23rd November 1921.

Frank M. Warren Esq.,

Portland, Ore.

Dear Mr. Warren;-

I have to acknowledge receipt of your letter of the 15th inst., and to thank you for such full expression of your views. In the main my opinion quite coincides with yours.

There is no question in my mind that holding sockeyes in waters like Herman Creek is not the correct method, in as much as it is not the natural method. I believe that sockeyes must have a lake area in which to develope and condition themselves for their future life in the sea. On the other hand I do not think it well to liberate them directly into lake waters, as this also is a departure from the habits of naturally spawned fish. Mr. Robertson, superintendent of the Harrison Lake Hatchery, and the most observing fish culturist we have in B. C., has found that fry hatched in gravel stay there even after the sac is absorbed, instead of proceeding directly into the lake. In one instance he found them there over two months after the absorption of the sac. Most artificially produced fry are hatched out earlier in the year than natural fry make their appearance, and it has been found that where the hatchery product is released prematurely the losses are enormous. On the other hand when reared in ponds until the natural time for releasing them such losses are reduced to a minimum.

I believe that the availability of natural food is the crux of the whole situation, and this is one phase which has been perisitently ignored in our propagation efforts. If a given spawning area naturally produced ten million fry, and the natural food in that area was only sufficient to maintain half that number, the other five million would have to seek other waters for their maintenance. Those hatched earliest would have an advantage over the latest hatched; would be more vigorous; and would deprive the weaker fry of their share of the food. As a consequence the latter would be compelled to migrate, and once out of the lake waters would have no chance for resting before reaching the ocean, and we know from Dr. Gilbert's investigations that all such perish.

Thus we find that under natural conditions there is an enormous waste through premature migration, which migration is probably caused by a shortage of food. Suppose on top of this that the five million that remained in the lake had to share the available food supply with five million chubs and suckers. If by some natural catastrophe, or through over fishing, the sockeyes became further

reduced, while the other species were unaffected, we might easily find that the latter increased in numbers, owing to more food being available, so that eventually instead of representing 50% of the total they increased to 75% or more. Under such circumstances what chance would the sockeyes have of restoring their former average, no matter how long a closed season on fishing was established for their protection ? I believe that the three lean years on the Fraser were caused by some such condition having existed and that it will never be rectified until chubs and suckers are reduced in numbers; a food supply in proportion to the number of salmon liberated both naturally and artificially is made available; and that the release of young fish correspponds in time with the presence and availability in the lake waters of the food on which they must subsist.

It is this object Mr. Clanton had in mind when selecting the rearing pond sites he suggested we should instal. While they would be artificial streams, and would possess water currents, they differ from Herman Creek in that, when ultimately the young fish were released, they would enter the quiet waters of a lake in which to remain for as long or as short a subsequent period as nature might dictate. The water entering the ponds would be obtained from the same sounss the lake gets its supply, and the current would bring in more or less natural salmon food to supplement that artificially supplied. Instead of holding the fish for 12 to 16 months, a as you do at Bonneville, the idea is to release them whenever it is demonstrated that warm weather has developed enough natural food to fully maintain the entire number of hatchery fish <u>in addition</u> to the native inhabitants of the lake waters. Mr. Clanton thinks with me that this will probably be about the end of July, when the sockeyes will be about 4 months old, but he puts it at 1st September to be on the safe side not only from the food standpoint but also to insure the fingerlings attaining sufficient size to make them immune from the depredations of natural enemies.. Personally I think we eventually will find that holding them until about 15th July will prove ample.

From the above you will see that my ideas correspond with your own as to lake waters being an important factor in the successful propagation of sockeyes. I believe however that in artificial propagation you must first employ stream rearing ponds in which to protect fry from natural enemies and to feed them until an ample food supply is available in the lake. I think Oregon will find that in the Willowa lake country they would get better results doing likewise than they will from putting them direct into either a natural or an artificial lake.

And in this connection, without any desire to offer suggestions re a proposition which is no concern of mine, I have always thought centralizing operations as they are at Bonneville is a mistake, even with Chinook salmon. In the first place you are not restoring runs to natural spawning areas. Secondly one catastrophe might deprive you of all the results of a season's work, which would be less likely to occur if operations were spread over a broader area. But beyond these considerations altogether I think there must be a great loss experienced every year by more fingerlings being released in the one

area than there is natural food in that area to sustain them. If all the cattle of Oregon were gathered annually at one place for producing their off spring, and ample supplies of food given them while confined, it would not follow that when the time came for sending them home a sufficient quantity of natural food would be available en route to sustain them on the journey. The chances are many - especially the calves - would perish from starvation. I believe there must be considerable loss with fish released from Bonneville due to a similar cause. I think that just as good results would be obtained at Bonneville if Chinooks were released in August or September of their first year instead of holding them over the winter. But if the number liberated exceeded that which the adjacent food supply could sustain losses would enevitably follow. If the number of fingerling salmon released is proportionate to the available food supply I see no reason why the percentage of return should not equal the percentage saved over natural propagation up to a like period of growth. The losses due to non fertilization of eggs, freshet losses and the depredation of natural enemies during the early stages of their existence are all avoided by artificial propagation. The saving thus effected should be fully maintained, if starvation does not decimate them, and they would fare equally as well as naturally produced salmon once they were in the ocean. There must be some cause that reduces the percentage saved on the spawning grounds down to the "two and one quarter to three and one quarter percent" which you think are the returns secured, and I believe this cause is that more fingerlings are liberated in a given area than there is food in such area available for their use.

When you have the time to spare I would like very much to have your opinion of the foregoing. If the salmon industry is to be saved it must be done quickly, and the more light we can throw on the proper methods the sooner will this be accomplished. Very few of those interested give more than a passing thought to the necessity of maintaining a supply. If they did their contributions toward that end would be more liberal. It takes considerable to get them to move and for one man to attempt it is an almost hopeless task. If I can show the Fraser river interests that my views, in the main, meet the approval of others who have studied the question, I can make more progress than I can at present, and I can assure you it will require all the moral support I can secure. The Pacific Fisherman dismisses Clanton's report with a flippant criticism which shows they know nothing of the subject they presume to discuss, yet more people will give credence to its opinion than to anything I could advance. This probably would be largely due to it furnishing them with an excuse for not subscribing the necessary funds for restoring the fishery.

On the other hand one is encouraged by the attitude of people like the Alaska Packers Assn., who declined last fall to contribute toward the cost of Mr. Clanton's trip. After getting his report they now write me;- "No other report has ever reached us covering this question in an equal comprehensive and effecient manner. The attention of our Board of Directors has been called to the same and we are pleased that authorization has been given to cooperate in

this matter. We should be pleased if you would indicate how we can be of any assistance."

With kindest regards,

Yours sincerely

HD/P.