XXI.—THE REPORT OF OPERATIONS AT THE UNITED STATES SALMON-BREEDING STATION ON THE McCLOUD RIVER, CALIFORNIA, DURING THE SEASON OF 1881.

By LIVINGSTON STONE.

HON. SPENCER F. BAIRD:

SIR: I beg leave to report as follows: When my last report closed in October, 1880, 2,000,000 salmon eggs had been left in the McCloud River hatching-house to be hatched by the State of California for the Sacramento River and its tributaries. These were successfully hatched and placed in the McCloud River before Christmas, when all work at this station was discontinued for the season.

Up to this time the rainfall had not been unusually large. Indeed, there had been more than the customary number of fair days until the 18th of December, when it began to rain and continued to rain eleven days in succession, the river rising on the 25th 8 feet and 2 inches above its summer level. This was nothing extraordinary, however, and no fears or even misgivings were entertained of any disaster from flood to the fishery buildings, they being built from 18 to 19 feet above the river. There was a dense fog over the McCloud River the last two days of December, but no rain, and when the new year opened the river had fallen back to within a foot and a half of its usual level.

The month of January, however, was attended by a rainfall wholly unprecedented in Northern California since its settlement by white men.*

Forty-seven inches of water fell at Shasta during this month, and in the mountains where the fishery is situated the fall must have been much greater. On the 27th of January the McCloud had risen 12½ feet, but the water had been higher than that in previous years, and still no one supposed that the buildings were in danger. Again the river fell, but this time the fall was succeeded by the greatest rise of water ever known in this river before, either by white men or Indians now living. During the first days of February the rain poured down in torrents. It is said by those who saw it that it did not fall as rain usually falls, but it fell as if thousands of tons of water were dropped in a body from

* Rainfall at Shasta, January, 1881 ..... 47 inches.
Rainfall at Shasta, February, 1881 ..... 17.5 inches.
Total rainfall for season ..... 109.7 inches.
I hereby certify the above to be correct.

JAMES E. ISAACS,
Weather Observer, Shasta, Cal.

SHASTA, CAL., *August* 1, 1881.

the sky at once. Mr. J. B. Campbell relates that near his house, in a cañon which is dry in summer, the water in not many minutes became 30 feet deep, and the violence of the current was so great that trees a hundred feet long were swept down, trunk, branches and all, into the river. On the 2d of February the McCloud River began to rise at the rate of a foot an hour. By 9 o'clock in the evening it was 16 feet and 8 inches above its ordinary level. This was within 4 inches of the danger-mark, and two young men who were at the fishery, Richard D. Hubbard and Oscar Fritze, made an attempt, at the risk of their lives, to save some of the most valuable movable property in the buildings. With great courage and determination they waded through the fierce current, in the blinding rain and pitchy darkness, and rescued many valuable things, but the water around the house was then up to their shoulders and the unequal struggle could not be long maintained. These young men are, however, entitled to great credit for succeeding in rescuing what they did from the flood on that frightful night.

The water was soon a foot above the danger-mark, and the buildings began to rock and totter as if nearly ready to fall. There was now no hope of saving them or anything in them. At half-past two in the morning of the 3d of February, they toppled over with a great crash and were siezed by the resistless current and hurried down the river.

When the day dawned nothing was to be seen of the main structures which composed the United States salmon-breeding station on the McCloud River. The mess-house, where the workmen had eaten and slept for nine successive seasons, and which contained the original cabin, 12 feet by 14 feet, where the pioneers of the United States Fish Commission on this coast lived during the first season of 1872; the hatching-house, which, with the tents that preceded it, had turned out 70,000,000 salmon eggs, the distribution of which had reached from New Zealand to St. Petersburg; the large dwelling-house, to which improvements and conveniences had been added each year for five years—these were all gone, every vestige of them, and nothing was to be seen in the direction where they stood except the wreck of the faithful wheel which through summer's sun and winter's rain had poured 100,000,000 gallons of water over the salmon eggs in the hatchery, and which now lay dismantled and ruined upon the flat-boats which had supported it, and which were kept from escaping by two wire cables made fast to the river bank. The river continued to rise the next forenoon until it reached a maximum height of 26 feet and 8 inches above its summer level. This, of course, is not a very extraordinary rise for a slow-moving river, but when it is remembered that the McCloud is at low water a succession of cascades and rapids, having an average fall of 40 feet to the mile, it will be seen at once what a vast volume of water must have been poured into this rapid river in a very short time, and with what velocity it must have come to have raised the river 26 feet when its natural fall was sweeping it out of the cañon so swiftly.

Those who saw this mighty volume of water at it highest point, rushing through its mountain cañon with such speed, say that it was appalling, while the roar of the torrent was so deafening that persons standing side by side on the bank could not hear each other when talking in an ordinary tone of voice.

It must be over two centuries since the McCloud River rose, if ever, as high as it did last winter. There is very good evidence of this on the very spot where the fishery was located, for just behind the mess-house, and exactly under where the fishery flag floats with a good south breeze, is an Indian grave-yard, where the venerable chiefs of the McCloud have been taken for burial for at least two hundred years, and there is no knowing how much longer. One-third of this grave yard was swept away by the high water last winter, and the ground below was strewn with dead men's bones.

Now, the fact that the Indians have been in the habit of burying their dead in this spot for two centuries proves that the river has never risen to the height of last winter's rise within that time, for nothing could induce Indians to bury their fathers where they thought there was the least danger of the sacred bones being disturbed by floods.

When the waters subsided, it became apparent what a clean sweep the river had made. Here and there the stumps of a few posts, broken off and worn down nearly to the ground by the driftwood rubbing over them, formed the only vestiges whatever to indicate that anything had ever existed there but the clean rocky bar that the falling water had left.

The inventory showed that over $4,000 worth of hatching apparatus, house furniture, tools, and other articles were lost or destroyed by the flood, besides the buildings themselves. The whole loss could not have been less than $15,000.*

At the time of the disaster all communication with the outside world was shut off by the high water in the rivers. On the 6th of February, Mr. Myron Green succeeded with great difficulty in taking a telegram from the trout ponds to Redding, a distance of 25 miles. Mr. Green was three days in accomplishing the journey, and in several instances swam the intervening creeks, carrying his clothes on his head. As soon as the news reached Professor Baird he telegraphed to Hon. B. B. Redding, of San Francisco, to telegraph Senator Booth, at Washington, to obtain an appropriation for rebuilding the fishery. It was now almost at the close of the Congressional session, but Senator Booth succeeded in securing an appropriation of $10,000, to be expended under the direction of Professor Baird in restoring the buildings and property destroyed by the flood. As soon as this appropriation was made Professor Baird gave me instructions to proceed at an early date to the McCloud River and enter at once upon the work of restoring the fishery.

* An account of the effects of the high water at the United States trout ponds, 4 miles farther up the McCloud River, will be found in the report of operations at that point.

In pursuance of these instructions I arrived at the fishery on the 19th of May, having previously arranged to have 30,000 feet of lumber delivered on the premises before my arrival. I immediately engaged workmen and ordered material, and on Monday morning, May 23, the work of rebuilding was under full headway, with a force of upwards of twenty white men and about a dozen Indians. There being no building of any magnitude left, we lived in tents until the mess-house was finished, one large tent, 60 feet by 30 feet, divided by a partition into two compartments, serving for a sleeping-room and dining-room for the workmen.

We encountered one serious difficulty at the very outset in putting up the new buildings. When we first built here it was supposed that the flat or nearly flat land lying 12 or 15 feet above the level of the river was safe from high water, and we accordingly erected our buildings there, protecting them from a possible rise of 3 or 4 feet more by a very ponderous breakwater. As the water last winter rose to the almost incredible height of 26 feet above the river's natural level, we were only left the alternative of putting the buildings on the hill-tops or on the hill-sides. The first being out of the question, of course we were driven by necessity to build on the hill-sides. This involved a great deal of grading, which in turn necessitated very laborious digging and excavating, sometimes even into the solid rock. It was a long, slow, and expensive work. It was a provoking paradox that here where land was as free as air and almost as boundless, it should cost, as it did in some instances, $1,000 an acre. It seemed at first as if we should never get through digging, but after the foundations were all laid the work went on rapidly, and progressed without any drawbacks, except a lack of means, until everything was done. The lack of means resulted from an attempt to accomplish with $10,000 what could not be done for less than $15,000, but it was work which could not be done by halves, and I concluded to go on and finish the work and trust to subsequent action of Congress for indemnification.

On the 1st of September we had on the fishery grounds a mess-house, hatching-house, and stable. We had also built a bridge 150 feet long across the river, and had added to it as usual a firmly built fence or rack that allowed the water to pass down but prevented the salmon from going up the river.

The mess-house is a well-built and nicely painted two-story house, 40 feet by 25 feet, containing a kitchen, pantry, store-room, dining-room, and men's room on the lower floor, with three large sleeping apartments on the second floor. It is well supplied with running water from a spring on the hill behind the house, so that there is always a full tank of fresh cold water in the kitchen, another tank on the second floor to be used in case of fire, and another on the porch where the men wash. This abundant supply of cold water in this very hot climate is a great convenience, not to say luxury. The mess-house rests on bed-rock, well up above high-water mark, and is perfectly safe from any future floods.

The stable is a well-built, substantial two-story building, 40 feet by 20 feet, with accommodations for four horses. It has two commodious store-rooms and a loft. On the north side, where it is protected from the sun in summer and the storms in winter, a shed is built joining the barn.

The hatching house is a large, handsome, painted building 80 feet long and 30 feet wide. It stands well above the danger mark of high water, and is provided with forty hatching troughs, each 16 feet long, furnished with seven hatching baskets, each 2 feet long, making two hundred hatching baskets in all. These baskets will carry 35,000 salmon eggs each, giving a total hatching capacity to the whole house in round numbers of 10,000,000 salmon eggs.

The hatching-house is provided with nine windows on each side, one window in each gable end, and five sky-lights on the roof, all of which combined furnish a good supply of light even on the dark, rainy days in the fall when the salmon are being hatched for the restocking of the tributaries of the Sacramento. On the east end of the house is a large shed built for the purpose of furnishing room and shelter while packing the eggs intended for distribution. The water supply for hatching the eggs is lifted to the house by a current-wheel in the river. This wheel is a fine piece of workmanship, and a credit to the builders. It is 32 feet in diameter, is furnished with thirty-two arms and thirty-two paddles, and revolves on a shaft 18 inches in diameter. It rests on two very substantially built boats, each 36 feet long and 8 feet wide. On these there rests, sustained on suitable supports, the current-wheel. The boats and wheel are placed at a point in the river where the current has the greatest velocity, which gives the wheel a lifting capacity of 24,000 gallons an hour.

In addition to the structures already mentioned, there was the post-office building, which was washed off its original foundation and somewhat injured by the high water, but which had been replaced, raised higher, and somewhat enlarged. This is now used as a dwelling-house. A small store-house which survived the flood, and the spawning-house for taking the eggs, complete the list of buildings at the McCloud River salmon fishery as it is now restored.

As may be supposed, some of the methods of work employed here are of a primitive character. To illustrate this, allow me to trace the boat gunwales through their various stages of progress till they were framed into the boats.

The boats' gunwales were to be 36 feet long and 29 inches wide. It was therefore necessary to find a tree which would furnish a stick of good timber 37 feet long and 30 inches wide; and we hoped at first to find a tree from which could be cut a rectangular joist 30 inches by 24 inches, and 37 feet in length. The work of getting out the gunwales began, therefore, with finding the tree. With this object in view, Mr. Campbell spent three or four days in the hills hunting for a suitable

tree, but could not find one within four miles of the fishery. He did find, however, a tree which would furnish a stick of timber of the required length and width and 12 inches in depth. This being the largest tree that could be discovered within a reasonable distance, it was cut down. Then four men spent three days scoring and hewing the log to get it reduced to the proper dimensions and shape to be sawed into two gunwales. When this was done a saw-pit was made and the timber was hoisted on the pit. Then two men spent nearly two days sawing it in two, lengthwise, with a whip-saw, one sawyer standing under the log and one above it. We now had in the rough two solid plank gunwales of the required length, width, and depth. As they lay on the saw-pit they weighed nearly a ton apiece, and were too heavy for even ten men to move any distance, so we forded the river with a pair of horses and drew the planks down the hill-side to the river. From here they were floated down the stream and across the river to the landing nearest the point where the boats were to be built. From here they were drawn by horses again to the "ship-yard," as we called it. Then after considerable hewing and finishing they were framed into the boats, making two very solid and satisfactory gunwales. After these were got in, the same process was repeated with another tree with the same results, from which we obtained two more gunwales for the other boat. I mention these details to show that we have something more to do here when we want a thing of this sort than to go to the lumber yard and order it.

In the four gunwale planks just described there were 1,600 feet of lumber. But this was not all the work of this kind that we had to do, for before the season was over we got out from the woods over 20,000 feet of square timber.

The hatching house and the wheel, and the flume for carrying the water from the wheel to the house, were no sooner completed than the salmon began to spawn. This was in the last week of August. The first ripe salmon, indeed, was caught August 25.

This reminds me that I must mention the work that had to be done on the seining ground, a large nearly circular basin in the river, where we draw the seine for capturing parent salmon. When we left off fishing last fall the ground over which we drew the seine was smooth and safe for seining. When we examined it this spring, after the floods, it was found to have been plowed through and through by the violence of the current. Such deep cuts had been made through the former bed of the river that both bowlders and sharp points of bed rock, before entirely covered, now projected 8 or 10 feet above the general level of the river bed, and made it wholly impossible, of course, to draw the seine over them. Our attempts to draw the seine before repairing the ground resulted in getting snagged the first few times and finally tearing the net entirely in two.

The restoring of the seining ground being absolutely necessary, we went to work at it as soon as the mess building was completed and the

workmen had a house to eat and sleep in. We began with carefully examining the ground by going over it with a boat, and by feeling of the bottom of the river with long poles. After finding out in this way where both the depressions and projections were, we went to work with giant powder and blasted for two or three days till we had broken up and leveled down to a great extent the projecting ledges and bowlders. We then took one of our large flat boats or scows and ran it out over the places to be filled up, and, bridging over the space between the boat and the shore, we set a force of a dozen Indians or so at work on a soft bank on the shore. The Indians with picks and shovels cut down the bank, and then with wheelbarrows carried the earth and gravel out to the scow and dumped them into the holes where the earth was needed in the seining ground. This work was carried on until all the depressions on the seining ground were filled up, and the tops of the broken rocks wholly covered over. After this was done a few hauls of the net smoothed the whole place over, and the seining ground was as good or better than before.

Before proceeding further with the taking of the salmon eggs, I ought to say that a strange and fatal disease made its appearance among the salmon of the river about the 25th of June. We first discovered it from observing dead salmon collecting in the eddies, and others floating down the river. Dead salmon during and after the spawning season are common enough in the river, but to see them in June was a very unusual sight. In fact it was a sight never seen before in our ten years' experience on the McCloud. The chief peculiarity of the disease was that many, if not most, of the dying fish presented a perfectly healthy exterior. They were clean, plump, silvery fish, free from fungus and parasites, and without a mark or sign on the surface to show that anything was wrong about them. I examined several to discover the cause of the mortality. In most of the fish that I dissected the mouth and gills seemed healthy and intact, while the viscera were very much congested with dark blood, and the spleen was very much enlarged. Later in the season, those that I examined all had unhealthy gills. The gills in these cases were very much abraded on the outer edges, and were almost stuck together by a slimy or gummy substance, as if the gills had been injured and had freely maturated. This was found to be the case with many living fish which were caught in the seine. Neither of the symptoms just described were ever observed here in the salmon before this year. I preserved in alcohol several specimens of the viscera of salmon dying from this disease, and sent them to the National Museum at Washington, where an examination of them will probably throw some light upon the causes of this mysterious epidemic.

Proceeding now with the taking of salmon eggs, I will go on to say that the number of ripe salmon caught at each haul in the seine soon commenced to increase, and on the 18th of August I thought it safe to begin to collect salmon eggs for the hatching house. On that day we

took 140,000 eggs, the parent salmon appearing to be very thick in the river. The next day we took 225,000, and by September 2 we had exceeded half a million a day. The next day we took more yet, and from this time till we stopped fishing we could have taken a million a day if necessary. Ripe salmon never were so abundant before in the fishing season. We caught frequently at one haul of the seine more than we used to catch, a few years ago, in twenty-four hours. The salmon were very large, too, the average weight of the spawned fish being several pounds more than last year, and the average number of eggs to the fish being 4,205 against about 3,000 in 1880 and a still smaller number in 1879. In consequence of the abundance of spawning fish, combined with their large size and average of eggs, the fishing season was made comparatively easy this year.

When salmon are scarce we have been in the habit of drawing the seine continuously night and day through the twenty-four hours. When they are plentiful the regular time for drawing the seine is from 4 a. m. to 10 a. m., and from 5 p. m. to 10 p. m. This year, on account of the extraordinary abundance of the fish, we frequently had to make but two or three hauls a day, and even at this rate we took all the eggs needed (7,500,000) before the spawning season was half over—a piece of good luck that never came within our experience before.

I may add here that this vast increase in the number of salmon in the river is the direct result of the artificial hatching of young salmon at this place. For several years past the United States Fish Commission has presented to the State of California 2,000,000 salmon eggs or more each year. These eggs the State fish commission has hatched each year at its own expense and has placed the young salmon in tributaries of the Sacramento. This artificial stocking of the river has resulted in a wonderful and wholly unprecedented increase of salmon in this river. So great has been the increas ethat the annual catch of salmon in the Sacramento River is worth nearly half a million dollars more than it was seven years ago, before the hatching operations were resorted to. This one result of the work done by the United States Fish Commission on the McCloud River would be ample compensation for all the outlay which has been made there, supposing that it were attended with no other results.

There was not much else done during the fishing season except to catch parent salmon and to collect eggs, as it takes nearly all hands to draw the seine and to take care of the eggs when taken. However, some work was done in adding conveniences to the hatching house and in preparing for shipping the eggs.

The last eggs for the regular season's supply were taken on the 8th of September, making a total of 7,500,000. The salmon in the river on the day we left off fishing seemed thicker than ever. If they had been needed I think we could have taken 20,000,000 eggs this season.

The time between the end of the season's spawning and the begin-

ning of the packing for shipment was devoted to the taking care of the eggs, to making crates and boxes to ship the eggs in, to picking over the moss to pack with, and to cleaning up generally for the season.

Everything went on smoothly till packing time, and without accident, with one exception. This exception, however, was one of the gravest character, and consisted of an accident to the wheel, which filled us all with consternation and alarm. It happened the 18th of September, on a remarkably quiet and pleasant Sunday morning. The white men employed at the fishery were scattered over the grounds, and there were three or four Indians about. No one had the slightest expectation of any disaster. Everything connected with the hatching of the eggs seemed to be going on with the utmost success and safety, when suddenly, in the direction of the current-wheel, which lifts the water for the hatching house, an ominous sound of a blow was heard, followed by a crash, like the breaking of a board—then another and another—and those who happened to be in sight of the wheel saw that it had begun to break up and was rapidly going to pieces. A moment before, hardly half a dozen men could be seen. A moment after, more than twenty men, white and red, were gathered on the bar opposite to where the wheel was stationed. It seemed at first as if the wheel would be torn to pieces in a moment. It was revolving at the rate of five revolutions a minute in a very rapid and powerful current. But the injury itself was the cause of its own cessation.

Though no one knows positively the cause of the accident, it is supposed that it was occasioned by driftwood coming down the river and catching somewhere about the wheel so as to obstruct it. The momentum of the current here being so great that it forced the wheel around, notwithstanding the obstruction, there could be but one result —the breaking up of the wheel. But, of course, after five or six paddles were broken off on one side of the wheel, there was a large space on the circumference of the wheel, where it did not reach the water at all; when this part of the wheel came around again to the surface of the water, there being no paddles to reach the current, the wheel stopped of its own accord.

As soon as the accident was discovered not a moment was lost in establishing a line of buckets from the river to the hatching house to supply water to the eggs. Every white man and Indian that could be pressed into the service was employed, and in less than ten minutes we had three lines, of eight or ten men each, bringing water from the river in buckets, tubs, watering-pots, and anything that could be found, that would hold water. This being accomplished, and the eggs released from immediate danger, I gave attention to the wheel. It appeared that seven paddles were broken off, with a portion of each arm attached. The question now was whether the men could hold out bringing water till the wheel could be repaired. I do not know what we could have done in this emergency without the Indians; but I do not think we

could have saved the eggs except by their aid. They worked splendidly, most of them from eleven o'clock in the morning, when the wheel broke down, until four o'clock the next morning, when it was started again—seventeen hours of continuous work, with two very short interruptions, when I allowed them, three at a time, to run to the house to get something to eat. During all this seventeen hours some of them were carrying buckets of water that weighed sixty or seventy pounds each. They did not work as if they were working merely for pay; but they worked with genuine enthusiasm. They kept in good spirits, too, till an hour or two after midnight. But about two or three o'clock in the morning it was evident that it was all they could do to keep at it. I do not think they could have held out much longer. I have seen white men look as tired as they did, but I never saw such a tired look on Indians' faces before as there was on the faces of those red heroes who saved our salmon eggs. When it is remembered that we consider 10,000 gallons of water an hour necessary to keep all the eggs in good condition, an idea may be formed of the labor that was involved in bringing the water to the eggs. I must not forget to say here that the white men worked as heroically as the Indians, though their work was not as exhausting, and I must especially mention Mr. J. B. Campbell, who took charge of repairing the wheel, and who worked with all his might from the time it broke till it was fully repaired. At four o'clock in the morning the wheel was again making its accustomed revolutions and raising the regular current of water to the hatching house. When this had been accomplished the rest of us, leaving one man to watch the wheel till breakfast time, retired to sleep the remainder of the night.

Before leaving the subject of the accident to the wheel, I will mention a contrivance which we adopted for furnishing water to the eggs, which, though very simple, saved an enormous amount of labor and is strongly recommended for any hatching house that may be unfortunate enough to have its water supply cut off for any length of time.

The device was as follows: A long, large, receiving tank was placed under the outlet of the hatching troughs so as to catch and hold the water that flowed from them. In addition to this, a line of raised spouts was erected from the outlet end of the hatching house to the filtering tank at the other end, sufficiently elevated to deliver into the filtering tank the water that was poured in at the other end. Several men then went to work at the outlet end of the house to dip the water up in buckets from the receiving tank and to pour it into the head of the elevated line of spouts. The water so dipped up flowed down the line of spouts into the filtering tank, and thence over the eggs again into the receiving tank.

In this way a constant circulation was kept up through the hatching troughs by the small stationary force of men dipping and pouring at the elevated spout. This, with the water that was also being brought from the river, formed an adequate supply, and the eggs were kept in

perfect condition all night, and, strangely enough, there was no perceptible loss of eggs during the whole time of the stoppage of the wheel, although there were 7,500,000 salmon eggs in the hatching house.

Everything went on smoothly and prosperously after the wheel was restored, the eggs matured with less loss than usual, and on the 24th of September they were ready to be packed for shipment. On that day we packed and crated 1,450,000 eggs. On the next day we packed and crated 1,700,000, and on the third day we packed and crated 450,000, making in all 36 crates, containing a total of 3,600,000 eggs. These were all taken to Redding in wagons and then loaded into a car as usual, nearly all the spare space in the car being filled with ice.

This car left with the passenger train for the East on Wednesday morning, September 28, and arrived at Chicago on Monday, October 3. From Chicago the eggs were distributed by the United States Express Company as follows:

Record of the distribution of salmon eggs from the United States salmon-breeding station on the McCloud River, California, during the season of 1881.

Applicants.	Destination.	Number of eggs.
T. B. Ferguson	Druid Hill, Baltimore, Md	500,000
R. O. Sweney	Saint Paul, Minn	200,000
R. R. Livingston	Omaha, Nebr	500,000
A. H. Powers	Plymouth, N. H	50,000
H. G. Parker	Carson City, Nev	50,000
Seth Weeks	Corry, Pa	100,000
C. J. Huske	Walhalla, S. C	300,000
C. S. White	Romney, W. Va	100,000
S. Wilmot	New Castle, Ontario	500,000
Percy C. Ohl	Plainfield, N. J	50,000
Curtis Johnson	Saint Petersburg, Pa	50,000
Fred Mather	Newark, N. J	500,000

Besides the eggs mentioned in the above table 50,000 were sent on the 21st of September to the New South Wales Zoological Society, Sydney, New South Wales.

There were also sent, on the 28th of September, from Sacramento, by express, to Hon. B. B. Redding, California fish commission, 200,000 eggs; and to the Lenni Fish Propagating Company, Sonoma, Cal., 500,000 eggs.

Allow me to say, in conclusion, that this closes the tenth season of the labors of the United States Fish Commission in taking salmon eggs at this station. During that period nearly 70,000,000 salmon eggs have been taken and distributed, and, though sometimes great difficulties—and some that appeared insurmountable at the time—have been encountered, fortune has favored us through the decade, so that every year of the ten has been a successful one.

Below will be found tables showing—

(*a.*) The daily record of eggs taken.

(*b.*) The number of fish taken in the seine.

(*c.*) The temperature of air and water during the season.

(*d.*) The various collections sent to the Smithsonian Institution.

Table showing the number of female salmon spawned each day and the number of salmon eggs taken each day during the season of 1881.

Date.	Number of fish spawned.	Number of eggs taken.
Aug. 28	35	175,000
29	55	225,000
30	98	370,000
31	81	331,000
Sept. 1	104	439,000
2	172	665,000
3	179	770,000
4	190	945,000
5	221	914,000
6	200	836,000
7	213	875,000
8	181	725,000
Total	1,729	7,270,000

Average number of eggs to fish, 4,205. Average weight of females, 11¾ pounds.

Table giving list of specimens collected for the Smithsonian Institution.

[Catalogue of alcoholic specimens from McCloud River, California. Contributed by Livingston Stone.]

No.

700. Dolly Varden trout. 1881.
701. Salmon. June, 1881.
702. Salmon. June, 1881.
703. Salmon. June, 1881.
704. Salmon. June, 1881.
705. Salmon, male. August 26, 1881.
706. Salmon, male. August 26, 1881.
707. Salmon, male. August 26, 1881.
708. Salmon, male. August 26, 1881.
709. Jar of trout from trout ponds. 1881.
710. Jar of trout from trout ponds. 1881.
711. Salmon, female. August 31, 1881.
712. Salmon, female. August 31, 1881.
713. Salmon, female. August 31, 1881.
714. Salmon, female. August 31, 1881.
715. Jar containing—
    1 split-tail fish. June, 1881.
    2 young humming-birds. June, 1881.
    1 beetle. June, 1881.
    1 young mole. June 12, 1881.
    1 young rat. June 12, 1881.
    2 spleens. June 16, 1881.
    1 insect. June 16, 1881.
    5 lizard eggs. June 16, 1881.
716. Jar containing gills and viscera of a female salmon that died of the disease prevailing in the McCloud River during the summer of 1881. The spawn was very far advanced but not loose. August 4, 1881. Also viscera of three more. August 5, 1881.

717. Viscera of diseased salmon. July, 1881.
718. Female salmon. August 31, 1881.
719. Female salmon. August 31, 1881.
720. Head of salmon. Gills and eyes partly destroyed by fungus and healed again. July 8, 1881.
721. Jar containing—
    1 rattlesnake. June, 1881.
    1 king snake. June, 1881.
    1 king snake. July, 1881.
    1 small striped snake. July, 1881.
    1 small snake. June, 1881.
    1 lizard. June, 1881.
    1 lizard. July, 1881.

Memorandum of nests and eggs of birds collected on the McCloud River from May 29 to June 12, 1881.

1. King oriole. Nest and young.
2. Redheaded woodpecker. Found in stump of tree.
3. Male and female linnet nest and 3 eggs. Found on rafters of barn.
4. Female blue jay. Nest found in tall live oak.
5. Flycatcher (male) and nest.
6. Humming-bird Nest and 1 egg.
7. Cat-bird and nest.
8. Goldfinch and nest.
9. Unknown nest.
10. Unknown nest.
11. Humming-bird's nest.
12. Quail's nest. Four eggs.
13. Dove and egg. Found in hollow of ground (no other nest).
14. Quail's nest. Seven eggs.
15. Unknown nest. Three eggs.
16. Unknown nest.
17. Sundry unknown nests.
18. Oriole's nest.
19. A yellow-breasted bird and nest.
20. A yellow-bird's nest.
21. Unknown nest and egg.
22. Meadow-lark's nest and 4 eggs.
23. Unknown nest and 2 eggs.
24. Humming-bird's nest.
25. Flycatcher. Nest and 2 eggs.
26. Unknown bird and nest. Found on ground.
27. Unknown bird. Nest and 4 eggs.

List of geological specimens contributed by Livingston Stone.

1. Bones from Cave Bear Cave, McCloud River, California. July 29, 1881.
2. Teeth, McCloud River, California. July 29, 1881.
3. Portion of skull, supposed to be that of a bear, from new chamber of Cave Bear Cave, McCloud River, California. July 29, 1881.
4. Portion of jaw-bone, from new chamber of Cave Bear Cave, McCloud River, California. July 29, 1881.
5. Bones from Cave Bear Cave, McCloud River, California. July 29, 1881.

6 to 12, inclusive. Bones from Cave Bear Cave, McCloud River, California. July 29, 1881.

Table showing the number of salmon taken daily in the seine, with temperature of air and water, during the season of 1881.

[Record of salmon operations conducted at United States Salmon Hatchery, on the McCloud River, California, from August 25, 1881, to September 9, 1881, on account of the United States Fish Commission, by Livingston Stone.]

Date.	Hour.	Temperature of—		Fish taken.		Ripe fish.	
		Air.	Surface water.	Males.	Females.	Males.	Females.
Aug. 25	5.30 p. m.						10
26	5.30 p. m.	70	59	200	100	About one-eighth.	8
28	9.00 a. m.	70	60	200	150	do	27
28	6.30 p. m.	65	59	250	100	do	19
29	7.40 a. m.	64	54	100	100	do	30
29	9.30 a. m.	72	54	150	50	do	12
29	5.15 p. m.	78	58	100	50	do	1
29	5.45 p. m.			15	10	do	2
29	7.10 p. m.	72	60	175	75	do	11
29	8.10 p. m.	63	56	200	200	do	17
29	9.15 p. m.	58	56	250	250	do	11
30	5.20 a. m.	45	54	150	150	do	9
30	5.40 a. m.	45	55	125	125	do	3
30	8.00 a. m.	63	56	100	25	do	12
30	9.30 a. m.	68	54	40	40	do	
30	5.00 p. m.	86	56	25	25	do	2
30	5.30 p. m.	86	56	60	30	do	8
30	7.15 p. m.	66	54	30	30	do	14
30	7.45 p. m.	66	54	300	300	About one-fourth.	16
30	9.15 p. m.	55	54	150	150	do	10
31	5.00 a. m.	45	56	300	300	do	32
31	5.30 a. m.	45	56	50	50	do	5
31	7.12 a. m.	47	56	20	20	do	6
31	9.15 a. m.	65	56	20	5	do	3
31	5.15 p. m.	84	56	75	25	do	10
31	5.40 p. m.	82	55	250	250	About one-eighth.	5
31	7.00 p. m.	72	54	350	350	do	25
31	9.00 p. m.	62	54	250	250	do	10
Sept. 1	5.00 a. m.	48	53	300	300	do	30
1	6.10 a. m.	47	54	200	200	do	15
1	7.30 a. m.	55	54	10	10	do	5
1	9.00 a. m.	62	55	50	50	do	5
1	4.15 p. m.	82	57	250	250	do	28
1	4.40 p. m.	82	56	175	175	do	12
1	7.30 p. m.	75	56	125	125	do	11
1	8.30 p. m.	60	56	150	150	About one-fourth.	11
2	5.15 a. m.	58	56	600	600	do	51
2	6.30 a. m.	57	56	400	400	do	35
2	8.10 a. m.	60	56	150	150	do	14
2	10.00 a. m.	61	56	250	250	do	13
2	4.20 p. m.	71	56	350	350	do	39
2	5.05 p. m.	63	56	200	200	do	17

Table showing the number of salmon taken daily in the seine, &c.—Continued.

Date.	Hour.	Temperature of—		Fish taken.		Ripe fish.	
		Air.	Surface water.	Males.	Females.	Males.	Females.
Sept. 2	8.20 p. m.	60	51	750	750	....do	86
3	5.00 a. m.	50	54	250	250	....do	38
3	8.20 a. m.	60	53	300	300	....do	54
3	10.00 a. m.	69	54	240	110	....do	41
3	4.25 p. m.	80	57	250	250	....do	45
3	7.40 p. m.	60	55	800	800	....do	118
4	9.10 a. m.	73	55	300	300	One-half	33
4	10.40 a. m.	80	56	250	150	....do	22
4	11.15 a. m.	80	56	150	150	About one-half.	20
4	4.45 p. m.	85	57	255	255	....do	27
4	7.40 p. m.	78	58	400	400	Nearly all	137
5	7.30 a. m.	67	56	300	300	....do	95
5	9.30 a. m.	73	56	150	150	....do	42
5	11.30 a. m.	80	57	25	25	....do	6
5	7.00 p. m.	76	60	800	400	....do	156
6	8.00 a. m.	70	54	200	200	....do	64
6	10.10 a. m.	80	54	200	150	....do	16
6	11.20 a. m.	81	55	200	200	....do	21
6	4.40 p. m.	77	58	150	150	....do	20
6	7.35 p. m.	64	55	200	200	....do	39
6	8.00 p. m.	64	55	300	300	....do	25
7	5.30 a. m.	52	54	200	100	....do	19
7	6.15 a. m.	52	54	125	125	....do	15
7	7.35 a. m.	57	55	110	110	....do	8
7	9.45 a. m.	78	55	200	200	....do	46
7	11.55 a. m.	87	56	150	150	....do	6
7	2.30 p. m.	92	57	125	125	....do	9
7	3.00 p. m.	92	57	50	50	....do	6
7	5.15 p. m.	68	58	275	275	....do	20
7	5.40 p. m.	73	58	100	100	....do	8
7	7.15 p. m.	66	56	130	130	....do	20
7	8.40 p. m.	65	54	250	200	....do	27
8	6.00 a. m.	48	54	175	175	....do	28
8	7.50 a. m.	50	54	200	150	....do	18
8	9.20 a. m.	70	56	160	160	....do	24
8	10.30 a. m.	74	56	125	125	....do	8
8	11.50 a. m.	87	57	115	115	....do	11
8	4.35 p. m.	82	58	50	50	....do	12
8	5.50 p. m.	80	57	50	25	....do	9
8	7.15 p. m.	68	54	150	150	....do	24
8	7.50 p. m.	66	54	300	200	....do	19

Table of temperatures taken at the United States salmon-breeding station, McCloud River, California, during the season of 1881.

Month.	Air.				Water.			Wind, 7 a. m.	Weather.
	Shade.			Sun.					
	7 a. m.	8 p. m.	7 p. m.	3 p. m.	7 a. m.	3 p. m.	7 p. m.		
	°	°	°	°	°	°	°		
Apr. 16	49	55	.....	.....	57	51	.....	SW.	Rain.
17	48	56	.....	.....	50	50	.....	SW.	Do.
18	49	56	.....	.....	50	50	.....	SW.	Do.
19	49	.....	.....	91	51	.....	.....	SW.	Clear.
20	49	57	.....	92	50	50	.....	.....	
21	48	58	.....	.....	50	.....	.....	.....	Rain p. m.
22	48	58	.....	.....	50	.....	.....	.....	Showers.
23	49	57	.....	.....	49	49	.....	.....	Rain a. m.; clear p. m.
24	42	70	.....	96	.....	.....	.....	.....	Clear.
25	43	74	.....	100	50	51	.....	.....	Do.
26	53	70	.....	104	51	53	.....	S.	Do.
27	40	.....	.....	105	51	.....	.....	S.	Do.
28	54	85	.....	110	52	56	.....	S.	Do.
29	55	86	.....	114	.....	56	.....	S.	Do.
30	55	.....	.....	.....	52	.....	.....	S.	Do.
May 1	.....	80	.....	100	.....	57	.....	S.	Do.

Table of temperatures taken at the United States salmon-breeding station, &c.—Continued.

Month.	Air.				Water.			Wind, 7 a. m.	Weather.
	Shade.			Sun.					
	7 a. m.	3 p. m.	7 p. m.	3 p. m.	7 a. m.	3 p. m.	7 p. m.		
	°	°	°	°	°	°	°		
May 2	55	78	.....	96	54	58	.....	S.	Clear.
3	55	84	.....	109	54	57	.....	S.	Do.
4	53	79	.....	81	54	55	.....	S.	Rain through night.
5	56	80	.....	96	54	.....	.....	S.	
6	60	78	.....	104	52	54	.....	S.	Clear.
7	56	.....	.....	.....	52	52	.....	S.	Rain.
8	59	68	.....	.....	53	55	.....	S.	Heavy rain.
9	61	65	.....	82	54	54	.....	S.	Clear.
10	47	.....	.....	91	50	52	.....	NW.	Do.
11	57	84	.....	94	51	52	.....	NW.	Do.
12	56	77	.....	89	53	56	.....	NW.	Do.
13	.....	86	.....	106	53	56	.....	NW.	Do.
14	58	86	.....	104	53	57	.....	NW.	Do.
15	59	.....	.....	.....	54	.....	.....	NW.	Do.
16	65	84	.....	101	53	56	.....	NW.	Do.
17	.....	85	.....	98	.....	56	.....	NW.	Do.
18	56	90	.....	106	53	56	.....	NW.	Do.
19	55	91	.....	111	54	57	.....	NW.	Do.
20	58	88	.....	100	55	58	.....	NW.	Do.
21	60	75	.....	88	55	57	.....	NW.	Cloudy.
22	60	60	.....	90	55	57	.....	S.	Clear.
23	51	72	.....	.....	52	54	.....	NW.	Do.
24	51	79	.....	91	52	55	.....	SW.	Do.
25	57	86	.....	101	52	56	.....	NW.	Do.
26	57	80	.....	82	54	56	.....	NW.	Do.
27	54	81	.....	52	53	54	.....	NW.	Do.
28	51	.....	.....	.....	52	.....	.....	NW.	Do.
29	.....	85	.....	100	.....	56	.....	SW.	Do.
30	60	69	.....	.....	53	54	.....	.....	Do.
31	61	79	.....	105	52	57	.....	.....	Do.
June 1	63	84	.....	109	55	58	.....	SW.	Do.
2	62	85	.....	102	56	59	.....	SW.	Heavy rain; thunder.
3	63	67	.....	.....	56	56	.....	SW.	Clear a. m.; rain p. m.
4	59	81	.....	103	53	57	.....	SW.	Heavy rain at night.
5	60	73	.....	.....	53	56	.....	SW.	Clear.
6	61	66	.....	.....	53	55	.....	SW.	Do.
7	53	66	.....	.....	52	53	.....	S.	Do.
8	55	68	.....	.....	52	54	.....	S.	Do.
9	.....	77	.....	97	54	55	.....	NW.	Do.
10	61	68	.....	.....	.....	55	.....	S.	Do.
11	.....	77	.....	82	.....	57	.....	S.	Do.
12	.....	84	.....	101	.....	58	.....	NW.	Do.
13	62	80	.....	.....	54	59	.....	.....	Cloudy.
14	63	84	.....	.....	53	59	.....	.....	Clear.
15	63	84	64	108	54	59	56	.....	
16	62	85	.....	114	54	58	.....	.....	
17	.....	86	66	109	.....	59	56	N.	
18	65	81	.....	94	55	59	.....	S.	
19	.....	70	66	93	.....	59	.....	S.	
20	60	75	65	94	55	58	57	S.	
21	64	82	68	108	54	58	57	NE.	
22	64	89	70	110	55	58	50	NE.	
23	61	91	.....	103	55	.....	.....	.....	
24	61	90	78	114	56	60	60	.....	
25	64	94	.....	116	57	60	.....	.....	Hazy.
26	68	96	80	124	57	61	60	.....	
27	68	97	82	123	57	61½	61	NW.	
28	68	84	80	103	58	61½	61	SW.	
29	60	73	69	84	57	59	58	SW.	Clear.
30	53	74	70	89	55	60	57	SW.	Do.
July 1	54	79	74	106	55	57	57	SW.	Do.
2	52	72	64	92	55	57	56	SW.	Do.
3	.....	90	71	110	.....	57	57	NE.	Do.
4	58	95	.....	122	55	59	.....	NE.	Do.
5	55	94	84	117	55	60	60	SW.	Do.
6	54	87	74	111	56	60	58	SW.	Do.
7	62	84	77	105	55	58	58	NE.	Do.
8	62	78	77	97	55	57	56	SW.	Do.
9	53	80	74	102	53	58	58	SW.	Do.
10	.....	91	81	115	56	60	59	NE.	Do.
11	72	93	81	116	56	60	60	NE.	Do.