beautifully they sing." Yes, they sing until their hearts break. They are trying to sing to their mates in the fields far away. They will sing only and live only as long as hope lives. When hope dies - Oh God! how he sings. Let him free on the altar of hope.

The instinct to pass to the sea and come back to fresh water to propagate is deeply fixed in these anadromous fish, reaching away back many millions of years to the Devonian, where it is first found in Eurypterid crustaceans, small lobster-like or scorpion-like creatures.

A large species, the Pterygotus, found petrified in the quarries at Lesmahagow Scotland, were 6 feet long.

Loss of stamina would hot out the salmon before loss of instinct could. Artificial propagation can increase the supply for some time, but without preserving their natural spawning instincts there can be no perpetuation.

The newest improved? method of stripping salmon is to bleed them to death; one popular method is to chop off the tail close up below the vent. When the fish is bled out, it is ripped open, the ovary taken out, opened, and the ripe detached shaken out into the fertilizing pan. It will only require such a method a certain time to exterminate any species on which it is practised.

Some fish, such as the salt water ling, a large female of which gives off from fifty to sixty millions of small buoyant eggs, can be quite careless over their eggs and young.

The salmon has larger and fewer eggs, that must be put away for safety, therefore the necessity for preserving unimpaired their spawning instincts.

Most people hardly realize how important these instincts are to some fish.

Take the awadosi (Indian for stone carriers) a species of chub in the rivers south of Hudson Bay. Many of them club together to build the communal nest by carrying stones in their mouths to the selected spot. Each nest is composed of from a barrow load to four or five tons of stones weighing from under an ounce, to a pound each. The eggs are laid on the heap, and roll down among the sheltering stones.

Among some species of fish the male is nurse. The male of the quaint little seahorse has a pouch at the base of his tail, into this the female lays her eggs and he carries them until hatched.

In some species the males carry the eggs in their mouths until they hatch, after which they still carry the young for a little while. During the whole period (which is a few days) they fast.

The little male stickle-back builds a nest and guards the eggs and young.

The male paradise fish (of China) first blows air bubbles that rise to the surface of the water and won't burst. They form a patch of lasting froth. The male then takes the eggs in his mouth and puts them under the bubbles as a nest.

In some species the female does the nursing. The female of an American fresh water species after laying her eggs presses the lower part of her body on them. A little cuplike receptacle then forms and encloses each egg which develops an attaching stalk. Ultimately the eggs hang suspended under the bellies of the females like fringes of little berries, until hatched.

Natural Propagation not now possible on the spawning beds of the Fraser River.

It is now too late to talk about natural propagation on the spawning beds. Settlement, lumbering, and the enormous increase of predaceous fish have now made that impossible. It would take hundreds of men to patrol the streams flowing into the Shuswap Lakes, and they would be guarding streams, or miles of stream, where a salmon might never come.

People will not respect laws that they believe to be unjust. The settlers in the valleys look upon the fish as belonging to them, and resent their being reserved entirely for the cannors and fishermen who intercept them for export commerce on their way back home from the sea. They object to any law that makes it an offense to eat "their own salmon" unless they pay so much a tin for it, to the people "who hold it up".

Salmon are now so scarce on the spawning beds that for several years no salmon have been seen in streams that used to run red. Many streams have not had a salmon in them since 1909.

One of the greatest authorities on fish in America, has said, "A sockeye egg under natural conditions, has not more than one chance in a thousand to develop, and survive to maturity. If a female lays 2,000 eggs, and this is not far from the usual number, not more than two of these on the average will proceed to sea, escape their enemies, and return to spawn at term."

How is natural propagation going to rebuild the Fraser's lost sockeye runs?

Take 2,000 eggs, representing the progeny from two sockeyes, a male and a female. Where is the increase to come from to rebuild the run now on the verge of total extinction from the Fraser. At that estimate natural propagation could never do it. The runs therefore have to be built up by some other system, by artificial propagation. Artificial or improved spawning beds would not save the Fraser's red sockeye now.

I will not here attempt to describe the destructive features in the system used in hatcheries, only hatchery men who have actually tended these systems for some time would understand.

I invented and tested a simple system in which none of the destructive features are present, but no system in itself will meet the serious situation on the Fraser now. Since the microscopic examination of sockeye scales has shown that only those sockeye return to spawn that lived their first year in a lake, and that the majority of young salmon, those that go to the sea with the first high water a few months after they are hatched, are all lost, it became plain that any hatchery unable to become part of a scheme which would prevent the young salmon from going to sea with the first high water after they were hatched, was of little value.

Instead of big centralized hatcheries, small shacks are all that are needed now on the spawning beds of the Fraser. The Kamloops District has over 1,000 lakes and large ponds, of these about 300 are suitable for the propagation of salmon and trout, and others could be made so.

It is too late now to talk about natural propagation. How could a salmon be safe in the creek where a cow isn't safe on the bank?

Rarity has made these salmon of such value now, that it is worth the expense to barricade a spawning stream, on the chance perhaps of getting a specimen for removal to where another specimen has been secured.

No, you didn't think it was so bad as that, but you are going to believe me yet.

The eggs should be kept at the parent stream, until they reach the eyed stage, and then removed to water flowing into the screened lake or pond, from which the resulting fry cannot leave until the first time of migration to the sea has passed. The idea behind the arrangement being to place them all in the year old migrant class, from which the spawning fish return.

In selecting and preparing these lakes as nurseries, there is a lot of thoughtful work to do. The maximum outflow must be learned before planning the screen, one requiring the minimum of, or no attention.

The spawning instincts of salmon need not be injuriously outraged.

I have invented two types of breeding pens wherein paired fish can associate in peace over what appears to be a gravel next where they may dig as they wish. These pens are light for mooring and very simple in construction, with no intricacies or unget-at-able corners. The naturally fertilized eggs may be taken daily by pulling up a sheet metal trap drawer.

There is a simple system of salmon and trout incubation, requiring very little attention and without any of the fatal features present in the systems now in use.

There are also light portable apparatuses for breeding salmon and trout without hatcheries.

There are little hatcheries that close up like a tool chest, for sending by express, small fish or eggs cannot smother in them, they cannot block with mud, leeches and predatory water bugs cannot enter, and the little fish cannot get out until they are free swimmers, able to take pretty good care of themselves. The only thing to guard against, after they are set and locked up, is interference with the water supply.

Simple cans have been devised too, for the carrying and long distance shipment of young salmon or trout, from which the vitiated water can be drawn off, leaving the good water in the can, or the whole water in the can may be changed in a few seconds without losing or injuring any of the little fish.

With the cans at present in use for carrying trout fry, there are very heavy losses. The attendant must stay up all night, changing water, and re-aerating it if waiting at a junction for another train, or at a station for a wagon at daylight. With cans of my design he may fix up a tap or spring and go to sleep, the fry doing as well in the cans as if in a creek.

Long trips with the cans at present in use are most exhausting. The attendant becomes so haggard and played out from want of sleep that on his return journey in the cars, he is a prize bonanza for all the influenza and other germs out to stake a claim.

Artificial propagation can be managed with much smaller loss than is generally believed.

While officer in charge of Granite Creek hatchery, my assistant Mr. Mathew Laitinen sent me eggs, which I used in an experiment. They hatched out and were released as active little fish with a loss of only one-fifth of one per cent ($1/5$ of 1%).

When Mr. Laitinen left the service the Department lost a great amount of valuable experience, incalculably so now, since the Fraser's red salmon runs have been permitted to reach the edge of extinction. He came to the hatchery in a temporary crew of young fellows who were rushed in during a busy spell. He was so dilligently thorough, dependable, and unspoilable, that I recognized in him a great acquisition, and brought him on the regular staff at the first opportunity.

He stayed with the work, and its long periods of isolation, when good times made help difficult to get, never getting more than \$50.00 a month, while higher wages were obtainable outside. On the closing down of the hatchery, after the destruction of the big runs, the Department should have retained his services elsewhere, and not dismissed him with a month's notice, and lost the years of close perception and invaluable experience that went with him. He drifted away, and when last I heard of him, was working loading cars at a lumberyard, not having learned any other trade but salmon.

Predatory fish in the nursery of the sockeye.

In preparing the lakes as nurseries for the young salmon, some of the fishless lakes could be used. Others would have to be cleared of trout by trapping them when they fall back in the outlet, or enter tributaries to spawn. The eggs could be taken to stock other lakes not needed as salmon nurseries, and the parent fish fenced out from getting back into the nursery lakes.

It would take three seasons to rid a lake of trout in that way. When the time of high water migration had passed, the screens could be arranged to let young salmon out if they wished to go, but prevent other fish from getting in.

Any young salmon that did leave would descend to an awful lot of hungry enemies, in the big Shuswap Lakes, which should be cleared of such fish as Ling and Char.

The ling, burbot, fresh water cusk, or lake lawyer, *Lota maculosa*, and the grey trout, *Cristivomer namaycush*, now rule the Shuswap Lakes. There are no young salmon for them now, but there are these beautiful little white fish, that come up the streams in the night to lay their adhesive eggs among the stones or in any cleft in an old snag, and get back to the deep lake before daylight.

Ling follow them right out of the water among the wet stones, devouring them until they cannot get another down, then they take one more in the mouth, and wait for room in the hold.

The following taken from one of my old reports will give an idea of what a poor chance salmon fry would have in the Shuswap Lakes unless work is done to rid them of certain fish.

The greatest fresh water enemy of the young salmon is the fresh water ling. This glutton for small fish is dull and stupid through the bright light during the day, but at night when the small fry have settled on the bottom, crowding down and nestling close together, the ling are slowly passing over the bottom and stealing upon their bunched up victims, that are taken in by whole schools.

The ling is a night feeder with the appetite of a hog, and an amazing intuitive knowledge of the whereabouts of fry. He can swallow until out of shape from distention, and has a capacity for about three thousand salmon fry at one meal. They flee from a light.

The greatest enemy of the salmon on the lakes has been the man with the gun, who can never resist the chance to try his skill on an osprey or fish hawk. Some years ago these birds were quite numerous. True, they caught many trout, but the ling were their easy prey, and the osprey did his fishing principally on the shallows where the ling lay. When an osprey arose from the water with a sucker or ling, the eagles watching in the big cottonwood trees, hopped off after him, and they would ascend in a spiral, the osprey trying to keep above the eagles, but weighted with his fish they would soon get above him, then he would let it drop, and a swooping eagle would catch it in its descent, before it reached the water.

I have seen an osprey robbed of its fish suddenly swoop down on the meadow and escape with a wriggling garter snake. The ospreys generally had to go hungry until all the eagles had been fish fed.

Since the destruction of these ospreys and eagles by sportsmen, the ling have increased until the balance is no more. In 1897, Indians camped near the site of Granite Creek hatchery for the winter, speared about twenty ling, in 1910 we speared tons at the same place. I got the school boys interested in the execution, provided them with spears, and found in them most enthusiastic allies.

When the ice on the lake was as clear as glass, before it became covered with snow, we could see the ling through the ice, lying on the sandy bottom, on the wide shallows at the head of the Skl-at-kwa Arm, sometimes beneath seven feet of water, from which depth the bottom drops almost abruptly to 316 feet.

So dull and stupid are the ling during the bright daylight, that they would not move while holes were chopped in the ice over them with an axe, the spear lowered and thrust through their heads.

One schoolboy aged ten found 14 in one bunch, chopped a hole and brought up all 14, one after another. Not one stirred until speared, and its struggles had no disturbing effect on the others. At night they were alert and on the move. After the deep snow had covered the ice they began to move about during the day. The weather though became so severe, with wind, extreme cold, and drifting snow, that work at the spearing holes became impossible, as they could not be kept clear or open for a minute, and we could not stand the exposure. The work was therefore confined entirely to the movable house or shelter that covered the hole in the ice where the salmon fry were released.

This movable house was made in parts, and could be put together in two minutes on runners, enabling it to be moved on the ice. It was 9 feet square, side walls 6 feet high, and walls 8 feet high at roof ridge, covered with cotton, and made impervious to light by two coats of black asphaltum varnish. The prevalence of strong wind made it necessary to have it securely guyed from the corners to stakes through the ice, driven into the sandy bottom.

The snow shovelled back from the walls outside admitted better light through the ice, the only light inside the house being a borrowed light through the ice floor and the water hole, which was about three feet square.

The spearman guarding the fry was in darkness, and through the hole in the ice had a clear view of the lit up bottom. The fry for liberation were skimmed from the hatchery troughs and carried in large pails to this house on the lake. We could not let them escape as ready, as a dredge was working in the creek, and owing to the numbers of ling in the channel.

The fry when liberated first settle on the bottom, then rise in a circling army to the surface. As they find their leaders and develop into schools they strike off close under the ice, if there are only a few ling about, and are gone in a few minutes. At other times they got no chance to depart.

They have stayed a whole day, circling around, and around at the hole under the shadow of the house, actually herded by surrounding ling, that were speared as soon as their shadows appeared on the sandy bottom.

At the approach of dusk these fry would all settle down on the bottom for the night, crowding close together, an easy prey for the slowly drifting ling, that with their huge mouths, and having wide loose gills to let the water pass out, can gulp them in, with a sudden inrush of water over a distance of several inches.

At such times we had to stay by them day and night, at night with lanterns outside the house shedding a dull glow through the snow-encrusted ice. Though below zero without, it was not nearly so cold inside the little house, but towards night the spear shafts would become thick and clumsy with their coatings of ice, and one would have to keep clearing away the thin ice skum that kept forming on the surface of the water hole.

We lay on sacks of hay, one on each side of the hole, and used the spear lying on the left shoulder to enable us to see as far under the ice as possible. At night the ling appears only as a dull uncertain shadow.

We tried all manner of spears, spring gaffs, etc., and found that for ling on a soft sandy lake bottom, the old fashioned 5 pronged leister is the best. They are difficult to extract from the fish, and much time is lost in the effort, to say nothing of the holes punched through the black cotton roof by the end of the shaft, as the spear comes suddenly from the fish, after one has at last succeeded in standing on it with both feet.

I got around that difficulty though, by securely lashing at one corner of the house inside, near the door, a simple contrivance made out of stout two-inch plank.

A square chute or box without a bottom, the back 32 inches long, coming down to the ice floor, the sides and front 12 inches deep, and 20 inches above the floor leaving room for another box to be placed underneath to receive the fish; a slot 1 inch wide by 6 inches deep comes halfway down the front of this upper, bottomless box. The ling on the end of the spear were swung over into the upper plank box or chute, the spear head falling into the slot. This upper box being securely fastened to the corner of the house, one quick pull or jerk on the spear shaft released the spear, and the ling dropped through the movable fish box below, which held about 50 ling. This box being taken outside, emptied and replaced from time to time.

While the fry have been herded at one hole, we have made others some distance off and released fry there, but ling soon got around there also.

The first sign of approaching ling are fry in panic fleeing for their lives. The man lying on his shoulder, with his face close to the water in the hole, pointed his spear in the direction from

which they came. A shadow appears on the sandy bottom, drifting along like a cloud, and generally before the snout of the ling came into view there was the crash of the spear through its hard flat head, followed by a splash, as the spearman rises to his knees and swings the impaled fish over to the corner by the door, then there is a crunch as he withdraws the spear from the ling's head behind the slot, and the ling drops through into the box of fish below. By that time another shadow would be creeping up behind another string of fleeing, panic-stricken little salmon.

We killed ling by the hundreds before they had a chance to get any fish, and we killed some with 3,000 young salmon in their stomachs. By opening such ling and emptying the contents of their stomachs into the water, hundreds of little Jonahs escaped alive. Most of these baby salmon would sink to the bottom, being partially digested, but the living ones would dart about in an excited and erratic manner, as if not knowing which way to flee, then calming down would fall in place with some departing school.

The autobiography of a salmon, well illustrated, could be a narrative of wonderful interest.

I examined the stomachs of trout, whitefish, squawfish, and suckers that ventured to the hole where we released the young salmon and found them to contain few.

It is the night feeding habit of the ling that makes it so dangerous. The safest time of day to release the young salmon was during the morning and early afternoon. The schools had then time to organize, and get some distance away. Released during the afternoon they were soon overtaken by darkness, especially under snow covered ice, and settle down on the bottom, a helpless prey for ling. Little salmon released in the spring when the ice was gone, the light long, ran much smaller risk. We kept up the slaughter of ling for two months that winter, 1909-10, but were unable to keep any full record of the numbers killed. They were lying around so many holes and being continually hauled away by settlers for salting down that to keep any tally was impossible. When the work was confined to the lake house we began to keep a record and counted at each emptying of the box.

Some settlers were indifferent to these ling as food, declaring "they tasted just exactly like a rattlesnake". With others they were in great demand, some coming with sleighs over a distance of twenty miles for them.

The following from our record will give an idea of what young salmon have to face:

Saturday	February	12th, 1910	72	ling)	
		13th	75)	
		14th	168)	
		15th	360)	about 5 yellow suckers
		16th	441)	a day.
		17th	442)	
		18th	47)	
		19th	63)	
(Wind blowing a hurricane)		20th	0)	1 sucker
		21st	66)	3 white fish, 4 squawfish
		22nd	122)	2 white fish, 10 suckers
		23rd	32)	6 suckers

after which numbers steadily declined, until some days many hours would pass without getting one.

Then a whirlwind struck our lake house, snapping the guys of stout, hard, braided sashcord, and taking it away like a balloon. When it landed about a mile or so away on the ice, all that remained were a few black rags and splinters of wood.

The increase in catches I attributed to improved methods, the decrease to resulting scarcity of ling.

The largest ling speared measured 2 feet 8½ inches, and weighed 7 ¾ pounds. They would average about 3 pounds each.

A 3 pound ling can take 3,000 sockeye fry at one meal.

The fresh water ling is a snake-like fish without scales. The color is protective, dark mottled green in imitation of aquatic plants on lake bottom.

On February 16th, 1910, I speared 101 during the noon hour. Every few days this lake house was moved twenty yards or so to a clean spot, as the ice floor became encrusted with ling blood, which converted into red slop if the sun came out for an hour or so about noon, through the black covering absorbing heat and making the house close inside. The people in the neighborhood called it the slaughter house. The psychic result of this continuous vigilance, and slaughter of ling, which was generally kept up until two in the morning, was that after a while all those engaged in it could not sleep without dreaming of ling.

Like the hatchery man who after long egg picking can see nothing when he closes his eyes but a boundless expanse of salmon ova, we could see nothing but ling. Ling that in our dreams became amphibious, and developed miraculous characteristics, with a faculty for sudden metamorphosis that would arouse the envy of a lightning change artist.

The trout and squawfish took dozens, the suckers hundreds, and the ling thousands at a meal. The ling speared in 11 days were capable of devouring 5,679,000 young salmon at one meal.

In the following year 1911, with an improved outfit we only secured 9 small sized ling in that same locality during the whole winter.

Before the Hell's Gate disaster these ling got such a start that the young salmon of Sockeye families D, C, and B, were not enough to provide a ling's square meal of 3,000 for each of the 442 ling that were speared at one spot in one day, the 17th of February, 1910.

The Sockeye salmon of the Shuswap Lakes had smaller eggs and more of them than Coast Sockeye. The eggs of Shuswap sockeyes pass through the meshes of the wire hatchery baskets that hold coast Sockeye ova.

I have counted 5,007 eggs from a sockeye 28½ inches long. In the early days of Granite Creek Hatchery, I remember a very large sockeye that had over 7,000 eggs. The average is much less, about 3,000.

These highly organized, valuable, and beautiful fish only spawn once, and the whole life's progeny from two specimens representing the sexes, may be devoured at one meal by an ugly, sluggish creature, the host of over 40 feet of tapeworms, that steals upon its helpless victims in the night.

While the bold trout, operating in broad daylight is taken with the goods in the form of a dozen or two young salmon, while incriminating evidence brings upon him all manner of ill fame, the true nocturnal villain in the tragedy is lying distended and dozey among the water weeds, sleeping off the effects of a mid-night supper of 3,000. Rarely seen and never fished, he is the owl of the waters, the fresh water ling.

It is another example of the great untruth, or misunderstood truth, wrapped up in that hackneyed phrase "the survival of the fittest" which only means the fittest to survive under certain conditions, which may be evil, and are always liable to change.

The survival of the fittest does not mean the survival of the best. Greed is not superiority, neither is sanguinary rapacity, or successful diplomatic deceit.

A Provincial Fisheries Society needed.

In the hatcheries of B. C. are many observant and thoughtful men. If their experience and ideas were assembled a system would result that would place the fisheries of B. C. in safety.

The Minister should found a society, including in its membership the hatchery men, naturalists, and biologists of the province. A society which should meet annually at some different group of salmon nurseries. Papers on fish culture and allied subjects should be prepared by the members to read at these conventions, lectures, and demonstrations given, and suggested improvements discussed.

With the Department's biologists as scouts, and roving about more there would be no danger of going astray, and the Minister could through them be in touch with the pulse of the nation's western fisheries.

Fish culture includes fish food culture, and a study of the life histories of insects aquatic and terrestrial, which leads on to the study of plants on which these insects depend for food, shelter, or places in or on which, to deposit their eggs, and the conditions under which these plants thrive. Stocking with fish, sometimes also means stocking with insects, mollusks and plants.

Students of all the natural sciences can aid in fish culture. It includes analysis of waters and soils. Engineering is also important. There is much to do in preparing B. C.'s salmon nurseries.

The Indian's Salmon should be saved by arrangement
until the runs are rebuilt.

Salmon canning on the Fraser should have stopped some years ago. It is now almost too late.

An arrangement should also be made with the Indians to abstain from taking any for a few years.

Don't Prussionate the Indians and suggest regarding their right or precious treaty as a scrap of paper as some do. Their people have been using these salmon since the glacial age, and that morally constitutes a prior right.

They could be given herring and other fish from the coast, or provided with gear, and transportation there and back. There is also Australian mutton.

We have been telling of our devotion to the great principles Liberty and Justice, and must show a rather sceptical world that we are really not the canting humbugs they seem to take us for.

The white men have destroyed the Indians Salmon food supply and should compensate him until they have rebuilt it.

B. C. is a great fish country, but we should realize that there is much to learn if we are to keep it so. Its waters can not last like the North Sea. To explain why would require the drawing of several maps or charts.

We should sober down, and take a lesson from the Fraser. The best salmon river in the world ruined. The most valuable strain of the most valuable fish in the world (the runs of which were described a few years ago as "inexhaustible") on the verge of extinction.

It doesn't seem to be realized yet, but that is the truth to which the people are going to awaken.

David Salmond Mitchell.