

### III.—EXPLORATIONS ON THE COLUMBIA RIVER FROM THE HEAD OF CLARKE'S FORK TO THE PACIFIC OCEAN, MADE IN THE SUMMER OF 1883, WITH REFERENCE TO THE SELECTION OF A SUITABLE PLACE FOR ESTABLISHING A SALMON-BREEDING STATION.

By LIVINGSTON STONE.

In the Territory of Montana, on the great Continental divide which separates the Atlantic slope of North America from the Pacific slope, and near where it is intersected by the forty-sixth parallel of latitude, is a very interesting spot. Here two tiny rivulets, close to each other at their source, set out on a long and widely diverging journey; one, flowing southward and taking a strangely circuitous course, becomes the Missouri River, and finally empties its waters into the Atlantic through the broad delta of the Mississippi, 4,000 miles from where it started; and the other, flowing northward, becomes at last the Columbia River, and enters the Pacific Ocean through an outlet 15 miles wide and fully 1,200 miles from its source. The latter rivulet, which is the one with which this report is concerned, although it is, correctly speaking, Clarke's Fork of the Columbia River, is not generally known by that name until it has become the river which is formed by the junction of the Flathead and Missoula. Looking now for the various sources which have formed this comparatively large river, we find that they all head in that part of the Bitter Root Mountains and the main range of the Rockies which, roughly speaking, lie between the forty-fifth and forty-eighth parallels of latitude and receive the waters of all the numerous small streams which flow from the southwest slope of the Rocky Mountain range and the northwest slope of the Bitter Root range. Most of the streams rising in the Bitter Root Mountains flow into the Bitter Root River, while the streams rising in the Rocky Mountain range flow into the Big Blackfoot River and the Hellgate River, which latter stream is known a few miles above, and from there to where it heads in the mountains, as the Deer Lodge River. Just above Missoula, Mont., the Big Blackfoot River and the Hellgate River unite and flow together to Missoula, where they receive the waters of the Bitter Root River from the south. Below the junction of these streams, at Missoula, the river is known as the Missoula River, until it receives the waters of the Flathead River from the north, at the southeastern end of the Cœur d'Aléne range of mountains, below which junction it

is called the Clarke's Fork of the Columbia, although the whole course of the river known under the various names of Deer Lodge River, Hellgate River, and Missoula River might be properly considered as Clarke's Fork of the Columbia, these being the original Clarke's Fork and forming one continuous stream as much as the Mississippi does from the Falls of Saint Anthony to Saint Louis. From the junction of the Flathead and Missoula the river flows for about 75 miles to Pend d'Oreille Lake through a magnificent wooded cañon which presents some of the finest scenery on the continent.

Pend d'Oreille Lake is really formed by the widening of the river, and is a large, beautiful sheet of water surrounded by picturesque mountains and navigable over its entire area. At the outlet of Lake Pend d'Oreille the river comes together again, taking here still another appellation, viz., Pend d'Oreille River, and flows smoothly and slowly for a distance variously estimated at from 15 to 30 miles, where it flows over a vertical fall 8 or 10 feet\* in height and enters a mountainous cañon through which it rushes with such violence as to be wholly unnavigable, and, finally leaping over a fall of 15 feet in perpendicular height, it empties into the Columbia just north of the United States boundary, in about latitude 49° and longitude 117½°.

The Northern Pacific Railroad crosses the great Continental divide of the Rocky Mountain range just where the little streams and mountain torrents gather together to form the Deer Lodge River, which, as above stated, is the upper portion of Clarke's Fork under another name. After crossing the divide the railroad follows along down the valleys of the Deer Lodge, Hellgate, Missoula, and Clarke's Fork, and passing around the north side of the main body of Lake Pend d'Oreille, crosses the western arm of the lake, which finally narrows again into the river. Here the road permanently leaves the valley of Clarke's Fork nearly at right angles, and does not strike the Columbia River again till it reaches the mouth of Snake River, at Ainsworth, 336 miles from the ocean.

My instructions being to select a point for collecting salmon eggs which would be near the line of the Pacific Railroad, this precaution being necessary both for convenience in operating the station and for facility in distributing the eggs, it follows that any point above Pend d'Oreille Lake would be a perfectly satisfactory place for a collecting and distributing station, provided that a sufficient number of spawning salmon could be secured. This last most essential condition is wanting, however, along this whole line of river channel, for very few, if any, salmon ever reach Pend d'Oreille or the waters above it. This fact was a great surprise to the writer, but it is undeniable.

The testimony of all the persons consulted on the subject at Deer Lodge, Missoula, Sand Point, and at various smaller stations on the railroad was unanimous to the effect that no salmon were ever caught in Clarke's Fork or above. One man who was interrogated said that

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\* Dr. Suckley, in 1853, estimated the height of this fall at 6½ feet.

he had caught salmon in Lake Pend d'Oreille, but finally admitted that he had caught but one salmon, and the admission was made in such a way as to make the catching of the one salmon appear doubtful. At all events it is certain that no point on or above Lake Pend d'Oreille would furnish salmon enough for obtaining any considerable number of eggs.

The cause of the absence of salmon from a lake which flows directly into one of the greatest salmon rivers of the world is supposed by the local inhabitants to be the falls, mentioned above, which occur on the river about 15 miles below the outlet of the lake commonly known as the Falls of Seniakwoteen. I will add here that these falls are not properly called Seniakwoteen Falls, for the word means "a crossing," and, although there is a crossing a few miles below the mouth of the lake, the falls are much farther and are neither near nor in any way connected with the crossing or "Seniakwoteen" proper. The residents on the lake think that these falls prevent the salmon from coming up the river, but the writer thinks that it is quite as likely that the salmon are all or nearly all stopped by the falls at the mouth of the Pend d'Oreille River (Clarke's Fork) where it empties into the Columbia. A white ("squaw man") fur-trader lives at the crossing (Seniakwoteen), but I am informed that there is not another white settler along the whole course of the river from this point to its mouth. It is consequently very difficult to get any information concerning the run of salmon in the river, but the few persons that know anything about that region, who were consulted, could not remember having seen or heard of any salmon there, and the probability appears to be that very few, if any, salmon get past the falls at the mouth of Clarke's Fork and the intervening cascades between there and the falls below Lake Pend d'Oreille.

However this may be, the falls of Seniakwoteen (so-called) would not be a suitable place for a salmon-hatchery station, for three reasons:

1. It is too far from the railroad, being 30 or 40 miles by the nearest trail to a railroad station.
2. The region through which the railroad passes was one of the wildest portions of the United States till the railroad was built through it, and is now only very sparsely settled and very poorly furnished with supplies. The expense and inconvenience of building and carrying on a salmon-hatching station anywhere in this region would consequently be very great; so great, indeed, as to render the undertaking virtually impracticable.
3. The Indians on the Pend d'Oreille River, or, more properly speaking, the Pend d'Oreille "division" of Clarke's Fork, have always held undisputed possession of their wild and rugged cañon, and are extremely jealous of the intrusion of white men.

I am informed that they have driven out all white men who have come in there to settle, a *prima facie* evidence of which is found in the fact that there are no white settlers there at this day except the fur-trader just mentioned. I need not say that this would be a serious objection

to the establishment of a station there, as no one could tell what these high-spirited northern Indians might do at any moment in a remote and uninhabited place like the cañon of the Pend d'Oreille, provided they resented the advent of white men, as they undoubtedly would. I wish to say, by way of explanation, that I do not consider the country in question unsafe for white men to travel through, nor is there any likelihood of an outbreak by the native inhabitants along the river. I do not mean that either of these things is probable. What I mean to say is that, if a small body of white men should go into the cañon to stay and their presence should be objectionable to the savage residents of the country, they would probably find some means of getting rid of the obnoxious intruders.

Below the falls, near Seniakwoteen, to the mouth of Clarke's Fork, and from there on the Columbia to the mouth of Snake River, any place, however favorable on other accounts, would be out of the question as a collecting and distributing point for salmon eggs, on account of its distance from the railroad and its general inaccessibility. I will add that there is scarcely a white man to be found in that whole region of nearly 10,000 square miles, embraced between the Pend d'Oreille River on the north and east, the Columbia on the west, and the forty-eighth parallel on the south, except the very few settlers directly on the Columbia and Colville Rivers.

It might be thought that if a station was established on the Columbia, supplies could be brought up the river by steamer. This, however, could not be depended on at present, because from Priest Rapids to Grand Rapids, inclusive, the river is unnavigable at the following places, viz.: At Priest Rapids, 409 miles from the mouth of the Columbia; at Cabinet Rapids and Rock Island Rapids, 463 miles; at Foster Creek Rapids, Whirlpool Rapids, and Mahkin Rapids, 559 to 582 miles; at Spokane Rapids, 646 miles; and at Grand Rapids, 704 miles.

But as navigation could be opened through these rapids at a reasonable expense, and as this will probably be done sometime, because it would open up a navigable river distance of 302 miles to Kettle Falls, the time may come when it will be found desirable to establish a hatching station somewhere on the Columbia River between the mouth of Snake River and Kettle Falls, which latter place itself seems to present many conditions favorable to such an undertaking.

It was remarked above that the Northern Pacific Railroad leaves the valley of Clarke's Fork quite abruptly just below Lake Pend d'Oreille. From here it pursues a general southwesterly course, crossing the great plain of the Columbia and not reaching the river again till it gets to Ainsworth, a railroad station on the Columbia at the mouth of the Snake River. On its way, however, it crosses an important river. This river is the Spokane, a stream flowing out of Cœur d'Alène Lake and emptying into the Columbia 309 miles above the mouth of Snake River and 645 miles from the ocean. The Spokane has always been

famous as a great salmon river. Dr. Suckley often mentions it in that connection, and ever since the country has been opened up by white men it has been known that the Indians from all quarters assemble in the fall on this river and at the mouth of the Little Spokane, 8 miles to the northwest, to get their winter's stock of salmon. When I arrived at Spokane Falls, which is the point at which the railroad touches the Spokane River, and which is 70 miles from its mouth, I heard that Indians were fishing for salmon at the mouth of the Little Spokane, 8 miles distant. On driving over to the Little Spokane we found a large camp of Indians there, several of whom were industriously engaged in putting a salmon trap across the river. These traps consist of a dam of poles firmly bound together by withes and extending entirely across the river, with holes or traps at intervals into which the salmon can enter, but from which they cannot return. Having brought an interpreter with us we soon learned from the Indians that great numbers of spawning salmon came up to the mouth of the Little Spokane about the 1st of September. It was impossible to learn from the Indians how many salmon could be caught there in the spawning season, owing, I presume, to a trait which I have often observed among Indians, viz., an inability to fix with any precision upon exact numbers. For instance, when the interpreter asked the Indian he was talking with if twenty-five was the number that they caught in a day, the Indian answered yes; and when he asked him if they caught a hundred a day, he also said yes; and his other replies in regard to the numbers of the salmon caught were of the same character. However, the general impression left on our minds was that a great many salmon were caught here during the entire spawning season, possibly enough to warrant the establishing of a hatching station at the mouth of the Little Spokane.

Leaving the subject of the Spokane River here, I will remark upon the other streams flowing into the Columbia below the mouth of Snake River, and will return to discuss more fully the expediency of operating on the Spokane.

As before mentioned, the transcontinental railroad, after leaving the Spokane River, crosses the great plain of the Columbia and the dry bed of the ancient Lake Lewis, and does not strike the Columbia or any of its tributaries until it reaches the mouth of Snake River. From the mouth of Snake River it follows the Columbia down past The Dalles\* and through the Cascade range of mountains almost to its terminus at Portland.

Of course the Columbia itself below Snake River, and Snake River anywhere near its mouth, are not to be thought of in connection with

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\* To avoid giving a wrong impression, perhaps I had better state here that the Northern Pacific Railroad proper terminates at Wallula Junction, Wash., at the mouth of the Walla Walla River, and that thence to Portland the railroad is owned and operated by the Oregon Railroad and Navigation Company.

a salmon-breeding station, their great volume and width making it wholly impracticable to collect any large number of spawning salmon from them. Below Snake River on the north or Washington side of the Columbia there are many salmon streams flowing into it, as Alder Creek, Klikitat River, Wind River, Washougal River, Lewis River, and Cowlitz River, besides many others; but, with the exception of perhaps the Cowlitz and Klikitat, they are all short, diminutive rivers which would never furnish breeders enough to supply any great number of eggs, and although the Cowlitz and Klikitat are of greater size and would yield a larger supply of eggs, they nevertheless could not furnish enough to warrant the establishment of a salmon-breeding station anywhere along their course. On the south or Oregon side of the Columbia its tributaries are much larger, but each one of them is open to some objection which would be fatal to the collecting and distributing of salmon eggs on a large scale.

The first river below Snake River, on the Oregon side of the Columbia, is the Walla Walla.\* This river, although on the same side of the Columbia that Oregon is, is nevertheless in Washington Territory, as the Columbia from the mouth of the Snake River to a few miles below Wallula lies wholly in Washington Territory. The larger affluents of the Walla Walla River rise in the Blue Mountains, about 100 miles east of the Columbia. About 15 miles from the Columbia they become united, and now, under the name of the Walla Walla River, their combined waters empty into the Columbia at Wallula Junction. Although several persons have recommended the Walla Walla as a good river for our purpose, and although in times of high water many salmon run up this stream, it is nevertheless, I am convinced, too small a river to conduct any large operations on in the way of collecting salmon eggs. The river is scarcely more than 60 feet in width at low water, and shallow a quarter of a mile from its mouth; and a river of this size would not carry a sufficient volume of water to induce salmon enough to enter it to furnish any great number of eggs in these times of canneries; for it should be remembered that the immense canning operations carried on along the Columbia River have entirely revolutionized matters, as far as the abundance of salmon eggs is concerned. Twenty years ago, before the business of canning salmon on the Columbia was inaugurated, salmon literally swarmed up all the small creeks and little tributaries of the main river in such immense quantities that several million eggs could, without doubt, have been easily collected from the spawning fish at the head of comparatively insignificant streams; but that day has gone by, probably forever. The vast number of nets that are being continually dragged through the water at the canneries on the main river during the fishing season catch millions of full-grown salmon on their way up the river to spawn, and of course reduce to a corresponding extent the number of parent fish that reach the spawning-grounds.

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\* Three hundred and twenty-five miles from the mouth of the Columbia.

The comparatively few that succeed in running the gauntlet of the innumerable nets in the main river would, if they could be gathered together at one spot, still be enough to supply a great many million eggs; but those which ascend the river above the nets, instead of all going to one place, separate and divide up among the hundreds of tributaries, large and small, that help to form the great Columbia. Consequently a very small percentage, indeed, of the few salmon that get by the nets are to be found in any one manageable stream, unless some peculiar natural causes exist at some specified place to make that point an exception to the general rule. It is accordingly useless to look now to small streams which are subject to ordinary conditions for a large supply of salmon eggs, however abundant the salmon used to be in them in the former and better days of these salmon rivers.

The same objection which applies to the Walla Walla applies also to the Umatilla, \* which is the next river entering the Columbia from the south. This river is much larger than the Walla Walla, but is not large enough to induce many salmon to leave the Columbia and ascend its current. In 1877, I was told that this river would be a good one for salmon-breeding, but a thorough investigation of it proved the contrary. I built across the river, about half a mile from its mouth, a rack similar to that which we are accustomed to put across the McCloud River in the spawning season in order to arrest the course of the salmon, and had it watched for two or three months in order to ascertain the magnitude of the salmon run. The result was that the run proved to be wholly inadequate for the collecting of a large number of eggs. So the Umatilla was abandoned.

Willow Creek comes next to the Umatilla, but is even smaller than that river, and consequently may be considered entirely out of the question.

The John Day River, † which comes next, rises in the Blue Mountains and, swollen by many tributaries, empties into the Columbia about 65 miles below the Umatilla. This river is large enough, but there are no accessible places on any part of it where fishing for breeders could be successfully carried on. At some future day, when railroads have become more abundant in Oregon, a suitable place may be found on the John Day which would also be accessible, but there are none at present.

Seventeen miles below the John Day River, the Deschutes ‡ empties, splashing and foaming over the rocks, with a rapid current, into the Columbia. This river heads in the Cascade Range, at Mount Theilsen, nearly as far south as the forty-third parallel, while a more eastern branch arrives from as far east as the southwestern spurs of the Blue Mountains. The Deschutes is a model salmon river, cold, large, and

\* Three hundred and two miles from the mouth of the Columbia.

† Two hundred and thirty-eight miles from the mouth of the Columbia.

‡ Two hundred and twenty-one miles from the mouth of the Columbia.

wide, rising in high mountains, flowing with a swift current, and finally emerging from its deep-sided cañon with great force, where it plunges into the Columbia River. It may not be generally known that a strong, rapid current of cold water is the most effective agent there is for inducing breeding salmon to turn from their course up a large river. It is very much a matter of chance whether they enter a river, even a large one, which is still and deep at its mouth. Such tributaries will certainly not attract the salmon into them from any great distance out in the main river. The Umatilla is a stream of this character; also the Willamette, and to some extent the Cowlitz. Many of the Columbia River salmon that are pursuing their upward course near the south bank of the river will very likely, when they reach these streams, be following the shore line, and in that way may be led into these rivers; but the salmon that are coming up on the other side of the Columbia, or are pursuing a middle course, will keep their course and disregard these streams that make so little impression on the main river. But such rivers as the Deschutes, which pour a cold, vigorous, swift-running volume of water into the main river, that makes itself felt to the further shore and for many rods below its mouth—such rivers call salmon up their channels by shoals, not only from their own side of the river but also from the opposite shore. These rivers always have a great run of salmon, and the Deschutes on this account would be a favorable stream to operate upon for collecting salmon eggs were it not for one drawback, and that a serious one, viz., It is unmanageable, for it is too large and violent a stream to control. As, I think, I have previously explained, the mere fact that the conditions for drawing a net in a salmon river are favorable does not by any means make it a favorable place for a large salmon-breeding station. To secure the necessary conditions of success, the river must be of such a character that the salmon can be stopped in some good seining place by erecting a temporary obstruction across the river. This could not be done on the Deschutes except at a very great expense. About 30 miles up the river, however, at a place called the "crossing" of the Deschutes, or sometimes simply Deschutes, there is a high fall which, except at very high water, keeps the salmon from going up any higher. Here the conditions are reversed. If now the river below was quiet enough to allow the successful drawing of the seine, this would be a good place for a breeding station, but the river here passes through a high rocky cañon with such violence as to render the drawing of a net impracticable. There are some other objections of less importance, but the one mentioned is enough. This point might, nevertheless, be a favorable one, if the falls themselves and the land around the falls could be secured, but this spot has been taken up by a settler who moved there many years ago and who now holds the premises at so high a figure as to make it very desirable to find a place somewhere else if possible.

The next large stream down the Columbia is the Big Sandy, which is a good salmon river, and probably has towards its headwaters some



favorable places for collecting salmon eggs, but at present they are not easily accessible. About 20 miles below the Big Sandy, the Willamette\* slowly discharges its immense volume of water into the Columbia, which here seems not much larger than itself. If the slow Willamette poured its great stream into the Columbia as rapidly and forcibly as the Deschutes does, probably more than half of the Columbia River salmon would turn aside into the Willamette, but the Willamette is so still and apparently so almost motionless where its waters join those of the Columbia that but few salmon, relatively speaking, ascend the Willamette. Most of those entering the river find their way up past the city of Portland, and on 12 miles further to the Clackamas. This is a cold, swiftly-running river that empties into the Willamette just below Oregon City; its cold, swift current, which heads in the snow-covered flank of Mount Hood, attracts a large proportion of the salmon from the larger but warmer river, and even those that go by go only half a mile further, where their course is abruptly checked by the Oregon City Falls, which, at most stages of water in the river, entirely prevent the salmon from going any farther up. The salmon thus arrested in their upward progress along the Willamette, after making ineffectual attempts to jump the falls, after awhile drop back discouraged as far as the mouth of the Clackamas, and as soon as they feel again the cold vigorous rush of the Clackamas, immediately shoot up this river and join the great army of salmon that have preceded them up the same river. It will be inferred from this description that most of the salmon coming up the Columbia finally find their way into the Clackamas. This inference is entirely true. It was this which led to the establishment of a salmon-breeding station on this river in 1877 by the Oregon and Washington Fish Propagating Company. This station, which a series of misfortunes caused to be finally abandoned, is undoubtedly well situated for the taking of a great many salmon eggs. It is, however, somewhat difficult to operate it, and perhaps it will be found that some other point farther up the basin of the Columbia will combine many of its advantages without being subject to its disadvantages.

From the mouth of the Willamette to the sea all the streams emptying into the Columbia are short and small, and there are none which would command a moment's attention as a suitable place for a large salmon-breeding station.

From what has been stated above, it will be seen that from the head of the North or Clarke's Fork, which forms one of the two great arteries that combine to form the Columbia—the Snake River being the other—and which rises in the Continental divide of the Rocky Mountains between Deer Lodge and Helena, Mont., to the Pacific Ocean, there is not a place lying near the line of the Northern Pacific which unites all the conditions required for the carrying on of a salmon-breeding station on a large scale, except possibly the one referred to on the Little Spokaue

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\* One hundred and eight miles from the mouth of the Columbia.

River. Some places supply some of the requisite conditions, others furnish what these have not, but none of them, with this one exception, combines all the needful conditions.

It seems surprising at first that this should be so. It seems surprising that there are not many points along the hundreds of miles of the Columbia and its northern fork where plenty of salmon eggs could be obtained and distributed, but nevertheless there are not. As this presents such a curious and interesting question, let us glance for a moment at the conditions that are required for the operating of a large and successful salmon-breeding station; and in order to bring out the subject with more distinctness, I will enumerate these conditions and consider them in regular order. Taking them in the order of their relative importance they seem to present themselves nearly as follows:

1. Abundance of breeding salmon.
2. Accessibility of location.
3. An adequate supply of water.
4. Convenience of location for obtaining water.
5. Availability of location.
6. Facility for catching parent fish.
7. Facility for arresting the upward progress of the breeding salmon.
8. Security from high water and attendant dangers.

1. **ABUNDANCE OF BREEDING SALMON.**—This first condition, viz., of the presence of an abundant supply of salmon, is such an obvious one that nothing more need be said about it. Of course there must be plenty of salmon, for a salmon-breeding station without the salmon would be like the play of Hamlet without the part of Hamlet. The Umatilla and Walla Walla Rivers are examples of rivers possessing all the conditions just enumerated, except this one—an abundance of salmon.

2. **ACCESSIBILITY OF LOCATION.**—Hardly less indispensable than the abundance of salmon is the accessibility of a salmon-breeding location. If it is so far removed from the traveled thoroughfares that the station could not be built, nor the eggs distributed, except at a cost that would practically be a prohibitory one, the location is of course of no value, no matter how abundant the salmon are or how favorable the other conditions may be. Several places on the great bend of the Columbia, between Priest Rapids and Lake Pend d'Oreille, which cannot be approached within 50 or 100 miles, except by very bad roads and trails, are illustrations of the absence of the essential element of accessibility.

3. **AN ADEQUATE WATER SUPPLY.**—Next in rank of importance seems to come the presence of a sufficient and suitable supply of water for hatching. Where this condition is lacking it is hardly worth while either to go to the expense of putting up hatching works or to make the attempt to collect a large number of eggs; for although, provided there is a considerable water supply, a correspondingly large number of eggs may often be matured for shipment or hatched, nevertheless an inadequate supply of water is not only always a source of care and uneasiness,

but is also a standing temptation to the operator to hatch more eggs than it is capable of doing. The result of this, of course, is usually a disastrous loss. Then, again, if a dry season should come, or one otherwise unfavorable to the supply of water, that season might prove almost an entire failure. It is consequently hardly desirable to undertake the hatching of salmon on a large scale without being sure of having plenty of water. Indeed, to be short of water in the hatching season is so annoying, not only from the causes just mentioned, but for various other reasons, that I would not want to have anything to do with a hatchery that did not have a large, superabundant, and unailing supply of water. The first station of the United States Fish Commission on the McCloud River was a very good example of the absence of this condition. The station combined almost all the conditions except this one, and those who carried it on the only season that it was in existence will never forget the great care and anxiety that were caused by the insufficient supply of water, or the alarm that was always felt when hot and dry weather shrunk the little supply that we had, and there was danger that all the eggs would be lost in consequence.

4. CONVENIENCE OF LOCATION FOR OBTAINING SUITABLE WATER.— This condition may seem at first sight to be identical with the last, but a second look will show that it is not only a different one, but one that may often be wanting where the other is unexceptionable. This is not an uncommon occurrence. You may have a large river full of salmon, plenty of water, and plenty of fish, and not be able to use any of the water for hatching the eggs that are taken. I refer now to an automatically provided supply of water. For I am, of course, aware that wherever there is water it can be raised to any reasonable height by steam-pumps and other agencies; but steam-pumps are expensive to begin with; they involve a current expenditure in the running of them, and are never wholly free from risk. It is consequently always desirable to provide the water for a hatching station automatically, and no place where this cannot be done can be said to combine all the conditions desirable for a successful hatching station.

It sometimes happens that sufficient water can be brought to the hatching house without much inconvenience, but owing to its becoming warm or muddy on its way it may be unfit to use after it reaches there. It also happens sometimes that, although abundant and suitable water for the hatching house may be very near, there may be great inconvenience and risk in bringing it to where it is wanted. It is consequently quite important in selecting a hatching station to find a place where the water can not only be found in abundant supply, but where it can be conveniently brought to the hatching house in suitable condition. Probably more ingenuity has been exercised by fish-breeders in their contrivances for bringing suitable water to their hatching houses than in any other department of their operations. Windmills, steam-pumps,

current-wheels, hydraulic rams, siphons, and about all of the more common appliances for raising water to a higher level have been resorted to, in order to utilize what was otherwise a good breeding spot with plenty of water for the fish to live in. This fact shows how desirable it is to have a breeding place where the hatching water comes naturally to the eggs and involves no expense in obtaining it.

The salmon-breeding works that were put up in Oregon, on the Clackamas River, in 1877, for the purpose of hatching Columbia River salmon, furnish a singular illustration of this. The spot selected for this station seemed to be favorably situated for the work, particularly in regard to the water supply for the eggs, for just behind the site of the hatching house was a large stream of water called Clear Creek, which furnished an unlimited supply of good water at a suitable height to be introduced into the hatching house. When, however, we came to undertake to dam up the creek for the purpose of taking water from it, it was found that the bed of the creek was quicksand to an indefinite depth, and that neither hard-pan nor bed-rock could be reached. Consequently, after various persistent but fruitless attempts to find a secure place across the creek for a dam, the creek as a water supply for hatching had to be given up. Water for the purpose was afterwards obtained the same year by other means, but only with considerable difficulty and at a large expense; and when the company which built the establishment concluded the next season to risk the experiment of damming up Clear Creek, the first large freshet carried away the dam and left the salmon eggs in the hatching house without water, which resulted in a serious loss.

5. AVAILABILITY OF LOCATION.—It would seem at first sight as if any favorable location for a salmon-breeding station would be available, but this is far from being the fact. For instance, some falls might be found in a good salmon river where every facility could be afforded for taking and hatching eggs, but if these falls belonged to some one who had taken up a claim there, the site could not be secured perhaps, except at an enormous price or an enormous rental, which would practically place it out of reach. Or, perhaps, a good place could be found on a river which was considerably settled above the proposed site of the fishery. This would also make it unavailable, because the upper settlers would in all probability never allow a dam to be put across the lower portion of the river to obstruct the ascent of the salmon, and without such obstruction no great quantity of salmon could be taken anywhere in the United States at least, unless it might be at the foot of some falls or natural obstruction.

If we needed an example to illustrate the absence of this condition we might find it at the crossing of the Deschutes River, where the falls which stop the salmon and where the land adjacent, are owned by a settler and held by him at a very high figure; or on the Little Sacramento, in California, where many salmon eggs could be taken and hatched if

a dam was put across the river, but where the settlers are so numerous above that such an obstruction would not be tolerated.

6. FACILITY FOR CATCHING PARENT FISH.—This is not so essential a condition as the preceding ones, because labor and dynamite can usually create a good seining ground almost anywhere. It is an important condition, however, because a poor seining ground is a great drawback and a very serious annoyance at a salmon hatchery, and in many places it would cost a great deal of money to make a good seining ground with labor and dynamite. Moreover, such artificially prepared grounds are torn to pieces, so to speak, every winter by the violence of the high water during floods. This difficulty of securing a good natural seining ground is more often encountered than one would suppose. An inexperienced person might perhaps think that a net could be dropped anywhere in a river where fish abounded, and be drawn in successfully. But it is not so. Indeed there are many things which bar out seining in a river. For instance, a seine cannot be hauled with any success in a swift and shallow place, for the net cannot be drawn inshore with any success, even supposing the river bottom to be comparatively smooth and level. Neither is it of any use to haul where there are deep holes in the river bed, for the fish will go into the holes as the seine passes over them, and will escape. Again, it is impossible to haul a seine where there are large bowlders, or worse still, projecting points of rock in the seining ground, as these obstructions will foul the net every time, and if the fishing is persisted in will soon tear the net to pieces. As suggested above, a sufficient expenditure of time and money will make a good seining ground out of a poor one, but it is often a very expensive undertaking, and when accomplished the seining ground that has in this way been artificially made will never be so good a ground for fishing as one that has been prepared, or nearly prepared for use, by nature.

As an example of the difficulty of finding a good seining ground I might mention the McCloud River, California, where, I suppose, there is not in the whole sixty miles of the course of the river a single place where there is a good seining ground or where a first-class seining ground could be made, except at the salmon-breeding station of the United States Fish Commission two miles from the mouth of the river.

7. FACILITY FOR ARRESTING THE PROGRESS OF THE BREEDING SALMON UP THE RIVER.—As every one knows, migratory fish, particularly those of the salmon family, develop an irrepressible instinct to ascend the rivers which contain their spawning grounds. So strong and violent, indeed, is this instinct in salmon that they will force their way over all obstacles not absolutely insurmountable, in their endeavors to reach the sources of the rivers which they enter to deposit their spawn. Taking advantage of this instinct, the salmon-breeder finds an easy method for holding them at the particular place where he wants them to stay, by throwing across the river a dam or fence, which allows the water to pass down but prevents the salmon from going up. Their in-

strict keeps them from going down the river, and the obstruction keeps them from going up the river, so that they are practically confined or, as the Californians say, "corraled" in the river just below the dam. The dam is usually constructed just above the fishing ground, where the fish collect in great numbers, and where they are not only safely confined but easily caught. This method of collecting the parent salmon during the spawning season in one place by putting an obstruction across the river is absolutely indispensable for taking eggs in great numbers (unless nature has already provided an equally effective obstruction), for all the salmon, even in the most favorable localities, that could be caught while passing on their way up the river would never be enough to furnish any very large quantity of eggs. Now, in selecting a site for a salmon-breeding station this consideration must always be borne in mind, for it is an essential condition of success. I need hardly say that across many rivers, especially the large and rapid ones, it is impracticable to place such an obstruction as has just been mentioned; and many a good salmon river has been abandoned as a good breeding point because, although salmon enough ascend the river, they could not be collected together in sufficient numbers anywhere, owing to the impracticability of constructing a dam or fence across its channel.

8. SECURITY FROM HIGH WATER AND ITS ATTENDANT DANGERS.— This is the last prerequisite of a salmon-breeding station which I will mention, but it is not by any means the least, nor is it a very easy one to secure. I know of but very few good salmon rivers that are not subject to dangerous and unmanageable freshets, and of course no prudent person would knowingly build a station that could be destroyed or rendered useless by high water. It might perhaps be carried on for one or two seasons, but it is naturally only a question of time when great mischief would be caused. Sooner or later the rise in the river will come and calamity will ensue.

#### THE LOCATION AT THE MOUTH OF THE LITTLE SPOKANE RIVER.

I return now to the consideration of the qualifications of the mouth of the Little Spokane River as a suitable place for conducting large operations in collecting and distributing salmon eggs. I think it is safe to say that we are sure that this point combines all the favorable conditions just enumerated, with possibly the very important exception of the first and most essential one of all, viz., the abundance of breeding salmon. This was a question which could not be determined during my examination of the place in July, because the run of breeding salmon does not reach the Little Spokane until August, September being probably the month when the spawning salmon are most abundant. All the information we could collect on this very essential point of the abundance of salmon in the breeding season was what the Indians gave in their vague and unsatisfactory way, and, although this informa-

tion left the impression that a great many salmon came up in August, it by no means amounted to establishing a certainty.

With a view to obtaining more precise data on this subject, I engaged a man living at Spokane Falls to collect statistics in regard to the number of salmon caught by the Indians during the fall run. The statistics which were collected, however, are not by any means such as the exigencies of the case require. The Indian's information, given with the customary Indian explicitness, was that the salmon were as "thick as crickets," which means, of course, that they were very numerous, but might be intended to mean 1,000 or 50,000. Taking the most accurate statements that could be obtained and basing a fair calculation upon them, it appears that about 2,000 salmon were actually caught by the Indians this season (1883) at the mouth of the Little Spokane, and it is possible that many more than this number were caught. I should think that with white men's appliances and improved facilities for their capture the number of parent salmon caught by the Indians might be doubled. This would make 4,000 breeding salmon to operate with, which would give a yield probably of from five to ten million eggs. I do not wish to be understood that this is my opinion about it. I only say that if the statistics collected this year should prove reliable, there is a fair prospect of getting from five to ten million salmon eggs at the mouth of the Little Spokane during the spawning season. I consider, however, that the question of the abundance of the salmon at this point is far from being settled.

In the meantime, let us see how the mouth of the Little Spokane meets the other requirements of a large salmon-breeding station. Taking them in the order in which they have just been enumerated, accessibility of location comes next to the abundance of fish. Here the location at the Little Spokane possesses extraordinary advantages. Eight miles from the mouth of the river, over a remarkably hard and level road, is the town of Spokane Falls, a new but thriving and promising settlement of perhaps 1,200 inhabitants. This town is situated on the line of the Northern Pacific Railroad, and is in daily connection with the rest of the world by mail, telegraph, and railroad, the railroad being one of the great transcontinental thoroughfares of the country. These general facts alone are sufficient to show the accessibility of the location without the necessity of mentioning details.

The water supply at the mouth of the Little Spokane for hatching the eggs is practically unlimited. As there is a strong current in the river, and the water does not rise till after the spawning season and hatching season are over, the water can be raised safely from the river itself by a current-wheel, as at the McCloud River station, and this being the case, any required quantity of water can be brought to the hatching house at a small expense.

The location is also favorable for obtaining water conveniently. The river never rises more than a few feet, and consequently the hatching

house can be erected not very far above the low-water mark. A small current-wheel will therefore be sufficient to raise the water to the hatching house, and the adjacent land is so favorable for building on, that the wheel can be placed very near the hatching house, which will render unnecessary the construction of a long flume from the wheel to the hatching house. As the river does not rise till the hatching season is over, the wheel need not be protected from drift-wood or arranged with reference to the rising and falling of the water. These are great conveniences; and, on the whole, it may be said that the water supply may be safely depended upon in every respect.

The location is also remarkably favorable as to availability. Fortunately the adjacent country is still in its primitive state. When I visited the place in July (1883) many Indians were encamped on the river bottoms, but I saw no white men. It is true some claims near the river have been taken up by white men, but they are not valuable, and could be bought without much expense. It is therefore very probable that the site of a salmon-breeding station could be obtained without much cost; and as there are very few settlers up the river, and no towns or villages, no objection would probably be raised to obstructing the ascent of the salmon during the spawning season by a dam across the river.

The Little Spokane is also of such a character that it would be an easy matter to capture the breeding fish. Indeed, I think a seining ground could be arranged, so that nearly all the spawning fish that came up the river could be caught; and furthermore, it being close to the main Spokane River, it would not be difficult to run two seining grounds—one in each river—which would undoubtedly somewhat increase the yearly catch of breeders.

It will be a very easy matter to build a dam or salmon-rack across the river to keep the breeders on or near the seining ground. Indeed, the frail structure which we saw Indians successfully erecting across the river shows how easy it would be for white men, with their superior appliances, to put a salmon-rack across the river, such as would be required to answer the purposes of a salmon-breeding station. There being no drought or freshet on the river during the season's operations at the station—and indeed no natural changes at all in the river—a very simple and easily constructed dam would be perfectly safe. This is a great advantage, as it often proves a very difficult matter in a river subject to freshets in the hatching season to put in an obstruction that is perfectly safe.

And last, but not least, the maximum rise of the river during the year is so inconsiderable that there will never be any danger of the hatching house and other buildings being washed away; even if they are placed, as it is desirable they should be, close to the river.

Besides possessing the essential qualifications just enumerated for a salmon-breeding station, the Spokane location has many convenient



features about it to recommend it. In the first place, it is in a good timber country, where lumber can be easily and inexpensively obtained for building. Then the roads in all directions are hard and good, even during the rainy season, which is an advantage that can be fully appreciated by those who have lived in other parts of the Pacific coast, where the roads become practically impassable during the rainy season on account of the great depth of the mud. The ground is also almost level from the mouth of the Little Spokane to the town of Spokane Falls, which would make communication with the town and freighting to and from the breeding station very easy. The climate also is a great recommendation to this place; as it is never very cold or very hot.

By glancing over what has just been said about the mouth of the Little Spokane it will be seen that it is known to be, in all the essential points but one, an unusually favorable location for a salmon-breeding station. If it should prove to be capable of furnishing an abundance of breeders, I should not hesitate to recommend it emphatically as one of the best situations to be found anywhere for taking and distributing salmon eggs. If, however, it should fail to supply the required quantity of spawning salmon, I do not know where we could look for any one place on the Columbia River or its North Fork which by itself would be adequate and satisfactory, and I think we should then be reduced to the necessity of going farther from the railroad or erecting two or three separate stations at different points. Of these two alternatives it would probably be most prudent to choose the latter, on account of the extreme difficulty of constructing a station for carrying on the work of taking, distributing, and hatching salmon eggs at any great distance from the railroad.

I think it proper to state here that perhaps the finding of another such place as the McCloud River station, in California, should not be expected. It may be that the McCloud River station has spoiled us for all other places by leading us to expect too much. Possibly there are no other places in the United States, Alaska excepted, where nearly twenty million salmon eggs could be obtained in one year\*. It certainly is not reasonable to expect such a combination of favorable circumstances to occur again as is found at the McCloud station. It is a combination, against the second occurrence of which there are many chances to one. In the case of the McCloud station, it so happened that all the other main tributaries of the Sacramento, with one or two exceptions, were so filled with the mud and dirt ("slickens") from the hydraulic mines above that no salmon would enter them. These rivers were as completely closed to the spawning salmon as if an impassable dam had been built at their mouths on purpose to keep them out. The consequence was that all the salmon passed by them, and, the McCloud

\* In 1878, 14,000,000 salmon eggs were placed in the hatching house at the station on the McCloud River, California, and several millions more could undoubtedly have been obtained if needed.

being the coldest and most inviting of the tributaries that were left, they swarmed up this river in vast quantities.

Besides, a good seining ground being found at the junction of the river with the California and Oregon stage line, the station was enabled to be built at a convenient place for communication with the outside world. A good place was found for putting a rack or fence across the river just above the seining ground, so that the vast hosts of salmon going up the river were stopped just where they were wanted most. There was an abundance of good water for hatching and it was easily obtained. All the land about the river was wild land, so that the site of the fishery cost nothing, and no one objected to the rack that was put across the river to stop the salmon, because only one white man lived up the river. Here was a collection of first-class qualifications which it is obvious would be extremely unlikely to be found combined together again, and it is possible that, in point of fact, no other such place will be found again south of the British possessions. If this should prove to be the case, then we should have to be satisfied with stations of smaller capacity and more of them, unless, as just suggested, it is thought desirable to go to a greater distance from railroad communication. In the meantime it seems safe to say that the mouth of the Little Spokane River appears at present to be the most favorable point now known for establishing a salmon-breeding station on the Columbia or its tributaries, which shall at the same time be near the line of the Northern Pacific Railroad.

I wish to add, however, that if Washington Territory and the State of Oregon, between which the lower Columbia flows, could agree upon a code of good protective laws for the salmon, the Clackamas River would again teem with salmon as before, and in that event perhaps the best point for a breeding station would be on that river where the station of the Oregon and Washington Fish Propagating Company was built in 1877. Before the times of canneries and excessive netting of the salmon in the lower Columbia, the Clackamas in Oregon was as good a salmon river as the McCloud in California, and if the salmon should ever be allowed to reach it, it might be again. There is no ground for the objection that the Clackamas salmon are an inferior variety of fish, for it has been proved repeatedly and indisputably that the Clackamas salmon are the Spring or Chenook salmon (*Oncorhynchus quinnat*) [*O. chouicha* (Walb.) J. & G.], and of precisely the same variety as those which are canned at the mouth of the Columbia, and which are held to be of the highest value for canning. Nor is the difficulty of obtaining water for the hatching house at this point a very serious objection, for if an abundance of breeders could be obtained it would warrant the incurring of sufficient expense to overcome this difficulty. If, therefore, the laws should ever protect the salmon of the Columbia, so that they could reach the mouth of the Clackamas, it might be found

the most feasible plan for obtaining salmon eggs on a large scale to restore the old breeding establishment on this river.

On my return from California, in September, 1883, so favorable an opportunity was offered for making some investigations in regard to the run of salmon in the upper tributaries of the Snake River or South Fork of the Columbia that I somewhat exceeded my instructions, which limited my inquiries to that portion of the Columbia River which lies along the line of the Northern Pacific, and went to Eagle Rock, Idaho, where the Utah and Northern Railroad crosses the Snake River, with some hope of finding a suitable place for salmon hatching, but to my surprise I found that no salmon ever came up as far as Eagle Rock. At Pocatello, Idaho, which is the junction of the Utah and Northern Railroad and the Oregon Short Line, I found also that no salmon came up to American Falls, which is 25 miles below Pocatello. In fact, all salmon are stopped in their progress up the Snake River at the Great Shoshone Falls, in Idaho, which are about 80 miles from the American Falls and 107 miles from Pocatello. These falls are very high, and the salmon cannot get over them. The falls are not directly on the line of the railroad, but are 27 miles from the track of the Oregon Short Line Railroad, the point from which they are most accessible probably being the station of Shoshone. At these falls the salmon, I was told, collect in great numbers, and it is likely that this point may be found to be a good place for establishing a station for collecting salmon eggs and for hatching them.

I will close by mentioning one more place in this connection, which may some time be found to be a favorable place for a station. This is Salmon City, on the Salmon River, in Idaho. I have the authority of Captain Bendire for stating that salmon can be found here in great quantities in the spawning season, and it probably has other desired qualifications, but it is 100 miles from the nearest railroad point, from which it is reached by a rough and hilly road. If it was not for this objection, a salmon-hatching station might be established here, but its comparative inaccessibility is a serious drawback to the location, and it ought not to be taken into consideration while other good and more accessible points can be found.

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