REPORT OF THE COMMISSIONERS OF FISHERIES.

STATE OF CALIFORNIA

1880.

California. Dept. of Fish and Game.
Biennial Report 1880.

(bound volume)

DATE DUE

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REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA,

FOR THE

Year 1880.

REPORT.

To his Excellency GEORGE C. PERKINS, *Governor of California:*

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature entitled "An Act to provide for the restoration and preservation of fish in the waters of this State," approved April 2, 1870, respectfully submit their sixth report.

Heretofore reports of the transactions of the Fish Commissioners have been made biennially, at the meeting of each Legislature. The change in time for submitting a statement of our operations, required by the adoption of the new Constitution, necessarily limits this report to the proceedings of the past year.

SACRAMENTO SALMON—ONCORHYNCHUS QUINNAT.

It is with pleasure we report that the annual hatching of two millions of these fish, and placing them in the tributaries of the Sacramento River, are producing their legitimate results. The numbers of salmon that could have been taken in this river, before the greater part of their spawning beds had been destroyed by sediment from the gold mines, can never be known. It is the testimony of all the pioneer miners that every tributary of the Sacramento, at the commencement of mining, was, in the season, filled with this fish, hurrying and struggling as if to reach the very sources of these streams. A few salmon continued to enter the Feather, Yuba, Bear, and American Rivers until the floods of the Winter of 1860–1, which covered the gravel bottoms of all those streams with mining sediment, and thereby destroyed their spawning grounds. Continuous and unrestricted fishing, and the destruction by mining of so large an area of clean beds of gravel, reduced this fish in numbers in the Sacramento until, in the season of 1872 and 1873, there were probably less than at any other time before or since. Several thousands of young fish, artificially hatched, were placed in the head waters by the United States prior to 1873. In that year we made arrangements with the United States authorities to hatch our quota of the eggs annually given to each State, at an expense of $1,000 for each million of fish hatched out and turned into the river. Including 2,225,000 fish just placed in the head waters, there have been hatched by the State, and turned into the McCloud, Pit, and Upper Sacramento Rivers, 15,350,000 young salmon.

It seemed desirable that a record should be kept of the catch of salmon in the Sacramento, so as to learn the effect on this industry of the annual deposit of these two million young salmon.

Since 1874 we have obtained the numbers and weight of salmon

caught in the Sacramento and San Joaquin, that have been transported from the place of capture, to the Cities of San Francisco, Sacramento and Stockton, by rail and steamboats, as also the numbers and weight of salmon put up in tins by the different canning establishments. We have been unable to obtain the weight of salmon salted, and the numbers and weight of salmon caught near the mouth of Feather River, and by the fishermen near Tehama, and in the upper waters of the Sacramento and San Joaquin. Neither can we obtain the numbers and weight of those taken to market by fishermen in their own boats, nor those caught and salted, in violation of law, during the close season. Therefore, to the weight of salmon actually taken to market by rail and steamboats, and the salmon actually tinned, we have added twenty-five per cent., the total being a close approximation of the actual catch for the season.

This system has been pursued since we commenced in 1873, to gather the statistics of the catch of salmon in the Sacramento River. The record is as follows:

For season ending August 1, 1875	5,098,781 pounds.
For season ending August 1, 1876	5,311,423 pounds.
For season ending August 1, 1877	6,493,563 pounds.
For season ending August 1, 1878	5,520,768 pounds.
For season ending August 1, 1879	4,432,250 pounds.
For season ending August 1, 1880	10,837,400 pounds.

In the season, ending August 1, 1879, the salmon were reported to be as numerous as ever before known, but for three weeks, during the height of the season, in consequence of a disagreement between the fishermen and the proprietors of canning establishments, no salmon were taken, except for daily consumption in the city markets. It will be seen that the catch of 1880 was the largest ever reported, and that the weight of salmon captured has doubled since the State's appropriation enabled us to place annually an average of two million young fish in the head waters of the Sacramento. The fishermen, as well as the proprietors of canning establishments, are beginning to acknowledge that the annual addition of two million young fish to the river, over and above those naturally hatched, does, after two or three years, add to the numbers of mature fish to be found in the river.

More young fish have been taken by the fishermen, during the past two years, than ever before; and more young fish have appeared on the spawning beds of the McCloud, during the same period, than have heretofore been observed.

The increase in the numbers and weight of fish taken, and the immense numbers of young fish that reach the spawning grounds from the ocean, are conclusive evidence that the expenditure, by the State, of money, in the artificial hatching of salmon, is a most profitable investment for the public benefit. The increase of fish, by artificial propagation, has doubled the annual catch of salmon in the river, correspondingly added to the numbers of men and boats engaged in the industry, and warranted the investment of not less than $300,000 in the erection and equipment of salmon canning establishments.

When the State commenced the work of artificially hatching salmon, and placing the young fish into the head waters of the rivers, there were no canning establishments on the Sacramento River. Now, on the river, and in the cities, there are nine. The State

appropriation for fish hatching may be said to have created this industry. To show with what rapidity this business is growing, it may be stated that in 1879 there were tinned, of Sacramento River salmon, 33,017 cases of forty-eight pounds each, or 1,584,816 pounds. In 1880 there were tinned 62,000 cases of forty-eight pounds each, or 2,976,000 pounds.

The average catch of salmon in the rivers, before the State added to the numbers by artificial hatching, was five million pounds. This, to persons not controlled by narrow personal interest or cupidity, would be convincing evidence of the wisdom of the State laws for the promotion and increase of this industry. Yet, strange as it may seem, it is the history of the fish industry of every State in the Union, and of all other countries, that when public moneys are used to add to the numbers of fish to be caught, not only the fishermen, but the owners of large capital invested in the business, are unremitting and persistent in their applications for the repeal of all laws that place any restriction upon unlimited fishing. The perpetuation of the salmon industry is absolutely dependent upon the fact that some of the fish must be allowed to pass the nets and reach their spawning grounds at the head waters. It is only at the sources of streams, and under the conditions there found, that the eggs will naturally develop into fish. It is only when the fish reach their spawning grounds that their eggs have become sufficiently matured so that they may be taken for artificial propagation. These facts are well known and undisputed, yet the Legislature is biennially besieged to repeal the law, or to so change it that practically there shall be no limit to fishing while there is a fish to be found in the river.

From the report of Mr. H. D. Dunn, who, in gathering statistics of the weight of salmon tinned from the Sacramento, may be learned the views of the gentlemen engaged in the salmon canning business. It will be seen that they also, with the fishermen, practically ask a repeal of the law which now allows some of the fish to reach their spawning grounds. They claim that if all nets were removed from the river from Saturday noon until Monday morning of each week, this would allow a sufficient number of fish to pass. They also assert that the present law (except by the canneries) is violated. They, however, neglect to state that if the close season were changed to suit their views, and increase the profits of their business, they would hardly stop to inquire, on Monday morning, whether the fish brought to them were caught on that morning or on Sunday.

Many changes have been made by succeeding Legislatures in the time for a close season for salmon. Every concession is taken as a basis for further changes, looking to the present profits of the fishermen and canners. Neither the fish, the public, nor the future of the business appears to have many friends. Any restrictions upon unlimited fishing and unlimited canning, while a fish can be found in the river, is looked upon as a personal injury, inflicted by a meddlesome and tyrannical government.

Under the present law the fish have so increased that the annual catch has more than doubled. Although the law is violated by many fishermen, yet the canning proprietors have so much capital invested that they fear to violate the law by canning fish out of season. Their obedience compels a partial observance of the law on the part of the fishermen. When the canneries cease work, as required by the present law, fish are usually quite numerous in the river. During

the close season no salmon are sold in the city markets, the canneries dare not purchase, and the greater number of fishermen cease work. A few, determined to oppose any law, still continue to draw their nets, and salt the catch in by-places among the tule islands. At this season the fish are gravid and unfit for food, and whenever canned or salted in this condition and sold, they injure the character, in the markets of the world, of all the fish shipped from the river where such fish are attempted to be utilized. On the Columbia River, without any requirement of law, the canners cease work on the first of August, not because there are not fish still to be taken, but because they are over ripe. They have found that the tinning of over ripe fish injures the reputation and lowers the standard of the whole season's work. The standing of the tinned salmon of the Sacramento would have been as high, in foreign markets, as that of the rivers of Oregon had not the greed of a prominent canning firm induced them, at the commencement of their business, to tin over ripe fish.

We desire to add that the present law for a close season may lessen immediate profits, but it perpetuates the business, leaves fish for those who will succeed us, compels a high standard for Sacramento salmon, makes this fish almost the cheapest food in the State, and is for the best interest of the public, who are taxed to keep up and increase the numbers of fish in the rivers.

The report of Mr. H. D. Dunn, which follows, in addition to the statistical information which it contains, also gives fully the views of the proprietors of the canning establishments, which, as heretofore, will be urgently pressed upon the attention of the Legislature. In reply to these requests so plausibly stated, we have to repeat, if salmon are to be continued in our rivers, a large number of the fish must be allowed to reach their spawning grounds, not accidently or by chance, but systematically, and by design. The fishermen will not cease fishing Sundays while there are canners to buy all that may be brought Monday morning. Therefore, as at present, the canneries should cease work during a few weeks of the time after the fish have come in from the ocean, and are on their urgent errand to their spawning beds.

SAN FRANCISCO, CALIFORNIA, December 21, 1880.

To Board of California State Fish Commissioners, San Francisco, California:

GENTLEMEN: From inquiries made of parties engaged in the business, I learn that there has been packed at the canneries on the Sacramento River and in this city about 62,000 cases of salmon, of four dozen one-pound tins each. All these salmon were taken from the waters of Suisun Bay and the Sacramento and San Joaquin Rivers. These salmon averaged about twelve pounds each when taken.

There were also packed in Smith's River, in this State, during the present year, 7,500 cases salmon of four dozen one-pound tins each, and five hundred barrels salted down.

There were also packed in Eel River, in this State, about 6,250 cases salmon of four dozen one-pound tins each, and as far as can be estimated, about 1,500 barrels salted down. The salmon in both these rivers are reported to have averaged about ten pounds weight each when taken.

A new feature this year was the engaging in the business in this city of four fruit canning establishments, viz.: Chas. King, of Wm. & Co., A. Lusk & Co., Emerson, Corville & Co., and the Cutting Packing Company. A portion of the fish canned by these firms was purchased at the wharves in this city, and the others of fishermen on the Sacramento River.

During the open season, the run of salmon in the Sacramento River was very large, being in excess of any previous year known. The supply taken by the fishermen at times being in excess of the wants of the canneries, the surplus fish were brought to San Francisco for sale, many spoiling and being thrown into the bay.

After the expiration of the close season (September 15th), the run of salmon was extremely large, but lasted for about ten days only, during which, on the 15th, 16th, and 17th of Septem-

ber, it was estimated that fully nine thousand fish were thrown back into the river, thus wasted, for want of purchasers.

An unusual circumstance, this season, connected with fishing on the Sacramento River, has been a large run of salmon during the present month (December), boats averaging from forty to fifty fish per day, when from five to ten were the catch in prior years. As the canneries are all closed, and an abundant supply salted for the present year, a very large number of these salmon will probably reach their spawning grounds, at the head waters of the Sacramento River.

During the close season, between August 1, and September 15, the law was openly violated by the fishermen, who defied arrest and conviction for the offenses. The few persons who were arrested were taken to Suisun City, Solano County, where no conviction could be had, it being stated that public opinion there was adverse to the law. That the close season was openly and persistently violated by the fishermen on the Sacramento and San Joaquin Rivers was a matter of notoriety, and parties, well informed, stated that the number of salmon taken, in violation of law, and salted and smoked, was in excess of those supplied to the canneries and city markets, during the legal season. As an illustration of the large number thus taken, a person of credibility, engaged in the canning business, stated to me that he knew of two fishermen (owning one boat between them) selling, since the close season expired, two hundred barrels salted salmon, which is equal to four thousand salmon, or more than the united catch of three average boats before August 1.

Another party informed me that salmon were taken frequently in sight of Collinsville on the Sacramento River, and also in the San Joaquin River, during the close season, in daylight, without any attempt at concealment. The same person stated that he saw lying on the wharf at mid-day, during the close season, at Webb's Landing, on the San Joaquin River, from five hundred to six hundred salmon, the fishermen cleaning and salting the same, regardless of who might see them.

Though the price of salmon ruled low (from one dollar and five cents to one dollar and ten cents per dozen) all the canneries in this State, except one at Black Diamond Landing, Contra Costa County, were actively employed during the past season. The canneries were as follows: One each, Washington, Courtland, Chipp's Island, Smith's River, and Eel River; two at Collinsville, and four in San Francisco—eleven in all employed. From what I can learn, a similar number will probably be employed during the coming season, action having already been taken for that purpose. A canning factory at Benicia, during 1881, is also among the probabilities. Unforeseen adverse circumstances excepted, it seems probable that more salmon will be canned in this State during 1881 than in any previous year, as should the catch justify it, other canneries in this city may engage in the trade. The city canneries have greater advantages, they employing skilled labor continuously during the larger portion of the year, while the time of the canneries on the rivers is not only limited, but is broken by the close season, after which it is difficult to engage workmen for so few days work as the run of fish may last.

As all information connected with the taking of salmon is of interest to the Commissioners, I deem it right to advise you of the feeling of canners with whom I have conversed, regarding the present law of this State. These parties complain that the six weeks' close season in the height of the run of salmon puts them to large additional expense, as compared with the canners on the Columbia, and other salmon rivers north; that at present, on the Sacramento and San Joaquin Rivers, the canneries have a supply of salmon for about six weeks only, as during the greater part of June and July the run is very uncertain; during which, they have to be at the same expense as if there was full work for their employés; that nothing is saved to the State by the close season, as salmon are taken in large quantities by the fishermen, in defiance of the law; that the fishermen, after having gone to the expense and labor of salting the salmon so taken, receive a less price for them than what would be paid them if it were lawful to sell them to the canneries: that while the canneries pay thirty-five cents for the fish delivered to them, the fishermen sell their salted salmon, delivered in this city, at from fifteen to twenty-five cents each; that allowing for salt, labor, and freight, the salted salmon net the fishermen from ten to fifteen cents, instead of thirty-five cents paid at the canneries.

The canners claim that while the present law against taking salmon in the close season is a dead letter, from inability to enforce it, that modifications can be made for their benefit without injury to the best interests of the State. Their desire is to have the close season for taking salmon limited to thirty-six hours each week, extending from Saturday noon to Monday morning, claiming that this time being observed, sufficient spawning fish will reach the head waters of the Sacramento River to furnish all the eggs required to keep up the supply. They ask that this may be done, pledging themselves to aid in enforcing the law, which they will be able to do by refusing to take any fish taken during the close time: that if this change is made, and the result is not satisfactory, after trial, to the Commissioners, they, the canners, will not oppose a reënactment of the present law, if the former desire it. To aid in keeping up the supply of salmon, the canners propose to have all the boats taking salmon licensed, and if need be the canners also; that the sum so collected be paid to the Fish Commission as a fund to be expended in hatching out salmon to keep up the supply; that the boats being licensed will keep out poachers, who will be easily detected if the licensed boats are properly marked with large figures to insure identification: that at the present time all fishing boats being of the same model, and painted of the same color, it is practically impossible to identify them, and they can be and are loaned to other parties who violate the law without liability to confiscation.

I have taken the liberty of writing thus fully the views of the canners, so that the Commissioners may be advised of the same before the meeting of the State Legislature, next month.

Also, that if it should be desirable to have the canners explain their views more in detail, the Commissioners could meet them for that purpose and thereby be able to devise, if possible, some united action by which the fishing interests of the State would be increased.

I am, yours truly,

HORACE D. DUNN.

The following statement shows the numbers of salmon transported by rail and steamers from the fishing grounds of the Sacramento and San Joaquin to the Cities of San Francisco, Sacramento, and Stockton, from September 15, 1879, to August 1, 1880. It is to be regretted that some of the transporting companies do not keep the numbers and weight of sturgeon separate from those of the salmon. It is, however, thought that the numbers and weight of sturgeon were not in excess of previous years. It is also to be regretted that in one instance the numbers of salmon had to be approximated, in consequence of carelessness in making the necessary entries:

SUMMARY.

Shipments per steamer Enterprise	40,829
Shipments per steamer Julia	24,661
Shipments per steamer Chin-du-Wan	2,276
Shipments per steamer Modoc	1,729
Shipments per California Transportation Company	70,354
Shipments per Stockton line (estimated)	34,547
Shipments per rail to Oakland	13,750
Shipments per rail to San Francisco	150
Total numbers	188,296

While gathering the statistics of the cases of Sacramento salmon canned during the past year, Mr. Dunn procured the following statistics of salmon canned in Oregon, etc., the present season, which is also of interest:

On the Columbia River, 512,000 cases	4 dozen 1-pound tins each.
On the Fraser River, 40,000 cases	4 dozen 1-pound tins each.
On the Skeena, and other rivers, 21,000 cases	4 dozen 1-pound tins each.

Besides the foregoing, there were canneries in operation at Sinslaw and Rogue Rivers, Oregon; Puget Sound, Washington Territory; Prince of Wales Island, and Sitka, Alaska Territory, the catch of which he has been unable to obtain.

Under wise laws and small appropriations the salmon industry of California has doubled in five years. With a more faithful observance of the present laws, it can be doubled again in another five years. It would seem to be wise policy for the Legislature to disregard the appeals of even good citizens, whose judgments are liable to be wrested by their present personal profits. The Fish Commissioners stand between the general good of the public and private interests, and look to the Legislature, as representing the intelligence of the whole community, to sustain them in their efforts to foster, advance, and increase a great industry.

SHAD—ALOSA SAPIDISSIMA.

On the 18th of June, 1880, we received from the United States Fish Commissioner, a donation of 240,000 young shad, which arrived without loss, and were placed in the Sacramento River at Tehama. This makes in all 640,000 of these fish that have been placed in

this river, through donations from the United States Fish Commissioner, and through importations by the State. These fish are now increasing by natural propagation, as fish of all ages are caught in the river, and in the salt water of the Bay of Monterey. A few years since, when mature shad first made their appearance, they sold for $1 50 per pound. They now sell for twenty and twenty-five cents per pound. They are as regularly quoted in the market reports as any other fish common to the waters of this State. Relatively to the numbers in our waters, more shad are caught in California than on the Atlantic Coast.

When the shad, after spawning, leave the eastern rivers they disappear and rarely, if ever, are taken in the ocean. Practically, they are only caught for market after entering the rivers. The shad turned into the Sacramento, when the time comes for them to leave the river, resort in large numbers to the Bay of Monterey, about one hundred miles south of San Francisco, where they find an abundance of food and remain until the procreative instinct compels them again to enter the river. Shad are caught at all seasons in the Bay of Monterey, in the nets of the fishermen while fishing for other fish. There is, therefore, no week during the year when shad cannot be found on the stalls in the San Francisco market. Looking to the natural increase of the fish, this is unfortunate, as it will require largely increased importations to fully stock our waters. When our rivers are fully stocked, now that the habits of this fish on our coast are known, there will be no difficulty in procuring this valuable fish at all seasons of the year.

Professor Baird, of the United States Fish Commission, is having constructed a railway car, to be solely used in the transporting of fish. When completed, he proposes to send in it two or three million young shad, which he believes will fully stock the Sacramento and San Joaquin Rivers, and eventually all the appropriate waters of this coast. We are entirely satisfied with the result of the experiments thus far made in importing and planting shad in the waters of California.

WHITE FISH—COREGONUS ALBA.

The 565,000 white fish, the eggs of which were brought from Lake Michigan, and planted in different lakes and streams of this State, appear to be thriving and increasing. We hear of them being occasionally taken. As they can only be successfully caught in nets made for the purpose, and rarely are taken with the hook, the probabilities are they will become very numerous before the fishermen will make a business of their capture. They are so valuable and highly esteemed fresh water fish that we shall make every effort to fully stock all our accessible mountain lakes. We have asked the United States Commissioner of Fisheries for a consignment of 250,000 of the eggs of this fish, to be hatched at the State's hatching house at San Leandro, for distribution during the present Winter.

SCHUYLKILL CATFISH—AMIURUS ALBIDUS.

The seventy-four catfish imported from the Raritan River, in 1874, have increased and multiplied, and this increase distributed, until now, we believe, there is no county in the State, from Del Norte to

San Diego, that has not been supplied with a greater or less number of these fish. They are regularly sold in all the markets, at the same prices as our most abundant fish. They are admirably adapted to the sloughs and warm waters of the great valley, and in them have so multiplied as to furnish a large supply of food. The aggregate value of this fish alone, sold in the markets of San Francisco and Sacramento annually, would more than equal the appropriation annually made by the State for fish culture. How constant has been the demand made upon us for the wide distribution of this fish, may be seen in our report of expenditures, which shows quite a large amount paid for their capture, and in sending them by express to different parts of the State. These fish are now so numerous and widely distributed that probably the time has arrived when their further distribution should be left to private enterprise, and the money of the State heretofore used for this purpose be employed in importing some other equally valuable fish.

CARP—CYPRINUS CARPIO COMMUNIS.

Since the date of our last report, we received from Professor Baird, at the Government carp ponds, in Washington, three hundred young carp of the most valuable variety. They were brought to California with the loss of but two. Sixty were placed in a public lake near Sacramento; the remainder were placed in the private pond of R. R. Thompson, in Alameda, who promised to protect them, and allow the State to remove them and their increase whenever desired. We have no report of those placed in Sutterville Lake; probably none of them have been caught. Those placed in the private pond at Alameda are doing well. These fish were hatched from the egg in June, 1879. When they arrived in this State, December 29, 1879, they averaged about two inches in length. In June, 1880, one year from the time they had left the egg, they had grown to a length of more than eight inches. During the latter month, at the request of Professor Baird, United States Fish Commissioner, we caused the pond to be netted, and of the carp taken, forwarded one dozen to the ponds at Mare Island, the Navy Department having expressed a desire that the ponds at this Navy Yard should be stocked with the most valuable variety of carp. The great increase in the size of the fish, and their fine appearance, make it certain they have found congenial homes. They were probably too young to have spawned last year. They will, without doubt, produce young fish during the Summer of 1881. When the young fish are ready for distribution, we shall take measures to distribute them to all the appropriate waters throughout the State.

The eight carp, of another variety, brought to this State in 1872, from Hamburg, by the late Mr. A. J. Poppe of Sonoma County, increased largely, and have been widely distributed. Wherever planted in our waters they have grown rapidly, and multiplied in numbers. No other variety of fish have so long been under the care and protection of man, and no other seems so capable of domestication. There appears to be a wide spread desire among farmers of this State, who have small natural or artificial ponds or sloughs on their land, to procure carp for stocking their waters. Although the carp belonging to the State have not yet produced any increase, and as it is not probable any of the young of this fish can be ready for

distribution before the Winter of 1881, yet we have already on file twenty-three applications for the young of this fish from farmers in seventeen different counties. The carp will certainly thrive in all the interior waters of the State, with the possible exception of the lakes near the summit of the Sierra Nevada, where the water in Summer may be too cold. The carp furnishes so large a supply of food to the people of Europe and Asia, and promises to be of so much value to the people of this State, that we condense from the report of Mr. Rudolph Hessel to Professor Baird, the following information of the habits and natural history, etc., of this fish. He says: The carp is partial to stagnant waters, or such as have not a too swift current, with a loamy, muddy bottom, and deep places covered with vegetation. It is able to live in water where other fishes could not possibly exist—for instance, in the pools of bog meadows and sloughs. It lives upon vegetable food, as well as upon worms and larva of aquatic insects, which it turns up from the mud with the head; it is very easily satisfied, and will not refuse the offal of the kitchen, slaughter-houses, and breweries, or even the excrement of cattle and sheep.

In central Europe, where the water of the carp ponds becomes very cold, the fish will, at the beginning of the cold season, seek deeper water, making holes in the mud, where they pass the Winter in a kind of sleep. They make a cavity in the muddy ground, called a "kettle." In this they pass the time until Spring, huddled together in concentric circles, with their heads together, the posterior part of the body raised, and held immovably, scarcely lifting the gills for the process of breathing, and without taking a particle of food. It is a most striking fact that the carp, though it does not take any food, during this Winter sleep, yet does not diminish in weight. In the warm climates of Southern Europe, Italy, Spain, Dalmatia, etc., the fish become lively at a much earlier season in the Spring, and Mr. Hessel doubts if, in these climates, it ever goes into a lethargic state, or ceases to feed during the Winter. When the Spring is early, or the water has become warmed by the sun, in central Europe, it is ready to spawn by May, and continues spawning at intervals for a month or two. Days and weeks may pass before it will have left the last egg to the care of nature. In Sicily, and in Algeria, which have climates not dissimilar to the interior of California, it commences to spawn in April. The female carp yields an immense number of eggs. One of five pounds weight has produced half a million. The eggs are adhesive, and are, when extruded, attached to aquatic plants, brush, or stones. The male fish follows the female among the growing water grass and weeds, and impregnates the eggs after they are extruded. If the weather is warm, the young fish are hatched in about two weeks. Cold water delays the hatching of the eggs for about three weeks. Ponds of cold water with a rock bottom are not favorable to the growth of this fish. If the water is warm, and the pond has a muddy bottom, the young fish should, at the close of the third Summer, weigh an average of three pounds. If the pond contain large quantities of food, the fish may weigh as much as five pounds at the close of the third year. This fish is said to live to a great age, and is also said to increase in weight up to about thirty years. Ponds for carp, in California, need not be over three feet in depth.

In stocking ponds, in Europe, it is estimated that there should be

placed in the water three mature females and two males to each acre. The eggs are subject to many casualties; they get smothered, are eaten by other fish, and even by the parents, so that it is not usual to obtain more than eight hundred or one thousand young fish from the vast number of eggs extruded by each female. A larger percentage of young fish would be obtained if the pond contained no fish but carp, and the parents were caught and removed to other waters after the eggs were deposited. The eggs of carp, although adhesive, have been hatched artificially. A more simple plan is to make a rough box-shaped frame of willow sticks, tied or nailed together, four or five feet long, three wide, and one high. This frame should be densely interwoven with the brush of Monterey cypress, or of the redwood, and not to be trimmed on the inside of the frame. Put this in the pond where it can float, and place in it two ripe females and one male; cover the top with netting, so that the fish may not escape. The females will fill the brush on the bottom and sides with eggs, which the male will impregnate. When the spawning is completed, the fish should be removed. In due time the young fish will make their appearance. This is a close imitation of nature, while the eggs are preserved from enemies.

The carp in Europe is considered so valuable a fish, and supplies such a large amount of food, that it is deservedly popular. Wherever it has been introduced in California, it has grown and increased in numbers.

So many persons are desirous of obtaining this fish for ponds, sloughs, and lakes, in their several localities that we have considered it advisable to give this condensed statement as to the best means for the care and increase of this variety of fish.

BLACK BASS—MICROPTERUS NIGRICANS.

The seventy-three black bass placed in Napa River in 1873, were probably all caught by anglers before they had time to propagate. We heard that some were caught, during that year, from the river in which they were deposited, but cannot learn that any have been seen since. Twenty-two mature fish were brought from the East in July, 1879, and placed by us in the Crystal Spring Reservoir, of the Spring Valley Water Company, in San Mateo County, with the assurance, on the part of the officers of that company, that the lake would be preserved and no fish allowed to be caught until the Fish Commissioners granted permission; and, with the further promise that, if the fish increased, the State could at all times take them for public distribution. These fish have done well, and are rapidly increasing in numbers. In another year the young can be caught and distributed to appropriate waters.

The Sportsman's Club, of San Francisco, have also imported a number of these fish and placed them in a lake in Alameda. We are pleased to learn that these also have increased in numbers.

STRIPED BASS—ROCCUS LINEATUS.

The one hundred and fifty striped bass brought in 1879, and placed in the water in the Straits of Carquinez are probably increasing. One of these fish was caught in the bay near Saucelito, and brought to market and identified. We have heard of a few others having

been captured at Monterey, and near Alameda. This is one of the most valuable ocean and river fish of the Atlantic coast, and supplies a large amount of food to the people of the Eastern States. There is now no doubt they will thrive in our waters, and we shall make every exertion to obtain large numbers, so that, in time, our bays and brackish waters, at the mouth of our rivers, may be fully stocked.

LOBSTERS AND EELS.

The twenty-four mature lobsters, to which were attached about two million eggs nearly ready to hatch, brought from the Atlantic in 1879, were placed in a sheltered cove near the Golden Gate. No person, so far as we can learn, has as yet tried to capture any of them, and none have been accidentally caught. As all the conditions seemed favorable, we have no doubt the young are growing, and that, during the coming Summer, we shall hear of California lobsters having been taken and brought to market.

Occasionally we hear of an eel being captured, but as yet they have not showed an increase in proportion to that of other imported fish.

EASTERN AND CALIFORNIA TROUT.

We each Winter hatch the eggs of large numbers of both these varieties of trout, and distribute them in streams in different parts of the State. The South Yuba and the North Fork of the American Rivers, which originally contained no fish above the high falls on each stream, are now well stocked with both kinds of trout. We have also stocked other streams, which naturally contained no fish, or from which all the fish had been caught.

FISH-WAYS.

Whenever we have learned that the passages for fish are obstructed by artificial dams in any streams, we have notified the owners of such obstructions to remove them, or construct fish-ways, so as to permit the free passage of fish. When the owners neglect or refuse to comply with the law, we place the matter in the hands of the District Attorney of the county for prosecution. The law controlling the subject is deemed wise and beneficial, and only in a few cases has it been found necessary to do more than call the attention of the offending parties to its requirements.

At the last session of the Legislature an Act was passed "To provide for removing obstructions in Pit River, above the mouth of Hat Creek, so as to enable salmon to reach the spawning grounds on the upper waters of said river and its tributaries."

At the place designated on the Pit, there is a fall of forty-one feet. The salmon in vast numbers reach the foot of this fall, and are now unable to pass. If a passage were made over this fall through which the fish could pass, they would find on the upper waters of the Pit and its tributaries, between two and three hundred miles of unobstructed spawning grounds. This would make an area of spawning ground equal to that now used by salmon in all the other tributaries of the Sacramento. Therefore, the removal of this obstruction should, in a few years, even if artificial propagation were discontinued, more than double the present number of salmon annually visiting the

Sacramento River. In addition, a passage for fish over this natural obstruction would give the rapidly increasing population of the northeastern portion of the State an abundance of fish. This Act provides that the Fish Commissioners should advertise for proposals, and let a contract for a fish-way over this fall, and makes an appropriation of three thousand dollars, with which to pay the cost and incidental expenses of this work.

As a preliminary to advertising, we appointed A. W. Von Schmidt, from his known reputation as a civil engineer, to make a survey and sketch of this fall, so that of the various fish-ways in use that best adapted to the situation might be selected. On the approval of his plan, an advertisement was published in different newspapers, as required by law. When the bids were opened, it was found that the lowest was that of Mr. S. C. Mooers, for $2,100. Contracts, in duplicate, were made out and sent to him for his signature. After some weeks he wrote, stating that he could not do the work for the amount of his bid. We then wrote to E. E. Van Sickel, F. H. Kenyon, and W. H. Kenyon, the only other bidders, who had proposed to do the work for $2,300, stating the facts as to Mooers' refusal, and asked them if they would contract to do the work, during the coming Summer, for the amount of their bid, $2,300. They replied that they would, and contracts have been signed by them, dated January 5, 1881. The work is to be completed between August 1, and November 1, 1881.

This Act is peculiarly worded. Section four says: "When the work is completed, approved, and accepted by the Fish Commissioners, they shall certify the amount due upon said contract or contracts, and the amount due for advertising and other necessary expenses incurred by them in carrying out the provisions of this Act to the State Board of Examiners, and when approved by said Board, the amount shall be paid out of the General Fund in the State treasury."

The Controller construes this Act to mean that none of the incidental expenses, such as surveying and advertising, can be paid until the whole work is completed. These necessary expenses, preliminary to letting the contract, amount to about $250, and, as the persons who have performed the work should be paid for their services, we have to request that a supplemental Act should be passed, allowing the Board of Examiners to audit these accounts, and the Controller to draw his warrant on the appropriation made for this purpose.

BAY AND COAST FISH.

Accompanying this will be found a report from Mr. W. N. Lockington giving a general and popular description of the most important of the fishes hitherto discovered in the inland and coast waters of the Pacific Coast, U. S. A. In this work he has had the benefit of the notes and discoveries of Professors Jordan and Gilbert, who, as the representatives of the Smithsonian Institute and the United States Census Bureau, have been engaged on this coast, during the past summer, in studying its fish fauna. Many of these fishes are known only by descriptions lately published in the Proc. U. S. Nat. Museum. Mr. Lockington's statements of the habits and migrations, as well as of the places, upon our coast, where particular varieties of food fish are most abundant, if studied by

our fishermen, would be of service in promoting their industry. His statistics and investigations in connection with the rapidly increasing codfish business of this coast have much interest in showing that the codfish banks are probably as extensive and inexhaustible as those of Newfoundland. As population increases on the Pacific Coast and new markets are found for the cured fish, this industry will be found capable of great enlargement, and thus promote varied industries and furnish employment to a large number of men and boys.

APPROPRIATION AND EXPENDITURES.

There is herewith appended a detailed account of the appropriation received and expenditures incurred since our last report. We have sought to exercise the greatest economy consistent with the work to be performed. With the experience we have obtained during ten years, it is believed that no money has been expended in doubtful experiments. We now know that the money of the people appropriated for fish culture is resulting in the production of a large increase of valuable and nutritious food, which is sold to the consumers at low prices. We also know that fish culture, by the State, is adding to the industries of the people and increasing the public wealth.

It is with gratification we add that our work seems to be appreciated by the public as one of increasing importance. We are looking for the time when the public will also appreciate the necessity of sustaining the officers of the law in performing their duties in restraining illegal fishing.

REPORT

UPON THE

EDIBLE FISHES OF THE PACIFIC COAST, U. S. A.

BY W. N. LOCKINGTON.

Since the publication of the last report of the Fish Commissioners of this State, more than forty new species have been described, the greater part of them by Professor D. S. Jordan and his assistant, Mr. Gilbert, both of the United States Fish Commission. Beside these hitherto unknown forms, our fauna has been enriched by the discovery of the occurrence upon our coast of numerous previously known species of pelagic habits, most of them either belonging to the Elasmobranchii (sharks and rays), or to the mackerel and allied families.

These discoveries, notwithstanding the elimination of several nominal species, raise the total number of California fishes to two hundred and seventy-eight.

If to this number are added thirty-four species occurring in Oregon and Washington Territory, and not yet recorded from our State, we arrive at a grand total of three hundred and twelve species belonging to the Pacific Coast of the United States.

This number includes the native species only; but the following introduced species are of more or less frequent occurrence in our markets, and must be considered as forming part of our supply of food fishes: Striped Bass, *Roccus lineatus;* Shad, *Alosa sapidissima;* Common Carp, *Carassius vulgaris;* Catfish (two species), *Amiurus catus*, *Amiurus albidus.*

Several other Eastern species have been introduced, but have not yet become of common occurrence.

For the greater portion of the facts brought together in the following pages, I have to thank Professor D. S. Jordan, who kindly placed his notes at my disposal, and assisted me in many other ways, and his indefatigable assistant, Mr. C. Gilbert. These gentlemen have made a more thorough investigation of the fish fauna of our coast than has ever been made before, so that the present year has been more fruitful in facts of scientific and economic interest than any preceding one since the date of publication of the explorations and surveys for a railroad route from the Mississippi to the Pacific.

My own observations have necessarily been for the most part confined to the neighborhood of San Francisco; the supply brought to the markets of this city; and the specimens in various collections, especially that of the California Academy of Sciences.

LIST OF THE FISHES OF THE STATE OF CALIFORNIA.

ABBREVIATIONS USED.

F. W. ..... Fresh water.
C. S. ..... Point Concepcion, southward.
C. N. ..... Point Concepcion, northward.
E. S. ..... Entire coast, commonest south.
E. N. ..... Entire coast, commonest north.
P. S. ..... Puget Sound.
Blank. ..... Entire coast.
F. ..... Monterey and San Francisco.
F. S. ..... San Francisco, southward.
F. N. ..... San Francisco, northward.
S. D. ..... San Diego, southward.
B. N. ..... Santa Barbara, northward.

ORIGINAL DESCRIBERS.

Gir. ..... Girard.
J. & G. ..... Jordan and Gilbert.
Ay. ..... Ayres.
Ln. ..... Lockington.
Cr. ..... Cooper.
Str. ..... Steindachner.
Guth. ..... Günther.
B. & G. ..... Baird and Girard.
Pal. ..... Pallas.
Cuv. ..... Cuvier.
Val. ..... Valenciennes.
L. ..... Linneus.
Ag. ..... Agassiz.
Rich. ..... Richardson.
Raf. ..... Rafinesque.
Walb. ..... Walbaum.

Other names are written in full.

PLECTOGNATHI.

Orthagoriscidæ—
Mola rotunda, Cuv. ..... F. S.
Diodon maculatus, Lac. ..... S. D.
Tetrodontidæ—
Tetrodon politus, Gir. ..... S. D.

LOPHOBRANCHII.

Syngnathidæ—
Syngnathus punctipinnis, Gill. ..... C. S.
Syngnathus californiensis, Storer ..... B. N.
Syngnathus dimidiatus, Gill. ..... C. S.
Syngnathus leptorhynchus, Gir. ..... S. D.
Hippocampidæ—
Hippocampus ingens, Gir. ..... S. D.

HEMIBRANCHII.

Gasterosteidæ—
Gasterosteus aculeatus var. serratus, Ay. ..... F. N.
Gasterosteus microcephalus, Gir.
Eucalia williamsoni, Gir. ..... F. W.
Aulorhynchidæ—
Aulorhynchus flavidus, Gill ..... C. N.

HETEROSOMATA.

Pleuronectidæ—
Hippoglossus vulgaris, Fleming ..... F. N.
Hippoglossoides jordani, Ln. ..... C. N.
Hippoglossoides exilis, J. & G. ..... C. N.
Atheresthes stomias, J. & G. ..... F.
Psettichthys melanostictus, Gir. ..... C. N.
Paralichthys maculosus, Gir. ..... F. S.
Xystreurys liolepis, J. & G. ..... C. S.
Citharichthys sordidus, Gir.
Glyptocephalus zachirus, Ln. ..... F.
Cynicoglossus pacificus, Ln. ..... C. N.
Pleuronectes stellatus, Pal. ..... C. N.
Pleuronichthys decurrens, J. & G. ..... F.
Pleuronichthys coenosus, Gir. ..... E. N.
Pleuronichthys verticalis, J. & G. ..... F.
Hypsopsetta guttulata, Gir. ..... F. S.
Parophrys vetulus, Gir. ..... B. N.
Parophrys isolepis, Ln. ..... F. N.
Lepidopsetta bilineata, Ay. ..... C. N.
Aphoristia atricauda, J. & G. ..... S. D.

ANACANTHINI.

Gadidæ—
Microgadus proximus, Gir. ..... C. N.
Pollachius chalcogrammus, Pal. ..... C. N.
Merlucius productus, Ay. ..... B. N.
Brosmophycis marginatus, Ay. ..... F.

Ophidiidæ—
Ophidium taylori, Gir. ..... B. N.

Zoarcidæ—
Lycodopsis paucidens, Ln. ..... F.
Lycodopsis pacificus, Collett ..... F. N.

ACANTHOPTERI.

Blennidæ—
Cebedichthys violaceus, Gir. ..... C. N.
Anarrhichthys ocellatus, Gir. ..... C. N.
Anoplarchus atropurpureus, Kittlitz ..... C. N.
Murænoides nebulosus, Schlegel ..... C. N.
Murænoides lætus, Cope ..... C. N.
Apodichthys flavidus, Gir. ..... C. N.
Apodichthys fucorum, J. & G. ..... C. N.
Xiphister mucosus, Gir. ..... C. N.
Xiphister chirus, J. & G. ..... C. N.
Xiphister rupestris, J. & G. ..... C. N.
Lumpenus anguillaris, Pal. ..... F. N.
Cremnobates monophthalmus, Gnthr.=integripinnis, Ros. Smith ..... S. D.
Gibbonsia elegans, Cr. ..... F. S.
Heterostichus rostratus, Gir. ..... F. S.
Neoclinus satiricus, Gir. ..... F. S.
Neoclinus blanchardi, Gir. ..... F. S.
Hypleurochilus gentilis, Gir. ..... C. S

Batrachidæ—
Porichthys porosissimus, Cuv. & Val. ..... .

Trachinidæ—
Icosteus ænigmaticus, Ln. ..... F. N.
Icichthys lockingtoni, J. & G. ..... F.
Caulolatilus anomalus, Cr. (=princeps?) ..... F. S.
Trichodon stelleri ..... F. N.

Trachypteridæ—
Trachypterus altivelis? Kner. ..... F. N.

Liparididæ—
Liparis pulchellus, Ay. ..... C. N.
Neoliparis mucosus, Ay. ..... C. N.

Gobiesocidæ—
Gobiesox reticulatus, Gir. ..... C. N.

Gobiidæ—
Gillichthys mirabilis, Cr. ..... M. S. (and N.?)
Lepidogobius gracilis=Gobius lepidus, Gir. ..... F. N.
Lepidogobius newberryi, Gir. ..... ?
Crystallogobius eos, Rosa Smith ..... S. D.

Agonidæ—
Podothecus vulsus, J. & G. ..... F.
Podothecus trispinosus, Ln. ..... E. S.
Brachyopsis verrucosus, Ln. ..... F.
Brachyopsis xyosternus, J. & G. ..... F.

Triglidæ—
Prionotus stephanophrys, Ln. ..... F.

Cottidæ—
Artedius pugettensis, Str. ..... F. N.
Artedius quadriseriatus, Ln. ..... F.
Artedius lateralis, Gir. ..... F. N.
Artedius notospilotus, Gir. ..... B. N.
Hemilepidotus spinosus ..... F.
Hemilepidotus gibbsii, Gill ..... F. N.
Leptocottus armatus, Gir. ..... .
Aspicottus bison, Gir. ..... F. N.
Liocottus hirundo, Gir. ..... C. S.

Oligocottus globiceps, Gir. ..... C. N.
Oligocottus maculosus, Gir. ..... C. N.
Oligocottus analis, Gir. ..... F. S.
Scorpænichthys marmoratus, Hy. .....
Uranidea gulosus, Gir. ..... F. W.
Uranidea asper (Rich) Gir. ..... F. W.
Ascelichthys rhodorus, J. & G. ..... F. N.
Blepsias cirrhosus, Pal. ..... F. N.
Nautichthys oculo-fasciatus, Gir. ..... F. N.

Chiridæ—
Zanioleps latipinnis, Gir. ..... F. N.
Oxylebius pictus, Gill ..... F. N.
Myriolepis zonifer, Ln. ..... F.
Chirus decagrammus, Pal. ..... C. N.
Chirus pictus, Ay. ..... F. N.
Ophiodon elongatus, Gir. ..... C. N.
Anoplopoma fimbria, Pal. ..... F. N.

Scorpænidæ—
Scorpæna guttata, Gir. ..... C. S.
Sebastichthys nigrocinctus, Ay. ..... F. N.
Sebastichthys serriceps, J. & G. ..... F. S.
Sebastichthys chrysomelas, J. & G.=fasciatus, Gir. ..... F. S.
Sebastichthys nebulosus, Ay. ..... F. N.
Sebastichthys carnatus, J. & G. ..... F. S.
Sebastichthys maliger, J. & G. ..... F. N.
Sebastichthys caurinus, Rich. Var. vexillaris, J. & G. ..... E. N.
Sebastichthys rastrelliger, J. & G. ..... F. S.
Sebastichthys auriculatus, Gir. ..... B. N.
Sebastichthys rubrivinctus, J. & G. ..... B. N.
Sebastichthys ruber, Ay. ..... B. N.
Sebastichthys constellatus, J. & G. ..... B. N.
Sebastichthys rosaceus, Gir. ..... B. N.
Sebastichthys rhodochloris, J. & G. ..... F.
Sebastichthys chlorostictus, J. & G. ..... F.
Sebastichthys miniatus, J. & G. ..... F. S.
Sebastichthys pinniger, Gill ..... F. N.
Sebastichthys atrovirens, J. & G. ..... F. S.
Sebastichthys elongatus, Ay. ..... F.
Sebastichthys proriger, J. & G. ..... F.
Sebastichthys ovalis, Ay. ..... F. S.
Sebastichthys entomelas, J. & G. ..... F.
Sebastichthys mystinus, J. & G.=Sebastodes melanops, Ay. .....
Sebastichthys ciliatus, Tilesius=melanops, Grd.=simulans, Gill ..... F. N.
Sebastichthys flavidus, Ay. ..... F. S.
Sebastodes paucispinis, Ay. ..... F. S.

Stromateidæ—
Stromateus simillimus, Ay. .....

Carangidæ—
Caranx caballus, Gnthr. ..... C. S.
Trachurus saurus, Raf. ..... F. S.
Seriola lalandi, Cuv. & Val. ..... C. S.

Echeneididæ—
Remora jacobæa, Lowe ..... F.
Echeneis naucrates, L. ..... F.

Xiphiidæ—
Xiphias gladius, L. ..... C. S.

Scombridæ—
Scomber pneumatophorus, De la Roché ..... F. S.
Scomber scombrus, L. ..... Straying to Santa Catalina Id.
Scomberomorus concolor, Ln. ..... F.
Sarda chilensis, Cuv. & Val.=Pelamys lineolata, Grd. ..... F. S.
Orcynus alalonga, Gmelin ..... F. S.
Orcynus pelamys? (sp. not seen.) Ln. ..... C. S.

Coryphænidæ—
Coryphæna hippurus? L. ..... Cayucos.

Pomacentridæ—
Hypsipops rubicundus, Gir. ..... C. S.
Chromis punctipinnis, Cr. ..... C. S.
Chromis atrilobata, Gill ..... C. S.

Labridæ—
Platyglossus semicinctus, Ay.---C. S.
Pseudojulis modestus, Gir.---F. S.
Pimelometopon pulcher, Ay.---F. S.

Embiotocidæ—
Hypsurus caryi, Ag.---F. S.
Ditrema jacksoni, Gir.---
Ditrema laterale, Ag.---B. N.
Ditrema atripes, J. & G.---F.
Ditrema furcatum, Gir.---F. S.
Damalichthys argyrosomus=vacca, Gir---E. N.
Amphistichus argenteus, Ag.---F. S.
Rhacochilus toxotes, Ag.---F. S.
Holconotus rhodoterus, Ag.---F. S.
Holconotus argenteus, Gibbons---F. S.
Holconotus agassizii, Gill---B. N.
Holconotus analis, A. Ag.---C. N.
Cymatogaster aggregatus, Gibbons---E. N.
Brachyistius frenatus, Gill---
Brachyistius rosaceus, J. & G.---F.
Abeona minima, Gibbons---F. S.
Abeona aurora, J. & G.---F.
Hysterocarpus traskii, Gibbons---F. W.

Sciænidæ—
Corvina saturna, Gir.---C. S.
Roncador stearnsii, Str.---C. S.
Genyonemus lineatus, Ay.---F. S.
Umbrina xanti, Gill---C. S.
Cynoscion parvipinnis, Ay.---C. S.
Cynoscion nobilis, Ay.---F. S.
Seriphus politus, Gir---F. S.
Menticirrus undulatus, Gir.---C. S.

Ephippidæ—
Parephippus faber, Bloch=Ephippus zonatus, Gir.---F. S.

Separidæ—
Girella nigricans, Ay.---F. S.
Scorpis californiensis---F. S.

Percidæ—
Xeicchthys californiensis, Str.---S. D.
Pristipoma davidsoni, Str.---C. S.
Stereolepis gigas, Ay.---F. S.
Serranus clathratus, Gir.---F. S.
Serranus nebulifer, Gir.---F. S.
Serranus maculofasciatus, Str.---C. S.
Archoplites interruptus, Gir.---F. W.

Ammodytidæ—
Ammodytes personatus, Gir.---F. N.

Sphyrænidæ—
Sphyræna argentea, Gir.---F. S.

PERCESOCES.

Atherinidæ—
Atherinopsis californiensis, Gir.---F. S.
Atherinops affinis, Ay.---C. S.
Leuresthes tenuis, Ay.---S. D.
Mugilidæ—
Mugil mexicanus, Str.---F. S.

SYNENTOGNATHI.

Scomberesocidæ—
Scomberesox brevirostris, Peters---F. S.
Tylosurus exilis, Gir.---C. S.
Hemiramphus rosæ, J. & G.---C. S.
Exocætus californiensis, Cr.---C. S.

HAPLOMI.

Cyprinodontidæ--
Fundulus parvipinnis, Gir.---C. S.
Cyprinodon californiensis, Gir.---S. D.

ISOSPONDYLI.

Synodontidæ—
Synodus lucioceps, Ay.---F. S.

Paralepidæ—
Sudis ringens, J & G.---C. S.

Scopelidæ—
Myctophum crenulare, J. & G.---C. S.

Alepidosauridæ—
Alepidosaurus borealis, Gill---F. N.

Salmonidæ—
Osmerus thaleichthys, Ay.---C. N.
Osmerus attenuatus, Ln.---F.
Hypomesus olidus, Pal.---F. N.
Oncorhynchus keta, Walb.—tsuppitch, Rich.---Sac. Riv. N.
Oncorhynchus gorbuscha, Walb.---Sac. Riv. N.
Oncorhynchus quinnat, Rich.---Ventura Riv. N.
Oncorhynchus kisutch, Walb.—canis, Suckley---Sac. Riv.
Salar mykiss, Walb.---Riv. of Mont. Bay, N.
Salar irideus, Gibbons---F. W.
Salar henshawi, Gill & Jor.---Lake Tahoe, etc.
Salar clarki, Rich.---Riv. of Mont. Bay, N.
Salvelinus malma, Walb.—spectabilis, Gir.---F. W.
Coregonus williamsoni, Gir.---Lake Tahoe.

Clupeidæ—
Albula vulpes, L.---F. S.
Clupea mirabilis, Gir.---E. N.
Clupea sagax, Jenyns---F. S.
Stolephorus ringens, Jenyns---E. S.
Stolephorus compressus, Gir.---C. S.
Stolephorus delicatissimus, Gir.---S. D.

EVENTOGNATHI.

Catostomidæ—
Catostomus occidentalis, Gir.---F. W.
Catostomus labiatus, Ay.---F. W.
Catostomus tahoensis, J.---F. W.

Cyprinidæ—
Orthodon microlepidotus, Ay.---F. W.
Gila conformis, B. & G.---F. W.
Gila grandis, Ay.---F. W.
Gila rapax, Gir.---F. W.
Siboma crassicauda, Gir.---F. W.
Myloleucus bicolor, Gir.---Klamath Lake.
Myloleucus formosus, Gir.---F. W.
Cheonda crassa, Gir.---F. W.
Lavinia exilicauda, B. & G.---F. W.
Lavinia harengus, Grd.---F. W.
Lavinia gibbosa, Ay.---F. W.
Notemigonus occidentalis, B. & G.---F. W.
Pogonichthys inæquilobus, B. & G.---F. W.
Pogonichthys symmetricus, B. & G.---F. W.
Pogonichthys argyriosus, B. & G.---F. W.
Mylopharodon conocephalus, Ay.---F. W.

APODES.

Murænidæ—
Muræna mordax, Ay.---C. S.
Myrichthys tigrinus, Gir.---Humboldt Bay.

Ophisuridæ—
Ophichthys triserialis, Kaup.---C. S.

CHONDROSTEI.

Acipenseridæ—
Acipenser transmontanus, Rich.---F. N.
Acipenser medirostris, Ay.=A. acutirostris, Gnthr.---F. N.

CLASS ELASMOBRANCHII.

HOLOCEPHALI.

Chimæridæ—
Chimæra colliei, Bennett ..... C. N.

PLAGIOSTOMI.

Dasybatidæ—
Urolophus halleri, Cr. ..... C. S.
Pteroplatea marmorata, Cr. ..... C. S.
Dasybatis dipterurus, J. & G. ..... S. D.

Myliobatidæ—
Myliobatis californicus, Gill ..... F. S.
Ætobatis laticeps, Gill ..... ?

Cephalopteridæ—
Manta birostris, Walb. ..... S. D.

Raiidæ—
Raia cooperi, Gir. ..... C. N.
Raia binoculata, Ay. ..... F.
Raia rhina, J. & G. ..... C. N.
Raia stellulata, J. & G. ..... F.
Zapteryx exasperatus, J. &. G. ..... S. D.

Rhinobatidæ—
Rhinobatus productus, Ay. ..... F. S.
Rhinobatus triseriatus, J. & G. ..... F. S.

Torpedinidæ—
Torpedo californica, Ay. ..... F.

SYUALI.

Squatinidæ—
Squatina angelus, Dumeril ..... F. S.

Heterodontidæ—
Heterodontus francisi, Gir. ..... C. S.

Hexanchidæ—
Notorhynchus maculatus, Ay. ..... F. N.
Hexanchus corinus, J. & G. ..... F. N.

Alopecidæ—
Alopias vulpes, Gmelin ..... F.

Scylliidæ—
Catulus ventricosus, Garman ..... F. S.

Lamnidæ—
Isurus oxyrhynchus, Raf. ..... C. S.
Carcharodon carcharias, L.=rondeletii, Muller & Henle ..... F. S.
Lamna cornubica, Gmelin .....

Cetorhinidæ—
Cetorhinus maximus, L. ..... F.

Galeorhinidæ—
Galeorhinus galeus, L. ..... F. S.
Galeocerdo tigrinus, Muller & Henle ..... S. D.
Carcharinus glaucus, L. ..... F. N.
Eulamia lamia, Risso ..... S. D.
Triacis semifasciatus, Gir. .....
Rhinotriacis henlei, Gill ..... F.
Mustelus hinnulus, Blainville ..... F. S.

Sphyrnidæ—
Sphyrna zygæna, L. ..... S. D.

Spinacidæ—
Squalus acanthias, L. ..... C. N.

MARSIPOBRANCHII.

Petromyzontidæ—
Entosphenus tridentatus, Rich ..... F. N.
Ammocœtes plumbeus, Ay. ..... F. N.

Myxinidæ—
Polistotrema dombeyi, Muller=Bdellostoma stouti, Ln ..... F. N.

CIRROSTOMI.

Branchiostomatidæ—
Branchiostoma lanceolatum ..... S. D.

FISHES OF OREGON AND WASHINGTON TERRITORY.

NOT YET ON RECORD, FROM THE COAST OF CALIFORNIA.

Heterosomata—
Hippoglossoides elassodon, J. & G. ..... P. S.
Parophrys ischyrus, J. & G. ..... P. S.

Anacanthini—
Gadus morrhud, Tilesius ..... P. S.
Scytalina cerdale, J. & G. ..... P. S.

Trachinidæ—
Bathymaster signatus, Cope ..... P. S.

Gobiidæ—
Liparis cyclopus, Gnthr ..... ?

Discoboli—
Eumicotremus orbis, Gill ..... Vancouver Id.

Agonidæ—
Aspidophoroides inermis, Gnthr. .....
Podothecus acipenserinus, Pal. ..... Puget Sd. N.
Bothragonus swani, Str. ..... ?

Cottidæ—
Psychrolutes paradoxus, Gnthr. ..... ?
Cottus polyacanthocephalus, Pal. ..... Puget Sd.

Chiridæ—
Chirus stelleri, Tilesius ..... Puget Sd. N.
Chirus nebulosus, Gir. ..... ?

Scorpænidæ—
Sebastichthys caurinus, Rich. ..... P. S.

Paralepidæ—
Paralepis coruscans, J. &. G. ..... P. S.

Scopelidæ—
Myctophum procellarum, Bean ..... ?

Salmonidæ—
Thaleichthys pacificus ..... Columbia R. and P. S.
Oncorhynchus nerka, Walb. ..... Columbia R. and P. S.
Oncorhynchus kennerlyi, Suckley ..... Columbia R. and P. S.

Murænidæ—
Nemichthys avocetta, J. & G. ..... P. S.

Scymnidæ—
Somniosus microcephalus, Bloch ..... P. S.

EVENTOGNATHI.

Catostomidæ—
Catostomus longirostris, Le Sueur ..... F. W.
Catostomus macrochilus, Gir. ..... F. W.
Lypomyzon luxatus, Cope ..... F. W.
Lypomyzon brevirostris, Cope ..... F. W.

CYPRINIDÆ.

Gila bicolor, Grd. ..... Klamath Lake, Or.
Gila oregonensis, Rich. ..... F. W.
Cheonda cooperi, Gir. ..... F. W.
Cheonda cærulea, Gir. ..... F. W.
Richardsonius balteatus, Rich. ..... F. W.
Richardsonius lateralis, Gir. ..... F. W.
Apocope nubilus, Gir. ..... F. W.
Mylochilus caurinus, Rich. ..... F. W.

The fishes, the names of which are printed in italics, are not included in the published list by Messrs. Jordan and Gilbert in the Proc. U. S. Nat. Mus., because not seen by them, yet by reliable report occur in our waters. It is probable that several additional species of pelagic fishes, especially those of the mackerel and allied families, will be found to occur at San Diego, the marine fauna of which place is largely that of Lower California.

The ranges given for the species must not be regarded as final, but simply as the range now on record. As there is no fishery of any importance between Tomales Bay and the mouth of the Columbia, it is probable that several species now believed to be extra-Californian occur in the northern part of our State, and that many not on record north of San Francisco extend much farther northward.

HETEROSOMATA—FLATFISHES.

Much additional information respecting the flatfishes of the Pacific Coast has been gathered together since the date of the last report. The thirteen species there enumerated have, by the researches of Professor D. S. Jordan, been increased to twenty-one, seventeen of which are known to occur, more or less frequently, in the markets of San Francisco, and nineteen on the coast of California. Three species of the genus *Hippoglossoides* are now known, as well as three of *Pleuronichthys*, and the species of *Parophrys* are increased from one to three, but all the other species are the sole representatives of their genera upon this coast.

It is the custom of the dealers to lump together all the flatfishes, except the two kinds called halibut, that known as "turbot," and *Pleuronectes stellatus*, commonly called the flounder, and to sell them all at the same price. Yet it is tolerably well known that the Turbot (*Hypsopsetta guttulata*), the Black-dotted Sole (*Psettichthys melanostictus*), and the Long-finned Flounder (*Glyptocephalus zachirus*) are superior to the others for the table.

Hippoglossus vulgaris, Halibut—The halibut of this coast is now known to be identical with that of the Atlantic. The Farallone Islands and Monterey appear to be the most southern point at which this fish is found, but it becomes abundant off Cape Mendocino and Humboldt Bay, and more so northward of California. It is essentially a northern species, and in Europe occurs around the coasts of England and Ireland, but becomes more abundant at the Orkneys, and is common on the coasts of Norway and Iceland. On the Atlantic coast its southern limit appears to be Massachusetts Bay. It will be seen that on the Pacific Coast its range extends further southward than in the Atlantic, a fact probably accounted for by the equable temperature of the ocean along the coast from San Francisco to the Columbia. The mean Summer temperature of the ocean at the Golden Gate is 58° Far., while at the mouth of the Columbia it is 60°, or slightly higher. In the Winter it is 53° off the Golden Gate, and 50° off the mouth of the Columbia. Thus it is evident that the temperature off the Golden Gate cannot be very unsuitable to fish that are at home off the mouth of the Columbia. The halibut is a deep water fish, and does not enter land-locked bays like those of Humboldt or Tomales.

When the large and abundant supply of this fish is considered, it is a matter of wonder that so small a quantity is smoked or canned for market. There is a prejudice in favor of Eastern halibut, which,

doubtless to some extent, hinders the development of this branch of business. The North Pacific Canning Company can some halibut at Klawack, Prince of Wales Island, and it is said to be of good quality.

The endeavor to bring fresh halibut to San Francisco from Puget Sound does dot appear to have been financially successful. A schooner load suddenly brought into a market already fully stocked with fish caused the price to fall to about ten cents per pound, and much of it could not be disposed of at that price.

Professor Jordan mentions a large halibut bank near Cape Flattery, and states that considerable numbers are taken with hook and line in the deeper channels of Puget Sound, north of which point it comes more abundant. It feeds upon large fishes, such as codfish.

Hippoglossoides jordani, Large-eyed Flounder—It appears strange that this common species should have escaped the notice of naturalists until last year. In the markets of San Francisco it abounds throughout every month of the year, and in Monterey Bay is the most abundant of its tribe. Professor Jordan informs me that about 500 pounds weight of this fish are taken daily at Monterey alone by the Chinese, besides large quantities taken by the Italians. An examination of the stock in trade of the Chinese located near Monterey, proved that over nineteen-twentieths of the fish that dry on hurdles and flap in the wind around the hovels consisted of this fish; a few sharks, with *Psettichthys melanostictus* and *Citharichthys sordidus* constituting the remainder.

It occasionally reaches sixteen inches or more in length, and a weight of five pounds, and is considered one of the best of its tribe, but is inferior to the black-dotted flounder, the turbot, and one or two others. It becomes rare northward, yet occurs in Puget Sound; south of Monterey it is not on record.

Hippoglossoides exilis, Large-scaled Flounder — This species is readily distinguished from the preceding by its much more slender form, and by the large size of the scales, which are very delicately ciliate on their hinder edge. The eyes are very large, their longitudinal diameter contained about 3¼ times in the length of the head. The greatest depth is contained about 3½ times in the total length.

In July it was tolerably common in the markets of San Francisco, and its previous rarity is probably occasioned by the fact that it is only taken in tolerably deep water, and is too small to be considered of much value.

The specimens I have seen were from eight to ten inches in length, and three quarters of a pound in weight. It occurs in Puget Sound, but is not very common.

Hippoglossoides classodon—Unlike the two preceding species, this has only a single row of small teeth in the upper jaw. The scales are small, so that it can readily be distinguished from *H. exilis*, while from *H. jordani* it differs externally in the more strongly ciliated scales, and slightly more anterior origin of the dorsal fin.

The example in Mus. Cal. Ac. Sci. was taken by Professor Jordan at Seattle, at which port and at Tacoma he reports it as tolerably abundant. It reaches a length of one foot, and a weight of about two pounds.

Atheresthes stomias, the Hook-toothed Flounder—Isolated examples of this species, of fifteen to eighteen inches in length, have several times occurred in the markets of San Francisco during this year, but do not appear to have been noticed previously.

In form it is extremely slender, the greatest width scarcely extending one fourth of the total length, and tapering rapidly toward both extremities. The head enters about four and a half times in the total length, and is narrow, with an immense mouth, the upper jaw of which exceeds in length the one half of that of the head. The eyes are almost even in front, the upper one placed almost across the top of the head, and looking toward the dorsal outline. The teeth are numerous, in a double row in both jaws, irregular in size, hooked incurved canines interspersed among smaller upright teeth. The scales are large and soft, resembling in their character those of *Citharichthys sordidus*, and the color is a dirty yellow.

Very few examples have yet been found in our markets, and most of these have been secured for scientific purposes.

The range of this species is not ascertained.

Glyptocephalus zachirus, Long-finned Flounder—Up to the present time this species is only known from the markets of San Francisco, to which it is brought from deep water near Point Reyes, some thirty miles north of the city. It is comparatively rare, seldom more than three or four are offered for sale on any one day, and it is not brought in at all in the winter. It attains a length of eighteen inches, and a weight of about two pounds, and is held in high esteem. Hitherto it is only known to occur in Monterey Bay and in the vicinity of San Francisco. As its mouth is too small for the hook, and its habitat too deep for the gill-nets, it is taken chiefly in sweep-nets.

Cynicoglossus pacificus, Short-finned Flounder—This is the *Glyptocephalus pacificus* of the report of the Fish Commissioners for 1879. It is usually brought to market from the same place as the preceding species, but is known to occur at other points from Monterey to Puget Sound. It occurs in the market much more abundantly than the last species, yet the adults cannot be said to be common. In size and flavor it does not equal *G. zachirus*. When fresh it is excessively slimy to the touch.

Pleuronichthys decurrens, Bastard Turbot—The species described by me as *P. coenosus* Girard (Proc. U. S. Nat. Mus. 97, 1879) was there surmised to be the *Pleuronectes quadrituberculatus* of the old Russian naturalist Pallas. It differs from Girard's *coenosus* in the presence of tubercles upon the side of the head on the colored side. It is now known not to be Pallas' species, and has been named *decurrens* by Jordan and Gilbert.

This fish is now of more frequent occurrence in our markets than formerly, and becomes more abundant towards the south. It reaches about a foot in length, and a weight of from two to three pounds.

Pleuronichthys verticalis, Spine-cheeked Turbot—This form was first noticed as a separate species by Professor Jordan, and was described by him from specimens found in San Francisco market. In 1879 I obtained a small example of this fish, but did not venture to describe it as distinct, although some of its peculiarities are noted in my review of the Pleuronectidæ (Proc. U. S. Nat. Mus. 1879, 99).

The dorsal fin is not carried downwards on the blind side of the head so far as in the previous species; the cheek is without spines, the posterior extremity of the interorbital ridge is developed into a backward directed spine, and the anterior into two shorter upright spines. This species has occurred in our markets during the present year with tolerable regularity. In Monterey Bay it is of common

occurrence, and attains a length and weight equal to the preceding.

Pleuronichthys coenosus—The *P. coenosus* of Girard proves to be a distinct species, and not, as surmised in my review of the Pleuronectidæ (Pro. U. S. Nat. Mus. 1879, 99) identical with the one known as *decurrens*. In this form there are no tubercles on the cheeks, and the dorsal fin is like that of *verticalis*, but the tubercles between the eyes are not developed into spines and the body is unspotted.

This fish is not often brought to the market of San Francisco, but occurs along the entire coast from Puget Sound to San Diego.

All the species of Pleuronichthys feed largely on algæ, with which their stomachs are found to be filled. In this particular they differ from the carnivorous habits of the other flounders. They all occur in deep water, and their increasing abundance in our markets shows that the depauperization of our bays and shallows is constantly forcing our fishermen into the depths.

Parophrys (*Isopsetta*) *ischyrus*—This is a course rough fish, in ist general appearance greatly resembling the "Flounder," (*Pleuronectes stellatus*) but differing from it in the ctenoid scales, and in the presence of an accessory lateral line, characters in which it agrees with the next species. It has hitherto been found only in Puget Sound, and reaches a length of about eighteen inches.

Parophrys (*Isopsetta*) *isolepis*, Rough Even-scaled Flounder—I established the genus *Isopsetta* to contain this species and the preceding, both of which have the characters of a nearly straight lateral line, and strongly ctenoid scales of equal development on head and body, but Prof. Jordan includes them in the same genus with the following species:

The examples brought to San Francisco market are usually small, but Professor Jordan informs me that it attains a length of fifteen inches, and a weight of three pounds. Its range extends to Puget Sound. Its occurrence in our markets is irregular, but occasionally it is abundant, being taken with sweep-nets off Point Reyes.

Parophrys vetulus—This species is abundant from San Francisco northward, becoming at Puget Sound the commonest of the flat fishes.

It has been taken by Professor Jordan at Santa Barbara, but appears to become rare south of Point Concepcion. Those brought to market are usually quite small, but occasional examples reach a length of fifteen inches, and a weight of two pounds, or more.

Lepidopsetta bilineata, Mottled Sole—The *Platichthys umbrosus* of Dr. Girard (U. S. P. R. R. Rep. X., 149 1858), is identical with the species described by Ayres, while the *Lepidopsetta umbrosa* described by me (Proc. U. S. Nat. Mus. 1879, 106), is the one since described as *Isopsetta isolepis*.

This species is found along our coast from Monterey to Alaska, is rather common about rocky places, and is abundant in Puget Sound.

In size and weight it is about equal to *Psettichthys melanostictus* and *Hippoglossoides jordani*, and in quality ranks with the latter.

Aphoristia atricauda, Black-tailed Sole—This fish, although apparently too rare to be of economic value, since the only specimens extant are about six in number, and do not exceed six inches in length, is interesting as the only species of true sole found in California waters.

The Soleidæ have been separated as a distinct family from the flounders by Dr. Gill, the chief distinguishing character being the

smallness or absence of the pectorals. But as there is a regular gradation from species with large pectorals to those without any, this character is scarcely definite. In *Cynicoglossus* the pectorals are very small.

FAM. GADIDÆ—COD AND WHITING, ETC.

The Gadidæ are spineless fishes with cycloid or smooth scales, and usually with more than one dorsal and more than one anal fin. In economic importance this family ranks next to the salmon family, but it is only represented on the Pacific coast, U. S. A., by four species.

Gadus morrhua, Codfish—Although this fish does not belong to the fauna of California, and is not common even at the northern extremity of the Pacific coast of the United States proper, its economic importance renders it necessary to include it in this report. Dr. Bean, whose mission it has been to investigate the fishes of Alaska, believes the codfish of Alaska identical with *Gadus morrhua*, the common codfish of the banks of Newfoundland, and the adjacent regions; for the Alaskan cod is not a rock-cod (*Sebastichthys*), as are the so-called cod caught in California, nor is it even a hake, pollack, or whiting; but it is a true codfish, having three separate dorsal fins, two separate anal fins, and a small barbel under the chin.

It seems strange that such fishes as the species of *Sebastichthys*, possessed of rough or ctenoid scales, a spinous dorsal, three spines upon the anal fin, and numerous more or less developed spines on the head, should ever be popularly confounded with fishes like the true cod, which have not a spine upon body, head, or fins, and the scales of which are smooth or cycloid. Yet the confusion exists, and the names of cod and rock-cod, applied to the spiny fishes aforesaid, are the result of the confusion, and in their turn serve to perpetuate it.

Whether the cod-fish brought from the Sea of Okhotsh are of the same species as those from Alaska, remains to be proved.

Compared with the fishery of the Atlantic, that carried on upon this coast is comparatively insignificant, yet this does not arise from any scarcity of the fish, which is stated to abound among the numerous islands of the northwest coast, but from the want of a market sufficiently extensive to permit of its increase. The expense of transcontinental freight, and the smallness of the population between the Sierra Nevada and the Rocky Mountains practically limits the market to the Pacific States, although small quantities have been sent to South America, and some have been shipped to Australia.

The fishery was commenced about sixteen years ago, and at that date the salted fish sold at nine cents per pound. At the present time the best case cod is quoted at from three and a half to four cents per pound.

The total catch brought to San Francisco, amounted, in 1878, to about 1,500 tons, in 1879 to 1,800 tons. Thirteen or more vessels, large and small, are engaged in the trade, which furnishes employment, on an average, to about two hundred and fifty hands. The largest vessels are barks of about 350 tons, each having a crew of thirty men. The larger vessels are principally employed in the Okhotsh Sea fishery, while the smaller vessels, fore and aft rigged, are sent to the shores of Alaska, principally to the Choumagin Islands.

Those which go to the Okhotsh Sea make but one trip annually, leaving from the middle of March to the end of April, and returning from the end of June to October. Those which fish at the Choumagin Islands return earlier than those from the Okhotsh Sea, and occasionally take more than one trip. Last year one schooner made three trips, but her cargo each time was made up from the catch of other vessels that did not return. The smaller vessels are better fitted for the tortuous channels among the islands of Alaska than those of larger size.

On the coast of Alaska the fishery is usually carried on at depths of from ten to fifteen fathoms, but in the Sea of Okhotsh lines are used at forty to fifty fathoms. Both trawl lines and angle lines are used in the cod fishing of this coast. The latter are employed in deep water, the former where the depth is not too great, and the bottom is clear of rocks. Angle lines are exclusively used in the Sea of Okhotsh, and frequently also in Alaskan waters. A trawl line consists of a line to which a number of hooks are attached at regular distances by means of shorter lines, while a weight is secured to each end. Several trawl lines are paid out in succession, the position of each being indicated by means of buoys, one of which is fastened to each end of every trawl line. The trawls used in the Alaska cod fishery are often six hundred fathoms long (3,000 feet), and bear on each side a row of hooks at every half fathom, or thereabouts. After they are paid out, they are examined at intervals, and are drawn once or twice a day, according to the rate at which the fish take the bait.

An angle line bears two hooks, kept apart by a piece of wire, and has a heavy weight attached near the hooks. Each man manages two lines, one on each side of him, drawing one as soon as he lets down the other.

The use of the angle line instead of the trawl line in the Sea of Okhotsh is necessitated partly by the deep water, but partly by the abundance on the sand banks of a small crustacean, called by the fishermen a "sand flea," which attacks and devours the fish upon the trawl line before it can be drawn.

The fishermen are paid according to their catch, a fixed sum per thousand fish. At Kadiak, where some fishing is done, natives are employed to head, split, and salt the fish, and are paid from seventy-five cents to one dollar per day. The fish are treated in a manner similar to that employed in the Newfoundland fishery, the fish as they are caught are passed to the header, who removes the head; by him to the splitter, who cuts open the body and takes out the viscera. The catch is then stored in pickle, as the salted condition is called, until its arrival in the Bay of San Francisco, where it is dried in establishments erected for the purpose.

The quantity given above, as the total of the season's catch, does not include that taken by local fishermen along the various parts of the long line of coast between Behring's Strait and Puget Sound, at which latter place it is found, but in small quantity compared with its abundance in Alaskan waters.

The three principal firms engaged in the cod fishery, are Lynch & Hough, the Pacific Fish Company, and N. Bichardt & Co. The first named, which does a somewhat larger business than the second, carries on the fishery exclusively in the Sea of Okhotsh. It employs about one hundred and twelve men afloat, and from ten to fifteen at its drying establishment, which is situated at California City, near

San Quentin. When the bulk of the catch comes in, the force on the shore is increased to about sixty. At this establishment the fish is not dried in bulk, and then piled, as is done upon the Atlantic coast, and also in some cases on this coast, but is kept in pickle, in tanks of redwood lumber, and dried when required. This method is doubtless adopted partly on account of the limited demand caused by the small population of this coast, but it is claimed that better results are obtained by it. The piled up heaps of fish, however carefully dried, are liable in the more or less foggy atmosphere of our coast to "sweat" or ferment, to the great detriment of the article.

The tanks used to hold the stock are of redwood three inches thick, dovetailed at the angles, and without nails or any iron whatever. The fish are washed before drying, and when the latter process is complete, are sorted into three sizes; the largest, put up into wooden cases, are known as "case" fish, and fetch the highest price; the next size are made into bundles; while the smallest, after having been divested of skin, vertebræ, and fins, are cut in halves, packed in cases, and sold as "boneless codfish." Much of the work of preparing boneless cod can be done by boys. Great care is taken to insure perfect cleanliness at every step of the preparation, and in this respect much of the dried cod of this coast is certainly superior to that of Newfoundland.

The drying establishment of the Pacific Fish Company is situated upon a small island in Richardson's Bay, opposite to Saucelito.

The quality of preserved codfish depends, to a great extent, like that of all other salted articles, upon the quality of the salt used. The impurities, as they are called, of salt, are simply other ingredients naturally contained in sea water, and not taken out in the process of salt making. Ordinary sea water contains, besides common salt or chloride of sodium, sulphate of lime or gypsum (the material of plaster of Paris), and sulphate of magnesia. The proportions in which these enter into the composition of the solid residue, left after the evaporation of the water of the sea, may be seen from the following analysis: Analysis of water of San Francisco Bay, made December, 1879, by Prof. F. Gutzkow:

Chloride of sodium	0023.756
Chloride of potassium	0000.470
Chloride of magnesium	0003.030
Sulphate of lime	0001.263
Sulphate of magnesium (Epsom salts)	0001.837
Bromide of magnesium	0000.025
Total solids	0030.381
Water	969.619
	1000.000

The salt used in curing codfish, as well as most of that used in salting meats, hides, etc., is made upon the salt marshes of Alameda County by the evaporation of sea water. Some makers simply evaporate, allowing all the impurities to remain, while others, knowing the degree of concentration at which the objectionable substances are deposited, adopt means to obtain really pure salt. Whatever success may be obtained by others, a personal examination of the works and methods adopted at the Pacific Union Salt Works has convinced the writer that the salt obtained by them is as nearly pure as salt can be, excelling in this respect even the best Liverpool salt, and it is satis-

factory to know that the greater portion of the codfish taken on this coast is cured with the salt made by this company.

The oil from the livers of these fish, which forms a valuable portion of the industry on the Atlantic coast, is not utilized here, nor are the "sounds," or swim bladders, put up for food purposes. As has been long ago remarked in the Atlantic, the fish occupying deep waters are superior to those found on the more accessible banks.

Merlucius productus, Ay., Hake—The *Merlucius productus* of Ayres may prove to be identical with the *vulgaris* of the European coasts. Until lately the examples brought to the markets of this city seldom exceeded eighteen inches in length, but during the present summer the Italian fishermen of Monterey have frequently caught individuals of two feet or more in length, and some of these have found their way to San Francisco. In consequence of the stout form of this fish, and its thickness and depth in the pectoral region, its weight is proportionately large, reaching eight pounds, or even ten.

Pollachius chalcogrammus, Pal., Pollack—This species, hitherto believed to be absent from the Californian coast, has lately been found in the market, to which it was brought from Monterey Bay. The only other Gadoid fish occurring in California is the well known Tom-cod (*Microgadus proximus*), which is not on record south of Monterey Bay, but ranges northward to Alaska.

CHIRIDÆ.

The somewhat heterogeneous group included under this title contributes at least seven species to the fauna of California, all of them of sufficient size, but only four of them sufficiently abundant for use as food. All have the character common to the *Chiridæ*, *Agonidæ*, *Cottidæ*, *Scorpænidæ*, etc., of a bony process uniting the suborbital ring with the preoperculum. Unlike the *Scorpænidæ*, and most of the *Cottidæ*, which have three and a half gills, the *Chiridæ* have four, and there is a slit behind the fourth—not present in *Scorpænids* (rock-cod), nor in some Cottoids. The dorsal and anal fins are usually long, but in *Anoplopoma* they are short. The scales are usually ctenoid (rough), but in *Ophiodon* they are cycloid. The scales in some species cover the entire body and head, but in others parts of the head are scaleless. *Chirus* has several lateral lines, but the other genera have but one. *Zaniolepis* and *Oxylebius* have three anal spines like the *Scorpænidæ*, and the latter would be a scorpænid were it not for the gill. *Anoplopoma* looks like a codfish or whiting and *Myriolepis* resembles a *Serranus*, or marine Percoid.

The family altogether is a refuge for a number of species that will not conveniently fit in anywhere else.

All the genera are confined to the North Pacific, and most of the species become more abundant northwards.

Myriolepis zonifer, Ln., is as yet known from a single example only, found in the market of San Francisco. The ctenoid scales cover body, head, and fins, except dorsal; and its general appearance much resembles that of a young Jew-fish, *Stereolepis gigas*. The coloration is black transverse bands on a whitish ground. *Oxylebius pictus*, Gill, may be known at sight by the six vertical cross bands on a yellow ground, barred fins, first dorsal of fifteen spines, anal with three, and especially by its elongated snout and small mouth. It is not very rare at Monterey, living among rocks in clear water near shore. From

its small mouth and peculiar habits it is seldom taken except in dip-nets baited with crushed crabs. Its range extends northward beyond California.

Chirus pictus, Painted Sea Trout—This species is not at all common in the San Francisco market, but becomes more abundant in higher latitudes. It is often beautifully colored when fresh with blotches of bright green upon a dark brown ground. In alcohol these blotches become purple. In size, quality, and food it is identical with the next species.

Chirus decagrammus, Bodieron, Sea Trout, Boregat—It has always been supposed that *Chirus guttatus*, which is covered with yellow roundish spots upon a bluish gray ground, was perfectly distinct from *Chirus constellatus*, which has more or less perfect circlets of dark spots surrounding areas of a brighter blue than the rest of the body; but Professor Jordan has examined numerous specimens of both forms, and finds that all the *constellatus* are male, while all the *guttatus* are female. The two forms always occur together, and in about equal numbers, and the fishermen consider them identical. Professor Jordan believes that both names will have to give place to *Chirus decagrammus*, Pallas, which is probably the same species, as surmised long ago by Dr. A. Gunther. This species is everywhere moderately common from San Luis Obispo northward, especially in Monterey Bay. It is also common in San Francisco Bay, and abundant in the markets throughout the year. It feeds chiefly on crustacea and worms, and spawns in July. It is a tolerably good food fish, but inferior to the rock cod or green cod (*Ophiodon*).

It dies very soon after it is taken from the water, and the flesh softens very quickly. It reaches two or three pounds in weight.

A form with longitudinal series of yellowish blotches along the sides, once believed by me to be distinct, will probably prove to be only a variety of the female.

This form is described in the Proc. U. S. Nat. Mus. 1880, 55.

Anoplopoma fimbria, Candle Fish—This, though essentially a northern form, occurs along the coast as far south as Monterey. Until recently, it has been rare in the markets of San Francisco, but last year it was present in tolerable quantity, and during the present year (1880) may be almost called common. At Seattle it is very abundant, and is taken with hook and line from the wharves. At Monterey the Chinese take it with hook and line, while those caught outside San Francisco Bay are taken with sweep nets. It feeds on crustacea, worms, and small fishes, and reaches a length of twenty inches, and a weight of four to five pounds. This is not greatly esteemed as a food fish, but is sometimes fraudulently sold as Spanish mackerel.

Zaniolepis latipinnis, Long-finned Zany—As this fish has no vernacular title, and is not sufficiently common to acquire one from the fishermen, that given above is suggested. Though of no importance as a food fish, its singular appearance merits notice. In color, it is greenish-yellow, with blackish dots and bars upon the fins, and the surface of the skin is covered with prickles. These prickles are comb-like points radiating from scales that are buried in the skin. The first dorsal spine is long, the second longer, projecting far beyond the others, and often equal in length to half that of the fish. It does not exceed a foot in length.

Ophiodon elongatus, Buffalo Cod, Green Cod, Ln.—This has the

reputation of being one of the most rapacious fishes of the coast. The various species of rock cod (*Scorpænidæ*) often come into the market mutilated, having lost a portion of the posterior part of the body. The dealers do not attribute this to the sharks, but to the green cod, which, they say, seldom or never takes the hook itself, but, darting out of its hiding place among the rocks in pursuit of the rock fish upon the hook, is caught and brought up along with it. It attains far larger dimensions than any of its brethren, among either the *Chiridæ* or *Scorpænidæ*, reaching a length of four feet. Its range extends along the greater part of the coast of California, but it is most abundant from Monterey northward. Professor Jordan states that it feeds on crustacea and squid, as well as upon other fishes; and that northward from San Francisco it attains a length of five to six feet, and a weight of from fifty to sixty pounds. The flesh is usually of a pale livid hue. On various parts of the coast it is taken with gill nets, as well as with hook and line. As a food fish it ranks high, and its size and abundance render it one of the most important species. Many are dried by the Chinese and Indians.

FAM. SCORPÆNIDÆ.

The species of rock cod or *Sebastichthys*, known previous to the present year, were eleven in number, and with *Sebastodes paucispinis* and *Scorpæna guttata*, made a total of thirteen *Scorpænidæ* peculiar to the coast of California.

To his own great surprise Professor Jordan has, during his stay here as Fish Commissioner, more than doubled this list; so that now twenty-five species of *Sebastichthys* are known to occur, besides one more northern form, making, with the other genera, a total of twenty-seven fishes belonging to this family on the coast of California.

Several of the forms described by Professor Jordan had been observed by the writer on previous occasions in the markets of San Francisco, but their resemblance to species already described was so great, the differences amounting often only to the greater or less development of certain spines upon the head, or to peculiarities of coloration, that, lacking the facilities for procuring an extended series, he did not venture to describe any of them as new, the more because the series of rock cod was already suspected by naturalists to be too long. But Professor Jordan, by an extended examination of numerous specimens of every species, of all ages and of both sexes, has proved that the characters which separate the various forms, slight though they may at first appear to be, are constant and thus of specific value. The spines upon the head, by their greater or less development, serration or by the addition of an extra pair; the gill-rakers; the form and height of the spinous dorsal; in a few cases the number of rays of the second dorsals and anal, and in all the species the pattern of the coloration are the characters relied upon to distinguish the species. The coloration is very constant in this group, so much so that a change in its pattern, or even in its color, is usually significant of a change of species. The twenty-five species of *Sebastichthys* all occur in the Bay of Monterey, and many of them at Santa Barbara. The Portuguese fishermen, who fish in deep water, give to the species they take distinctive names, and are perfectly well aware that they are different; but the Italians con-

found the shallow water species under one common title. The spines upon the top of the head are most developed in *S. nigrocinctus*, and in this respect *S. serriceps* comes next. Both are rare in the markets of San Francisco; the first the rarer, and both are black-banded. In the attempt to give his fish a descriptive name, Ayres called the former *nigrocinctus*, or black-banded, a name which applies better to the second species; while *serriceps* or sawhead would fit *nigrocinctus* even better than it fits the species to which it is applied. Ayres observed *serriceps* as long ago as 1859, for he remarks to this effect: "There is in the markets occasionally another fish of the *nigrocinctus* type which may eventually prove distinct." The spines or spinous ridges on the head of the fishes of this genus are an anterior pair upon the snout (nasals,) a posterior pair on the back of the head (occipitals,) and between these three pairs which, from their position, are called pre-ocular, supra-ocular, and tympanic. A pair of post-oculars, dismembered from the supra-oculars, is often present, and some have a pair of spines called "nuchal," behind the occipitals. In *nigrocinctus* the nuchal and tympanic pairs are wanting, but the others rise into high ridges with undulating or jagged edges. In *serriceps* the nuchal pair is present, and all the ridges end posteriorly in sharp spines rising well above the surface of the head.

S. nebulosus, *chrysomelas* and *carnatus* are a trio of fishes exceedingly similar in appearance, differing, in fact, only in coloration, and with only one or two specimens of each to look at, it is difficult to believe in their distinctness; yet, when one has seen lying, side by side, a hundred examples of *S. carnatus*, all exhibiting red spots in almost exactly the same positions of the yellow ones of *nebulosus*, and when one has seen a pile of *chrysomelas* with its characteristic broad yellow band from front of dorsal to tail, following nearly the same line as the principal spots of the *nebulosus*, and when this color difference has been correlated with certain differences in the form of the body and head, it is difficult to avoid the conclusion that we have here three distinct yet very closely related forms.

S. maliger and *S. vexillaris* may be known from all others by their very high spinous dorsal, with the membrane deeply emarginated between each spine, and from each other by the bright chrome yellow tint of the former.

In all the foregoing species the jaws are equal in length or nearly so, and the form of the body is short and thick; the greatest depth equal to or more than one third of the length of the fish. *Nigrocinctus* and *chrysomelas* are remarkable for the great width of the body at the origin of the dorsal, and for the abruptly shelving form of the nape and top of head. In the succeeding species the jaws are still nearly equal, but the body is more elongated. *S. rastrelliger* may at once be known by a glance at the gills, or rather at the gill-rakers, or comb-like teeth set upon the inner or throat side of the bones bearing the gills. In all the other species these are more or less elongate, but in this they are often broader than they are long. This is an exceedingly dark colored species, dark brown, clouded with still darker, and the dorsal fin is very low.

S. auriculatus, the common rock-fish of the bay, may be identified by the black spot upon the tip of the gill-cover; *S. rubrivinctus*, which rarely, if ever, comes to the markets of San Francisco, by the broad transverse stripes of red and yellow upon its body; and *S. ruber* by its deep uniform red tint, large size, and broad, flat preopercular spines.

S. auriculatus may also be known by the pair of small coronal spines near the median line of the skull.

S. constellatus and *S. rosaceus* have four or five light pink spots upon their dorsal outline, and the former is covered on back and flanks with small white spots. *S. chlorostictus* is similar to these in many respects, but may be known by the green spots scattered over its upper portions and dorsal fin, as well as by the greater height of the spinous part of the latter.

S. rhodochloris resembles *rosaceus*. *S. minatus* is of a deep red tint, darker even than *ruber*, and is without the broad, flat preopercular spines which characterize that species. From *S. pinniger* it may be known by the rough scales which cover the entire head, even to the tip of the jaws.

S. pinniger, the *rosaceus* of Ayres, is usually more or less orange, with maroon blotches, and the fins, except the dorsal, are bright red. The scales on the head are not rough. Occasionally this species exhibits large blotches of black.

We started with species in which the spines were well developed, and have now reached those in which they are either present, but slightly developed, or are reduced in number. Moreover, in the remaining species the lower jaw protrudes beyond the upper, the protrusion increasing as we proceed.

S. elongatus has its greatest depth contained some four and a half times in its total length, and the gill-rakers long, equal to more than half the diameter of the eye, which is very large. The interorbital space is slightly concave.

S. proriger is nearly as elongate as the last species, but the outline of the back is more rounded; the gill-rakers are longer, the eye smaller, and the forehead or interorbital space is slightly convex. In both species the body is irregularly banded with lighter and darker longitudinal bands, and the lateral line lies on a decided light streak.

S. ovalis may be readily distinguished from the two preceding by its much more ovate form, as well as by the almost uniform height of the dorsal, and its still more protruding lower jaw.

In *S. entomelas* the second anal spine is about equal in length to the third, the spines upon the head are very small, and hidden by the scales, and the peritonæum, or lining of the abdomen, is black, whence the specific name.

S. mystinus=*S. melanops*—Ay: is the most abundant species in the markets, and is generally distinguished by dealers as the Black Rock Cod. Its black color at once distinguishes it from all other species, the nearest to it in this respect being *S. ciliatus*, which, however, is spotted with black upon a gray ground. In *S. mystinus*, the top of the head is spineless, but there is a small tubercle in the place of the preorbital spine, which tubercle is absent in *S. ciliatus*, which is identical with *S. melanops*, Gir., and with *S. simulans*, Gill.

S. flavidus is greenish yellow, and might be called the Yellow Rock Cod, were it not for the brighter yellow of some portions of *maliger* and *rubrivinctus*. The projection of the lower jaw reaches its maximum in this species, its tip entering into the dorsal outline, and the gill-rakers are very long and slender, equal in length to three fourths of the diameter of the eye. In the three last species, the third anal spine is longest, and the anal rays eight in number. Small nasal spines are present.

Sebastodes paucipinis, Small scaled Rockfish, is placed in another genus on account of its small scales, straight back, and other peculiarities. The snout is almost twice as long as the diameter of the eye; there are nine anal rays, and the third anal spine is longest. A few economic particulars of these species may prove interesting:

S. nigrocinctus, the Black, or rather the Dark Brown banded Rock Cod, is found from Monterey to Puget Sound, and is tolerably abundant, in very deep water, in the Straits of Fuca. About San Francisco it is rare. It reaches a weight of four pounds.

S. serriceps, the Saw-head or Tree fish, is more southern in its range, but is abundant in rather deep water about Santa Catalina Island. The bands are decidedly black, instead of dark brown, as in *nigrocinctus*, and are more numerous than in that species. Northern specimens are larger, paler, and more brightly colored than southern. It reaches about three pounds, and is rare in the markets of San Francisco, though met with more frequently than the preceding.

S. carnatus, *S. nebulosus*, and *S. chrysomelas* are known to the fishermen by the name of Garrupa. The first is taken in great numbers with gill nets in rather shallow water, and is occasionally abundant in our markets. It is rare at Santa Barbara, and has not yet been noticed north of San Francisco. It reaches a weight of about two and a half pounds. It is classed with *atrovirens*, *flavidus*, *nebulosus*, and others, and is accounted a good food fish.

S. nebulosus is about equal in size and weight to the preceding, but is found in rather deeper water, and is scarcely so abundant.

S. chrysomelas, the Yellow-Banded Rock Cod, ranges from San Pedro to Puget Sound, and becomes more abundant northward. It occurs in water of moderate depth, and is taken with hook and gill nets. It reaches three and a half pounds.

S. maliger is found in rather deep water, and is commonest in the Straits of Fuca, where it is taken with hook and line. Occasionally it occurs in the San Francisco markets. It is larger than any of the preceding species, reaching a weight of six pounds.

S. rastrelliger, Garrupa, Dusky Rockfish, is not very rare in our markets, and reaches a weight about equal to that of the latter. About the Santa Barbara Islands it is taken with hook and line and with gill nets, rarely with seines. It is esteemed as food.

S. auriculatus, Wharf Rock-fish, is in individuals the most common of all the group in the San Francisco markets; and as it is plentiful in the bay, and is taken throughout the year, the total weight of the species brought in is probably about equal to that of *S. mystinus*, notwithstanding its smaller size. It is the only kind that frequents shallow bays, and is taken near shore from wharves and similar places, with hook and line. It reaches a weight of three pounds, but the greater part of those brought into the markets of San Francisco are young, and do not weigh more than half a pound.

S. vexillaris is the most variably colored and one of the most widely spread of the species, ranging from San Diego to Puget's Sound. It reaches a weight of five or six pounds, and is occasionally tolerably abundant in the markets of our city.

S. chlorostictus—Green-spotted Rockfish, the Pesce Vermiglia of the Italian fishermen, reaches a weight of four pounds, and is known only from Monterey Bay, where it occurs in considerable abundance along with the three following:

S. rhodochloris—Fly Fish, is only known from Monterey Bay. It

is occasionally sent to San Francisco in considerable abundance in spring. It is not a large species.

S. rosaceus—Corsair. This is the smallest of the group, rarely exceeding one and a half pounds. It occurs among reefs in deep water, and where found is the most abundant of the red species. In San Francisco market it is abundant throughout the year.

S. constellatus—Bagre. This is another deep water southern species, taken with hook and line only. It is rather abundant, and of frequent occurrence in our markets. Together with the preceding small red species, it spawns at Monterey early in the spring. It reaches from two to three pounds.

S. rubrivinctus is appropriately styled the Spanish Flag by the Portuguese fishermen of Santa Barbara, on account of its gay red and yellow transverse bands. It occurs on reefs in very deep water, and is occasionally taken with hook and line in spring. It reaches a weight of six pounds.

S. ruber—Large Red Rockfish, Tambor, is probably the largest of all the species, reaching a weight of twelve pounds, or even more. It is graded upon the stalls with *pinniger* and *miniatus*, from which the dealers do not distinguish it. Its range extends to Puget's Sound, and its habitat is deep water, so that it is taken with hook and line. Professor Jordan, from whom all our additional knowledge of this group is derived, mentions that about Victoria the skulls of large specimens are infested with an encysted parasitic worm.

S. miniatus, Rasher, Rascira—Another deep water species, taken with hook and line, and also with gill nets, and occasionally sent to the city markets in considerable numbers. It is scarcely as large as *S. ruber*, but reaches eight or ten pounds, and is equally esteemed.

S. pinniger, Smooth Red Rock Fish, Hiaume. This is a deep water species, abundant everywhere from Monterey northward, and taken in great numbers, usually with set lines It is probably the most abundant of all the red species in the San Francisco markets, and in size is inferior only to *S. ruber*, since it reaches a weight of from eight to ten pounds. It is esteemed as food, except when very large, when its flesh is rather coarse. Many are split and salted in the deep waters of Puget Sound.

S. atrovirens, Garrupa—Dark Greenish Rock Fish, abundant in rocky places in rather shallow water, and taken in great numbers in gill nets, south of Point Conception. Many are taken during Winter at the Santa Barbara Islands, and considerable numbers are salted and dried by the Chinamen. It reaches three pounds.

S. elongatus, Reina—Abundant with *S. proriger* in very deep water. Weighs about two pounds, and is not common in markets except in spring.

S. proriger rarely exceeds one and a half pounds in weight. Not rare in its haunts about Monterey Bay. In quality similar to other small red species.

S. ovalis, Viuda, Widow—A southern species, taken with hook and line in very deep water, and apparently somewhat rare. This species and *rubrivinctus* have not been observed in the San Francisco markets either by Professor Jordan or by myself, yet Ayres' type was procured there.

S. entomelas, Black-bellied Rock Fish—At present the least abundant of the group, and known only from Monterey Bay, where it is

taken with hook and line in very deep water. This and the preceding are equal in size and value to the next.

S. flavidus, Yellow Tail—Not common in Puget Sound, but very abundant in Monterey Bay and about San Francisco. It occurs in both deep and shallow water, and is taken in large numbers both with gill nets and set lines. It is one of the largest of the group, reaching a weight of six to seven pounds, and is considered one of the best.

S. mystinus, Black Bass, Black Rock Cod, Black Garrupa, Pesce Pretre—More common about Monterey and San Francisco than either southward or northward of those points, and sent from Monterey and Tomales Bay to the San Francisco markets in greater quantity than any other, although from its dark color it is less salable than the more brightly tinted species. Large quantities are wasted, especially in autumn, when they fail to find purchasers at a cent per pound. It is found in rather shallow waters, is mostly taken in gill nets, and reaches a weight of five pounds.

S. ciliatus, Black-spotted Bass. This fish, in size, habits, and value, is similar to the preceding, and is by no means rare in the markets of San Francisco. It is most common in Puget Sound.

Sebastodes paucispinis, Boccaccio, Merou, Jack—The Italian "Boccaccio" or big mouth, fits this fish well. It is a large species, reaching a weight of from twelve to fourteen pounds, and a length of two feet eight inches. It is one of the best food fishes, and although not very common at San Francisco, becomes more abundant southward. The adults inhabit reefs in deep water, but the young come near shore in the Spring, and are taken from the wharves.

The rock fish generally live on small fish and crustacea. They spawn early in the spring, and some at least are viviparous. The young of the *S. flavidus* are extruded at a length of over one third of an inch, and the same is the case with *nebulosus*, *rosaceus*, *carnatus*, etc. Probably the whole group is viviparous. The first to notice this peculiarity was the Californian ichthyologist, Dr. W. O. Ayres, whose observations have in most cases stood the test of examination.

FAM. STROMATEIDÆ.

This family, a subdivision of the Scombridæ of Cuvier, is characterized by the presence of spinous processes from the vertebræ, forming teeth in the œsophagus, as well as by the absence of ventral fins. Only one species is known to occur upon our coast.

Stromateus simillimus, Pompino—This highly valued species occurs along the entire Pacific coast of the United States, having been seen in Puget Sound in the summer. It moves from place to place rather irregularly, appearing in schools at almost any season. It is but a small fish, rarely exceeding half a pound in weight, but its flesh is rich and fat, and its name helps to sell it, so that it readily fetches from twenty-five to fifty cents per pound. It is taken in seines, with hook and line, or by grabhook from the wharves.

A very curious monstrous example of this fish was brought to San Francisco market in the autumn of 1879. This individual was possessed of two mouths, externally alike, equal in size, and similar in structure; the lower mouth, situated somewhat behind the upper, directly beneath the eye, and in front of that bone of the gill cover

which is denominated by naturalists the interoperculum, while the upper was in the usual position.

FAM. CARANGIDÆ.

Most of the species of this family, which is a subdivision of the old mackerel family (*Scombridæ*), that occur upon this coast, are widely spread and well known forms, and the presence of some of them was not suspected until Professor Jordan commenced his researches in the Spring of this year.

Trachynotus ovatus, a form more nearly allied to the New Orleans Pompino than is the fish which bears that name at San Francisco, was recorded by the writer as from Lower California in 1876, and probably extends as far north as San Diego.

T. pampanus, also found on the Atlantic coast of North America, occurs in Lower California, but has not yet been met with within the limits of our State. It may readily be known from *T. ovatus* by its more elongate body, accompanied by longer dorsal and anal fins, and by its darker color.

Trachurus saurus, the Horse Mackerel, is an old friend of the Levantines who carry on here the same occupations they pursue in the Mediterranean. Occasionally it strays up the coast as far north as San Francisco. It is taken in large numbers in seines, and salted for bait. It may be known from all other fishes found in the markets of San Francisco by the row of keeled plates along the center of the posterior part of the body for its entire length.

Caranx caballus may be known from the last species by the limitation of the keeled plates to the posterior portion of the body, as well as by a black patch upon the operculum.

Naucrates ductor, the Pilot-fish of authors—that small oceanic fish which is said to guide the shark to his prey—is said to occur south of Point Concepcion. It may readily be distinguished by the darker vertical bands across its bluish flanks.

Selene argentea is another species, found both in the Atlantic and Pacific, but at present not known to occur in the waters of our State, although, as it is common in Magdalena Bay, it is not improbable it may straggle farther northward. It is excessively compressed and thin, the top of the head almost vertical, so that it looks highly intellectual. The anterior rays of the dorsal and anal are very long.

Seriola lalandi—This is the well known Yellow-tail of the coasts of the tropics, and South America and Africa. At present, it is on record from this coast only from San Diego and the Coronados Islands northward to Santa Barbara, where it is abundant in the summer, spawning about July and August. In winter it is not seen. It is taken entirely by trolling, sometimes in considerable numbers, and as a fresh fish, ranks somewhat below the Barracuda. When dried, it is considered equal to the Barracuda, or to *Caulolatilus*.

It feeds upon squid and small fishes, and reaches a weight of fifty to sixty pounds, and a length of four to four and a half feet.

The curious Remoras, which have a sucking disk of large size occupying the whole of the upper side of the head and nape, constitute a small family, nearly related, in some respects, to the Carangidæ and Scombridæ, or mackerel family.

The sucking disk is a transformed spinous dorsal, and consists of a number (varying according to species) of transverse laminæ united

to a central bar, and capable of being raised or closed like the slats of a set of blinds. By means of this sucker, the Remora attaches itself to a shark, a ship, or other floating object, and allows itself to be carried wherever its host pleases, thus economizing labor. An example of *Remora jacobæa*, which has seventeen to nineteen laminæ in its disk, was last year taken in the Bay of San Francisco from the body of a shark, which it had accompanied in its wanderings. The larger *Echeneis naucrates* has also occurred at San Francisco.

FAM. SCOMBRIDÆ.

All the true Scombridæ have a greater or less number of finlets behind the soft dorsal and soft anal, each finlet consisting of a single ray followed by a membrane of triangular shape.

There is little to separate them from the *Carangidæ*, except the non-protractile mouth; and one genus bridges over this difference. All are oceanic and swim in large schools.

Scomber pneumatophorus, Spanish Mackerel—This species is known also as Easter Mackerel, and Little Mackerel, and occurs from Monterey Bay southward, coming up in irregular and often large schools in summer and fall. It is occasionally sent to the markets of San Francisco. It does not exceed fourteen inches in length.

Scomber scombrus, Mackerel—There is little doubt of the occurrence of this fish upon the southern part of the California coast, although Professor Jordan did not see it. Captain Charles Willughby, Indian Agent at Neah Bay, and formerly a Massachusetts mackerel fisher, gave information that he once netted a school of Eastern mackerel off Catalina Island; and a fisherman at Santa Barbara claimed to have taken it off Anacapa Island.

Scomberomorus concolor—This species is here called the Spanish Mackerel, is very rare, is held in high repute, and fetches a high price. It may be known by its slim form, and toothless palate. This is the *Chriomitra concolor* of my previous report. The nearest of kin to this fish is the *Cybium maculatus* of the Atlantic Coast.

La Cepedes's name *Scomberomorus* has precedence of *Cybium*, and as *S. maculatus* has the palate toothless, our Spanish Mackerel must be included in the same genus. Minute papillæ upon palate and other parts of the internal surface of mouth and gill-cavity are possessed by both species, but the only true teeth are those in the jaws.

Sarda chilensis, Bonito, Skip-jack—This is not identical with the European bonito, although it belongs to the same genus. It was first described from Chili, and is known to occur along our coast as far north as Monterey Bay. In the summer it is very abundant, and is taken in great numbers by trolling, especially about Santa Barbara and San Diego. Many are salted and dried, but the flesh is rather coarse, and is considered inferior to the Barracuda and Yellow-tail. Some persons aver that it makes them sick. It reaches an average weight of about twelve pounds, and sells at about twenty-five cents in the localities where it is taken. About August it becomes abundant in the markets of San Francisco, so much so, that it frequently cannot be sold while fresh.

Orcynus alalonga, Albicore—This is one of those widely spread species which confound the best efforts of naturalists who have not had abundant opportunity for comparison. As *Thynnus pacificus*, this species was described by Cuvier, and Valenciennes, and again,

under the name of *Orcynus pacificus*, by Cooper in 1863 (Proc. Acad. Nat. Sci. III, 75), but Professor Jordan considers, from examination of fresh specimens, that it is identical with the well known *Thynnus* (*Orcynus*) *alalonga* of the Mediterranean and Atlantic, the alalonga or long-wing of the Italians. There is no mistaking the fish for any other found upon our coast. Its long pectoral fin, reaching a considerable distance beyond the second dorsal fin, is a distinctive mark which none can overlook. The first dorsal is long, and has fourteen spines, while the second, of twelve soft rays, is followed by eight finlets, or separate rays, each with a membrane attached. The anal has eight separate finlets. In color it is steel blue upon the sides, becoming blackish above, and silvery white below.

It occurs in the Bay of Monterey in the later months of summer; is brought occasionally to San Francisco market, and becomes abundant farther southward, notably among the islands of the Santa Barbara channel. It affords excellent sport, being caught by trolling while sailing very rapidly, and biting voraciously at a white rag. Those brought to the markets of San Francisco were caught from the deck of a vessel.

It frequents deeper water than the bonito, and in Santa Barbara channel is rarely taken within six miles of the shore.

Like the bonito, it feeds chiefly on anchovy and squid, but is occasionally taken with rare deep water fishes in its stomach.

It reaches greater weight, is comparatively deeper in form than the bonito, and is less valued even than that fish.

Another species of *Orcynus*, probably *O. pelamys*, also a Mediterranean species, is known to occur on our coast; and a *dolphin* (*Coryphæna*) species unknown, is known from an individual once washed ashore at Cayucos Landing.

FAM. LABRIDÆ.

The Labridæ, or Wrasse family, a numerous tribe of fishes, is but poorly represented upon the coast of California, where its place is to a great extent filled by the Embiotocidæ, or viviparous perch. The Labridæ have a single dorsal, the spinous portion of which is at least as much developed as the soft, and are covered with cycloid scales of moderate or large size. The lips, as the name indicates, are largely developed, and the mouth is capable of great protraction, the length of the ascending processes of the intermaxillaries, or upper jaw bones, permitting much forward movement.

Many of the fishes of this family are beautifully colored, and most of them attain dimensions that render them valuable as food fishes.

The Labridæ live largely upon mollusks, and some are more or less herbivorous.

Pimelometopon pulcher, first described by Dr. W. O. Ayres, under the more pronounceable name of *Labrus pulcher*, is, as its name implies, a highly colored fish. Its chief adornment consists of a bright red band extending across the body from the head to a perpendicular from the anus, contrasting strongly with the black head and hinder portions of the body. This is one of those species which prove that it will not do to attach too much importance to comparative proportions of depth to length, since the depth and thickness of the front portion of the body increases with age so much, that one of

those mathematical naturalists who seek to bind nature to fixed rules might make several species out of it. It attains a length of two feet or more, and a weight of from twelve to fifteen pounds. It is very abundant in the kelp south of Point Concepcion, and is taken in immense numbers by the Chinese, who dry and salt it.

The flesh is rather coarse, but the fat forehead is esteemed for chowder. It feeds upon crustacea and mollusks. Rare instances of its occurrence at Monterey are on record.

Platyglossus modestus, King-fish—This species shares with several others, in no wise related to it, the names of king-fish and sea-trout. It is rarely brought to the markets of San Francisco, yet it is of common occurrence in the Bay of Monterey, and from that point southward. It is a shallow water species, and frequents the kelp that floats near the shore, and is taken from the wharf at Monterey in dip nets.

When fresh, the adults are far from deserving the name of *modestus*, since they are decorated with waving, broken lines of bright green upon the sides of the head, are bright orange red below, becoming brown above, and have the front edge of each scale marked with a line of green. The first dorsal is bright blue at the base; there is a dark green or blue spot at the upper pectoral axil, and a black blotch on the base of the tail-fin.

The young are much less brightly tinted, the green lines are not conspicuous, and the color is olivaceous above, fading into whitish below. It is common in the kelp, and is often taken with hook and line, or with baited dip net. It is chiefly used for bait, although its flesh is said to be of good quality.

Platyglossus semicinctus, the Kelp Fish, is not rare in the kelp from Santa Catalina southward, and at San Pedro is occasionally taken in gill nets and sometimes with the hook. It is larger than the last species, reaching about a pound in weight.

FAM. POMACENTRIDÆ.

Of this family, which includes numerous short-bodied, large-scaled fishes with the lower pharyngeal bones united, only three species are know to occur upon our coast, and neither of these ranges north of Point Concepcion.

Hypsipops rubricundus, Garibaldi, Red Perch—This species is abundant at the Santa Barbara Islands and southwards; is taken chiefly with gill nets; reaches a weight of three or four pounds, and is not held in high esteem as food.

Chromis punctipinnis, known as the Blacksmith, is abundant in the same localities as the last, and is taken with gill nets, or with hook and line. It reaches two pounds in weight, but is not valued. Like the other species of the tribe, it feeds on shell fish and crustacea.

FAM. EMBIOTOCIDÆ.

This curious tribe of viviparous fishes has had its numbers increased by the addition of three species, described by Messrs. Jordan and Gilbert, and all occurring in the markets of San Francisco.

One of these, *Ditrema atripes*, is exceedingly like the better known *Ditrema* (*Phanerodon*) *furcatum*, but is larger, and may be distinguished by the darker tint of the sides, becoming still darker on

the back, where the ground color is interspersed with small streaks of dard red; as well as by the black-tipped ventrals. This species is occasionally sent to market in considerable numbers from Monterey, where it is taken in seines.

Brachyistius rosaceus is a pretty little pinkish fish, with two darker spots on each side near the base of the soft dorsal.

The first specimen observed in the market was treasured by the dealer as a curiosity, and the second was secured by the writer for Professor Jordan, who has since obtained two or three others. It is rare, and at present only known from the markets of San Francisco.

Abeona aurora is, from the structure of the teeth, nearly related to the Least Shiner, (*Abeona minima*) but does not very closely resemble it, in general appearance, and is larger. It may be identified by the brassy streak which extends along the body from the snout to the base of the caudal, and by the blackish axil of the pectoral, and the considerably forked tail fin. At present it is certainly known only from Monterey Bay, where it is very abundant about rocks. Many inhabit the larger rock pools at Point Pinos. It reaches about a third of a pound in weight.

Some alterations have been made in the nomenclature of this group. The short, broad species, called by Gibbons' *Hyperprosopon* have, together with *Hypercritichthys* of Gill, been placed by Professor Jordan in *Holconotus*, (Agassiz) from which they are not distinguished by any structural character; and for similar reasons the genera *Phanerodon* of Girard and *Tæniotoca* of Agassiz have been merged in *Embiotoca*, which must itself give way for the older name of *Ditrema*, since the species which of all the group was first described, namely, *Ditrema temminckii*, a Japanese fish, turns out to be, according to Professor Jordan, generically identical with *Embiotoca* of our own coast.

As food fishes, the Embiotocidæ are far inferior to the other leading groups of the coast, but their abundance in species and in individuals renders them valuable. All the tribe feed upon crustacea and small fishes.

The great peculiarity of this tribe does not consist so much in the mere fact that the eggs are hatched within the body of the mother, since this occurs also in the large group of rock cod; but in the small number and high state of development of the young, and in the modifications of structure of males and females, resulting in an evident differentiation of the sexes. The eggs are hatched, and afterwards the young develop, within the ovaries, which are developed for the purpose into a number of pouches or rather folds, and from which they escape into the sea through the vulva. There is no trace of any connection of any kind between the young and their parent; no rudimentary placenta, as there is in some sharks. The males have the anal fin constructed differently to that of the females, and it is probable that some sort of copulation takes place, as the eggs must be fecundated while within the ovary. The hard structure in the anal fin of the male is a clasping organ.

In most genera there is between the ventral fins and the anal an elongated naked area, forming a groove, and between the basis of the ventrals is a lance-shaped blade, covered with scales, its free tip overhanging the front of the scaleless area.

From Professor Jordan's notes I glean the following fresh particu-

lars respecting the previously known species, which were treated of more fully in the report for 1879.

Rhacochilus toxotes, is known to the fishermen as the Alfione, bring forth from fifteen to twenty young in summer, and is considered the best of the group.

Damalichthys argyrosomus, ranges northward to Puget Sound, where it is exceedingly abundant; is probably of all the species the third most numerous in individuals, and in quantity ranks next to the preceding. It is called White Perch.

Ditrema furcatum (*Phanerodon furcatus*, Gir.) lives in sheltered bays and is taken in seines in great numbers; is very abundant from San Francisco southward, but has not been noticed north.

Ditrema laterale, Surf Fish, Blue Perch—This species is very abundant north of our State, reaching to Puget Sound, and is on the whole, the most common of the large species.

Ditrema jacksoni, the Black Perch, Pogy, or Black Bass, belongs especially to California, but extends to Puget Sound.

Hypsurus caryi. Bugara—This fish is usually very abundant at the edge of the kelp, especially at Monterey, where it is often taken with hook and line, or in baited dip nets, and sometimes in great numbers in seines. It is used chiefly for bait for rock cod; but the larger ones are sent to market.

Amphistichus argenteus, Silver Surf-fish—called by the fishermen Surf-fish and White Perch, is, on some sandy shores, very abundant, especially in the surf. At Santa Barbara and Soquel, it is more common than elsewhere.

Holconotus rhodoterus, which may be called the Red-finned Perch, is not so common as most of the others, except in certain localities, one of which is Soquel. It reaches about a pound and a half in weight.

Holconotus agassizii (*Hyperprosopon agassizii*) is, like the preceding, known to range from Tomales to Santa Barbara, and is small, rarely weighing over half a pound.

Holconotus (*Hyperprosopon*) *argenteus*, Wall-eye or Silver Perch—is everywhere abundant, and is taken in great numbers in seines on sandy shores, as well as with hook and line from wharves. It is not much esteemed as food, and is small—usually weighing about half a pound.

Holconotus analis. Only locally abundant; common at Santa Cruz and Soquel, where large quantities are taken, along with the Shiner (*Cymatogaster aggregatus*), as bait for rockfish. As it does not weigh more than a quarter of a pound, it is seldom brought to market.

Brachyistius frenatus. Widely distributed, and at some localities, as at Monterey, Point Reyes, etc., very abundant; but used chiefly for bait, on account of its small size (quarter pound), and not sent to market, unless accidentally mixed with other species. Ranges to Puget Sound.

Cymatogaster aggregatus, Shiner, Sparada, Minnie, Little Perch—This is, everywhere, from San Diego to Puget Sound, the most abundant of the group, and is found especially in sheltered bays. It is about equal in size to the last.

Abeona minima, Shiner—The smallest of the tribe.

Most of these species occur in the Bay of San Francisco, and all that weigh half a pound or over are sent to market. The most important, as regards the weight actually sold, are *Dit. jacksoni*, *D.*

laterale, *D. furcatum*, *Rhacochilus toxotes*, *Damalichthys argyrosoma*, *Amphistichus argenteus*, and *Holconotus argenteus*. In the spring (April and May), *Hypsurus caryi*, the Orange-banded Perch or Bugara, is common. The Red-finned Perch is not often in the market.

The Silver Surf-fish (*Amph. argenteus*) was, during last Winter, sent in great numbers from Monterey, and many individuals approached the Alfione, or Thick-lipped Perch, in size and weight, reaching a length of fourteen to sixteen inches, and a weight of four or five pounds.

Professor Jordan does not believe *Hyperprosopon arcuatus* to be a valid species; so that all the large-eyed, up-turned mouth and short-bodied perch, are to be considered as one species, and the name Wall-eye will suit very well.

Hysterocarpus traski, the only member of the family that inhabits fresh water, has been frequently sent to market during the summer, notwithstanding its small size. It occurs in streams at least as far south as San Luis Obispo.

FAM. SCIÆNIDÆ.

The family of sciænoids is not largely represented on the northern portion of our coast, but its members become more numerous from Point Concepcion southwards. Into the Bay of San Francisco come *Cynoscion nobilis*, the sea bass; *Genyonemus lineatus*, popularly called king-fish, and *Seriphus politus*, also called king-fish. The last is far from common, but the first two are well known and highly prized food fishes. The first attains a large size, examples of from forty to sixty pounds weight being frequently brought to San Francisco market in summer months.

The king-fish rarely exceeds ten inches in length, but makes up for its small size in its delicate flavor.

Below Point Concepcion occur *Corvina saturna*, *Roncador stearnsii*, *Umbrina xanti*, *Cynoscion parvipinnis*, and *Menticirrus undulatus*, making a total of eight species.

Cynoscion parvipinnis, Blue-fish, Corvina, also called Caravina, and Sea Bass—This species, originally described by Dr. W. O. Ayres, occurs at San Pedro and southward, and is not rare in winter, when it frequents the bays and is taken in seines and gill nets. It feeds chiefly on crustacea. Its flesh is esteemed, but will not keep long, reeembling in this respect the weak-fish—(*Otolithus regalis*)—of the Atlantic States. It reaches a length of two feet, and a weight of five pounds, (Jordan).

Cynoscion nobilis (*Atractoscion nobilis*), Sea Bass, White Sea Bass—Very abundant in spring and summer from San Francisco southward. It feeds on crustacea, anchovies, etc. The young are sold as sea trout, and are often considered by fishermen a distint species. This is one of the most valued food fishes of the coast, having firm white flesh. Examples of from fifty to sixty pounds weight are not rare in our markets.

Menticirrus undulatus, Sucker Bass, also known as Bagre and Sucker—Abundant from Santa Barbara southward, on sandy shores, and taken in seines and gill nets. It feeds largely on crustacea, reaches a length of eighteen inches, and a weight of two pounds and a half, and is held in moderate esteem as food. (Jordan).

Umbrina xanti, Yellow-finned or Yellow-tailed Roncador—This

species is abundant from Santa Barbara southward, on sandy shores; feeds on crustacea, squid, etc., and spawns in July. It reaches about a foot in length and two pounds in weight. Many are taken in seines and gill nets. It is considered a food fish of good quality, and at San Pedro many are split and salted.

Genyonemus lineatus, King-fish, Little Bass, Little Roncador—This species ranges southward at least to San Pedro, but is most abundant northward, especially in summer, becoming scarce in winter. It lives between the shore and the kelp, and is taken with hook and line at the border of the kelp, as well as in great numbers in seines. Crustacea form its principal food. Many are dried by the Chinese. The flesh is rather soft.

Roncador stearnsii, Croaker, Roncador—Abundant from Santa Barbara southward, on sandy shores, in rather deeper water than *Umbrina xanti*, and taken chiefly in gill nets. It feeds mostly on crustacea, spawns in July, and reaches a length of two feet, and a weight of five or six pounds. It is considered a good food fish.

Corvina saturna, Black Roncador—This fish has the same range and occurs in similar situations with the preceding, but is less abundant, and smaller, not exceeding eighteen inches in length, and about three pounds in weight. It is less attractive in color than *Umbrina* and *Roncador*. This species may be recognized by its dark gray color, bluff snout, and short body.

Seriphus politus, King-fish, Queen-fish—Rare at San Francisco, but more abundant southward, along sandy shores. It is taken in seines, especially at Santa Barbara and Soquel. Although in flavor probably the best of the small *Sciænoids*, its small size—seldom more than eight inches—causes it to be but little valued.

FAM. PERCIDÆ—PERCH.

This family has been divided and subdivided into numerous groups, and it now appears likely a reunion may be established. The *Sparidæ*, which have the hinder end of the maxillary hidden behind the suborbital in the closed mouth, and are furnished either with cutting incisors in front of the jaws, or grinding molers at the side, seem at first very distinct, but they are linked by such forms as the *Pristipomatidæ* with the more typical *Percoids*. As only nine species are yet known upon our coast, it will be as well to consider them all as *Percidæ*.

Girella nigricans, Blue-fish—This appears to be the only sparoid fish found on the coast of Upper California. It occurs but rarely in the markets of San Francisco, where it is brought from the Bay of Monterey. Its proper range ends near Point Concepcion, northward of which those found are only stragglers, while southward it is abundant.

It may be recognized by its curious three pointed, or rather three lobed teeth. In form it is an elongated oval, and in color an almost uniform brackish olive. It is abundant about Santa Barbara, where it is usually taken in gill nets, and is an important food fish.

It is entirely herbivorous in its habits, and is very tenacious of life. Soon after death the flesh begins to soften. It reaches a length of about a foot, and a weight of four pounds.

Scorpis californiensis, Moon-fish—Exceedingly rare, though this species is at San Francisco, it becomes abundant south of Point Con-

cepcion, so much so that the great bulk of the fish taken by the Wilmington fishermen off Santa Catalina Island, for the supply of Los Angeles, consists, Professor Jordan informs me, of this fish. The few that have been taken in Monterey and even in Tomales bays must be regarded only as stragglers from the crowd. Its chief food is crustacea. It reaches about a foot in length and three pounds in weight, and ranks high as a pan fish.

In color it is gray, the ventral fins are covered with scales, the form is a regular oval and the mouth is small, with three lobed incisors.

Serranus maculofasciatus, Rock Bass—Abundant in bays from Point Concepcion southward, especially at San Diego, where it is taken in seines and also with hook and line from the wharves. It is not found in deep water nor about islands. It feeds chiefly on crustacea and squid; reaches a length of fifteen inches and a weight of from two to three pounds, and is considered an excellent food fish.

This species is prettily spotted all over with small round purple spots, and across the body, overlying the spots, run several irregular darker transverse bands.

Serranus nebulifer, Johnny Verde—The greenish tint of this species explains its common name, but the lower part of the head exhibits purple spots similar to those of the last species, to which, despite its more elevated dorsal, it is closely related. It ranges to Monterey, and is common in San Pedro and San Diego Bays. A large example reaches twenty inches in length, and a weight of about four pounds. It is considered a good food fish.

Serranus clathratus, Cabrilla, Rock Bass, Kelp Salmon—From Monterey southward, becoming more abundant towards the southern extremity of the State, and constituting one of the most important food fishes of the Santa Barbara Islands. It lives among rocks in not very deep water; feeds on crustacea and squid, and reaches about the same size as the last species. It is considered one of the better class of food fish, and is only occasionally split and salted.

Stereolepis gigas, Jew-fish, Black Sea Bass—The Farallones appear to be the northern limit of the range of this huge sea-perch, which becomes abundant southward, especially about the Santa Barbara Islands. It is said to be an excellent food fish, but from its great size, is not often taken. It is caught by still-fishing, not by trolling, but individuals are often taken by swallowing white-fish, etc., when the latter are on the hook. Small examples are sometimes brought to San Francisco market, and its occurrence within the Bay of San Francisco is on record. It reaches a weight of four to five hundred pounds.

FAM. AMMODYTIDÆ—SAND LANCES.

Ammodytes personatus, the sole member of this family recorded from this coast, is abundant upon sandy shores from Monterey northward. In Puget Sound it is exceedingly abundant, swimming about bays close to shore in immense schools. Sometimes it is found buried in sand between tide marks. It reaches a length of five or six inches and is seldom eaten.

The *Ammodytidæ* have no ventral fins; the gill membranes are continuous around the throat, and the vent is situated far back upon the body. In the Aleutian Islands this fish is called the Candle fish.

FAM. SPHYRÆNIDÆ—BARRACUDAS.

This small family of highly carniverous and swift swimming fishes contains the genus *Sphyræna* only, and is represented on this coast by *S. argentea*, the well known Barracuda of our markets. From San Francisco southward it is abundant in summer, when it probably comes near shore for the purpose of spawning. Its chief run is in July. In the winter it probably retires to deeper water. Professor Jordan states that it is taken chiefly by trolling at a distance of three or four miles from shore, except about the Santa Barbara Islands, where it is taken with hook and line. In autumn and winter the young are sometimes taken in seines. It is considered one of the best food fishes, and and when salted and dried, sells at a higher price than Alaska codfish. It reaches a length of three or more feet, and a weight of twelve pounds. The Sphyrænidæ are covered with smooth scales, and have the ventrals placed far back.

FAM. ATHERINIDÆ—FALSE SMELTS.

Three species of this family, which, though containing chiefly small fishes with feeble teeth, agrees with the last in having smooth scales, and in the abdominal position of the ventrals, are found upon this coast.

Atherinopsis californiensis, the Common Smelt, is taken in great numbers in all bays open to the ocean from San Francisco southward. It resides in positions sheltered by rocks, and is often caught by trolling with a small hook.

Atherinops affinis, the Little Smelt, prefers, according to Professor Jordan, more sheltered situations than the former for a residence. It is considered a pan fish of good quality, having firm but rather dry white flesh. Though smaller than *A. californiensis*, it reaches a foot in length. Many are dried by the Chinese.

Leuresthes tenuis—This occurs in large schools at San Diego, and reaches a length of five inches.

FAM. MUGILIDÆ—MULLETS.

The Mullet, mentioned in the last report of the Fish Commissioners, proves to be really *Mugil mexicanus*. In San Diego Bay, Professor Jordan found it abundant. At San Pedro it made its appearance three years ago, and has since been tolerably common, and it is occasionally sent to our markets from Monterey. Professor Jordan believes that it is spreading northward along the coast. It feeds upon mud containing organic matter, reaches a length of about fifteen inches and is much esteemed as a pan fish.

In winter, it enters creeks and lagoons, where many are landlocked and destroyed by sea birds.

FAM. SCOMBERESOCIDÆ—GAR-FISHES.

This group of fishes is represented on the southern part of our coast by four species. From all otherwise related families these may be known, by the union of the lower pharyngeal bones into a single bone (as in the *Labridæ*), and by the presence of a series of keeled scales along each side of the belly.

As in the Cyprinodonts, there is no adipose dorsal fin, and the dorsal and anal are placed far back upon the caudal part of the body.

Belone exilis—Needle-fish, Gar-fish. In summer, this species frequents bays and lagoons along the coast from Santa Barbara southward, for the purpose of spawning, but it is not common. It reaches a length of two and a half feet, and is esteemed as food.

Exocœtus californicus, Flying-fish, Volador—Professor Jordan has found this species abundant along the southern part of our coast, as far north as Santa Cruz. It is particularly common in Santa Barbara Channel, and about Santa Catalina Island. It goes in great schools. Respecting its habits, the following is quoted from the MS. of Professor Jordan:

"The Flying-fish flies for a quarter of a mile, not rising more than three or four feet above the surface. Its motive power is given by rapid movements of its powerful tail in the water, which movements are continued after the body is out of the water and the pectorals spread. When the tail is out of the water, the ventral fins are also spread out, and the motions of the pectorals cease. Its motion is then very swift, and in a straight line, which afterwards becomes a curve by the partial turning over of the body, one wing being placed partly against the wind. Motion is often renewed by putting the tail once more in the water, as the fish falls so as to touch it. It is to some extent able to shy off from a vessel. In the water its movements are very rapid. It reaches a length of fifteen inches and a weight of a pound and a half or more, and is considered excellent food. It spawns about the beginning of August, which is the cause of its visit to the coast. Large numbers are taken in seines and gill nets off Catalina Island. Nine-tenths of those seen in July were males."

FAM. SALMONIDÆ—SALMON AND TROUT.

The salmon and trout, once reported to be so numerous in species, are gradually becoming fewer as examination is made of the same species at different seasons of the year, in salt and fresh water, and at the various periods of its life.

The long list of anadromous salmon (*Oncorhynchus*) is now by the researches of Professor Jordan and Mr. Gilbert, reduced to six, which bear the provisional names of *nerka*, *gorbuscha*, *quinnat*, *kisutch*, *keta*, and *kenneriyi*.

These names are provisional because some, if not all, of the species not only occur upon the Pacific Coast, U. S. A., but extend northwards to Behring's Straits, and down the opposite coast of Kamtschatka. They are thus probably identical with some or other of the species previously described from the coast of Asia.

The various species of salmon and trout are subject to great variations in consequence of change of habit, as well as to others caused by age, sex, and season; and these changes have been the cause of the excessive multiplication of nominal species. Salmon, when in the sea, are of a silvery, steely, or bluish tint, darkest upon the back. When in the river, the silvery tint is lost and the flesh also becomes lighter. The young of all the species are cross-barred with darker tints which disappear with age. The form and proportions of the body are also, in the anadromous species, liable to change, as also those of the fins. Neither can comparative size be depended upon.

The *Salmo sebago* of the lakes of Maine is believed to be only a landlocked *Salmo salar* depauperated by the more confined habitat. The trout of a small brook never attain the size of those of a larger river.

The *quinnat* of this coast was prevented from returning to the ocean from the lakes San Andreas and Pilarcitos by the erection of the dams of the Spring Valley Water Company, and now those lakes are full of salmon which mature their eggs and milt when less than a pound in weight.

The characters which can be depended on to distinguish the species of salmon are as follows: To some extent, the form of the caudal fin and the arrangement of the spots upon the body, especially near the tail; the number of rays in the anal fin (*Oncorynchus* has fourteen or more, *Salar* or *Salmo* about twelve); the size of the scales; the number and size of the gill rakers, or toothlike processes upon the bones which bear the gills; the number of branchiostegal rays; and the number of the pyloric cæca which are attached to the lower end of the stomach. The teeth are also to be regarded, but not implicitly, as they are liable to alterations with age. More attention has naturally been devoted to the study of this group than to that of any other, on account of its importance as a source of food.

Upon this coast, the salmon fishery upon the Columbia alone accounts for about a million and a half of salmon, weighing when taken at least twenty-five pounds each on an average. This is probably equal to twice the total weight of all other fisheries, salmon included, carried on upon the Pacific Coast of the United States, even with the Alaska cod fishery thrown in.

The life history of these fishes is thus invested with much interest, since, upon our knowledge of it, depends the success of any attempt that may be made to prevent, by judicious legislation, the threatened decrease of the species.

The season of the principal run differs according to the species, and it appears to be tolerably well established, by the reappearance of marked fish, that some individuals make good their retreat after spawning, and return again next year, although the greater portion die of the exhaustion consequent upon their ascent of the streams. This is the case more particularly with those which ascend highest, jumping falls, passing rapids, and braving the difficulties of a long journey without food.

Oncorhynchus quinnat, the Common Salmon—This is the salmon *par excellence* of the Pacific Coast, the victim of the canning industry, the Columbia River salmon, the taste of which is familiar to Briton, Australian, Frenchman, and Teuton. As the salmon business is fully discussed in the Report of the Fish Commissioners, no statistics need be given here. An interesting fact in its natural history is that, as with the shad, so with the *quinnat*, we know where some at least of the individuals spend their time while absent from our rivers. In this respect we are ahead of our Atlantic brethren, who, as yet, have not found out what *Salmo salar* or *Clupea sapidissima* do with themselves during their holidays. *Quinnat*, like *Clupea sapidissima*, and all the rest of our fashionable society, recreates in the Bay of Monterey, where he has this year furnished much amusement and some food.

It appears singular that few *quinnat* were caught during summer in the above named bay until this year, and this may appear to sug-

gest a change of habit in the fish; but, in view of the fact that new species of fish and crustacea are continually being brought in, and that this is known to be caused by the search of the fishermen in new fishing grounds, it is more probable that the *quinnat* have always been there, but that the fishers have failed to find them until lately. But it must not be supposed that all the *quinnat* go to the Bay of Monterey. Examples have been taken far southward of this point, and a few run up Ventura River every year.

South of this river our coast does not present any streams running freely into the sea, as the rivulets terminate in lagoons separated from the ocean by sand bars. The *quinnat* has evidently the most southern range of any of the species of *Oncorhynchus*, and possibly becomes less abundant northward, the most abundant salmon of Fraser River being *O. nerka*, the blue-back of the fishermen. Yet it is thought that the large "King-salmon" of Alaska is this species.

Notwithstanding the study that has been given to the habits of salmon, there are yet many points in their life history which are not cleared up. They are hatched in clear running brooks accessible from the ocean; they run down to the ocean when three or four inches long, and they return to the rivers to spawn. This much is certain, and it is certain also that the greater portion of the returning fish are large, and of the age of about four years. As smaller individuals, containing spawn, are sometimes taken, it is not unlikely that some run up the river and spawn once or twice before their final and fatal journey. However this may be, it appears that when full-grown, the salmon approach the coast, where, meeting with currents of fresh water from the rivers, they become irresistibly attracted, and follow them up until fairly within the stream. When at sea they feed freely and bite vigorously at a hook, but as soon as they are fairly within a river, they cease to feed and cannot be tempted to bite. The proof that they do not eat lies in the fact that the stomach of those taken in the river is always empty. Once in the river, they become impressed with an irresistible desire to penetrate further and further, and in obedience to this impulse, they mount rapids, spring up small cataracts, and flounder through shallows until, spent with exhaustion, battered and wounded by contact with rocks and other obstacles, and still further worn out by the process of spawning, the greater portion die. All spawn before they die, and as the strength of the individuals differs, they spawn at various points all along the river and its tributaries, but always in comparatively shallow and clean water. In spawning, they pair off; the female deposits her spawn upon the gravel, and the male pours out upon it the fertilizing milt. As the males mount up the river, a great change takes place in the form of the head. The jaws commence to enlarge and to curve, the upper forming a hook directed downwards, the lower a similar hook directed upwards. Coincident with the growth of the jaws, is that of the group of teeth upon their lips, which become relatively immense. The result is a "dog salmon" with a physiognomy utterly unlike the straight-jawed, neat looking individuals just arrived from the sea, and it is no wonder that such old males have been described as distinct species. The males also develop a more or less conspicuous hump upon the shoulder, but this is not very evident in the species we are now considering.

The females do not, at least as a rule, develop the hooked jaw, although it is reported that some individuals with hooked jaws

have been found to contain ova. Dead salmon are often found in the shallows of the upper courses of the rivers, having died before they could reach deeper water.

Some adventurous individuals follow the Columbia into the Territory of Montana before they succumb.

The color of the flesh of a salmon does not indicate its species, since the same individual which had bright red flesh when in the ocean, and at the commencement of its run, will become nearly white at or after spawning. It is clear from what has been said that the flesh of the "kelts," as the salmon after spawning are called in England, can scarcely be fit for consumption by human beings. Covered with wounds upon which fungus spores find a suitable nidus, many look sufficiently repulsive. It is probable that the stories of so called "poisonous" fish and other marine animals arise entirely from the injudicious eating of such creatures when exhausted with spawning, or when afflicted with some disease, the outward symptoms of which we do not recognize.

In the smaller rivers of the coast the run of salmon takes place in the autumn, thus, in Eel River, it commences when the first rains have caused the waters to rise. Thus the canning season upon the Coquille, Eel, and other small rivers, commences after that of the Columbia River is over. Some *quinnat* run up the Columbia in the autumn, and it is to this fact that we owe the preservation of the species, in spite of the immense numbers taken. The fishing is carried on during the spring run only, from April to July, during which season some 1,500 boats are perpetually engaged in it, so that from the bar up to off Mount Ranier there is an almost continuous web of nets, effectually preventing the ascent of by far the greater portion of the fish. Professor Jordan is, however, of opinion that the autumn run is sufficient to counterbalance the destruction. In Klamath, Fraser, Sacramento, and Rogue Rivers there is also a spring run. An ordinary full grown *quinnat* weighs about twenty-five pounds, but individuals attain a much greater size, reaching as much as sixty pounds or even seventy. Those found in the Sacramento are, as a rule, smaller than those of the Columbia, not averaging more than eighteen pounds. In Puget Sound the *quinnat* are also smaller and less fat than in the Columbia.

The *quinnat* has from fifteen to eighteen branchiostegals, or small bones supporting the gill membranes; and has the body, dorsal, and caudal fins spotted with round spots. On the approach of the spawning season it becomes darker and sometimes, but not always, acquires a reddish tinge. The scales become covered with a coating of mucus so that the fish cannot readily be scaled. The pyloric cœca are very numerous, varying from a hundred and fifty to two hundred, so that it may be readily known by an examination of the stomach from *O. nerka*, which has about seventy-five very small cœca, and *O. keta*, which has from sixty to eighty large and thick ones. In this character *O. kisutch* and *O. gorbuscha* are near *quinnat*, but the branchiostegal rays of these species, like those of *nerka* and *keta*, are only thirteen or fourteen in number. *O. keta* has fewer spots than *quinnat*; the caudal has a few spots on its upper rays, and the dorsal a few on its first rays. *O. nerka* is *immaculate* as is *O. kisutch*.

Oncorhynchus keta, Silverside Salmon, Cohoe Salmon—The *tsuppitch* of Dr. Richordson has at length been identified by Professor Jordan as the *keta* of Walbaum. It turns out to be a salmon of the genus

oncorhynchus, and not a trout as heretofore supposed. Its previous identification with the so called "Black Trout" of Lake Tahoe is thus found to have been an error. There is but one species of trout yet known from that lake, the presence or absence of teeth upon the hyoid bone being the result of accident or individual peculiarity. The real *tsuppitch* or *keta* reaches a length of fifteen to eighteen inches, and a weight of four or five pounds. When in the ocean, it feeds on crustacea, herring, etc. This salmon is said to be very superior in Quinnault River, where it is abundant and is salted by the Indians, as it is also at Neah Bay, at which point it was formerly canned. Professor Jordan saw it at Seattle, and speaks of it as abundant in Puget Sound and at Cape Flattery, as well as for some distance north and south from thence. As a food fish it ranks with the young of the *quinnat*. It runs up Eel River, California, and has been taken in the Sacramento.

Oncorhynchus nerka, Blueback; also called by fishermen, Rascal, Sukkeye, Redfish, Dog Salmon—This is a much smaller salmon than the *quinnat*, and apparently has its headquarters farther north. In the Columbia it is common, but less so than the *quinnat*, while in Fraser River and the streams of British Columbia generally it is the commonest salmon. It is often canned upon the Columbia, but without acknowledgment, as four of them are reckoned and paid for as one *quinnat*, although of course four *nerka* exceed in weight one of the latter.

In Puget Sound it is abundant, and ranges northward as far as the Aleutian Islands. It reaches eight to twelve pounds in weight. This species runs up the river principally in the Spring.

Oncorhynchus gorbuscha, Humpback—This species may readily be distinguished from the *quinnat* by the smaller size of the scales, and also, at least in the Sacramento, which it ascends in tolerable numbers in October, by the greatly developed hump formed by the dorsal outline immediately behind the head. *O. nerka* also becomes humpbacked, but not to so great an extent as the present species. The males, in the spawning season, present in perfection the character upon which the genus *Oncorhynchus* was founded, viz.: the hooked jaws, which give the fish a repulsive appearance. It does not appear to be a common species, except in Puget Sound, and does not exceed five to eight pounds in weight.

Oncorynchus kisutch, Dog Salmon—This, the true Dog Salmon, occurs in Puget Sound, Fraser River, etc. In most characters, except the scales, it agrees with the last species; but the scales are larger, and the aspect of the fish different. The males, when they enter the rivers in the fall, have reddish transverse bands alternating with greenish, and become blotched with these colors as they ascend. The females are bright silvery on entering the rivers.

Oncorhynchus kennerlyi, the Red Fish—This species appears to be, for the most part, an inhabitant of lakes that have no outlet, and is thus debarred from taking a trip to the ocean. Living in the lakes as ordinary salmon do in the sea, it runs up the rivers that flow into them, and deposits its ova in their clear water, just as other salmon run up the rivers flowing into the sea.

After spawning, other salmon become redder in their external coloration, and are "redfish," but this is the "Redfish" *par excellence* of the Indians, the valued fish of the lakes, to procure which they take long journeys.

The Redfish attains a weight of from four to five pounds.

Salmo henshawi, the Silver Trout—Two species of trout, *S. tsuppitch* and *S. henshawi*, commonly called the Black and the Silver Trout, were once supposed to inhabit Lake Tahoe and other lakes, but *S. tsuppitch* proves to be a salmon instead of a trout, leaving *Salmo henshawi* in sole possession as at once the Silver and the Black Trout of Lake Tahoe. Again and again has the writer examined the so called Black Trout of Lake Tahoe, in the endeavor to find any difference between it and the Silver Trout, and has failed. Head, teeth, gill-covers, fins, tail, all external characters of form, were alike. Yet the dealers make out two species; and in the Museum of the Academy of Natural Science we have what purport to be specimens of both, presented by the Acclimatization Society. These also I examined with the same result as with the fresh specimens. *Salmo tsuppitch*, the Black Trout, was said to be without teeth upon the hyoid bone. Occasionally a large trout without these teeth would occur, but invariably it was a particularly silvery and unspotted individual. If there were two species, it became evident that it was the Silver Trout that was without these teeth; yet other silvery trout had them. At last Professor Jordan claimed that he had found the real *tsuppitch* in the Columbia, and that he believed all the trout in Lake Tahoe were *henshawi*. It is well known that the delicate hyoid teeth become worn off by age or accident, in many cases. The Black Trout of the dealers must, therefore, be a myth, so far as species is concerned; yet, as those called "black" usually arrive here at a different season of the year than those called "silver" (which are often as dark as the black), it is not unlikely that there may be some peculiarity in the flesh, especially as the dealers profess to find a difference in firmness between them.

S. henshawi is sparsely covered with rather large dark round spots.

It reaches a weight of two or three pounds. Large quantities are sent from Wadsworth, on the Central Pacific Railroad, to the markets of San Francisco.

It is not confined to the lake it is named after, but occurs also in other mountain lakes, and in the Sacramento River, but it has not yet been traced to salt water.

Salmo irideus, the Brook Trout—This is the almost universally diffused brook trout of the streams of this State, and is, when adult, singularly handsome, glowing with peculiarly shaped spots or short bars of metallic golden green.

It has been generally catalogued as an exclusively fresh water fish, but it appears to share to some extent the anadromous habits of *Salmo salar*—as "sea trout"—possessing all the characters of *Salmo irideus* except the color, which is light, almost uniform, silvery, are frequently brought to the markets of San Francisco during the winter months, and there is little or no doubt that these are *iridea* which have left the streams for a more or less prolonged visit to salt water.

The fact is that all trout although for the most part inhabitants of fresh water, take occasional trips to the sea when the waters they inhabit are favorably situated for the purpose. *S. irideus* is usually of small size, not exceeding a foot in length, but under favorable circumstances reaches eighteen inches. In the Columbia it is rare, but Professor Jordan saw a few from a stream above Astoria.

The fish is seldom brought into the markets of San Francisco from fresh water.

Salmo mykiss, Hard-head, and Black Salmon—This is an exceedingly large trout, equal or superior in size to *Onc. nerka*, since it reaches a weight of from fourteen to eighteen pounds. It inhabits the mouths of large rivers, such as the Columbia, Fraser, Skeena, etc., and is occasionally found in Puget Sound. It appears to spawn in spring, somewat earlier than the salmon, and occurs upon the coast at the same time with the latter. It is believed to be migratory. In some regions it is esteemed as a food fish, but in the Columbia the flesh is very white, and it is considered valueless. The body is less deep than that of a salmon, and the tail much heavier.

Salmo clarki, Oregon Trout, Salmon Trout—This species is very abundant in all lakes and rivers north Mount Shasta, but is not found south of that locality. It is abundant in salt water in Puget Sound, where it is taken in seines in great numbers. It reaches a weight of from two to three pounds, and is reckoned an excellent food fish.

Salvelinus malma, Dolly Varden Trout—The Charr is abundant in the lakes and streams of the Cascade Range, from Central Oregon northward, and is also very common in the salt waters of Puget Sound, where many are taken in seines. Specimens obtained at Seattle and in the markets at Victoria reached a weight of eleven pounds, but in the mountain lakes and streams it does not exceed three pounds. Many are brought in by the Indians at the places before mentioned. It feeds freely on sticklebacks, herrings, etc., and is an excellent food fish.

The Dolly Varden trout of the Upper Sacramento, formerly known as *Salvelinus bairdi*, proves to be identical with this. Mr. Smith, who is stationed at the fish-hatching establishment upon the McCloud River, has examined many specimens, and finds that the characters relied upon to distinguish them utterly fail. Teeth are present upon the hyoid bone, in most examples from the McCloud, as in the typical *spectabilis*. The supposed absence of these teeth was the chief character upon which *bairdi* was based.

Hypomesus olidus, Surf Smelt—Professor Jordan did not meet with this fish south of Monterey, and states that it is very abundant in Puget Sound, where it spawns in the surf in the spring. It reaches nearly a foot in length, is very fat, and is held in high esteem as a pan fish. In the markets of San Francisco it is tolerably common, but seldom exceeds eight inches in length.

Osmerus pacificus, Eulachon, Candle-fish—The Eulachon has not yet been recorded from the coast of California, but is abundant from Oregon northward, ascending the rivers in enormous numbers, but for no great distance. In the Columbia, as well as in Fraser and Nass Rivers, it is especially abundant. In Fraser River the run is in May. On Nass River is a factory for making Eulachon oil, which is used as a substitute for cod-liver oil. When fresh it is one of the finest of pan fish. Many are pickled and shipped to San Francisco, where they are held in the highest esteem. Its use as Columbia River Sardines has been previously mentioned. The largest reaches a length of about ten inches.

Osmerus thaleichthys, Smelt, Small Silver-smelt—Tolerably common from Monterey Bay northward, but not running in such num-

bers as the two preceding smelts. It reaches six to eight inches long, and from its smaller size and softer flesh is less valued than the eulachon or surf-smelt. It rarely comes to San Francisco market in very good condition, and hence is less salable than the spurious smelts, of the family *Atherinidæ*.

Osmerus attenuatus, Slender Smelt—About equal in size to the preceding, but of a more attenuated form, with a straight lower jaw instead of a curved one, and a different upper surface of head. Not very common in the markets of San Francisco. Range not made out.

Albula vulpes. Lady-fish—This world-wide species, which, though by some classed with the herrings, differs from them in the rounded form of the abdomen, which in the latter is compressed and sharp-edged, and in the numerous pavement-like teeth of its mouth, is apparently resident at San Diego, where it is rather common, and is sold as a food fish along with the mullet. Its bright silvery coloration renders it salable, but it is not highly valued. It spawns late in the autumn, and reaches a length of about a foot.

FAM. CLUPEIDÆ—HERRINGS.

Including the Anchovies, this family has only five representatives upon the coast of California, only three of which reach San Francisco.

Clupea sagax, Sardine—This species occurs more or less abundantly in our markets throughout by far the greater portion of the year. In April and May those brought in are chiefly young, and it is commonest about July and August. The sardine may be distinguished from the herring by its thicker and more elongated body, somewhat longer head, and striated gill-cover, as well as by the total absence of teeth; by the even jaws (in the herring the lower jaw projects); by the narrow pointed form of the area included between the ridges on the top of the head, and by the row of spots on the sides. At San Diego it is even more abundant than at San Francisco, and is taken from the wharves with hook and line.

This species is very close to, if not identical with the *Clupea pilchardus* of Europe, the young of which are the sardines put up in oil that are so highly prized. It appears strange that no attempt in this direction has been made in California.

Clupea mirabilis, Herring—The herring of this coast is, on the whole, slightly smaller than that of the Atlantic, and since it is not salted or dried to any great extent, it does not figure so largely as an article of food. This, however, is not due to any scarcity of the fish, which occurs in shoals along the coast of California in the winter season, and is still more abundant northward. During some of the winter months, the bulk of the fish brought into San Francisco market consists of these species. In September the first of the season are taken. In November it becomes abundant, and in March or April falls off and disappears. Some have been cured in Humboldt Bay, but are said to be very poor; indeed, it is stated that the herring found along the Pacific Coast of the United States are far inferior to those taken between Puget Sound and Oonalashka. At the latter place the Alaska Fish Company put up a small quantity, and the Cutting Packing Company salt some at Sitka. The Indians press the whole fish for oil, and the spawn is kept to form part of their winter stock of food. At Puget Sound many

barrels are sometimes taken at one haul of the seine. It reaches about a foot in length, and spawns in January at San Diego, but much later on the northern part of our coast. It is nowhere much valued.

Clupea (*alosa*), *sapidissima*, Shad—This species has prospered since its introduction into the Sacramento, and is now brought to market pretty regularly, although it still bears a high price. As in the Atlantic States, it descends to the sea at intervals, and the locality chosen by a large proportion of the species is the Bay of Monterey. Others scatter to a greater distance, as Professor Jordan took two examples on the Columbia River; and it has also been taken as far south as Wilmington. The largest shad I have yet heard of on this coast was sold in the spring of this year, by Messrs. Spence & Johnson, of the California Market. This individual measured twenty-six inches in length, nine and a half in width, and weighed eight pounds and a half. One of about the same dimensions, but not quite so heavy, was sold by the same dealers last year.

Stolephorus ringens, Anchovy—This is one of the most abundant of the finny tribe along the coast of California, and although not taken largely by the fishermen, is of great indirect service to man, since it forms a large part of the diet of other fishes. Even the tomcod, itself the prey of almost every fish used for food, devours its share of *S. ringens*. It frequents quiet bays. Two other species of anchovy occur in the southern part of California, viz.: *S. compressus* and *S. delicatissimus*. Both of these species differ widely in color from *S. ringens*, being yellowish, with a silvery streak along the flanks, instead of deep bluish.

In *S. compressus* the oval fin is much longer than in either of the other species. *S. compressus* reaches a length of about five inches, and is very abundant in the Bays of San Pedro and San Diego. It is not eaten, as its flesh is very dry.

S. ringens is chiefly used for bait, especially by the Chinese, who salt it for that purpose. In San Francisco market it is occasionally pickled with spices. It reaches a length of six inches.

S. delicatissimus is a very small species.

ORDER APODES, FISHES WITHOUT VENTRAL FINS.

This order, which includes numerous fishes having an extremely elongated form, with numerous vertebræ, very small branchial apertures, no ventral fins, and fin rays of simple structure, is but poorly represented on this coast, since only the specimens occur within the limits of California, and one or two others farther north. All of these are marine.

Muræna mordax, Conger Eel, Congaree—The Conger is abundant about Santa Catalina Island, and at San Diego, where it lives among rocks near tide marks, and may sometimes be taken on land. It is very pugnacious, striking like a snake. The flesh is fat and palatable like that of the fresh water eel, and as it reaches a length of five feet, and a weight of fifteen to twenty pounds, it is esteemed as food, although the skin is reputed to be poisonous.

The four species catalogued from this coast, have dwindled to two upon further examination. *Acipenser brachyrhynchus*, the large short-nosed sturgeon, of the Bay of San Francisco, proves to be identical with *A. transmontanus* of the Columbia River; while the *A. acutirostris* or sharp-nosed sturgeon of Ayres is the young of the same species.

The only other species, although no sharper-nosed than the preceding, must bear Ayres' name of *medirostris*, while the *A. acutirostiis* of Gunther (Cat. Fish. Brit. Mus. VIII. 344), and the *A. agassizii* of Dumeril, are but the young of this species. Both have the snout acutely pointed when young, and becoming more bluff with age.

Acipenser transmontanus, White or Common Sturgeon—This sturgeon is common in all bays and large rivers from San Francisco northwards, and is taken in great numbers on the Sacramento, Columbia, and Fraser Rivers. It feeds to a considerable extent on crustacea, and Fraser River gorges itself with the eulachon.

It runs up the rivers in the spring with the salmon. It reaches eight, ten, and even twelve feet in length, and a weight of six hundred pounds, but most of those brought to market are much smaller, from twenty-five to fifty pounds. The flesh is largely consumed in this city, and is very cheap. Much of it is smoked. The eggs are used as caviare, and are much esteemed by Germans and other Europeans.

Acipenser medirostris, Green Sturgeon — The distribution and habits of this species are the same as those of the preceding, but it is much less abundant, and though a large species, is probably inferior in size. It is not eaten, as it has the reputation of being poisonous. The smaller number of plates in the lateral line, the greater striation of all the plates, and the different position of the anal fin, are characters by which it is easily distinguished, to say nothing of the green color of the flesh, which is probably the cause of its bad reputation and certainly prevents its sale as "sea bass." The flesh is in reality as good as that of the white sturgeon.

CLASS—ELASMOBRANCHII.

The *Elasmobranchii*, or Sharks and Rays, are fishes of a generalized type, differing widely on the one hand from the true bony fishes, and on the other from the far less organized lampreys and myxines. In the days when it was believed possible to arrange all the forms of life in a straight line, ascending or descending, naturalists were puzzled to know where to place these creatures. In some part of their structure they seem to be as far above true fishes as in others they are below it. The brain is in many respects superior to that of a typical fish, such as a perch or salmon, and the arrangements for securing the reproduction of the species approach in complexity those of the mammalia. On the other hand, the skeleton is cartilaginous and imperfectly developed, and by far the greater number are without a gill covering. The development of the reproductive organs varies greatly in the different families and genera of this class; some are oviparous, but produce few and large eggs, while in others the young are hatched within the body of the mother, and in some species of sharks a rudimentary placenta is formed, the vascular wall of the

umbilical sac becoming plaited, and interdigitating with similar folds of the walls of the uterus.

The great majority of the Teleostei, or true fishes, deposit an immense number of ova; but some, as the Embiotocidæ, or viviparous perch of this coast, are ovoviviparous, that is, the young are hatched within the ovary. In these cases, however, there is no trace of a placenta developed, as in the Elasmobranchs. But there is another and greater difference. In true fishes there is no union of the sexes. The milt of the male is squeezed out over the ova of the female—the two sexes, in some cases at least, assisting each other in the operation by rubbing their bodies together. But in the Sharks and Rays, fertilization is secured in the same manner as in all vertebrates above fishes, as well as in insects, crustacea, spiders, etc., namely, by the direct introduction of the male element into the female reproductive organs. In this respect the Teleostei, however specialized in other matters, took a step downwards, while the Elasmobranchs foreshadow, in their oviparous forms, the higher oviparous vertebrates, and in their viviparous forms the mammalia. While in the Teleostei the two sexes are usually much alike, and are distinguished externally only by slight differences in the form of the abdomen, or in the color (especially at the breeding season), the males of the Elasmobranchs may be readily distinguished by the pair of large organs known as "claspers," which are really intromittent organs.

The skin of the members of this class is more or less studded with calcified papillæ, forming, when the papillæ are numerous and thickly set, what is known as shagreen; and the entire skeleton is cartilaginous.

This class is divided into two orders, the first of which includes only the Chimæra and its allies, which are characterized by the coalescence with the skull of the cartilage forming the upper jaw and palate, and by the presence of a single gill-opening only, and the *Plagiostomi*, or Sharks and Rays, in which the jaws are distinct from the skull, and there are from five to seven gill-openings. The pouches within these branchial slits are narrow, and divided from each other by a membrane, but the respiratory processes do not extend to their edges, except in Chimæra and its allies.

The Sharks and Rays, the two sub-orders of the *Plagiostomi*, are distinguished from each other chiefly by the more or less cylindrical form and lateral gill-openings of the former, and the depressed body and ventrally situated gill-openings of the latter. But the two orders approach closely by such forms as the depressed monkfish and the sawfish (*Pristiophorus*), with lateral gill-openings, and the scarcely more depressed sawfish (*Pristis*), with gill-openings on the under surface.

ORDER HOLOCEPHALI—CHIMÆRAS.

Chimæra collici, Rat-tail, Rat-fish—This species, the Pacific representative of the *Chimæra monstruosa* of the Atlantic, is by no means rare on all parts of the North American coast north of Point Concepcion, and is occasionally, on account of its bizarre appearance, brought into the market of San Francisco as a curiosity. In museums it is one of the most ordinarily occurring species, for every novice in ichthyology who procures one, believes that such thing was never seen before, and forwards it accordingly.

The two sexes of the chimæra differ widely in appearance. The female is larger and stouter than the male, and has less singularity of form, but the smaller male has upon the snout a curious cartilaginous organ, armed with recurved teeth on its button-like extremity. This projection can be used on occasion as a weapon of defense, but its normal use is that of a prehensile organ, subservient to the purpose of reproduction. The claspers of the male are of complex structure.

While performing the reproductive act, the shorter male holds the female lightly grasped by the pectoral fin, by means of the hooked projection upon its forehead.

This fish frequents rather deep bays, feeds on fishes and marine invertebrates, and takes the hook readily. It spawns in July, and its egg-cases are long and slender, and unprovided with tentacles. The liver is extremely large and fat, but the fish, which does not exceed twenty to twenty-four inches in length, with a weight of from six to eight pounds, is too small to allow of its profitable pursuit.

SUB-ORDER BATIDÆ—RAYS AND SKATES.

In the typical rays, *Raiidæ Dasybatidæ*, the trunk is surrounded by the immensely developed pectoral fins, so that it forms a broad, flat disk, from which protrudes posteriorly a more or less long and slender tail. Some of the genera, however, approach the sharks, having a thick tail, and much of the body free from the pectorals. The gill openings are five in number, and are always on the lower surface of the body. Spiracles (breathing holes), are always present; there is no anal fin, and the dorsal fins, if present, are quite small and placed upon the tail. Fourteen species are now known to inhabit our coast, and all but three are peculiar to the west coast of North America. Previous to the visit of Professor Jordan, only seven were known to occur.

Myliobatis californicus, Stingaree, Sting Ray, Eagle Ray—This species is abundant along our coast at least as far north as Tomales Bay; and along the northern portion of its range is the only sting ray known. As the pectoral fins are not continued around the head, the sides of which are free, *Myliobatis* is not classed with the *Dasybatidæ*.

The Eagle Ray is especially abundant on sandy shores, and is very destructive to oysters, for the mastication of which, the broad flat surface presented by its hexagonal pavement like teeth is peculiarly fitted. It also devours crustacea and fishes, and reaches a weight of seventy-five pounds. It is not eaten by whites, but is occasionally dried by the Chinese.

Probably the same as *Myliobatis aquila* of the Mediterranean, Atlantic, and Australian Coasts.

Manta birostris, Sea Vampire—This gigantic species, which reaches fifteen to twenty feet in width, is said to occur on the extreme southern part of our coast. The mouth is wide, at the anterior extremity of the body, and contains teeth only in the lower jaw. These are small but numerous, in about a hundred longitudinal rows. This species is also called the Devil Fish, and has been said to carry down men beneath its outstretched pectorals. It is best known from the Atlantic, and is common in the Gulf of Mexico.

FAM. DASYBATIDÆ—STING RAYS.

Like the Raiidæ this family has the pectoral fins continued around the front of the head and confluent at the extremity of the snout, but unlike them the tail is armed with a strong serrated spine capable of inflicting considerable damage.

Three species are known to occur on our coast, one of which, *Urolophus halleri*, Round Sting Ray, is abundant in every bay and lagoon and along sandy shores south of Point Conception, especially in San Diego Bay. Although the smallest of the species, reaching a length of eighteen inches only, it is the most dangerous, having great muscular power in its tail and striking quickly and accurately. It is not eaten though often taken in nets. An example thus taken was seen by Professor Jordan to strike its "sting" quite through the body of another one.

Dasybatis dipterurus is rather abundant in San Diego Bay, and, in summer, many were seen of from two to two and a half feet in length, without the tail.

Pteroplatea marmorata, is far broader than it is long, reaching two and a half feet in width and two feet in length. It is common on bays and on sandy shores from Santa Barbara southwards. The large individuals taken at San Pedro are sent to Los Angeles, where they are eaten by the French residents. It is the only ray eaten there.

FAM. RAIIDÆ—RAYS, SKATES.

Five species of this family are now known to be found upon our coast, four of them discovered and described this year by Messrs. Jordan and Gilbert.

Zapteryx exasperatus, abundant in San Diego Bay in winter, is too small for use as food; and *Raia stellulata*, which in winter and spring is very abundant in Monterey Bay, is not sent to market on account of its very rough skin and dark brown color, which render it less salable than the other rays.

Large numbers of both adult and young are taken in gill nets. It reaches two to two and a half feet in length.

Raia rhina ranges from Monterey to Vancouver, is often taken with hook and line from the wharf at Seattle, and is brought to San Francisco market in company with the other rays. Elsewhere it is seldom eaten, and is nowhere much valued. It reaches a length of two and a half to three feet.

Raia binoculata, is on the whole the most abundant species of ray in the markets of San Francisco, and is common along the coast from thence to Monterey. Those brought to market are mostly caught in the immediate vicinity. It reaches a length of two to two and a half feet. The French are the chief consumers of this fish, and eat it in the form of *Raie avec buerre noir*.

Raia cooperi—This is the giant of its tribe, reaching a length of from five to six feet, and a weight of sixty pounds or more. Those sent to San Francisco market are usually much smaller, but examples three to four feet long may be seen there. From the preceding species it may be known at sight by the white spots upon its upper surface. It is abundant all along the coast from Monterey to Alaska, especially in Puget Sound, frequenting bays and sandy shores, and feeding on crustacea and fishes. It is taken both

in nets and with hooks. Its egg cases, deposited in July, are about a foot in length, and squarish with short tentacles at the angles. It is seldom eaten except at San Francisco, and yields but little oil.

FAM. TORPEDINIDÆ TORPEDOES.

Torpedo californica is not often taken in the Bay of San Francisco, but is tolerably common in the Bays of Tomales and Monterey. The fishermen in the latter bay do not appear to have seen any very large examples, but in the spring of this year one was brought to this city from Tomales Bay of the respectable length of three feet and half an inch, and measuring two feet across the disk. The width across the ventrals was thirteen inches, the eyes were three inches apart, and the spiracles an inch in length. The Italian fishermen call it *Tremulo*. When fresh it is of a leaden color above, with darker spots, and white below.

FAM. RHINOBATIDÆ.

Rhinobatus productus, Shovel-nose Shark, Guitar—The name guitar refers to the form of this fish, intermediate between that of a ray and a shark, having the thick tail of the latter, and the expanded pectoral fins of the former. It is tolerably common in the Bay of San Francisco and abundant in those of San Pedro and San Diego, residing on muddy and sandy bottoms, and bringing forth its young in August. It reaches a length of two feet or more. The tail is eaten by the Chinese and Mexicans, but is not valued. Otherwise it is only used as a bait for lobsters (*Panulirus*).

Rhinobatus triseriatus, Guitar—This species is much more ray-like in its form than the preceding, the disk formed by the pectoral fins predominating entirely over the rest of the body, the hinder portion differs only from that of a skate by its somewhat greater thickness. But the true skates or rays (*Raiidæ*), are oviparous, while the present species, like the preceding and all the *Rhinobatidæ*, is viviparous. Three or four young are produced in each ovarial sac, and are brought forth in August. It reaches a length of two feet, and a weight of four pounds. It is not used.

SUB-ORDER SQUALI—SHARKS.

Until Professor Jordan commenced his researches this year, only nine species of sharks were on record from this coast, of which three only, viz., *Triacis semifasciatus, Notorhynchus maculatus, and Heterodontus francisi*, were peculiar to it. The list is now increased to twenty, but all the newly recorded species are well known forms inhabiting the opposite coast of the Pacific, or more commonly the Atlantic, and Mediterranean also, so that it appears probable that all the species found in the Atlantic will ultimately be found here.

None of the sharks are used as food by the white inhabitants of this coast, but oil is expressed from the livers of some, and "sharks fins" are sold to the Chinese. In Europe some of the smaller sharks or dog-fishes are eaten.

Some of the sharks have spiracles, or breathing holes, but others are without them; the dorsal fins are large, usually two in number, and placed upon the body, and an anal fin is usually present. In

some of the species the eye is protected, like that of birds, by a nictilating membrane, or interior eyelid.

Squatina angelus, Angel-fish, Angelo, Monk-fish—This curious species is in many respects intermediate between the sharks and the rays, while it differs from both in the terminal position of the mouth. It is tolerably common in Tomales, San Francisco, and Monterey Bays; and thence southward. It reaches a length of five feet and a weight of seventy-five pounds, and ranges throughout the Pacific and Atlantic Oceans, as well as in the Mediterranean. The monk-fish has no anal fin, the pectorals are expanded horizontally, ray fashion, and the dorsals are situated upon the tail portion of the body.

Heterodontus francisi, Leopard Shark—This shark is found at least as far north as Monterey Bay, and is abundant at San Diego and San Pedro Bays. It spawns in winter, and its egg-cases are large, cylindrical, and a spirally twisted fringe around them. It reaches two and a half feet in length.

This species extends along the coast of Mexico, but is apparently distinct from the Australian species. The family to which it belongs is remarkable for its broad rolls, formed by the oblique series of large lateral teeth in the jaws.

Notorhynchus maculatus—This shark has seven gill openings, has been found at several points from Monterey northward to Puget Sound. The teeth of the lower jaw are set with numerous cusps upon their exterior edges. It attains a length of seven feet or more. Professor Jordan has lately obtained of a species of *Hexanchus* having six gill openings on each side. This he has named *H. corinus*. These species have one dorsal only; and the eye is without a nictitating membrane.

Alopias vulpes, Fox Shark, Thresher—This species does not appear to be common upon this coast, but undoubtedly occurs. It is reported by Ayres from Tomales Bay; and a tail, which in this fish is nearly equal in length to the rest of the body, and is thus enough for identification, was found by Professor Jordan at Monterey. It is occasionally taken in seines at Soquel.

This species is found also in the Mediterranean and the Atlantic. The story that it attacks the whale appears to lack proof, as it is difficult to understand how it could inflict much mischief on so large an animal by striking it with its tail as is reported. It reaches a length of thirteen feet.

Catulus ventricosus, Ground Shark, Puffer Shark—This species does not appear to occur north of Monterey Bay, but is tolerably abundant at Santa Barbara in the winter, where it lives among the kelp, and is often caught in the lobster-pots set to catch the craw-fish or spiny lobster (*Panulirus interruptus*), which is sent from Santa Barbara to San Francisco in great numbers. The pots are baited with salted fish of which the puffer appears to be very fond. None are seen in summer. This shark has acquired its vernacular name from its habit of inflating its stomach with air, after the fashion of a globe fish (*Diodon*. *Tetrodon*), when it is made prisoner. It reaches two and a half feet in length and is of no value to man. In February the eggs are ready for extrusion, and this may account for its presence near shore. The egg cases are flat, oblong, and quadrangular, with very long tentacles at the angles.

Cetorhinus maximus, the Basking Shark—This is one of those widely spread forms that inhabit both the Pacific and the Atlantic;

occurring alike off the coasts of Ireland and California. It is one of the giants of the finny tribe, attaining a length of more than thirty feet, but, spite of its size, is one of the least formidable of sharks. Its teeth are very small; showing that, like the giant cetaceans, it is not adapted to prey upon large animals. Its presence on this coast was not known to naturalists until Professor Jordan noted its presence in Monterey Bay. The first example measured was thirty-one feet in length. Since then, others have been brought or cast ashore.

The name of Basking Shark has been given to this fish on account of its lazy habit of resting upon the surface of the water, with its dorsal fin exposed.

It is occasionally harpooned in Monterey Bay, and now and then becomes entangled in the gill nets. The livers are utilized for oil.

Sphyrna zygæna, Hammer-head Shark—This shark appears to be tolerably abundant in Lower California, since several examples were obtained there by W. I. Fisher in 1876 and 1877, one of them about fourteen feet long. An example, taken at San Pedro, was sent to the Smithsonian Institute by Dr. Cooper. None of the finny inhabitants of the seas can show a more singularly shaped anterior extremity than this species, which has its eyes placed at the end of the transverse prolongations of the head, each of which is as broad as it is long. The species occurs in all tropical and sub-tropical seas.

Mustelus hinnulus, the Dog Shark, and *Rhinotriacis henlei*, also called the Dog Shark, are usually about two feet and a half long, but occasionally more, and are used only for bait. The former is known to feed chiefly on crustacea and small fish. Neither are on record north of San Francisco. Both are Atlantic species.

Triacis semifasciatus, Leopard Shark, Cat Shark—This species is abundant in Humboldt Bay, and thence southward, and is very common everywhere, frequenting sandy shores and entering lagoons in summer to spawn. It attains a length of five feet, but yields hardly any oil, and thus is of no economic value. Peculiar to this coast.

Galeorhinus galeus, Tope, Oil Shark—Very abundant everywhere south of San Francisco from May to August, when it enters lagoons to spawn, and is taken in great numbers for the oil furnished by the liver. Soquel and Monterey, and more especially Westminster and Newport, near San Luis Obispo, are the places where this fishery is carried on. It feeds on any other fish, but herring and similar silvery fish make the best bait. It attains a length of five feet, and a weight of fifty or sixty pounds, but thirty-five to forty pounds is more usual.

From two thirds of a gallon to a gallon of oil is obtained from the liver. The pectoral, dorsal, and caudal fins are cut off and sold to the Chinese, at twelve and a half cents per pound, for soup fish.

The Tope occurs in all temperate and tropical seas, as do also *Galeocerdo tigrinus*, *Carcharinus glaucus*, and *Eulamia lamia*. The second of these is the Blue Shark of the British coast, and attains a length of eleven feet.

Lamna cornubica (Porbeagle); *Isurus oxyrhynchus*—These two allied species seem to be rare on this coast, yet undoubtedly occur. Doctor C. L. Anderson, of Santa Cruz, has a drawing of an example of the former species taken at that place in 1879, and the jaws of another specimen were procured by Professor Jordan at Wilmington. A small individual of the latter species was sent from Monterey Bay

to San Francisco in August last as a curiosity, and was secured by Professor Jordan. It is common in the British Channel, and occurs in the Mediterranean, in the Atlantic Ocean, and on the shores of Japan.

The *Isurus* is found on the Atlantic Coast of the United States.

Carcharodon carcharias, Man eater, White Shark, Great Blue Shark—The White Shark, the terror of the waters, the "man eater" who swallows sailors and carries off innocent bathers, has been found in Monterey Bay. Lest this announcement should bring ruin to the bathing-houses of Santa Cruz and Monterey, it is well to remark that either because of his comparative rarity, or because he has not yet learned to relish the taste of Caucasian flesh, he does not appear to have ever made off with any of the fair Nereides who frequent those well known beaches Professor Jordan secured the jaws of an example twenty feet in length, taken at Soquel this year, and records the capture of one twenty feet in length at Carmelo. A few years ago a young sealion, weighing one hundred pounds, was taken from the stomach of one of these monsters caught at Soquel.

The only useful part of this fish is the liver, from which oil is expressed. This large and dangerous shark, which attains a length of thirty-six feet, occurs in all oceans and large seas of temperate and tropical regions.

Somniosus microcephalus, Black Ground Shark, Nurse Shark—This species is not recorded south of Puget Sound, where it is not very uncommon, and is occasionally taken on trawl lines set for dog-fish. It attains a length of eight feet, and is very sluggish, lying in the water like a log. The livers are used for making "Dog-fish Oil."

Squalus acanthias, L., Dog-fish, Spinarola—The "Piked Dog-fish," is found at Santa Barbara and Monterey, but is not abundant south of Puget Sound, where it is taken in vast quantities for the oil in its liver. It has a long spine before each of the two dorcals.

It inhabits deep or quiet bays and channels, and comes into shallow water in pursuit of schools of herring and salmon. Its chief food is the herring, but it eats everything it can, even its own young, which in Puget Sound are born in June.

It reaches a length of three feet, and inhabits all temperate seas of both the northern and the southern hemispheres. It occurs on the coast of Alaska as far north as Kodiak.

CLASS MARSIPOBRANCHII.

Entosphenus tridentatus, Large Lamprey—The species of Lamprey, formerly supposed to be five, have under investigation dwindled to two, namely the small *Ammocœtes plumbeus* and the large *Entosphenus tridentatus*.

The latter reaches a length of two feet, is extremely fat, and has been observed at various points from Santa Cruz to Puget Sound. Like other lampreys it ascends rivers in spring to spawn. It runs up the Columbia in June. In Humboldt county, and probably elsewhere, it is occasionally eaten.

Ammocœtes plumbeus, the small Lamprey or Lamperina, is very thin and small, often only about six inches long, and never over a foot.

Polistotrema dombeyi, Hag—The habits of the Myxines or Hags are, in a general way, well known, but the writer had never wit-

nessed the result of their ravages until this summer, when, on a visit to Monterey, where it is especially abundant, he was shown by Professor Jordan several rock cod which had been literally eaten alive by them, and had washed ashore mere shells. The hag enters by the gills, or occasionally by devouring the eye, and eats its way into the flesh of its victim, consuming it until it dies of weakness, but presumably leaving, like the ichneumons that prey upon butterfly caterpillars, the vital parts untouched till last. Shells of fishes thus eaten are frequently found in Monterey Bay, and are usually quite fresh, as if but just dead. The hag is fitted for its work by its suctorial mouth, terminal, soft, unprovided with jaws, and forming a round opening when in use, as well as by two rows of teeth on each side of the gullet. The mouth is surrounded by barbels, and in preserved examples is scarcely visible. The aspect of the hag, the lowest of vertebrates except the lancelet (if the latter has any right to be called a vertebrate), is strongly suggestive of a relationship between worms and vertebrates, and the observer can scarcely maintain the superiority of such a creature as this over beings organized as intricately as insects and crustacea. In form it is wormlike. There is no fin above or below to break the continuous round body, and the barbels suggest a worm, rather than a vertebrate; yet a vertebrate it undoubtedly is, having the nervous system and backbone of a vertebrate, although the former is of low order, and the latter is but a cartilaginous rod, with a rudimentary cranial expansion at its anterior extremity.

This species, which is widely spread, was first noticed as Californian by myself, and was described as new, under the name of *Bdellostoma stouti*, from an example taken in Eel River, Humboldt County, California—a river which derives its name not from the presence of eels, but of lampreys and hags, both of which are sold for food as eels. The number of gill openings is not—at least in some examples—equal on both sides, but is twelve on one side and eleven on the other.

The fishermen of Monterey declare that one of these parasitic fishes will devour a fish of six to eight pounds weight in a single night. It is especially destructive to fish taken in gill-nets. When the hulk is taken out of the net, the hag scrambles out with great alacrity. It reaches a length of fourteen inches, and is not used for food at Monterey.

RECEIPTS AND EXPENDITURES.

The following is on account of receipts and expenditures since our last report:

Receipts.

November 1, 1879—By cash on hand as per last report	$3,873 70
July 29, 1880—By cash, State appropriation	5,000 00
Total	$8,873 70

Expenditures.

November 1, 1879—To paid H. C. Marks, balance due, copying report for printer	$60 00
November 23, 1879—To paid Cowdery & Preston, attorneys, in suits in Fishways, Stanislaus, and Merced	23 00
December 24, 1879—To paid expense in transporting 300 carp from Washington	33 55
December 27, 1879—To paid Livingston Stone, on account of hatching 2,500,000 salmon	1,054 50
January 1, 1880—To paid half month fish hatching, J. G. Woodbury, December, $75; coas oil, express, wood, and sundries, $23 45	98 45
January 3, 1880—To paid postage on reports, $5; express on 50,000 trout eggs, $22 60	27 60
January 26, 1880—To paid L. Stone, 50,000 trout eggs, $204 80; S. P. Baird, eleven fish cans, $73 60	278 40
January 26, 1880—To paid H. Pither, 2,500 cat-fish, barrels, and express	80 60
January 26, 1880—To paid drafts exchange, $1 00; Wells, Fargo & Company, expressage on cat-fish, $9 75	10 75
January 31, 1880—To paid Stratton, cartage, $2; brush and broom, $2 35	4 35
January 31, 1880—To paid J. G. Woodbury, on account of January, fish hatching	30 00
February 3, 1880—To paid J. A. Richardson, three quarter month's labor, January	75 00
February 16, 1880—To paid Marks, copying notices, $10; J. G. Woodbury, on account of fish hatching, $60	70 00
February 20, 1880—To paid expense for distributing cat-fish in Alameda	6 40
March 6, 1880—To paid drayage and express, $2; Woodbury, balance for January, fish hatching, $60	62 00
April 3, 1880—To paid two telegrams, $1 15; Stratton, cartage, $7; brush, etc., $2 50	10 65
April 26, 1880—To paid J. B. Campbell, 33,000 trout eggs, $100; express, etc., $3 50	103 50
April 26, 1880—To paid J. A. Richardson, three months' labor to May first	300 00
May 6, 1880—To paid freight, express, salt, telegrams, paint, and other items	18 85
May 6, 1880—To peid Woodbury, three months' fish hatching to May first	450 00
June 7, 1880—To paid People's Ice Company's bill, ice, February to May	38 80
June 17, 1880—To paid fare of assistants for transporting shad to Tehama	38 25
June 25, 1880—To paid express on cans from Yosemite	90
July 1, 1880—To paid Woodbury, expenses on carp for Mare Island	24 65
July 15, 1880—To paid Marks, on account of labor, copying	20 00
July 16, 1880—To paid A. W. Von Schmidt, examination of dams on Pitt River	100 00
July 30, 1880—To paid Marks, balance for labor, copying	80 00
July 30, 1880—To paid H. Pither, expense for distributing 5,300 cat-fish	122 70
August 2, 1880—To paid H. Pither, expense for distributing 2,500 cas-fish	55 50
August 2, 1880—To paid L. Stone, balance due on hatching 2,500,000 salmon	45 50
October 11, 1880—To paid express on fish cans to San Leandro	1 00
December 8, 1880—To paid Lockington, report on Pacific Coast fish	100 00
December 8, 1880—To paid Wells, Fargo & Company, express on cans, $1; J. H. Stone, salmon statistics, $50	51 00
December 8, 1880—To paid Marks, on account, copying report	20 00
December 17, 1880—To paid H. Pither, catching, transporting, and distributing 2,750 cat-fish	95 50
December 22, 1880—To paid H. D. Dunn, gathering salmon statistics	20 00
December 22, 1880—To paid L. Stone, hatching 2,250,000 salmon	1,002 50
January 3, 1881—To paid galvanized wire	1 25
January 3, 1881—On hand to balance	4,258 55
Total	$8,873 70

This balance of $4,258 55 will be consumed in the hatching of native and foreign fish during the present Winter, and in the importation of striped bass and shad in the Spring.

All of which is respectfully submitted.

B. B. REDDING,
S. R. THROCKMORTON,
J. D. FARWELL,
Fish Commissioners.

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D. B. Hundley.....Courtland.

ARKANSAS.

N. B. Pierce.....Osage Mills.

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IOWA.

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Eli R. Miller.....Richland.
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Daniel Cameron.....La Crescent.
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W. L. May.....Fremont.

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H. G. Parker.....Carson City.

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Luther Hayes.....South Milton.
Albina H. Powers.....Plymouth.

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