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By Joel W. Hedgpeth

LIVINGSTON STONE AND FISH CULTURE IN CALIFORNIA

By Joel W. Hedgpeth ¹

When Livingston Stone came to California from New Hampshire in 1872 and established the first salmon hatchery on the Pacific Coast in the wild and unsettled McCloud River country of California, he could have had no idea that his site and much of the river itself would be far beneath the surface of one of the world's largest reservoirs 71 years later. Yet this will be the fate of Baird Hatchery when Shasta Dam is completed in 1943; not only will the site of the hatchery be under nearly 300 feet of water, but the remains of the faithful Indians who worked at the hatchery will be exhumed as well to be reinterred in some other "last" resting place. Of the hatchery itself there will be no memorial but the successful transplanting of chinook salmon to New Zealand and the entertaining but almost forgotten reports written by its founder to Professor Spencer Fullerton Baird, the first U.S. Commissioner of Fisheries. The magnificent salmon which brought Livingston Stone to California with the hope of establishing them in the East to replace the Atlantic salmon will no longer spawn in the McCloud by the foot of Mount Persephone, nor can they long be expected to survive, in any considerable numbers, the changes which will be wrought in their ancient domain by the development of the Central Valley Project. Yet long before this elaborate plan was considered possible, Livingston Stone foresaw the eventual extermination of the salmon in California by the "slow but inexorable march of the destroying agencies of human progress * * *. The helpless salmon's life is gripped between two forces - the murderous greed of the fisherman and the white man's advancing civilization * * *," he declared in an address before the American Fisheries Society in 1892, predicting the salmon's fate by asking a question that needed no answer, " * * * and what hope is there for the salmon in the end?" ² That eleventh hour of which he spoke has lasted until the season of 1940, however, when some unaccountable train of circumstances has permitted a greater number of salmon to return to the rivers of central California than many can remember in the past 20 years. Perhaps it is appropriate that the salmon themselves should contribute this final irony to the long and for the most part futile struggle of the fish-culturists to maintain their numbers in the face of the ever increasing development of hydro-electric and irrigation projects. That this effort has failed and gives but little hope of future success is no reflection on the pioneer work of Livingston Stone, for few men have worked with such indefatigable energy as did this former clergyman for the cause of fish culture and the dissemination of desirable fish to other parts of the country. It is on the doorsteps of those who have forgotten or who ignore the experiences and efforts of such men as Seth Green, Charles G. Atkins and Livingston Stone that we must lay the blame for the fact that fish culture has not progressed as far as it should.

¹ The writer was formerly employed by the U.S. Engineer Department, Sacramento, California on the debris , on the debris dams fisheries investigation and the U.S. Bureau of Reclamation on the Shasta Dam salvage investigation. The opinions expressed in this paper are the author's own.

² A national salmon park. American Fisheries Society. Transactions, 1892, pp. 149-162, 1893. In this paper Stone advocated the establishment of a natural preserve on Afognak Island. The island was set aside shortly after this address by presidential proclamation as a forest and fish-cultural reserve, and in 1908 a hatchery was constructed.

Acknowledgments

The author wishes to express his obligation and gratitude to Mrs. Edmund Cushing Stone for much information about her late father-in-law and for the generous loan of material and photographs. Other sources for this paper are the annual reports of the U.S. Commissioner of Fisheries from 1872 on, especially those volumes in which Stone's reports of operations at Baird appeared, and numerous scattered papers. Mr. Don Bloch of the informational service of the U.S. Fish and Wildlife Service and Miss Ruth G. Buffum Librarian of the Meadville Theological School have kindly consulted records for the writer and their letters have supplied important details. A sketch of Stone's life and genealogy, with a photograph taken in later life, appeared in the first volume of R.A. Oakes' "Genealogical and family history of the County of Jefferson, New York," pp.626633 (New York and Chicago, Lewis Publishing Co., 1905, 2 vols.), and his fisheries papers are listed in Bashford Dean's "Bibliography of Fishes". Sources directly quoted in this paper have been indicated by footnotes.

I

Livingston Stone, the founder of Baird Hatchery and one of the pioneers of the Federal fish-cultural program was born on October 21, 1836, in Cambridge, Massachusetts. He was descended by direct lines from the earliest settlers of Plymouth Colony, for his father's people arrived in the new world in 1636, and his mother was a Winship, of one of the oldest families of New England. Little has been recorded of his boyhood except his excellent record in the public schools of Cambridge, and of his career at Harvard not much more is known except that he studied Latin, Greek and mathematics, and was graduated with honors in 1857. Although his health had been delicate since childhood, he had learned to box and play tennis and was fond of outdoor excursions, but he seems to have attained his greatest proficiency at chess. In his later years he was noted as an excellent player, capable of defeating half a dozen opponents in a simultaneous match while blindfolded. It is not surprising that he should have decided to enter the ministry since he came from a staunch Unitarian family, and after completing his course at Harvard he entered the Meadville Theological School, from which he was graduated in 1860. Evidently his poor health prevented him from serving as a chaplain in the Civil War, since he was posted on the list of "Candidates for Settlement" shortly after his graduation and until his ordination as pastor of the Charlestown, New Hampshire, church on June 1, 1864. During the year 1862 he was in charge of the Unitarian Church in Billerica, Massachusetts, and toward the end of 1863, accepted the invitation from Charlestown, which resulted in his being called to the pulpit of that church in the following year,

Although Stone was well liked by his congregation and seemed destined for at least a modest success as a clergyman, his health did not improve and he decided to retire from the ministry in favor of an occupation which would enable him to be out of doors. Accordingly, he resigned his pastorate in 1866, despite the pleas of his parishioners to remain, and established his Cold Springs Trout Ponds at Charlestown. His decision to take up fish culture had apparently been reached as a result of a preliminary experiment in hatching trout eggs. Whether this experiment was a natural result of his canoeing and fishing excursions in Maine and New Brunswick waters or the consequence of a meeting with some early fish-culturists, Stone does not say in his reminiscences. As his friendship with Seth Green began about this

time, it does not seem unlikely that Green's example had some influence on Stone's selection of a new profession.

When Livingston Stone established his hatchery in 1866, fish culture was in its infancy in North America, and the very idea that fish could be artificially hatched was a novelty. The newspapers made much of the new fad and Stone found himself on the ground floor of a growing business. He became the editor of a fish-culturist's column for a New York paper and soon established himself as an authority on the subject. "Those were the palmy days of trout breeding in this country," he wrote many years later. ³ And, indeed they were, with eggs selling for \$10 a thousand and fry for \$40 a thousand. Among other items sold by Stone's hatchery in its early days was a complete outfit of one hundred fish and a trough for the parlor, suggested in a circular as a "novel Christmas present."

Stone was not content to work with trout alone, and in 1867 he was among the first to attempt the artificial propagation of salmon in the United States. These early experiments were carried out with eggs collected from salmon speared in New Brunswick by W. W. Fletcher. A salmon hatchery had already been started on a small scale by Samuel Wilmot at Newcastle, Ontario, but the exorbitant price of \$40 a thousand demanded for eggs by the Canadians was too much for the new State fish commissions, and in 1868 Stone was sent to New Brunswick in a cooperative venture by the State commissions of New Hampshire and Massachusetts to establish a salmon hatchery, under an arrangement by which half of the eggs were to go to the Canadians. This hatchery, the first large scale establishment of its kind in North America, was on the Miramichi River. The eggs for New Hampshire and Massachusetts were brought back by Stone to his Charlestown hatchery, but the Canadian share was neglected by the man left in charge and after two seasons the project was abandoned.

By 1870, fish culture was an established profession and a need for an association or society was recognized by those engaged in it. The idea for a sort of trade association to fix prices and discuss hatchery procedure seems to have occurred first to Rev. William Clift, but it is not difficult to imagine that most of the actual work of getting the group together was done by Livingston Stone. At any rate, in 1870, Clift, A.S. Collins, J.H. Slack, Fred Mather and Stone met to organize the American Fish Culturists' Association. Clift was the first president of this new society, now known as the American Fisheries Society, and Livingston Stone was the first secretary, and one of the drafters of the constitution. During the first year Stone wrote over 500 letters, including one to Louis Agassiz which began an enduring friendship, and on February 8, 1872, the society held its first annual meeting. At this meeting the need for a policy broader than that of price fixing and exchanging trade secrets was recognized and accordingly the name was changed to the American Fisheries Association (later to Society) to symbolize its broader policies, and the federal government was petitioned to establish salmon hatcheries on both Pacific and Atlantic coasts and to undertake a general fish-cultural

³ Some brief reminiscences of the early days of fish-culture in the United States U.S. Fish Commission. Bulletin. vol. 17 (1897). pp. 337-343, 1893.

program.⁴ The young association evidently had an influential champion in congress in the person of Hon. Robert B. Roosevelt, an ardent angler and amateur fish-culturist, for by June, 1872, an appropriation of \$15,000 was made by Congress for the propagation of food fishes, with the details of the program left up to Commissioner Baird. Baird promptly called a meeting of the state commissions and members of the American Fisheries Association to recommend the disposition of these funds; At this meeting, held on June 13, 1872, it was agreed to assign a third of the funds to planting shad in the Mississippi, and Seth Green and William Clift were selected for this task; another third was to subsidize Charles G. Atkins' salmon hatchery (built in 1870) on the Penobscot River in Maine; and the remaining third of the funds was to be used in establishing the groundwork for the collection of eggs of the Pacific salmon to be introduced in eastern waters to compensate for the depletion of the Atlantic salmon. As Livingston Stone was an active participant in this meeting and the idea of bringing eggs from the Pacific coast was his, he was delegated to carry out this last phase of the program. Accordingly, after a series of conferences with Baird, he was officially notified of his appointment as a Deputy Fish Commissioner by a letter dated July 6, 1872.

Livingston Stone, at the time of his departure for California, must have been a striking figure with his magnificent russet brown Dunderies in their prime, although he was of a medium, stocky build. The threat of ill health that had driven him from the ministry must have lost some of its force or he could scarcely have considered a trip to California in the days when railroad travel was not without its vicissitudes, as he was to discover a year later at the peril of his life. He had planned to expand his hatchery at Charlestown, acquiring for that purpose considerable areas of land which he was to advertise for sale many years later in a series of amusing broadsides, and had just completed his book on trout culture, "Domesticated Trout," which was to go through several editions and become one of the standard manuals of fish culture. Although he kept his Cold Springs hatchery for several years after his appointment as Deputy Commissioner, his life for the next 30 years was to center around the hatchery on the McCloud River, which he named Baird in honor of his friend and employer. The Cold Springs hatchery is now operated by the New Hampshire Fish and Game Department.

⁴ A somewhat different version of the founding of the Society is given by Mather in his book on fish culture (F. Mather fish culture in fresh and salt water, "Field and Stream Publishing Co., 1900). According to his account, "Mr. A.S. Collins, Dr. J.H. Slack and myself called a meeting" which resulted in the organization of the American Fisheries Society. Finding that this did not help to sell their eggs any better, they passed resolutions for government action. Mather evidently believes that he was also responsible for the establishment of the U.S. Fish Commission, to judge from his discussion, which is not phrased in the most modest of self-effacing terms. He ignores the existence of Stone (still active when this book was written) except to point out that he knew more about packing salmon eggs for shipment than Stone did and that his discovery of the method of lining hatchery troughs with tar superseded Stone's charcoal method. Ward T. Bower's version of the history of the American Fisheries Society (American Fisheries Society Transactions, 1910, pp. 323-369), although based on Stone's account ("The origin of the American Fisheries Society," Ibid., 1898, pp. 56-64), is the most objective account that has been published and is free from the personal bias evident in Mather's account.

Livingston Stone lost little time in starting on his mission after receiving his **official** authorization of July 6, 1872. On August 1 he left Boston for California, had found a hatchery site on the McCloud River by September 1, and on December 9 he was in San Francisco writing his report of the first season of his pioneering adventure in fish culture. This brief chronology gives little idea of the almost desperate dashing from place to place to find a hatchery site during those first weeks in California nor of the actual work accomplished.

On arriving in California, Stone discovered that little was known about the habits and spawning grounds of the salmon, and that even the California Fish Commissioners had only the vaguest ideas on the subject. Their first suggestion was that he establish himself at Rio Vista, a few miles below Sacramento, where the salmon were presumed to spawn. He needed only a glance at this broad sluggish reach of the river to realize that it would be necessary to search much farther upstream for the spawning grounds of the salmon. After a few other false leads he met the chief engineer of the Pacific Railroad, who mentioned having seen Indians spearing salmon on the McCloud River. Following this lead Stone journeyed north to Red Bluff, then the railroad terminus, and thence by stage to the Pit River ferry.

From there he walked up the river bank to the McCloud and two miles up that stream to the ancient Indian campsite and fishing grounds.

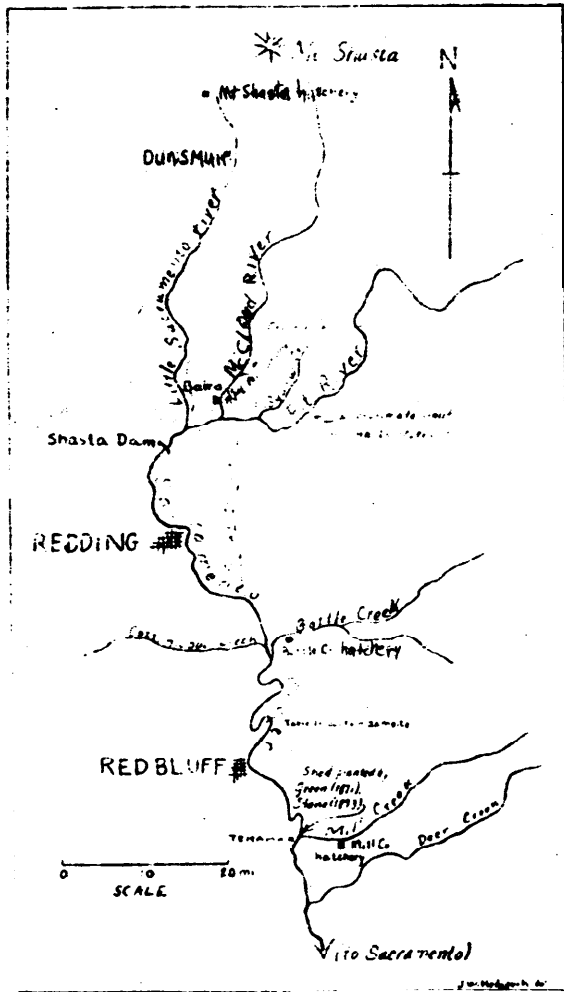


FIG. 31. Map of the upper Sacramento River System, showing the location of Baird, Mill Creek, Battle Creek and Mt. Shasta (formerly Sisson) hatcheries.

It was a spectacular scene. On the far side of the river the forest grew down to the very water's edge and behind the dark trees the grey limestone crags of Mount Persephone loomed like a tremendous bastion. On the near side, the river, after turning around the base of a little knoll on which the Indians buried their dead, ran quietly by a sand-bottomed cove. Here the Indians waded out to the white water of the rapids to spear the salmon as they cleared the shallow bar, and behind the cove was the camp ground, a shoulder of a hill, pitted by the fire holes of countless generations. Even today arrowheads can be found in the blackened earth among the heat-shattered river stones.

When Livingston Stone first saw this scene on August 30, 1872, the season was already far gone and he and his two young assistants, Myron Green and Willard T. Perrin (his nephew), set to work without delay. They had hoped to enlist the aid of the Indians but found that few of them knew any English, and being unable to communicate with them they had to build the station by themselves. In 15 days they had built a house and hatchery apparatus, including tanks and flume, and were ready to begin collecting eggs, although they were over 50 miles from the nearest railroad and sawmill and had to work during a hot spell with the mercury wavering from 105⁰ to 112⁰ in the shade during the fortnight. On September 16 they began to capture the salmon but found that they were too late for the best part of the run. They managed to gather 50,000 eggs, however, and 30,000 of these survived to be shipped East on October 23. Of these first 30,000 eggs, all but 7,000 had to be discarded on arrival. Although the record is somewhat vague on the point, between two and three hundred of these eggs appear to have been reared to fingerling size and planted in the Susquehannah River in March, 1873.

Lover of the out of doors that he was, Stone could not help but be impressed by the almost virgin wilderness in which he had established the hatchery, and in his reports are many fine descriptions which would never reach print were they submitted to those who edit today's carefully dehydrated government reports. Especially memorable is his description of a night during the first season in 1872, on the McCloud River: "On the darkest nights the scene on the river bank was exceedingly wild and picturesque. Behind us was the tall, deep shadow of Persephone Mountain, and before us at our feet ran the gleaming, rapid current of the McCloud, while the campfire threw an unsteady light upon the forest, mountain and river, suddenly cut off by the dense darkness beyond. The flaming pitch pine torches stuck into the sandy beach at intervals of 20 feet, to guide the boatmen, the dusky forms of a half dozen Indians coiled around the fire, or stoically watching the fishing, the net, the fishing boat, and the struggling fish, added to the effect, and made a picture which, especially when the woods were set afire to attract the fish, was one of surpassing interest. It was quite impressive, in the midst of these surroundings, to reflect that we were beyond the white man's boundary, in the home of the Indians, where the bear, the panther, the deer and the Indians had lived for centuries undisturbed." ⁵

⁵ U.S. Fish Commission. Report, 1872-73, pp. 172-173. This is the first mention of Persephone; perhaps the name was given by Stone himself.

There is no trace of sermonizing in these long reports, however, for is there any other evidence that he carried his former profession with him, although the absence of oaths and cards at the hatchery did cause a reporter to marvel when he visited the hatchery in 1874. While he was always interested in Sunday services for the Indians at Baird and perhaps participated in them to some extent, he had evidently given up preaching entirely, renouncing all the privileges and prerogatives of minister. On at least one occasion he preached at his former pulpit in Charlestown, however coming to the rescue of a pastor taken suddenly ill. Perhaps he thought it unseemly, being a serious minded man, to mix his former profession with his present one, but it seems more likely that fish culture was his greater love. Although he was occasionally referred to with the title of Reverend by some of his colleagues, he preferred to forget the title and in later years dropped it altogether. When he did use a title, it was the honorary A.M. granted by his alma mater in recognition of his services to fish culture.



FIG. 32 The founders of Baird - Myron Green, Livingston Stone and Willard T. Perrin
(Photograph taken in San Francisco in 1873.)

Not only did he succeed in describing the wilderness about him in vivid language, but he also recorded something of the customs of the Indians, and in his first reports, devoted several pages to a vocabulary of their language, certainly an unexpected detail to be included in a report of fish-cultural operations. But all this did not seem to be enough to keep him busy, for he found time to look over the country between Mount Shasta and San Francisco. In those days when rough narrow wagon roads were the only highways, this must have been a rather strenuous pastime, but he mentions it only in a brief paragraph in his report: "Permit me to ad that during the fall, I traveled the whole length of the Sacramento River, from its sources around Mount Shasta to its outlet at the bay of San Francisco, and also ascended the McCloud River as far as it is accessible which is about 20 miles * * *." 6

Livingston Stone's second season in California, that of 1873, was even busier than his first. In January he was still in San Francisco, preparing to receive a shipment of whitefish eggs from the Great Lakes. He had been given short notice of this shipment and was obliged to scurry around for a suitable lake in which to plant the fish. He selected Clear Lake after satisfying himself that it appeared suitable for fish life since there were already several varieties of fish, some of them in abundance, in the lake. The spawning migrations in the small brooks tributary to the lake were so heavy for example, that it was "difficult to cross the fords with a horse * * *" because of the almost solid mass of fish running. The whitefish eggs arrived safely and were hatched in an improvised establishment at Kelsey's Mill near Kelseyville and the fry planted in the lake. Although a few fish were taken for a year or two after this experiment, the attempt was unsuccessful, as were all the later attempts to plant the whitefish in other California lakes.

The arrangements for hatching the whitefish eggs had hardly been completed when Stone was summoned East to bring out an aquarium car - a fruit car improvised for the purpose - with a load of approximately 300,000 assorted fish, including catfish, eels, bullheads, perch, bass, trout and lobsters. After numerous delays, sidetrackings and a continuous struggle for ice between New Hampshire and Chicago, Livingston Stone, Myron Green and Willard T. Perrin were finally on their way west from Chicago, destined to meet with a disaster which nearly cost them their lives. They had reached Omaha safely and were beginning to believe that they would be able to get the fish to California safely when the bridge over the Elkhorn River gave way and threw part of the train, including the fish car, into the river. One man was crushed to death in the cab and two swept down the river in a "drowning condition." Stone and his assistants managed to work free of the car in which they were trapped by the shifting fish tanks and swim to safety.

The worthy Fish Commissioners of California, Messrs. Throckmorton, Redding and Farwell, were determined to have fish brought to California, and Stone had hardly finished telegraphing the news to Professor Baird of the inadvertent planting of the fish in the Elkhorn River before he was ordered to return East and take a shipment of shad to California. § This venture proved more successful and the transportation across the continent proceeded without mishap although with a continuous struggle to keep the fish cool during the first part of the trip and warm over the Rockies. It was considered necessary to change the water every two hours, and there were several lively arguments between the engineers and train crews on one side and the fish culturists on the other. Of the 40,000 shad brought from the Hudson River on this trip, 5,000 were planted in the Jordan River in Utah, and 35,000 in the Sacramento River at Tehama on July 2, 1873, with a loss of but 400 fish on the long trip. This was the

7 The U.S. Fish Commission Report, 1873-74 and 1874-75, p. 378.

8 That Professor Baird did not believe the fish a total loss is evident from his report for 1872-73, in which he remarks that "some of (the fish) will be valuable acquisitions to the systems of water where fate has consigned them." U.S. Fish Commission. Report, 1872-73, p. xxix.

second planting of shad in California, the first planting having been accomplished two years before by Seth Green. ⁹

Having seen the shad safely into the river, Stone and his two assistants left for the McCloud River to begin the second season of egg taking. They arrived the next day to find the Indians resentful over this usurpation of their traditional fishing grounds, and it was not until they understood that the fish were to be turned over to them after the eggs had been taken that they became reconciled to the new order of things. There must have been other tense moments during this season, and we find Stone writing in his report that the "Indians had until this time succeeded in keeping the white man from their river, with the exception of a Mr. Crooks, whom they murdered a week after I arrived." Although Stone himself seemed to have a way with the Indians and became their lifelong friend, there was Indian trouble of some kind or another for several years in the vicinity. Most of the trouble was more imagined than actual, although it must have been a trying day for Loren Green (Myron's elder brother) in 1879, when he was obliged to stare a group of Indians in the eye while they fingered their knives and waited for him to make the first move, on the very scene of the demise of the Mr. Crooks mentioned above. Fortunately for Green, the Indians, after several tense hours, took themselves off without acting on their threat.

The second season on the McCloud was also noteworthy for the construction of a water wheel to supply the hatchery troughs (as in the first season, the troughs were under a large tent). This effort was watched with the "greatest solicitude," and when the wheel was completed the occasion was celebrated by raising a large flag at sunset. But the wheel failed to work as expected and there was great gloom in the camp when the wheel stopped after an abortive groan. With the removal of half the buckets, however, the wheel operated successfully and for several years a wheel of some kind or another was the main source for the hatchery water supply. While most of the eggs from the season of 1873 were shipped East in the effort to replace the Atlantic salmon, a half million fry were returned to the McCloud River and 20,000 eggs were shipped to New Zealand. This was the first of many shipments of eggs which eventually resulted in the establishment of the chinook salmon in New Zealand waters, which must be considered one of the happier examples of fish introduction. ¹⁰

The first two seasons on the McCloud were experimental in character, but with the season of 1874 operations on a large scale were begun in earnest and 5,752,000 eggs were taken. In that year a crew of nine, including a photographer and a Chinese cook, was engaged and an extensive building program was carried out. Dwelling houses, sheds and a rack in the river were constructed, but it was not until 1876 that a permanent hatchery building was erected. The hatchery was now becoming famous and began to attract visitors, among them a roving

⁹ For a detailed account of the various introductions of fish to California, see Hugh M. Smith, 'A review of the history and results of the attempts to acclimatize fish and other animals in the Pacific States.' U.S. Fish Commission. Bulletin, vol.15 (1895), pp. 379-472, pls. 73-83, 1896.

¹⁰ Introductions before 1900 were failures, according to F.A. Davidson and S. J. Hutchinson. "The geographic distribution and environmental limitations of the Pacific salmon (genus *Oncorhynchus*). U.S. Bureau of Fisheries. Bulletin, vol. 48 (1938). pp. 667-692.

journalist who contributed a full page article to the "Sacramento Record," in which he made much of the energy of the crew and their willingness to sleep on rough planks, and was evidently impressed by Livingston Stone's polished Harvard manner, for he came away with the opinion that the workers had proved that "cultured intelligence and horny hands may meet in harmony." A more formal article appeared in the "Overland Monthly" for January, 1875, overburdened with the mellifluous language of the day but revealing that from a thousand eggs taken by the hatchery 950 fish could be expected. That nature could do better was inconceivable, is at least the implication of this article, which in one passage describes salmon eggs as "amber colored spawn globules." ¹²

Another visitor in 1874 was John Muir, walking from Redding to Mount Shasta, a trip which was described in his "Steep Trails," although he did not mention his stay at the hatchery in the book. For several days he remained at the hatchery, observing the Indians and trying to persuade Stone to accompany him on his trip to Mount Shasta. John Muir, who could never leave a hill unclimbed, and Livingston Stone, always eager for such an excursion, climbed Mount Persephone on October 19. They ran most of the way down the hill, and Stone earned Muir's admiration for his running ability. Unfortunately, Stone could not spare the time to go to Mount Shasta after all, so John Muir went on alone, after writing a brief description of the hatchery which appeared in the "San Francisco Bulletin" for October 29, 1874. ¹³

With a large crew the work was easier than it had been during the first two seasons and Sunday became a day of rest and recreation. It was on one of these quiet Sundays that Stone and some of his young assistants explored the caves in the limestone crags of Mount Persephone across the river from the hatchery. This excursion is described in such vivid detail that it might well be published in a guide book for the Shasta reservoir area, for a trip by boat from Shasta Dam up the McCloud River to the Baird caves (famous among paleontologists for the Pleistocene fossils found in them) may become one of the scenic attractions of the region when Shasta Dam is completed. Reprinting this original description of the caves would go far toward correcting a curious mistake in a recent guide book. ¹⁴

¹¹ Salmonidae. Pisciculture, etc. Sacramento Daily Record, August 29. 1874. p. 8.

¹² Turner, W.M. Salmon hatching on the McCloud River. Overland Monthly, vol. 14, pp. 79-85, 1875.

¹³ From John Muir's journal. The writer wishes to thank Mrs. Linie Marsh Wolfe for her courtesy in showing him Muir's journal and scrapbook.

¹⁴ "California, a guide to the Golden State" (American Guide Series) New York Hastings House. 1939. 713 pp. The note on page 436 under Baird reads: 'Left from Baird on a dirt road 0.2 mi. to the United States Fish Hatchery where salmon are propagated in the California Caves on the bank of the river.' Stone's description will be found in U.S.Fish Commission Report.1873-75, pp. 463-464.

It was in this year, 1874, that Stone brought out the second assortment of fish in an aquarium car to make up for the accident in Nebraska the year before. This shipment included black bass, glass-eyed perch, catfish, Atlantic salmon, eels, lobsters, and some unidentified catfish taken on at a stopover at the Elkhorn River. The California Fish Commission had also asked for striped bass, but their suggestion came too late for the proper preparations to be made and these fish were not brought out until 1879. Most of the fish brought out on this trip did not establish themselves, but the plantings of black bass and horned pouts (*Ameiurus nebulosus*), together with successive plantings, were successful, and now these fish are major elements of the fauna of California waters. "To Mr. Stone more than to any other person is the direct credit due for the introduction of most of those fishes which have since attained economic importance, : wrote Smith in his report on the acclimatization of fish in the Pacific States, 15 and according to Stone himself it was no mean feat to bring a car load of fish across the country in the days when railroad schedules were not too reliable and suitable water often unavailable for hundreds of miles. The 1874 trip lasted eight days and was evidently uncomfortable: "The unusual chill and dampness that pervaded the car, together with the immense labor and loss of sleep, had made nearly all on board sick, for a greater or less time; and altogether the trip had been one of such extreme hardship and severe labor, that we hailed the last day with a sense of greatest relief." 16

Stone did not conduct another such wholesale experiment in fish introduction until 1879 when he brought out 150 striped bass, which he released at Martinez, along with a consignment of lobsters, eels and black bass. The striped bass established themselves with remarkable success from this insignificant number and the second planting by J.G. Woodbury in 1882 was more or less of an anticlimax. Twenty-one of the original twenty-two berried lobsters survived the trip and were planted off Bonito Light, never to be heard of again.

By 1875, the hatchery on the McCloud River was well established and placed on a year-round basis under the charge of Myron Green during the time when Stone was away. On December 9, 1875, the hatchery and its environs were set aside as a government reservation by a presidential proclamation, although it was not known as Baird until the establishment of a post office in 1878. During the season of 1875, when there was a notably large salmon run in California, Stone was delegated to investigate the declining salmon fishery of the Columbia. Two years later he founded the Clackamas Hatchery near Portland, partially as a result of this investigation. The season on the McCloud River was not without its diversions, however, principally on account of one Leschinsky who believed that his use of the fishing ground near the hatchery had given him a prior claim to the property.

15 Smith, H.M., loc cit. p. 380

16 California Fish Commission. Biennial Report, 1874-75. p. 30.

Leschinsky's insistence on fishing below the rack resulted in "a very exciting collision, in which some violence was resorted to on both sides, though no deadly weapons were used." ¹⁷ As Leschinsky subsequently took himself off, there seems to be no doubt about who won the fight, which is hardly surprising when it is remembered that Stone was an excellent boxer and not averse to taking on a heavier opponent. Although he makes no mention of it in his official report, this was Livingston Stone's honeymoon - - he had just been married in April after a courtship which began when he was called to the pulpit of the Charlestown Unitarian Church.

Leschinsky was back again the next year, however, taking advantage of a clerical error in the presidential proclamation of 1875 by which the principal seining ground had been omitted from the reservation. After a few altercations had disturbed the peace in camp, Stone mounted his horse and rode over the hills to the nearest copy of the State laws, in which he found that it was illegal to seine more than a third of the width of the river. Since Leschinsky had been fishing from more than his share of the river, he was frightened off by threats of durance vile.

The next year, in 1877, to impress upon certain elements of the scanty population of the region that the hatchery was government property and perhaps to protect the Indians, the U.S. Army, in the person of a lieutenant and four privates, was garrisoned at the hatchery. Leschinsky appeared again and was conducted off the premises by a U.S. Marshal. During this season of 1877, Stone was away from Baird most of the time, establishing the Clackamas Hatchery under difficult and trying circumstances, including the complete loss of the first catch of eggs by a sudden rise of the river.

Although the country was still unsettled and uncivilized a year later, the corporal's guard was not in evidence during the season of 1878. There was an Indian scare, a local threat of intertribal war between the McCloud and Yreka Indians, probably part of the great Ghost Dance disturbance of 1878, which made the men at the hatchery so nervous that Stone telegraphed for arms and ammunition. One dark Sunday night, when Stone and an assistant were alone at the hatchery, some prowlers so frightened them that they dared not venture outside to investigate, but locked all the doors against what might have been a band of desperadoes, lurking in the bushes and planning to cut their throats. A week later, two robbers, perhaps the same men, stole 20 demijohns of whiskey (as well as his ready cash) from a teamster stopping over at the hatchery and started a drunken debauch among the Indians.

With the sixth report of operations at Baird (1879) the narrative became more business like and less entertaining to the general reader, although there is an interesting account of the establishment of the Crooks Creek trout ponds a few miles up the river from Baird. ¹⁸ It was

¹⁷ U.S. Fish Commission. Report, 1875-76, p. 936.

¹⁸ The story of the work at the trout ponds has been recently reviewed by J.H. Wales in his "General report of investigations on the McCloud River drainage in 1938." California Fish and Game. vol. 25, no. 4, pp. 272-309, 1939.

during this first summer at the trout station that Loren Green had his brush with the Indians. It was evidently an eventful summer for the Greens, as Loren also had an encounter with a mountain lion (whose closer acquaintance he avoided by jumping into his boat) and Myron Green was bitten by a tarantula. The treatment for this latter calamity was an external application of moist tobacco and a tumblerful of alcohol internally -- somewhat diluted by water. "I mention these incidents," remarked Stone, for the benefit of his colleagues in the settled East, "merely to show that with tarantulas, scorpions, rattlesnakes, Indians, panthers and threats of murder our course here is not wholly over a path of roses." ¹⁹ The operations at the salmon hatchery proceeded without notable incident during this season; the army was back, the Indians docile, and two racks were used for the first time. Grilse appeared to be the dominant element of the run this year, a fact which was blamed on the intensive fishery by the now numerous canneries on the lower river. That the salmon could support such a large canning industry seemed to prove, according to Stone and the California Fish Commissioners, that Baird Hatchery was the major factor in the increase of the salmon in the Sacramento.

Perhaps the most significant item in the 1879 report is the recommendation that a trained biologist be added to the staff and that scientific investigation be a regular part of the work at the hatchery. Had this suggestion been adopted and the precedent of an adequate check-up of hatchery effort been established, our knowledge of the salmon might have advanced beyond the rudimentary stage in which it is even today, 70 years after the establishment of Baird Hatchery.

There is nothing eventful in the report of operations at Baird for 1880, but in January, 1881, an epic flood in northern California carried away practically the entire establishment and the hatchery had to be completely rebuilt on higher ground. Livingston Stone was evidently at his best when building something, and in this report, the last long one published, we find a complete description of the harrowing nights of February 2 and 3 when the McCloud River rose 26 feet, carrying all before it, and the vivid story of rebuilding the hatchery to the tune of hammers on new boards and the shouts of the teamsters urging their horses on in the difficult task of grading rocky hillsides for safer building sites. All through the hot summer the work went on, from May 23 to September 1, and in that time the force of 20 white men and a dozen Indians had built a substantial mess house, hatchery building and stable, as well as a bridge and rack across the river. It was also necessary to fill in the bottom of the seining ground and make new boats which served as floats for the current wheel. Their troubles were not over with the rebuilding of the hatchery, however, for they had hardly completed their work and begun the season's operations when some debris rammed the current wheel, putting it out of commission. For 17 hours the Indians supplied water to the hatchery troughs by a bucket line while the wheel was being repaired.

¹⁹ U.S. Fish Commission. Report 1879. p. 718.

After this last great effort, Stone's career at Baird was almost anticlimactic. In 1883 the construction of the railroad along the Little Sacramento River north of Redding so affected the salmon that only a million eggs were taken, and operations were suspended at Baird from 1884 to 1887, inclusive. The Crooks Creek work with the trout was continued during this time. The season for egg taking receded each year, indicating a diminution of the trout population of the river, and in 1887 this work was abandoned, it having been decided that the establishment of the rainbow trout in eastern states made it unnecessary to continue gathering eggs at the McCloud River station.

Livingston Stone was recommended for the position of U.S. Commissioner of Fisheries after the death of Professor Baird in 1887, by his old friend Seth Green. Stone declined this honor, however, as he believed that outdoor life was essential to his health. A few months later, in 1888, Stone was made field superintendent for the Pacific Coast, with instructions from the new Commissioner, Marshall McDonald, to intensify the fish-cultural program and to arrange for the acquisition of Clackamas Hatchery from the State of Oregon. Baird was opened as a salmon station for the 1888 season under the supervision of George B. Williams, and Stone spent much of his time at the Clackamas Hatchery, which he succeeded in obtaining for the Federal Government without cost. During the summer of the following year, Stone was one of a party under the leadership of Tarleton H. Bean, investigating the salmon fisheries of Alaska, particularly on Kodiak and Afognak islands. Stone advocated the establishment of a hatchery on Afognak Island and was instrumental in having the island set aside as a fish-cultural reserve in 1892.

After the resignation of Williams as superintendent of Baird in 1892. Stone returned to his first post, where he remained in charge until 1897. ²⁰ By this time his son had reached high school age and his wife longed for the social environment in which she had been raised, so on July 10, 1897, at his own request. Livingston Stone was transferred to Cape Vincent Hatchery, New York.

During Stone's last years at Baird the custom of employing college students for summer work at a dollar a day had become established, and many men who are now prominent in the universities and museums of the country can look back on their summer's work at Baird with pleasant memories of the old Indians and their feasts, of the Widow Derby's boarding house, and of Livingston Stone himself, bewhiskered and favoring a straw hat and shirt sleeves, partial to those young men who could give him a good game of tennis. The foreman during those days was Theodore Bass, whose principal claims to fame were his 14 children and the doubtful honor of having had his horse stolen by Joaquin Miller. ²¹

²⁰ According to the record in the office of the U.S. Fish and Wildlife Service. Stone was furloughed March 31, 1890. What he did from that date until his return to Baird August 1, 1892, is not mentioned.

²¹ The writer wishes to acknowledge his indebtedness to Dr. Alvin R. Seale, Director of the Steinhart Aquarium, San Francisco, for these reminiscences.

Although Livingston Stone was past 60 when he reluctantly left Baird, realizing that he would never again see the place he had come to love, he had not yet retired but kept his new post at Cape Vincent for nine years. He could still play a good game of tennis and apparently retained much of the energy which had carried him through the strenuous pioneering days at Baird. As America's senior fish-culturist, he was called upon to supply his reminiscences for the National Fisheries Congress in 1898, and in 1903 took part in the ceremonies in which the granite boulder memorial to Professor Baird at Woods Hole was dedicated. When he retired in 1906 at the age of '70, Stone had completed 40 years in the cause of American fish culture. He had seen it grow from its beginnings in the little private trout hatcheries of New England to the far flung enterprise of the U.S. Bureau of Fisheries. The vocation he had adopted in 1866 to save his health had not failed him and in his turn he had been one of its most prominent figures for the greater part of his life. He spent the remaining years of his life with his family in Pittsburgh, his last years clouded by a failing memory. He died on December 24, 1912, at the age of 77 years, and is buried in Boston's historic Mount Auburn cemetery.

III

After Stone's departure from California, Baird Hatchery continued to operate about as usual until 1909, handling several million eggs each season. In 1903 and 1905 over 25,000,000 eggs were taken, a huge increase unexplained in the reports. The records for 1910 were not published, and in 1911 only 60,000 eggs were taken from the McCloud River - - the end was in sight. Only once after 1911, in 1931, were more than a million and a half eggs taken, while for many years the collections were negligible. During these later years Baird was primarily a handling station for eggs from Battle Creek and Mill Creek hatcheries, established in 1896 and 1901, respectively. The impossibility of determining, from the published records, the comparative size and composition of the runs from year to year with any accuracy, and the total lack of any reliable figures on the exact numbers of eggs taken or the losses incurred during incubation for the 60 years of operations at Baird make it impossible to determine the effect of Baird Hatchery on the Sacramento River salmon fishery. 22

22 That Hatchery records still left much to be desired even as late as 1935, when Baird was in its final season, is evident from the article on hatchery records by M.C. James in the "progressive Fish Culturist," no. 2 pp. 1-4, 1935.

It is not surprising that the original plan of establishing the Pacific salmon in eastern waters to replace the Atlantic salmon did not succeed; at the time very little was known about the Pacific salmon, and it has only been conceded in the last few years that a thorough preliminary study of the fish and the waters into which they are to be transferred should be made before any attempt to transfer them as resumed. In the 1906 Report of the U.S. Commissioner of Fisheries the failure to establish the chinook salmon in eastern waters was admitted. It was suggested, by way of explanation, that this species was too large and robust for the smaller eastern streams. Thereafter several attempts were made to establish the smaller silver and hump back salmons, but without success. Rumors of small salmon runs from species introduced in the East turn up from time to time but Huntsman and Dymond discount these rumors and deny that there is any evidence that introduced Pacific salmon have produced a second generation in Atlantic coast streams. ²³ The recent capture of two adult chinooks off the mouth of the Pemaquid River in Maine has revived interest in transferring the chinook, but it may be several years before the necessary investigations are completed and another experiment in transferring these fish is made. ²⁴

²³ Huntsman, A.G., and Dymond, J.R. Pacific salmon not established in Atlantic waters. *Science*, vol. 91, no. 2367, pp. 447-449, 1940.

²⁴ U.S. Fish and Wildlife Service. Fisheries Service Bulletin. no. 306, pp. 1-9. 1940.

Whether this policy leads to successful introduction or not, it is an advance over the days when fish were promiscuously introduced into all sorts of waters, with the avowed hope that something would “take” somewhere. As Stone put it, salmon were introduced into “many places in Eastern States, where they will undoubtedly be a total failure, but should the Commission make a success of a single river * * * it would pay for all that has been expended in this direction in all the other waters of the United States.”²⁵ California’s share of this epidemic of fish transferring was marked by several conspicuous successes, notably the shad, catfish and striped bass, but the introduction of the carp, in which Stone had no part, can hardly be considered an unmixed blessing. Because of the paucity of desirable native fishes in California rivers the introduction of many of these species was well justified. On the other hand, while the virtual extermination of the sturgeon from California waters can not be blamed entirely upon the introduction of other species, it does not seem unreasonable to assume that these introductions had some influence on the depletion of the sturgeon, as well as contributing toward the reduction of less important native species. Early objections to the introduction of this or that fish were overruled on the grounds that the plan was to introduce everybody’s favorite fish, and even a few Atlantic salmon were released at Redding, a veritable gesture of carrying coals to Newcastle. Promiscuous introductions are now frowned upon and our various fish and game commissions have at least advanced beyond the unenlightened attitude of the California Fish Commissioners of 1874, who advocated that nine-tenths of the sea lions be shot and their oil be used for lubricating purposes because they were suspected of destroying more salmon than the fishermen.

Equally fantastic were the claims made for the share of the Baird Hatchery in the increase of the salmon fishery on the Sacramento. In 1874 the policy of returning a large number of eggs to the McCloud River at Baird was adopted in order to build up the run, and by 1877 the increased fishery was considered conclusive evidence of the success of the hatchery. Although it now seems obvious that the increase was primarily due to the intensified fishing effort, it must be remembered that the life cycle of the chinook salmon was misunderstood for many years. Livingston Stone, although recognizing that the majority of the salmon in the McCloud River were several years old, speculated on the possibility of the fish spawning in other rivers before their final migration, and the California Fish Commission refused to believe that the salmon spawned but once. “It if were the fact,” the Commissioners contended, “* * * it would detract from their value.”²⁶

²⁵ California Fish Commission. Biennial Report, 1874-75, p. 18.

²⁶ California Fish Commission Biennial Report, 1876-77, p. 7. That the chinook salmon spawns but once and then dies was first proven conclusively by Evermann’s investigations in Idaho in 1895. (‘A report upon salmon investigations in the head waters of the Columbia together with notes upon the fishes observed in that state in 1894 and 1895.’ U.S. Fish Commission. Bulletin. vol. 16 (1896) pp. 149-202, 1897). Stone’s views on the natural history of the chinook, together with a brief history of Baird and fish-cultural methods, follows Evermann’s paper in the same volume (pp. 203-235).

The principal basis for the assertions of the extravagant claims for the hatchery in its early years was the misconception of the efficiency of natural reproduction, evidently based on nothing more than an a priori assumption that nature was inherently wasteful and inefficient. Stone in his first report, part of which consisted of answers to a series of questions written out by Professor Baird, "No one knows" opposite Baird's inquiry on the survival of naturally spawned eggs. At some time or another, he did dig into a nest, recovered some eggs, and found but 8% of them "vitalised".²⁷ According to the 1878-79 Biennial Report of the California Fish Commission, "in a state of nature, only two eggs in a thousand hatch." No authority is given for this interesting statement, however.

No attempt seems to have been made to investigate the life of the salmon in California until 1896, nearly 18 years after Stone's request for a biologist as part of the regular staff at Baird Hatchery. In that year studies of downstream migration were begun by N.B. Scofield and A.B. Alexander. This investigation was continued from 1897 to 1903 under the direction of Cloudsley Rutter, but was based at the Battle Creek Hatchery. During the summers of 1901 and 1902, C.W. Greene made studies of the physiological changes undergone by the salmon during migration, spending most of his time at Baird.²⁸ It was during the study by Rutter and his assistants that the first serious attempt was made to observe the spawning of chinook salmon and determine natural losses. As excellent as Rutter's work was in other respects, his observations of the spawning process were so inaccurate that he concluded that the female salmon dug holes in the gravel to loosen the eggs in her body and that no eggs were deposited in the nest at all but simply released to find their way into the gravel.²⁹ It is not surprising that he should have concluded from such observations that the natural loss was 99%. As controversial as these findings appear to present day investigators, they were unchallenged until the appearance of Hobbs' classic paper in 1937 on the natural reproduction of salmon and trout in New Zealand.³⁰ The mere fact that the salmon have persisted in some of the Central Valley streams where there are no hatcheries, despite the steady encroachment on their spawning grounds by hydroelectric and irrigation projects and a heavy fishery indicates the remarkable tenacity of the species and tends to support Hobbs' contention that the natural reproduction of the salmon is a highly efficient process.

²⁷ The only reference found to this is in Robert Barnwell Roosevelt's "The game fish of the northern states and British provinces" (New York, Orange Judd co., 1884), this seems to be based on a conversation with Stone (cf. p. 235). In his 1896 paper (loc. cit.) Stone states that the percentage of survival of naturally spawned eggs is unknown.

²⁸ Greene, C.W. Physiological studies of the chinook salmon. U.S. Bureau of Fisheries. Bulletin. vol. 24 (1904). pp. 429-456, 1905.

²⁹ Rutter, Cloudsley M. Natural history of the quinnat salmon. A report of investigations in the Sacramento river, 1896-1901. U.S. Fish Commission. bulletin, vol. 22 (1902), pp. 65-141, 1904. Perhaps Rutter did not have the time to dig thoroughly into the nests; it often requires several hours to find the pockets of eggs in a single nest, especially in the murky Sacramento. In addition to the salmon investigation, Rutter was directing a survey of the sea lion population from Puget Sound to San Diego, and in 1902 began a survey of the salmon fishery of Alaska. He died suddenly in 1903 while working on the embryology of the salmon.

³⁰ Hobbs, D.F. Natural reproduction of quinnat salmon, brown and rainbow trout in certain New Zealand waters. New Zealand. Marine Dept. Fisheries Bulletin, no. 6.104 pp.. 1937. Perhaps it is poetic justice that this study, which proved that losses to eggs under natural conditions compared favorably with the rosier claims of the Fish culturists, should have been made with salmon introduced to New Zealand from Baird Hatchery.

On the other hand, the high claims made for artificial propagation by hatchery proponents are not supported by the records of the three northern California hatcheries, Baird, Battle Creek and Mill Creek. While these records must be taken with a grain of salt, they do not exaggerate the numbers of eggs taken. In many cases the figures published in the reports of the U.S. Commissioner of Fisheries are considerably lower than the original hatchery records (cf. appendix tables 19-20 of Hanson, Smith and Needham, "An investigation of fish-salvage problems in relation to Shasta Dam." U.S. Bureau of Fisheries. Special Scientific Report, No. 10, 200 pp., 1940), indicating some sort of double entry method of accounting for losses to eggs in the hatcheries. Furthermore, it must be remembered that the total number of eggs collected at a hatchery is not an accurate indication of the size of the run since early flash floods frequently made it impossible to gather a large number of eggs from good runs, while poor runs may have supplied large totals in years of favorable weather conditions. Bearing these sources of error in mind, however, some interesting conclusions can be deduced from the records as summarized in the accompanying table.

The record of Baird reflects the difficulties of seining fish in the McCloud River more than it does the abundance of fish in that stream, but in later years the comments submitted with the records mention the scarcity of fish in the river, and it is apparent that the last decline had begun before the effects of the opening of the Glen-Colusa ditch in 1910 should have been evident and certainly before the construction of the Anderson-Cottonwood Irrigation District Dam at Redding in 1917. As a matter of fact, from 1919 to 1926, with the exception of 1921, a million and a half eggs were taken annually at Baird although the dam was without a proper fishway until 1927, whereas the collections from 1911 to 1919 were negligible. It is also interesting to note that egg collections dropped to zero in 1927 and were not very much more than that during the last years of Baird's existence as an active fish hatchery with the exception of 1931, which was a good year at all three hatcheries. It was necessary to open the racks and permit the surplus fish to ascend the streams and spawn naturally during that season. During the last active season at Baird, that of 1935, only 5,200 eggs were taken (probably from a single female) and 1,500,000 were transferred from Battle Creek.

The records of Battle and Mill creek hatcheries are more interesting in that they reveal a steady drain upon the spawning populations of these streams without destroying the runs. From 1901 to 1912 there is no mention of any fry having been released in the streams from which the eggs were taken, and the practice during this period was to ship most of the eggs to the California State hatchery at Sisson (Mount Shasta). Most of the fry from these eggs were released in the upper Sacramento River. After 1908 the egg take in these streams dropped and in 1913 nearly five million fry were returned to Battle Creek and the attempt to build up the Mill Creek run began a year later. The egg collections declined steadily, however, until about 1920, after which there was no significant fluctuation. This may have been determined in part by the dire financial straits of the U.S. bureau of Fisheries about that time, but as far as the record is concerned, the effect of the hatchery operations and the various transfers of eggs from one place to another on the balance of the salmon population among the three streams was insignificant. It would appear from these records that the runs in Battle and Mill creeks include a considerable number of fish that have strayed from the run in the main river. As a result of a marking experiment in 1920, in which fish were released from Mount Shasta Hatchery (from eggs taken at Mill Creek), and recoveries made in Battle and Mill creeks, Snyder concluded provisionally that "such (fish) as return are probably scattered over the

entire basin, or because of adverse conditions they are forced to enter tributaries before they are able to reach the one into which they were originally introduced.”³¹

In 1903 work was intensified at the hatcheries and 27,350,000 eggs were taken at Baird. The fishery, in the meanwhile, was declining and the canneries were suspended after the 1905 season. The mile-cure catch increased slightly from 1903 to 1906 and then dropped but reached a record high of over 4,000,000 pounds in both 1909 and 1910. Over a hundred million eggs had been taken by the three hatcheries in 1905, and the subsequent release of the fry from Mount Shasta Hatchery may conceivably have had some effect on this increase, although it is also possible that 1909 and 1910 were simply good years for salmon, comparable to the 1940 season. Although the canneries were closed after 1919 and the mile-cure catch fell considerably below that of former years, there was no significant increase in egg collections that might be attributed to a greater escapement.

In recent years the river fishery has declined steadily, falling below the 500,000 pound mark on several occasions, but this does not indicate the true value of the Sacramento River as a salmon stream, since most of the fishing effort has been transferred to the ocean.³² The value of this fishery is one of the crucial points involved in the selection of a salvage plan to replace the spawning grounds which are now being cut off by the construction of Shasta Dam. The cost of whatever plan is adopted must be balanced against the value of the fishery in terms of dollars and cents.

³¹ Snyder, J.O. Salmon of the **Klamath River, California, California**. Division of Fish and Game. Fish Bulletin, no. 34, p. 71, 1931. In this experiment, 15,400 fry, raised at Mount Shasta Hatchery from eggs taken at Mill Creek, were marked and release in SullawaCreek hatchery. None of these fish appear to have returned to Sullaway Creek, although six were recovered from Mill Creek and fifteen from Battle Creek. Although this and similar experiments have been accepted as support of the home stream (or home drainage basin) theory , it might also be accepted as an indication that the Mill and Battle Creek runs are more in the nature of dispersions from a single main run, subject to the variations in stream conditions from year to year. Although Rich ("Local populations and migration in relation to the conservation of Pacific salmon in the western states and Alaska, " in "The migration and conservation of salmon," American Association for the Advancement of Science. Publication, no. 8, pp. 45-50, 1939) maintains that "practical conservation measures must be based on the 'home stream theory' as an essentially correct statement" (p.47), it would not appear that proposals to divert runs from one stream to another in the upper Sacramento River drainage by the transfer of one or two cycles of adults will be successful on the basis of the scanty information available. Such a program may mean the perpetual hauling of adult salmon from collecting stations to streams in which they are to spawn or be held for ripening and subsequent artificial propagation. We may have a better understanding of this matter when the results of the wholesale transfers of fish to the tributaries of the Columbia River between Rock Island and Grand Coulee dams become apparent, although those streams are more constant, in flow at least, than the streams in northern California. An experimental transfer of salmon from Redding to Deer Creek, 18 miles north of Chico, is being made during the summer of 1941. It is hoped that this experiment will demonstrate the feasibility of holding a large number of spring run salmon in this stream during the hot summer, but any effect on the salmon population of Deer Creek cannot be anticipated for several years, however.

³² Clark. G.H. California salmon catch records. California Fish and Game, vol26, no. I. pp. 49-66. 1940.

As a result of an investigation begun in 1938 by the U.S. Bureau of Reclamation of salmon biology and stream conditions in northern California (which was, incidentally, based at Baird) several salvage plans were conceived. Because there is so very little water left in the region, all the plans required hatcheries, racks and waterworks, in one case even the rehabilitation of an entire stream, Stillwater Creek. ³³ The plan now under consideration involves a system of racks in the Sacramento River between Battle Creek and Redding to hold fall run salmon in enclosures where they will be expected to spawn, and a huge hatchery, one of the world's largest, on Battle Creek to handle the eggs from spring and early fall run fish. Whether the racks will work or not, no one is certain as the scheme has never been tried before, but hatcheries have been none too successful in that part of the world, however efficient they may have been in other regions. Baird Hatchery would probably have been abandoned in any event. It is not unreasonable to assume that Livingston Stone, were he alive today, would admit that another hatchery seems a poor substitute for California's once magnificent river system and that here at last is the doom of the salmon which he foretold. Nor would he fail to appreciate the irony of the fact that the biological investigators who sought to determine a salvage plan were based at Baird after it was no longer a hatchery.

It is doubtful, however, that the Chinook salmon will become entirely extinct in the rivers of central California, for there are still a few accessible spawning areas left and in time the species may adjust itself to the remainder of its territory if it is adequately protected from poachers on the spawning riffles and its seaward migrating young screened out of diversions. The problem of salvaging salmon from the streams which will be blocked by Shasta Dam is so difficult that any attempt to cope with it may be unsuccessful. It should not be forgotten that there is another dam on the Sacramento River in the plans for the development of the State's water resources. The site for this dam is at Table Mountain near Red Bluff and its construction would wipe out the salvage investment between it and Shasta Dam, as it would be 300 feet high. ³⁴

³³ The report of this survey. 'An investigation of fish-salvage problems in relation to Shasta Dam,' by H.A. Hanson, O.R. Smith and P.R. Needham, mimeographed as Special Scientific Report, no. 10 (1940) of the U.S. Bureau of Fisheries, has been published in a condensed version in vol. 70 (1941) of the Transactions, American Fisheries Society.

³⁴ The present agitation to hurry completion of power facilities of various projects in the name of the national emergency is a serious danger to wildlife, as pointed out by Ira N. Gabrielson, director of the U.S. Fish and Wildlife Service, in an address to the Sixth North American Wildlife Congress. This agitation is especially strong in behalf of Shasta Dam. According to George C. Tenney, editor of "Electrical West," the power supply for northern California is adequate, however, and there seems to be a coincidence between these so-called power shortages and the necessity for large appropriations to complete the projects. The inconsistency of blocking the expansion plans of a private power company while inching upon the early completion of Shasta Dam caused Tenney to remark, 'Under the circumstances, there is room for questioning all but the political validity of these so-called 'power shortage' claims.' (San Francisco Chronicle, February 8. 1941, p. 15.) Since the Pacific Gas and Electric Company has now been granted permission to carry out its expansion program it would seem reasonable to assume that there should now be no necessity to adopt inadequate salmon salvage measures at Shasta Dam simply to complete the project ahead of schedule.

To the engineer who plans the dams and the politician who promotes them for the glory of his constituents, the salmon have little sentimental value, although in fairness to these gentlemen it must be said that the fish had been given up for lost in California long before this and they could hardly be expected to share the biologist's peculiar interest in the preservation of a species for its own sake. Yet, whoever has seen the magnificent leap of a salmon over the crest of a weir can not but regret its passing from so many of our streams. The great runs are gone and with them have vanished the simple Indians whose life depended on them, and soon the rivers themselves will be gone, their ancient beds far beneath the surfaces of the reservoirs. While speculation about the value of this sort of progress is vain (and there are many economists who deny the necessity for some of these grandiose projects) the destruction or impairment of an important natural resource is a high price for such progress, and it has been more than unfortunate that actual construction of the dams involved was begun without any consideration of the fish runs in the rivers.

“The unpardonable indifference of Californians” toward their most valuable fish resource which so disgusted Professor Baird in the 80's has not changed perceptibly; if anything, it has increased. Yet the salmon have persisted and even increased in some years despite the works of man and his indifference to their welfare. Now, man, as an unwitting by-product of his great power and irrigation scheme, has started an experiment with the salmon's life which will be irrevocable. Whether or not it succeeds will make but little difference, for it will be too late to make any changes when the result is finally known. Let us hope that the salmon will persist, even if only as a scattered remnant of its once abundant legions.

We should not forget, as did a recent writer on the history of the Sacramento River, ³⁵ that once salmon canning was one of California's major industries and that the fish were first canned in this State. Nor should we forget that there was a day when our salmon were so highly esteemed that an energetic man with flowing Dundrearies came 3,000 miles to gather their eggs in an attempt to plant the fish in his own New England.

³⁵ Dana, Julian. *The Sacramento, river of gold*. New York, Farrar & Rinehart, 1939. 294