53D CONGRESS, 2d Session. | SENATE. | MIS. DOC. No. 200.

IN THE SENATE OF THE UNITED STATES.

REPORT

OF THE

COMMISSIONER OF FISH AND FISHERIES

ON

INVESTIGATIONS IN THE COLUMBIA RIVER BASIN

IN REGARD TO

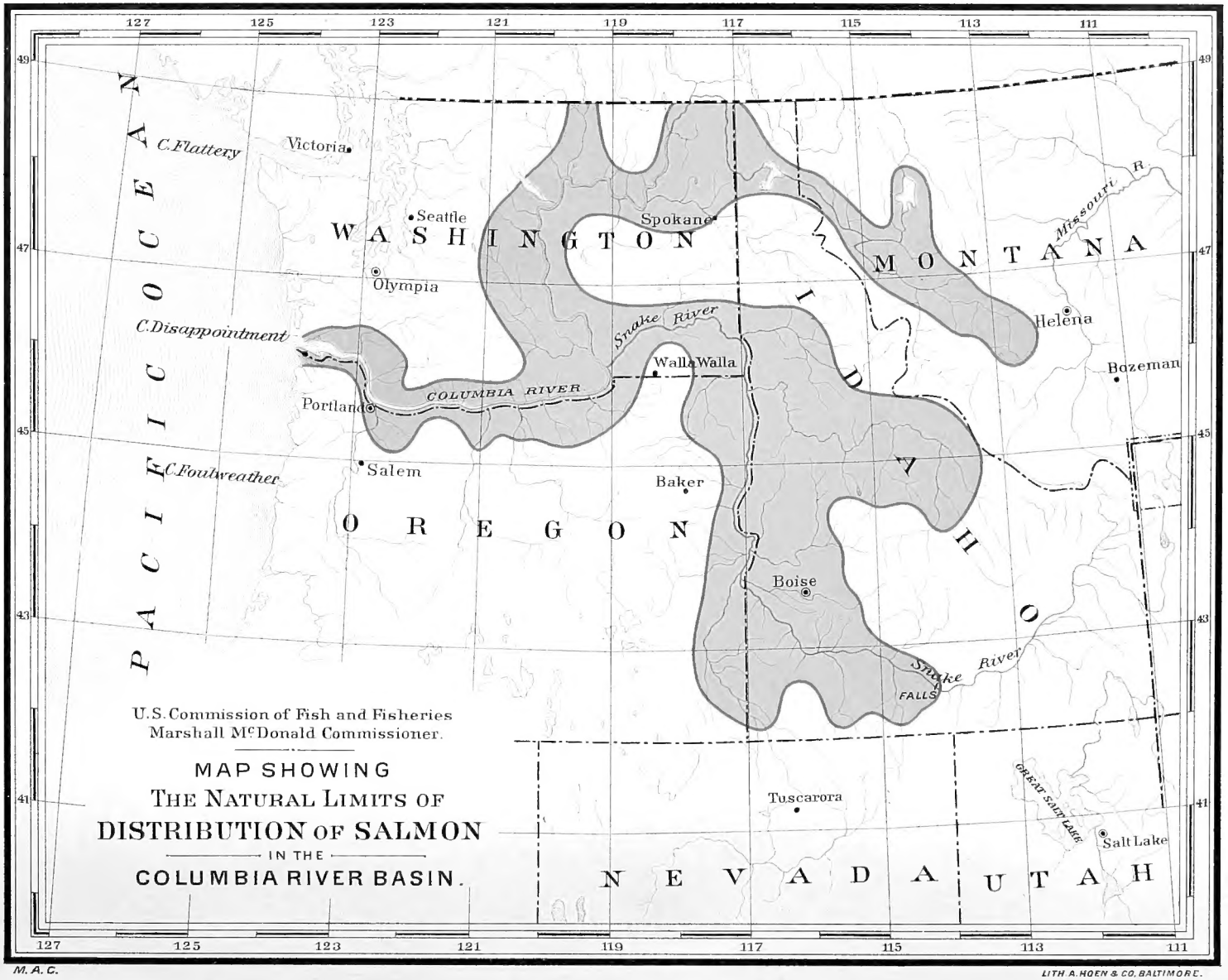
THE SALMON FISHERIES.

PRESENTED BY THE VICE-PRESIDENT.

MAY 31, 1894.—Laid on the table and ordered to be printed.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1894.

a. J.S. Aug. 13/08



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THE SALMON FISHERIES OF THE COLUMBIA RIVER BASIN.

By MARSHALL McDONALD,
United States Commissioner of Fish and Fisheries.

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., May 31, 1894.

Hon. ADLAI E. STEVENSON,
President of the Senate:

SIR: In compliance with instructions conveyed in the provisions of the Sundry Civil Bill, which became a law August 5, 1892, I have the honor to submit a report of investigations in the Columbia River Basin.

The first of the provisions above referred to authorized the expenditure from the appropriation for inquiry respecting food-fishes of $2,000, or so much thereof as may be necessary, "In examining the Clarke's Fork of the Columbia River, with the view to ascertain the obstructions which prevent the ascent of salmon up said river to the Flathead Lake and adjacent waters."

The second provision directed an investigation and report respecting the advisability of establishing a fish-hatching station at some suitable point in the State of Washington, and appropriated for the same "$1,000, or as much thereof as may be necessary."

It was not known whether the failure of the salmon to enter the Clarke Fork of the Columbia was due to natural obstructions preventing their ascent, or was to be attributed to the extensive fishing operations prosecuted in the Lower Columbia, or possibly to other causes to be disclosed by the proposed investigation. Again, the location of the hatchery proposed for the State of Washington would be necessarily determined by our ability to secure an adequate supply of spawning salmon within convenient distance of the hatchery.

It appearing probable that the methods of the large fisheries pursued in the Lower Columbia, if permitted to continue, would effectually intercept the run of salmon to the headwaters, and thus defeat the object for which the hatchery is proposed, it was thought proper and expedient to institute a general investigation covering the entire Columbia River Basin, and if conditions were disclosed threatening disaster to these valuable and productive fisheries, to bring the matter to the attention of Congress and the States interested in their prosperity.

The direction of the field investigation was intrusted to Prof. B. W. Evermann, assistant in the Division of Inquiry Respecting Food-Fishes, whose report is appended to and constitutes an integral part of the report of the Commissioner of Fisheries.

A very complete statistical investigation into the history, methods, apparatus, present conditions, product, and annual value of the salmon fisheries of the Columbia has also been made by Mr. W. A. Wilcox, under the direction of Dr. H. M. Smith, assistant in charge of the Division of Statistics and Methods of the Fisheries, the results of which are embodied and discussed in the report which is herewith respectfully submitted.

CONDITIONS DETERMINING THE SALMON PRODUCTION OF A RIVER BASIN.

There are fundamental conditions determining the salmon production of a river basin and the nature and extent of the fisheries which may be maintained without overtaxing the productive capacity of the river. All the species of salmon which are the object of the fisheries are alike under the constraint of a natural law, which compels them to enter the fresh waters for the purpose of spawning. Some species ascend to a relatively short distance above tide water. Others, like the chinook, push their migrations to the remotest sources of the rivers and tributary streams when not prevented by natural or artificial obstructions. Where the area of distribution is contracted by the erection of barriers, dams, or other obstructions which the salmon can not surmount, the production of the river is diminished *pro tanto*, for the reason that the young salmon remain for some months in the waters in which they are hatched—they must here find their food—and consequently the extent of the feeding-grounds open to them will be the measure of nature's ability to repair the waste occasioned by natural casualties and the fishing operations. If there be no contraction of the breeding area by artificial obstructions, but, on the other hand, the times, methods, and apparatus of the fisheries are such as to intercept or in a large measure prevent the run of salmon into and up the rivers, then a serious decline in the fisheries is inevitable.

It is possible by fish-cultural operations pursued on an adequate scale, by hatching and planting the fry in the head waters of the Columbia and its tributary streams, to realize the full productive capacity of the river, so long as eggs can be obtained in sufficient numbers to furnish a basis for the extensive operations required. This would not be possible, however, if the fishing operations in the lower river practically excluded the salmon from the streams to which it would be necessary to have recourse to obtain a supply of eggs. It is evident, therefore, that fish-cultural operations can not be relied upon exclusively or chiefly to maintain the salmon supply in the Columbia. The regulation of the times, methods, and apparatus of the fisheries should be such as to assure the largest opportunity practicable for reproduction under natural conditions. Artificial propagation should be invoked as an aid and not as a substitute for reproduction under natural conditions.

THE LIMITS OF MIGRATION OF SALMON.

The limits of migration of salmon in the Columbia River basin, as determined by impassable falls in the larger tributaries of the Columbia and their affluents, is shown in the accompanying chart, there being no serious obstructions existing in the main river within the limits of the United States.

The area of distribution is approximately 90,000 square miles. This immense tract is drained by innumerable streams of clear cold water, into which the salmon enter for the purpose of spawning and up which they ascend till their progress is stopped

by falls or other obstructions which they cannot surmount. These waters furnish the feeding-grounds of the young salmon during their early life, which is spent in the fresh waters. Their migration seaward does not begin until they are at least a year old and have attained a length of from 8 to 10 inches. These streams are the nurseries of the great salmon fisheries of the lower Columbia. From each goes out every year a colony, more or less numerous, to swell the aggregate of young salmon necessary to repair the waste by natural casualty and by capture.

The area of natural distribution has not as yet been very materially abridged. Certain streams, such as the Bruneau and the Boise, have been obstructed by dams near their mouths, but the vast extent of waters still accessible to salmon and affording suitable breeding and feeding grounds, indicates that we must look to other causes to explain any ascertained deterioration in the salmon fisheries of the Columbia.

DECREASE OF SALMON IN THE HEAD WATERS OF THE COLUMBIA RIVER.

The investigations made by Prof. Evermann and the parties under his direction establish conclusively the fact that there has been a very great reduction in the number of salmon frequenting the head waters of the Columbia River and its tributaries. This decrease is more notable in the main river. In the early history of the fishery salmon were found in the head waters in marvelous abundance. According to the information obtained by Prof. Evermann:

> They were abundant in the Columbia River at Kettle Falls as late as 1878. Since then there has been a great decrease. They have been scarce since 1882. Since 1890 there have been scarcely any at Kettle Falls. The Meyers Brothers say that they have been almost unable to buy any salmon for their own table from the Indians for three years. Certain Indians with whom we talked at Kettle Falls said salmon were once very abundant there, but that very few are seen now. Other persons testified to the same effect. Essentially the same information was obtained regarding the decrease of salmon in other parts of the upper tributaries of the Columbia, viz: at Spokane, in both the Big and Little Spokane rivers, and in the Snake River and its various tributaries.

Dr. O. P. Jenkins, an assistant of Prof. Evermann, makes the following report in reference to the Yakima River, Washington:

> The Yakima is the main stream of the valley. It receives many tributaries, the main ones being Manistash and Wilson creeks. The river near the city (Ellensburg) is 160 feet wide, by an average of 10 feet deep, and flows with a velocity of 1 foot per second. Temperature at 9:15 a. m., August 24, 1893, 60° F.; water clear. Those acquainted with the facts state that formerly, up to about 1885, salmon of three or four kinds, including the quinnat, ran up the stream to this valley and spawned in the river in great numbers; at present very few make their appearance.

There is no reason to doubt—indeed, the fact is beyond question—that the number of salmon now reaching the head waters of streams in the Columbia River basin is insignificant in comparison with the number which some years ago annually visited and spawned in these waters. It is further apparent that this decrease is not to be attributed either to the contraction of the area accessible to them or to changed conditions in the waters which would deter the salmon from entering them. We must look to the great commercial fisheries prosecuted in the lower river for an explanation of this decrease, which portends inevitable disaster to these fisheries if the conditions which have brought it about are permitted to continue.

The relations of the decreased number of salmon in the head waters to the development of the commercial fisheries is brought out in a very instructive way by an analysis of the following table:

Summary of the salmon-canning industry of the Columbia River from its origin to the present time.

Year.	Gross weight of salmon utilized.	Number of cases packed.	Value.	Average value per case.	Year.	Gross weight of salmon utilized.	Number of cases packed.	Value.	Average value per case.
	Pounds.					*Pounds.*			
1866	260,000	4,000	$64,000	$16.00	1881	35,750,000	550,000	$2,475,000	$4.50
1867	1,170,000	18,000	288,000	16.00	1882	35,184,500	541,300	2,600,000	4.80
1868	1,820,000	28,000	392,000	14.00	1883	40,911,000	629,400	3,147,000	5.00
1869	6,500,000	100,000	1,350,000	13.50	1884	40,300,000	620,000	2,915,000	4.70
1870	9,750,000	150,000	1,800,000	12.00	1885	35,997,000	553,800	2,500,000	4.51
1871	13,000,000	200,000	2,100,000	10.50	1886	29,152,000	448,500	2,135,000	4.76
1872	16,250,000	250,000	2,325,000	9.30	1887	23,140,000	356,000	2,124,000	5.97
1873	16,250,000	250,000	2,250,000	9.00	1888	24,211,005	372,477	2,327,981	6.25
1874	22,750,000	350,000	2,625,000	7.50	1889	20,685,495	309,885	1,809,820	5.84
1875	24,375,000	375,000	2,250,000	6.00	1890	28,781,385	435,774	2,407,456	5.52
1876	29,250,000	450,000	2,475,000	5.50	1891	26,450,635	398,953	2,240,964	5.62
1877	24,700,000	380,000	2,052,000	5.40	1892	32,185,995	487,338	2,679,069	5.50
1878	29,900,000	460,000	2,300,000	5.00	1893	24,050,000	370,000	2,107,500	5.70
1879	31,200,000	480,000	2,640,000	5.50					
1880	34,450,000	530,000	2,650,000	5.00	Total	658,424,515	10,098,427	59,029,790	5.85

Canning operations on the Columbia River began in 1866, when 4,000 cases were packed and sold at an average of $16 per case. As early as 1872 the total pack reached 250,000 cases, the price per case having declined to $9. Each succeeding year operations were extended and reached their culmination in 1883 and 1884, when upwards of 600,000 cases were packed each season. From this time on the catch declined, having reached its lowest point in 1889, the number of cases packed that season being 309,885, or less than half the number of cases packed in 1883 and 1884.

Up to 1888, practically the entire pack consisted of the king or chinook salmon, and the fishing season did not extend beyond the first of August. In 1889 the packers began canning bluebacks and steelheads to make up the deficiency in the supply, and extended their operations to the first of September.

DETAILED STATISTICS OF THE SALMON INDUSTRY OF THE COLUMBIA RIVER, 1889–92.

The following series of tables shows, in some detail, the extent of the salmon fishery and canning industry of the Columbia River during the years 1889 to 1892, inclusive, as determined by the inquiries conducted by this Commission.

The number of fishermen and shore employes connected with the salmon industry in each of the years named is indicated in Table A:

A.—*Table showing the number of persons employed in the salmon industry of the Columbia River from 1889 to 1892.*

How engaged.	1889.	1890.	1891.	1892.
Oregon:				
Fishermen	1,606	1,648	1,929	2,064
Shoresmen and cannery employes	870	1,028	1,057	1,100
Total	2,476	2,712	2,986	3,164
Washington:				
Fishermen	1,535	1,510	1,575	1,677
Shoresmen and cannery employes	594	602	654	704
Total	2,129	2,112	2,229	2,381
Total for river:				
Fishermen	3,141	3,194	3,504	3,741
Shoresmen and cannery employes	1,464	1,630	1,711	1,804
Total	4,605	4,824	5,215	5,545

The number and value of boats and apparatus and the value of shore property and capital employed in the salmon fisheries of the Columbia River in 1889, 1890, 1891 and 1892 is given in Table B.

B.—*Number and value of boats and apparatus, and the value of shore property, and cash capital employed in the salmon industry of the Columbia River in 1889, 1890, 1891, and 1892.*

Apparatus and capital.	1889.		1890.		1891.		1892.	
	No.	Value.	No.	Value.	No.	Value.	No.	Value.
Oregon:								
Boats	751	$99,850	776	$104,400	876	$120,815	998	$131,550
Pile-drivers and scows	21	5,900	23	6,300	30	8,300	29	7,400
Pound nets	102	72,300	98	76,500	140	98,900	247	173,400
Trap nets	2	1,600	.....	.....	2	1,600	2	1,600
Seines	7	4,800	6	2,700	19	11,150	12	5,650
Gill nets	757	152,000	760	159,450	790	181,265	861	190,100
Wheels	31	120,052	29	107,552	30	108,152	40	132,852
Dip nets and squaw nets	95	475	85	425	60	300	50	250
Shore property	.....	502,955	.....	486,355	.....	455,205	.....	507,805
Cash capital	.....	395,000	.....	581,000	.....	520,000	.....	614,000
Total	.....	1,354,932	.....	1,524,682	.....	1,505,687	.....	1,764,607
Washington:								
Boats	475	60,340	468	59,780	534	67,280	538	64,895
Pile-drivers and scows	39	9,050	37	9,950	42	10,750	45	13,550
Pound nets	62	48,200	70	55,200	98	77,000	131	103,400
Trap nets	2	1,400	2	1,400	2	1,400	1	700
Seines	33	18,700	29	16,400	30	16,900	26	10,000
Gill nets	436	88,775	432	89,480	472	101,780	453	98,130
Wheels	9	25,000	12	48,500	14	45,000	17	49,100
Dip nets and squaw nets	15	75	18	90	23	115	25	125
Shore property	.....	245,950	.....	247,280	.....	321,050	.....	282,800
Cash capital	.....	304,000	.....	331,000	.....	332,000	.....	330,000
Total	.....	801,490	.....	859,080	.....	973,275	.....	952,700
Total for river:								
Boats	1,226	160,190	1,244	164,180	1,410	188,095	1,536	196,445
Pile-drivers and scows	60	14,950	60	16,250	72	19,050	74	20,950
Pound nets	164	120,500	168	131,700	238	175,900	378	276,800
Trap nets	4	3,000	2	1,400	4	3,000	3	2,300
Seines	40	23,500	35	19,100	49	28,050	38	15,650
Gill nets	1,193	240,775	1,192	248,930	1,262	283,045	1,314	288,230
Wheels	40	145,052	41	156,052	44	153,152	57	181,952
Dip nets and squaw nets	110	550	103	515	83	415	75	375
Shore property	.....	748,905	.....	733,635	.....	776,255	.....	790,605
Cash capital	.....	699,000	.....	912,000	.....	852,000	.....	944,000
Total	.....	2,156,422	.....	2,383,762	.....	2,478,962	.....	2,717,307

Comparing 1892 with 1889, we find increases or decreases in the number of the different sorts of apparatus as follows:

Apparatus.	1889.	1892.	Increase.	Decrease.
Pound nets	164	378	214	.....
Seines	40	38	.....	2
Gill nets	1,193	1,314	121	.....
Wheels	40	57	17	.....
Dip nets and squaw nets	110	75	.....	35

The following tables, C, D, E, and F, show by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1889, 1890, 1891, and 1892:

C.—*Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1889.*

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Pounds.	Value.	No.	Pounds.	Value.	No.	Pounds.	Value.
Pound nets:									
Chinook	86,777	2,169,425	$108,469	40,323	1,008,075	$50,353	127,100	3,177,500	$158,822
Blueback	33,372	166,860	8,342	24,199	120,995	5,904	57,571	287,855	14,246
Steelhead	37,958	379,545	11,386	22,460	224,600	6,737	60,418	604,145	18,123
Total	158,107	2,715,830	128,197	86,982	1,353,670	62,994	245,089	4,069,500	191,191
Trap nets:									
Chinook	710	17,750	887	2,275	56,875	2,844	2,985	74,625	3,731
Steelhead	440	4,400	132	803	8,030	241	1,243	12,430	373
Total	1,150	22,150	1,019	3,078	64,905	3,085	4,228	87,055	4,104
Seines:									
Chinook	24,752	618,800	30,940	63,782	1,594,550	79,727	88,534	2,213,350	110,667
Blueback	3,500	17,500	875	2,444	12,225	611	5,944	29,725	1,486
Steelhead	16,720	167,200	4,816	43,978	439,780	13,193	60,698	606,980	18,009
Total	44,972	803,500	36,631	110,204	2,046,555	93,531	155,176	2,850,055	130,162
Gill nets:									
Chinook	252,044	6,301,325	312,563	226,053	5,759,050	281,470	478,097	12,060,375	594,033
Blueback	27,623	139,115	4,751	17,218	86,090	3,044	44,841	225,205	7,795
Steelhead	16,472	164,720	5,090	15,970	159,700	4,785	32,442	324,420	9,875
Total	296,139	6,605,160	322,404	259,241	6,004,840	289,299	555,380	12,610,000	611,703
Wheels:									
Chinook	15,182	379,550	12,867	6,876	171,900	6,978	22,058	551,450	19,845
Blueback	140,090	700,450	23,090	51,064	230,322	9,260	191,154	930,772	32,350
Steelhead	6,329	63,290	2,043	1,480	14,800	484	7,809	78,090	2,527
Silver	4,500	31,500	630	2,540	16,780	503	7,040	48,280	1,133
Total	166,101	1,174,790	38,630	61,960	433,802	17,225	228,061	1,608,592	55,855
Dip nets and squaw nets:									
Chinook	2,291	57,283	1,146	1,360	34,000	510	3,651	91,283	1,656
Blueback	16,910	84,550	1,841	8,112	40,560	608	25,022	125,110	2,449
Steelhead	1,145	11,450	229	509	5,090	77	1,654	16,540	306
Silver	5,142	35,994	540	3,175	22,225	333	8,317	58,219	873
Total	25,488	189,277	3,756	13,156	101,875	1,528	38,644	291,152	5,284
All apparatus:									
Chinook	381,756	9,544,133	466,872	340,669	8,624,450	421,882	722,425	18,168,583	888,754
Blueback	221,495	1,108,475	38,899	103,037	490,192	19,427	324,532	1,598,667	58,326
Steelhead	79,064	790,605	23,696	85,200	852,000	25,517	164,264	1,642,605	49,213
Silver	9,642	67,494	1,170	5,715	39,005	836	15,357	106,499	2,006
Total	691,957	11,510,707	530,637	534,621	10,005,647	467,662	1,226,578	21,516,354	998,299

D.—*Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1890.*

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Pounds.	Value.	No.	Pounds.	Value.	No.	Pounds.	Value.
Pound nets:									
Chinook	104,099	2,602,475	$78,491	71,346	1,783,659	$53,510	175,445	4,386,125	$132,001
Blueback	50,493	252,465	5,048	42,097	210,485	4,209	92,590	462,950	9,257
Steelhead	51,600	516,000	5,160	41,412	414,120	4,140	93,012	930,120	9,300
Total	206,192	3,370,940	88,699	154,855	2,408,255	61,859	361,047	5,779,195	150,558
Trap nets:									
Chinook				3,629	90,725	2,721	3,629	90,725	2,721
Blueback				303	1,515	30	303	1,515	30
Steelhead				2,979	29,790	298	2,979	29,790	298
Total				6,911	122,030	3,049	6,911	122,030	3,049
Seines:									
Chinook	10,750	268,750	8,063	53,752	1,343,800	41,402	64,502	1,612,550	49,465
Blueback	2,250	11,250	225	14,292	71,460	1,425	16,542	82,710	1,650
Steelhead	9,013	90,130	901	36,701	367,010	3,669	45,714	457,140	4,570
Total	22,013	370,130	9,189	104,743	1,782,270	46,496	126,758	2,152,400	55,685
Gill nets:									
Chinook	369,196	9,229,700	288,730	211,675	5,366,675	166,167	580,871	14,596,375	454,897
Blueback	81,909	409,545	8,440	25,718	138,590	2,884	107,627	548,135	11,324
Steelhead	29,593	295,935	3,819	18,635	186,350	2,467	48,228	482,285	6,286
Total	480,698	9,935,180	300,989	256,028	5,691,615	171,518	736,726	15,626,795	472,507
Wheels:									
Chinook	83,202	2,080,053	62,401	27,972	699,317	20,979	111,174	2,779,370	83,380
Blueback	529,646	2,648,155	79,444	207,298	1,036,465	30,431	736,944	3,684,620	109,875
Steelhead	71,239	712,390	16,474	13,801	138,010	2,322	85,040	850,400	18,796
Silver	4,660	31,612	749	1,500	10,500	210	6,160	42,112	959
Total	688,747	5,472,210	159,068	250,571	1,884,292	53,942	939,318	7,356,502	213,010
Dip nets and squaw nets:									
Chinook	5,021	125,534	1,958	2,242	56,068	841	7,263	181,602	2,799
Blueback	32,748	163,740	2,450	7,717	38,585	579	40,465	202,325	3,029
Steelhead	11,000	110,000	1,650	1,402	14,025	210	12,402	124,025	1,860
Silver	10,180	71,260	1,068	4,500	31,500	472	14,680	102,760	1,540
Total	58,949	470,534	7,126	15,861	140,178	2,102	74,810	610,712	9,228
All apparatus:									
Chinook	572,268	14,306,512	439,643	370,616	9,340,235	285,620	942,884	23,646,747	725,263
Blueback	697,046	3,485,155	95,607	297,425	1,497,100	39,558	994,471	4,982,255	135,165
Steelhead	172,445	1,724,455	28,004	114,930	1,149,305	13,106	287,375	2,873,760	41,110
Silver	14,840	102,872	1,817	6,000	42,000	682	20,840	144,872	2,499
Total	1,456,599	19,618,994	565,071	788,971	12,028,640	338,966	2,245,570	31,647,634	904,037

E.—*Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1891.*

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Pounds.	Value.	No.	Pounds.	Value.	No.	Pounds.	Value.
Pound nets:									
Chinook	108,983	2,724,575	$108,983	94,624	2,365,600	$94,594	203,607	5,090,175	$203,577
Blueback	22,988	114,940	2,298	52,164	260,840	5,336	75,152	375,780	7,634
Steelhead	54,080	540,800	7,029	44,448	444,464	6,308	98,528	985,264	13,337
Total	186,051	3,380,315	118,310	191,236	3,070,904	106,238	377,287	6,451,219	224,548
Trap nets:									
Chinook	630	15,750	630	712	17,800	712	1,342	33,550	1,342
Blueback	148	740	15				148	740	15
Steelhead	786	7,860	118	501	5,010	75	1,287	12,870	193
Total	1,564	24,350	763	1,213	22,810	787	2,777	47,160	1,550
Seines:									
Chinook	16,489	412,225	16,489	48,596	1,214,900	36,884	65,085	1,627,125	53,373
Blueback	2,252	11,260	225	8,325	41,625	1,221	10,577	52,885	1,446
Steelhead	5,092	50,920	919	27,469	274,690	5,467	32,561	325,610	6,386
Silver	857	5,999	190				857	5,999	190
Total	24,690	480,404	17,823	84,390	1,531,215	43,572	109,080	2,011,619	61,395
Gill nets:									
Chinook	448,500	11,212,500	447,031	208,633	5,341,525	208,593	657,133	16,554,025	655,624
Blueback	25,679	131,395	4,102	15,268	76,340	2,589	40,947	207,735	6,691
Steelhead	17,274	172,740	3,541	20,581	205,815	3,468	37,855	378,555	7,009
Silver	285	1,995	60	694	4,858	145	979	6,853	205
Total	491,738	11,518,630	454,734	245,176	5,628,538	214,795	736,914	17,147,168	669,529
Wheels:									
Chinook	23,645	591,153	17,735	9,621	240,540	7,216	33,266	831,693	24,951
Blueback	80,004	400,020	12,000	36,675	183,375	5,502	116,679	583,395	17,502
Steelhead	27,053	270,530	6,675	11,536	115,360	3,460	38,589	385,890	10,135
Silver	4,920	34,440	933	2,730	19,110	573	7,650	53,550	1,506
Total	135,622	1,296,143	37,343	60,562	558,385	16,751	196,184	1,854,528	54,094
Dip nets and squaw nets:									
Chinook	2,943	73,591	1,119	403	10,083	151	3,346	83,674	1,270
Blueback	30,436	152,182	2,388	13,887	60,918	914	44,323	213,100	3,302
Steelhead	7,459	74,590	1,149	2,016	20,164	302	9,475	94,754	1,451
Silver	10,370	72,591	1,089	4,260	29,820	447	14,630	102,411	1,536
Total	51,208	372,954	5,745	20,566	120,985	1,814	71,774	493,939	7,559
All apparatus:									
Chinook	601,190	15,029,794	591,987	362,589	9,190,448	348,150	963,779	24,220,242	940,137
Blueback	161,507	810,537	21,028	126,319	623,098	15,562	287,826	1,433,635	36,590
Steelhead	111,744	1,117,440	19,431	106,551	1,065,503	19,080	218,295	2,182,943	38,511
Silver	16,432	115,025	2,272	7,684	53,788	1,165	24,116	168,813	3,437
Total	890,873	11,072,796	634,718	603,143	10,932,837	383,957	1,494,016	28,005,633	1,018,675

F'.—*Table showing by apparatus the number, weight, and value of each species of salmon taken in the Columbia River in 1892.*

Apparatus and species.	Oregon.			Washington.			Total.		
	No.	Pounds.	Value.	No.	Pounds.	Value.	No.	Pounds.	Value.
Pound nets:									
Chinook	127,627	3,191,675	$127,627	89,852	2,246,300	$89,852	217,479	5,537,975	$217,479
Blueback	99,602	498,010	10,010	191,222	956,110	19,122	290,824	1,454,120	29,132
Steelhead	112,661	1,126,610	16,899	76,998	769,980	11,549	189,659	1,896,590	28,448
Total	339,890	4,816,295	154,536	358,072	3,972,390	120,523	697,962	8,788,685	275,059
Trap nets:									
Chinook	530	13,250	530	20	500	20	550	13,750	550
Blueback	240	1,200	24				240	1,200	24
Steelhead	879	8,790	132	150	1,500	150	1,029	10,290	282
Total	1,649	23,240	686	170	2,000	170	1,819	25,240	856
Seines:									
Chinook	27,707	689,535	20,686	27,582	689,550	20,687	55,289	1,379,085	41,373
Blueback	48,347	237,735	7,132	75,031	375,185	11,256	123,378	612,920	18,388
Steelhead	18,544	185,352	3,707	34,843	348,430	6,969	53,387	533,782	10,676
Silver	1,428	10,000	300				1,428	10,000	300
Total	96,026	1,122,622	31,825	137,456	1,413,165	38,912	233,482	2,535,787	70,737
Gill nets:									
Chinook	355,715	8,892,870	355,715	223,197	5,715,675	223,167	578,912	14,608,545	578,882
Blueback	94,141	470,705	9,714	21,021	110,105	3,303	115,162	580,810	13,017
Steelhead	37,043	370,430	5,866	33,428	334,280	5,090	70,471	704,710	10,956
Silver				714	5,000	150	714	5,000	150
Total	486,899	9,734,005	371,295	278,360	6,165,060	231,710	765,259	15,899,065	603,005
Wheels:									
Chinook	45,964	1,149,115	34,474	16,705	417,630	12,529	62,669	1,566,745	47,003
Blueback	314,585	1,572,923	47,187	145,766	728,832	21,865	460,351	2,301,755	69,052
Steelhead	95,654	956,540	28,696	45,056	450,560	13,517	140,710	1,407,100	42,213
Silver	39,255	274,785	8,234	4,872	34,104	1,023	44,127	308,889	9,257
Total	495,458	3,953,363	118,591	212,399	1,631,126	48,934	707,857	5,584,489	167,525
Dip nets and squaw nets:									
Chinook	1,356	33,900	509	578	14,450	217	1,934	48,350	726
Blueback	59,023	295,109	4,427	15,380	76,900	1,154	74,403	372,009	5,581
Steelhead	6,780	67,802	1,017	2,890	28,900	434	9,670	96,702	1,451
Silver	12,386	86,703	1,301	4,850	33,950	510	17,236	120,653	1,811
Total	79,545	483,514	7,254	23,698	154,200	2,315	103,243	637,714	9,569
All apparatus:									
Chinook	558,899	13,970,345	539,541	357,934	9,084,105	346,472	916,833	23,054,450	886,013
Blueback	615,938	3,075,682	78,494	448,420	2,247,132	56,700	1,064,358	5,322,814	135,194
Steelhead	271,561	2,715,524	56,317	193,365	1,933,650	37,709	464,926	4,649,174	94,026
Silver	53,069	371,488	9,835	10,436	73,054	1,683	63,505	444,542	11,518
Total	1,499,467	20,133,039	684,187	1,010,155	13,337,941	442,564	2,509,622	33,470,980	1,126,751

The number and location of the salmon canneries operated on the Columbia River in the years 1889 to 1892 were as follows:

Location.	1889.	1890.	1891.	1892.	Location.	1889.	1890.	1891.	1892.
Oregon:					Washington:				
Astoria	8	8	8	8	Ilwaco	1	1	1	1
Clifton	1		1	1	Knappton			1	1
Maple Dell	1	1	1	1	Chinook	1	1	1	1
Warrendale	1	1	1	1	Pillar Rock	1	1	1	1
Dalles	1	1	1	1	Brookfield	1	1	1	1
Celilo		1		1	Waterford	1	1	1	1
Portland*				1	Eureka	1	1	1	1
					Cathlamet	1	1	1	1
Total	12	12	12	14	Bay View	1	1	1	1
					Eagle Cliff	1	1	1	1
					Total	9	9	10	10
					Grand total	21	21	22	24

* This cannery, on the Willamette River, received its fish from the Columbia River.

The proportion of each species of salmon in the salmon pack of the Columbia River from 1889 to 1892 is shown in Table G:

G.—*Table showing by species the salmon pack of the Columbia River from 1889 to 1892.*

States and species.	1889.		1890.		1891.		1892.	
	Cases.	Value.	Cases.	Value.	Cases.	Value.	Cases.	Value.
Oregon:								
Chinook	140,741	$844,446	196,414	$1,138,787	222,963	$1,279,092	214,631	$1,244,500
Blueback	15,979	90,628	53,351	268,104	10,859	58,816	51,106	287,984
Steelhead	11,692	49,899	26,608	106,432	15,584	62,236	45,403	181,612
Silver							4,176	20,880
Total	168,412	984,973	276,373	1,513,323	249,406	1,400,144	315,316	1,734,976
Washington:								
Chinook	125,956	755,736	139,190	807,300	130,944	759,474	129,636	751,888
Blueback	1,818	10,423	3,994	21,965	4,623	25,426	15,441	84,925
Steelhead	13,699	58,688	16,217	64,868	13,980	55,920	26,945	107,280
Silver								
Total	141,473	824,847	159,401	894,133	149,547	840,820	172,022	944,093
Total for river:								
Chinook	266,697	1,600,182	335,604	1,946,087	353,907	2,038,566	344,267	1,996,388
Blueback	17,797	101,051	57,345	290,069	15,482	84,242	66,547	372,909
Steelhead	25,391	108,587	42,825	171,300	29,564	118,156	72,348	288,892
Silver							4,176	20,880
Total	309,885	1,809,820	435,774	2,407,456	398,953	2,240,964	487,338	2,679,069

In 1893 the pack of chinook salmon amounted to 290,000 cases.

The extent to which the different species of salmon enter into the pack, and the variations in the proportions during the four years covered by the figures, are shown in the following table. It appears that in 1892 the percentage of chinook salmon canned was less and that of each of the other species greater than in any of the preceding years.

Percentage of each species of salmon in the salmon pack of the Columbia River from 1889 to 1892.

Species.	1889.	1890.	1891.	1892.
Chinook	86.06	77.01	88.71	70.64
Blueback	5.74	13.16	3.88	13.65
Steelhead	8.20	9.83	7.41	14.85
Silver				.86
Total	100.00	100.00	100.00	100.00

In discussing the data furnished by the foregoing tables and others which will follow, I will confine myself to the chinook salmon for the following reasons:

1. It is the most important species considered economically.

2. It is taken equally by all forms of apparatus.

3. Active fishing operations continue practically during the entire period of its sojourn in the river, and it is therefore the species which would be the first to feel the influence of excessive fishing.

These considerations do not apply with equal force to the other species, viz, the steelhead, the blueback, and the silverside, which are taken under similar conditions and at present constitute about one-fourth of the entire pack.

The spawning run of the steelhead takes place before fishing operations have begun on the river.

The spawning run of the silverside takes place after canning operations are concluded for the season, while the small size of the blueback gives it comparative immunity from capture by the gill nets, which take much the larger part of the king salmon.

Referring to Table G we find that the pack of the chinook or king salmon on the Columbia River in the years 1889, 1890, 1891, 1892, and 1893 was as follows:

	No. of cases.
1889	266,697
1890	335,604
1891	353,907
1892	344,267
1893	290,000

Or an average of 318,095 cases per annum.

In the previous five years, beginning with 1884, the pack of salmon, consisting almost entirely of chinook, was as follows:

	No. of cases.
1884	620,000
1885	553,800
1886	448,500
1887	356,000
1888	372,477

Or an average of 470,155 cases per annum.

It will be seen that in the five years beginning in 1884, the average pack per season was 152,060 cases in excess of the average pack of the five-year period beginning in 1889. During the latter period the amount of netting in use had been greatly increased, the fishing season extended, and the movement of the salmon into and up the river more completely intercepted.

Undoubtedly, for the reasons above stated, the proportion of the entire run of salmon caught was larger in the latter than in the former period of five years, which suggests that the decrease of salmon in the latter period compared is probably larger than is indicated by the difference in the average catch. There is no reason to doubt that this decrease is due to and inherent in the conditions under which the salmon fisheries of the river are now prosecuted, and that it will continue progressively so long as these conditions continue.

The lower average of the pack during the five-year period ending with 1893 is due to conditions interfering with and limiting natural reproduction during the period of 1884 to 1888, when access to the head waters was not impeded to the extent it now is by the fishing operations. The influence of the more effective exclusion of the salmon from their breeding-grounds for the last five years is yet to be disclosed. The seed for the harvest of the present year was sown in 1888 or 1889. What the extent of the harvest will be depends upon the opportunity that was afforded in these years for the salmon to reach their spawning-grounds.

For the ensuing five years we are powerless to influence conditions. What the production will be has been already determined, so far as we can influence it either by the regulation of the fisheries or by artificial propagation. There is every reason to apprehend that for the five years to come the average production of king salmon will be lower even than the average for the five years just passed. This is the penalty

that must be paid for the improvidence and total disregard of the conditions necessary to maintain supply which has characterized the operations of the salmon fishermen on the Columbia River.

ARTIFICIAL PROPAGATION OF SALMON ON THE COLUMBIA RIVER.

In 1888 the U. S. Fish Commission, by direction of Congress, established a salmon-hatching station on the Clackamas River, Oregon. The work done is given in the following table:

Statement showing the number of Quinnat salmon eggs collected and fry distributed from Clackamas Station since its organization by the U. S. Fish Commission to the close of the fiscal year 1893.

Fiscal year—	Eggs collected.	Eggs distributed.	Fry distributed.
1888–89	4,500,000		4,500,000
1889–90	4,314,000	1,000,000	2,766,475
1890–91	5,860,000	700,000	4,902,000
1891–92	2,036,000		1,332,400
1892–93	4,444,000		4,100,000
Total	21,154,000	1,700,000	17,600,875

NOTE.—The fry were all deposited in the Clackamas River. The 1,700,000 eggs were furnished to the Oregon fish commission and the fry produced were deposited in the Clackamas River.

This work was undertaken on the urgent solicitation of those concerned in the salmon fisheries of the Columbia River, who realized that their fisheries were being exhausted, and it was hoped that some compensation for the deficiency in natural reproduction could be made by artificial stocking and breeding. It is certain that this work has exercised some conservative influence upon the catch. It is doubtful, however, whether it has been on a sufficiently extensive scale to compensate for the damage resulting from the interference with natural reproduction by the operation of the fisheries.

THE FISHING-GROUNDS.

On the accompanying charts, the locations of the fishing-grounds resorted to by the fishermen using different kinds of apparatus are indicated, and the number and position of the fixed appliances operated in 1892 are shown.

The fishing-grounds of the Lower Columbia extend from the mouth of the river to Kalama. The apparatus employed consists of gill nets, pound nets, and haul seines.

The greater number of pound nets are located in Baker Bay, on the Washington side of the river and on the outside of Sand Island. They are not, however, confined to this region, but are located at every point of vantage on both sides of the river, from the mouth up to Kalama, a distance of 80 miles.

The haul seines are located either on the shores or flats, wherever a desirable location can be found.

The principal region of gill-net fishing extends from the mouth of the river to Cathlamet Bay, and covers, practically, the entire river outside of the limits of the pound nets. Other important areas of gill-net fishing are in Cordell channel, in the channel and back of the islands opposite Pillar Rock and Brookfield, and in the long reach of river from Puget Island to Eagle Cliff. Minor fishing operations are

conducted between Kalama and the Cascades, both in the river and its tributaries, such as the Willamette, the Cowlitz, etc. The fishing operations on the Upper Columbia, from the Cascades to the mouth of the Deschutes River, are conducted almost exclusively with salmon wheels, which are turned by the force of the current. These, when properly located and operated, constitute most effective engines of capture.

A careful examination of the charts giving the number and location of the different fishing apparatus will show how effectually the salmon are embarrassed or intercepted in their attempts to reach their spawning-grounds. It is not a matter of wonder that, under existing conditions, there has been a serious deterioration in the value of these fisheries. It is, indeed, a matter of surprise that any salmon have been able to elude the labyrinth of nets which bar their course to the Upper Columbia. It is hardly an exaggeration to state that the entire volume of this great river is strained through the meshes of the innumerable nets which occupy and obstruct every passageway to the spawning-grounds. It is certain that the continuation of these fisheries under present conditions will eventually result in rendering them unremunerative. It concerns alike the whole people of the State, as well as those directly interested in the fisheries, that such regulations of the times, methods, and apparatus of these fisheries should be established and enforced as are necessary to maintain supply.

THE FISHING SEASON.

It is a wise policy on the part of the State to encourage the largest catch that can be permitted consistent with maintenance of supply; to impose no unnecessary embarrassments or restrictions upon the enterprise of the fishermen, yet at the same time to insist upon such protective regulations and restraints as may be found necessary to prevent the serious impairment of an important industry by the operations of the fishermen. The fishermen themselves, who have such important interests at stake and the security and profit of whose large investments depend upon the maintenance of the salmon supply, should be prompt to propose and vigilant to enforce such regulations as may be necessary to this end. The nature of the protective regulations which can be enforced with the least restraint or embarrassment to the salmon fisheries and the canning industries is indicated by reference to the following table, showing by months the number and weight of each species of salmon taken for canning on the Columbia River.

Table showing by months the number and weight of each species of salmon utilized for canning purposes on the Columbia River in 1889, 1890, 1891, and 1892.

Years and months.	Chinook salmon.		Blueback salmon.		Steelhead salmon.		Silver salmon.		Total.	
	Number of fish.	Gross weight.	Number of fish.	Gross weight.	Number of fish.	Gross weight.	Number of fish.	Gross weight.	Number of fish.	Gross weight.
		Pounds.		*Pounds.*		*Pounds.*		*Pounds.*		*Pounds.*
1889—April	89,266	2,231,650	36,676	183,330	9,408	94,080	.....	.....	135,350	2,509,110
May	156,117	3,902,925	76,517	382,585	14,709	147,090	.....	.....	247,343	4,432,600
June	168,959	4,223,975	82,453	412,265	62,695	626,950	.....	.....	314,107	5,263,190
July	301,254	7,535,350	36,717	183,585	76,166	761,660	.....	.....	414,137	8,480,595
Total	715,596	17,893,900	232,363	1,161,815	162,978	1,629,780	.....	.....	1,110,937	20,685,495
1890—April	32,727	818,175	63,180	315,900	11,005	110,050	.....	.....	106,912	1,244,125
May	236,776	5,919,400	202,580	1,012,900	22,983	229,830	.....	.....	462,339	7,162,130
June	252,754	6,318,850	297,234	1,486,170	87,567	875,670	.....	.....	637,555	8,680,690
July	357,183	8,932,575	150,299	751,495	139,596	1,395,960	.....	.....	647,078	11,080,030
August	13,941	348,525	22,107	110,535	15,535	155,350	.....	.....	51,583	614,410
Total	893,381	22,337,525	735,400	3,677,000	276,686	2,766,860	.....	.....	1,905,467	28,781,385
1891—April	82,413	2,060,325	17,437	87,185	5,178	51,780	.....	.....	105,028	2,199,290
May	184,090	4,502,250	55,229	276,145	13,314	133,140	.....	.....	252,633	4,911,535
June	223,964	5,599,100	83,743	418,715	52,676	526,760	.....	.....	360,383	6,544,575
July	398,247	9,956,175	32,389	161,945	97,900	979,000	.....	.....	528,536	11,097,120
August	58,670	1,466,750	3,701	18,505	21,286	212,860	.....	.....	83,657	1,698,115
Total	947,384	23,584,600	192,499	962,495	190,354	1,903,540	.....	.....	1,330,237	26,450,635
1892—April	55,021	1,375,525	86,449	432,245	10,503	105,030	.....	.....	151,973	1,912,800
May	187,492	4,687,300	308,946	1,544,730	32,795	327,950	.....	.....	529,233	6,559,980
June	239,498	5,987,450	330,558	1,652,790	141,194	1,411,940	.....	.....	711,250	9,052,180
July	343,421	8,585,525	128,043	640,215	199,333	1,993,330	.....	.....	670,797	11,219,070
August	84,124	2,103,100	19,110	95,550	52,991	529,910	.....	.....	156,225	2,728,560
September	.....	.....	.....	.....	11,293	112,930	19,489	136,423	30,782	249,353
October	.....	.....	.....	.....	22,629	226,290	33,966	237,762	56,595	464,052
Total	909,556	22,738,900	873,106	4,365,530	470,738	4,707,380	53,455	374,185	2,306,855	32,185,995

In 1889 the fishing season extended from the 1st of April to the 31st of July. The total catch of chinook salmon amounted to 17,893,900 pounds, 87½ per cent of this amount being taken in May, June, and July, and 12½ per cent during the month of April.

In 1890 the fishing extended from April 10 to August 10, inclusive, and yielded a total product of 22,337,525 pounds of chinook salmon. Of this amount, 94½ per cent was taken in May, June, and July, and 1½ per cent during April and August.

In 1891 the fishing season extended from April 10 to August 10, inclusive, the total product of chinook salmon being 23,584,600 pounds, 85 per cent of which was taken in May, June, and July, and 15 per cent in April and August.

In 1892 the total catch of chinook salmon amounted to 22,738,900 pounds, and the fishing season extended from April 10 to August 10, and during September and October; 85 per cent of the total catch was made in the months of May, June, and July; 15 per cent in April and August; none in September or October.

It will be evident from the percentages given above, and by reference to the table, that the most productive fishing operations for the pound-net and gill-net region of the river are during the months of May, June, and July. The number of chinook salmon taken in April and August is relatively small, and under conditions not so profitable, either to the canneries or the fishermen, as those carried on during the months of May, June, and July. The April run of this salmon, if allowed to pass without interruption to the headwaters of the Columbia and its tributaries, would spawn in those waters, and the present productive capacity of the river would be increased to such an extent as to much more than compensate for the restrictions imposed by the prohibition of the fishery operations during the month of April.

The August run of chinook salmon consists of gravid fish near their spawning time. The flesh for this reason has undergone deterioration, and if canned constitutes an inferior product, the sale of which will discredit the reputation which the Columbia River salmon justly hold in public estimation. None of the August run of chinooks probably ascends the Columbia above the Dalles. They spawn in the tributary streams of the Lower Columbia and in the main stream between the Dalles and the mouth of the river.

RECOMMENDATIONS.

Having in view the considerations above presented, there can be no doubt of the necessity of restrictive regulations to maintain the salmon fisheries of the Columbia River. The enactment and enforcement of such regulations as may be necessary to this end is the prerogative of the States occupying the Columbia River basin. There is no precedent for the exercise by the General Government of control over the fisheries of our interior waters, except in so far as the forms of apparatus in use might be regarded as obstructions or impediments to navigation.

Whether the power to regulate the fisheries of interstate and bounding territorial waters is vested in the General Government or in the States is a subject which has provoked, and will continue to provoke, controversy until the respective rights and powers of individual States and the General Government are duly ascertained and defined by the courts of last resort. Having reference, however, to the interests of the fisheries, there is no doubt that these interests would be best subserved by uniform and concurrent regulations covering the entire region in which any special fishery is prosecuted.

In the case of the Columbia, we find that the great market fisheries for the salmon are prosecuted in the lower river, and the immediate evident advantage is to those who are engaged in the capture of the salmon or in canning them for the market. On the other hand, the nurseries for the young salmon, upon the abundance of which depend the productiveness and profit of the fisheries in the lower river, are in the remote tributaries and sources of the river in Washington, Oregon, and Idaho.

Regulations and restrictions of the net fisheries, so as to permit a reasonable number of salmon to reach their spawning-ground in the upper rivers, and protection of the salmon in these waters during their spawning season, in September and October, present the conditions to be fulfilled to keep up supply, so far as this can be accomplished by legal restraints.

To effectively restrain or regulate the net fisheries requires the concurrent action of the States of Washington and Oregon. Effective protection to the salmon on their spawning-grounds can be established only by concurrent action on the part of Washington, Oregon, and Idaho establishing a close season during the months of September and October. Here a serious difficulty arises. On the one hand it will be urged by the net fishermen of Washington and Oregon that any restraint on their operations will be burdensome to them without any corresponding advantage, since the fish they permit to escape their nets will be taken in the head waters to which they go before they have had an opportunity to spawn, and so they will be subject to serious losses and inconvenience without any compensating advantage. On the other hand, the citizens of eastern Washington and Oregon and of remote Idaho will be reluctant to impose any restraints on their own people in reference to the taking of salmon, for the reason that any increase in the fishery arising thereby will inure solely to the benefit of the fishermen between the Dalles and the mouth of the river.

The necessity of concurrent action on the part of the States occupying the Columbia River Basin, and of their cordial coöperation in measures necessary to maintain the salmon fishery of the Columbia River and to improve it, is evident from a consideration of the facts presented. The investigations of the U. S. Fish Commission in the Columbia River Basin made under the instructions of Congress clearly indicate that there is a serious deterioration in the product and value of the salmon fisheries of this river; that this deterioration is to be attributed in large part, if not entirely, to the exclusion of the salmon from their spawning-grounds by the operations of the net fishermen, and that artificial propagation on an adequate scale to compensate for the waste of the fisheries is no longer possible under existing conditions of the fisheries.

The initial step in attempting the restoration of the salmon fishery is to restrict and regulate the net fishing. The restriction that may be put in force with the least hardship to the fishermen is the shortening of the season of net fishing.

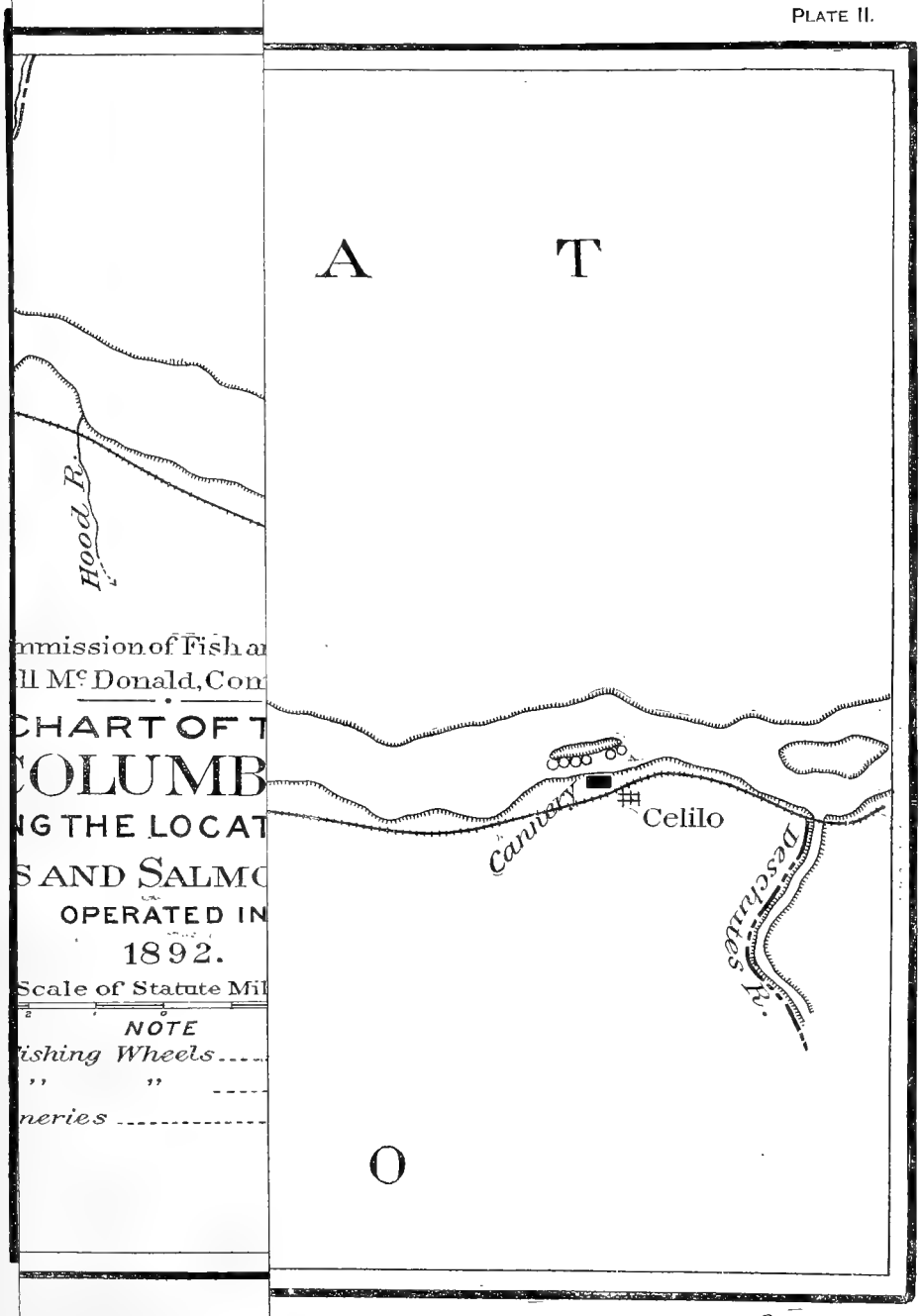
The use of pounds, gill nets, traps, and seines in the lower river, from the Cascades to the mouth, should be limited strictly to the months of May, June, and July. The wheels should not be permitted to take salmon prior to the middle of May, so as to permit the salmon which have entered the river in April the opportunity to pass up to the head waters. A further closed season for wheels should be established from the 1st of August to the 10th of September, so as to provide for the uninterrupted spawning of the August run of salmon. There does not at present appear sufficient reason to prohibit the wheel fishing during the balance of September and during the month of October. Protection for the salmon which have thus been enabled to reach their spawning-grounds should be afforded by a close season during the months of September and October, covering the streams in Washington, Oregon, and Idaho to which the salmon resort for breeding.

Should the policy above outlined be adopted by these States and the requisite measures to carry it into effect be enacted and enforced, it will be possible for the U. S. Fish Commission and the State commissions to greatly enlarge their fish-cultural operations, and to prosecute them under much more satisfactory and economical conditions than at the present time. Until the States interested adopt measures to restrain net fishing, so as to permit a portion at least of the salmon entering the river to pass up to their spawning-grounds, it is not deemed wise or expedient to attempt to increase or extend the work of artificial propagation of the salmon.

All efforts will be disappointing, unprofitable, and nugatory so long as the fisheries continue under existing conditions, and I would recommend, therefore, that no further steps be taken at present looking to the establishment of additional salmon-breeding stations in the Columbia River Basin.

MARSHALL MCDONALD,
U. S. Commissioner of Fish and Fisheries.

PLATE II.



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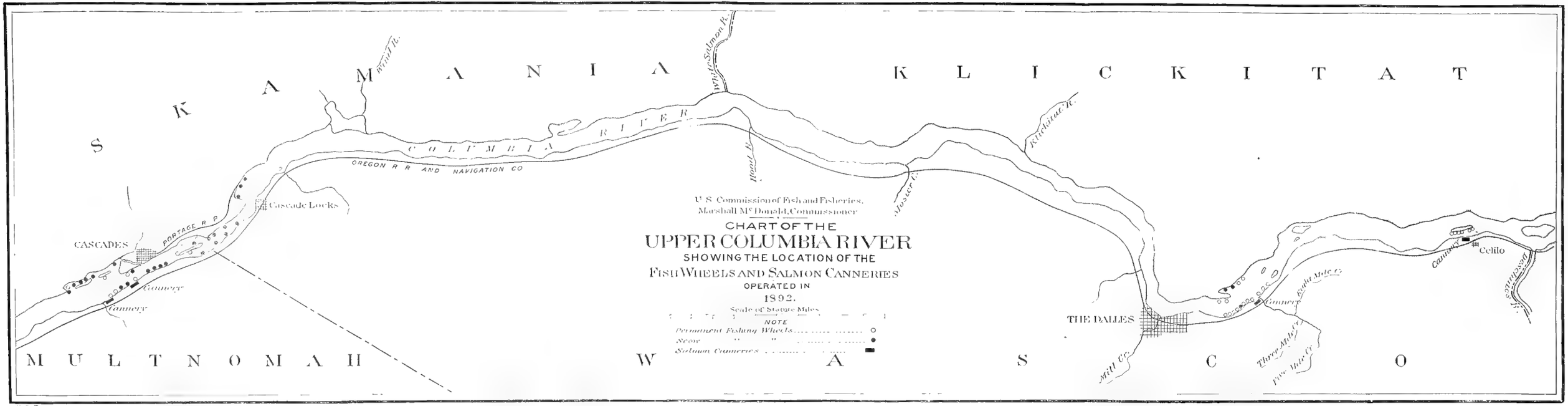
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U S Commission of Fish and Fisheries.
Marshall Mc Donald, Commissioner
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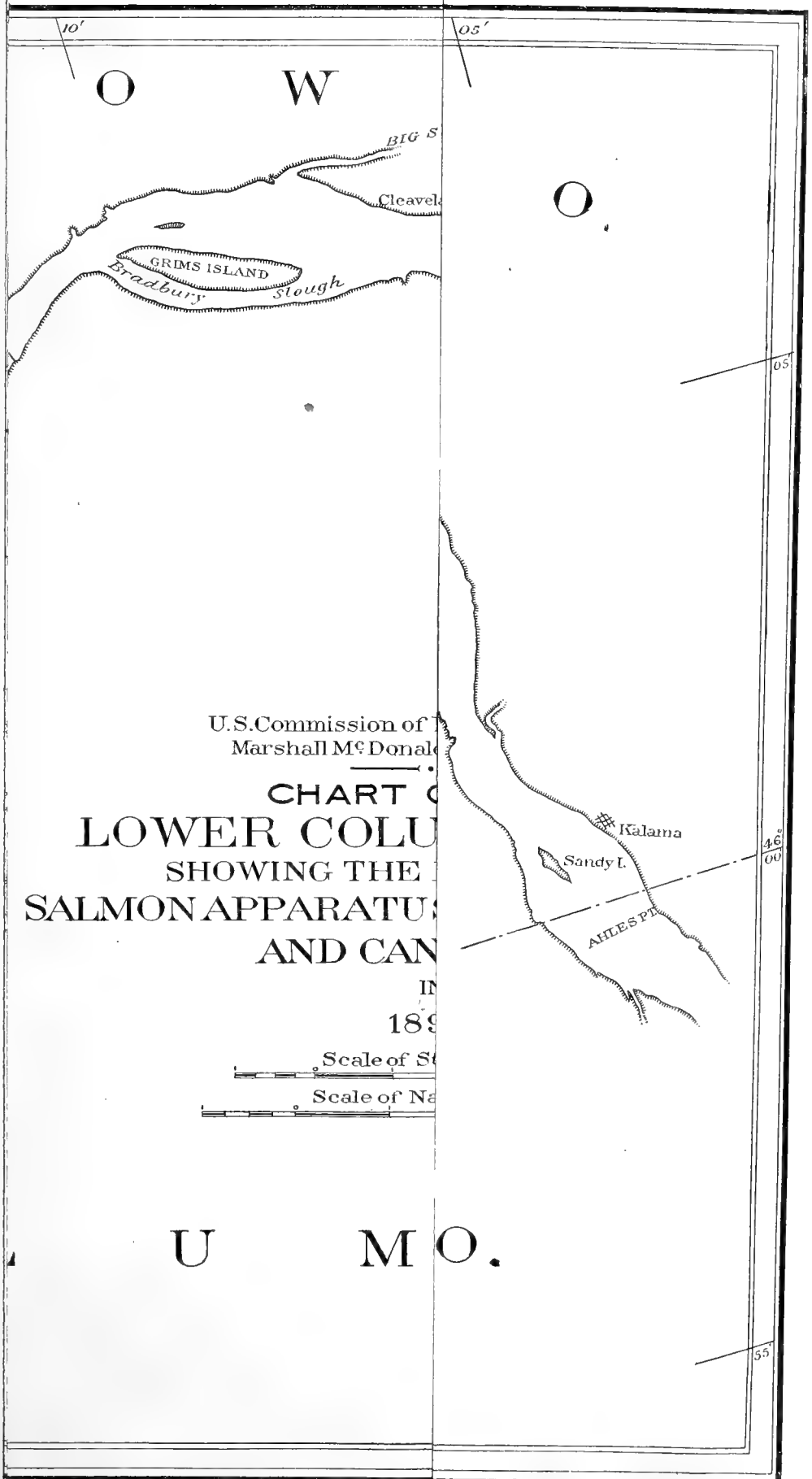
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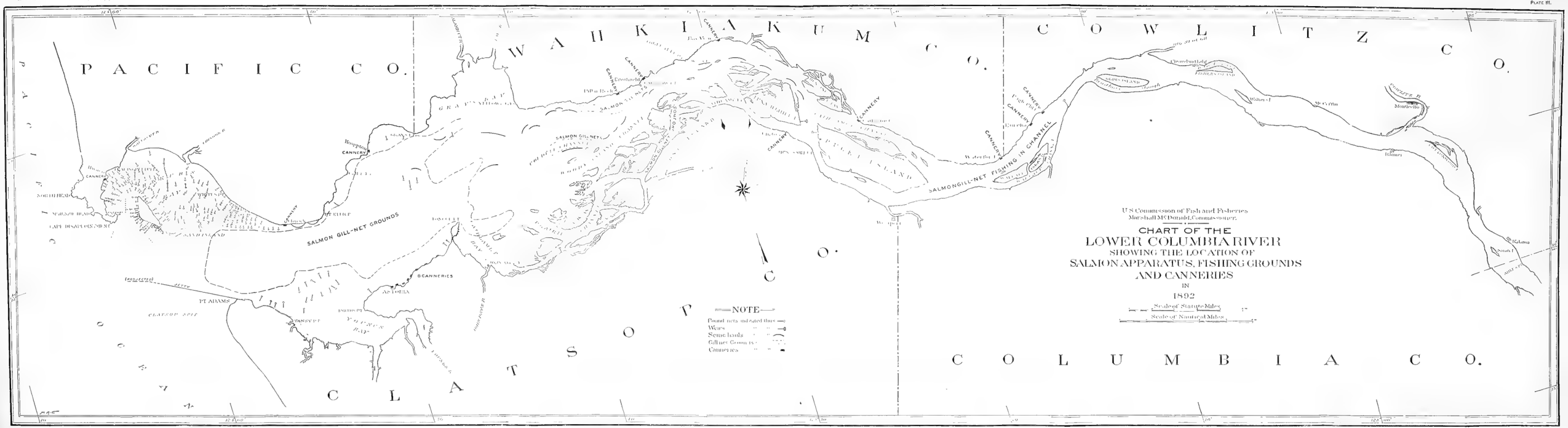


U S Commission of Fish and Fisheries
Marshall McDonald, Commissioner.

CHART OF THE LOWER COLUMBIA RIVER SHOWING THE LOCATION OF SALMON APPARATUS, FISHING GROUNDS AND CANNERIES IN 1892

Scale of Statute Miles
Scale of Nautical Miles

A REPORT UPON INVESTIGATIONS IN THE COLUMBIA RIVER BASIN, WITH DESCRIPTIONS OF FOUR NEW SPECIES OF FISHES.

BY

CHARLES H. GILBERT, *Professor of Zoology, Leland Stanford Junior University,*

AND

BARTON W. EVERMANN, *Ichthyologist of the U. S. Fish Commission.*

INTRODUCTION.

The investigations upon which this report is primarily based were provided for by two items in the sundry civil bill, approved August 5, 1892. The first of these items authorized the expenditure, from the appropriation for inquiry respecting food-fishes, of the sum of $2,000, or so much thereof as may be necessary, "in examining the Clarke's Fork of the Columbia River, with the view to ascertain the obstructions which prevent the ascent of salmon in said river to the Flathead Lake and adjacent waters." The second item provided "for investigation and report respecting the advisability of establishing a hatching station at some suitable point in the State of Washington, $1,000, or so much thereof as may be necessary."

The purposes of these two investigations were very intimately related. Any inquiry regarding obstructions which might interfere with the movements of salmon in any of the tributaries of the Columbia would have a bearing upon the advisability of establishing a salmon-hatchery at any point in that river basin. These two inquiries were therefore conducted as one, and the results are presented in a single report.

This work was begun in September, 1892, by Dr. Charles E. Gorham, engineer and architect of the Commission, assisted by Mr. Barton A. Bean, of the U. S. National Museum, and Mr. A. J. Woolman, teacher of science in the high school at South Bend, Ind. Dr. Gorham died before the completion of the investigation, and Prof. Evermann was instructed by the Commissioner to continue the work during the summer of 1893. While carrying on these investigations he had the assistance of Drs. Charles H. Gilbert, Oliver P. Jenkins, and W. W. Thoburn, and Mr. Cloud. Rutter, all of Leland Stanford Junior University. The work was taken up by us at Pocatello, Idaho, August 2, it having been determined to include an examination of the obstructions in Snake River and a preliminary study of the natural-history features of the upper waters of the Columbia basin, with special reference to the present or former occurrence of salmon in those streams.

To expedite matters as much as possible in the limited time which could be given to the work, the force was divided into two parties at Pocatello. Gilbert, Thoburn, and Rutter were instructed to go down Snake River, examine the various falls in that stream, make investigations as to the physical and natural-history characteristics of as many of the tributary streams as possible, and then carry on similar inquiries along the Columbia from Idaho to the Lower Columbia. Evermann and Jenkins went up the Snake River to Idaho Falls, where the rapids were examined, and then proceeded to Sand Point, Idaho, where was begun the examination of Clarke Fork or the Pend d'Oreille River, the latter being the name by which this river is generally known in that region. The Pend d'Oreille River was examined throughout the entire distance from Sand Point to within a few miles of the international boundary line. The two parties came together at Spokane. From this point Evermann returned east, and the work was continued by Gilbert, Jenkins, Thoburn, and Rutter.

Investigations were made at various points in the Lower Columbia basin, chiefly for the purpose of selecting a site for a salmon hatchery and for gaining information respecting the occurrence and abundance of salmon in the various streams tributary to the Lower Columbia.

While carrying on the investigations regarding the obstructions to the free movement of salmon in these rivers and the selection of a salmon-hatchery site, considerable opportunities occurred for a study of the natural history of the salmon and the general natural-history features of the waters of the Columbia basin. Considerable valuable information was obtained regarding the former as well as the present distribution of salmon in this region.

Large collections of fishes were made at the various places where collecting was possible, and their study has greatly increased our knowledge of the variations in and the geographic distribution of the fresh-water fishes of the northwestern United States.

In this report we give (1) detailed descriptions of the various streams visited by the different members of the party; (2) a list of the species of fishes obtained in the Columbia River basin, together with a discussion of their relationships and distribution; (3) notes on the breeding colors of the whitefish (*Coregonus williamsoni*), by Barton A. Bean; and (4) an annotated list of the reptiles and batrachians obtained.

The time which has been given to the study of the various problems pertaining to the salmon question has been wholly inadequate to a satisfactory understanding of the matter, and any views which we venture to give in this paper must be regarded as tentative. An exhaustive study of the natural history of the various species of salmon and trout of the Columbia has never been made. The investigations now in progress will, it is confidently expected, lead to a much better understanding of the questions involved.

LIST OF STREAMS EXAMINED.

The following is a classified list of the streams examined, together with the dates upon which the various places were visited:

Snake River: President Camp, Wyoming, August 14, 1891 (Evermann and Jenkins); Idaho Falls, August 4 and 5 (Evermann and Jenkins); American Falls, August 5 (Gilbert); Shoshone Falls, August 6 (Gilbert); Twin Falls, August 6 (Gilbert); Auger Falls, August 7 (Gilbert); Blue Lakes, August 7 (Gilbert); Upper and Lower Salmon Falls, August 7 (Gilbert); Mouth of Boise River, Caldwell, Idaho, August 8 (Gilbert, Thoburn, and Rutter); Payette, Idaho, August 10, and Lewiston, Idaho, August 15 (Gilbert, Thoburn, and Rutter).

Ross Fork of Snake River, near Pocatello, Idaho, August 4 (party).

Port Neuf River, Pocatello, August 2 (Evermann and Rutter) and August 3 (party).

Mink Creek near Pocatello, August 3 (party).

Little Wood River near Shoshone, August 5 (Thoburn and Rutter).

Boise River near Caldwell, August 8 (Gilbert, Thoburn, and Rutter).

Payette River at Payette, August 9 (Gilbert, Thoburn, and Rutter).

Clearwater River near Lewiston, August 15 and 16 (Gilbert, Thoburn, and Rutter).

Potlatch Creek near Lewiston, August 16 (Gilbert, Thoburn, and Rutter).

Palouse River near Colfax, Washington, August 17 (Gilbert, Thoburn, and Rutter).

Grande Ronde River near La Grande, August 11 (Thoburn).

Pataha River at Starbuck, August 14 (Gilbert, Thoburn, and Rutter).

Pend d'Oreille River: Throughout the entire distance from Albany Falls, Idaho, to Big Eddy Cañon, near the international boundary line, August 9 to 15 (Evermann and Jenkins), and from its mouth to the international boundary, September 23 to 26, 1892 (Gorham and Bean).

Deer Lodge, Little Blackfoot, Big Blackfoot, Hell Gate, Bitter Root, Missoula, and Flathead rivers, together with many of their tributary streams, July and August, 1891 (Evermann and Jenkins).

Flathead Lake, August 1 to 4, 1891 (Evermann and Jenkins), and September, 1892 (Gorham and Woolman).

Thompson Falls, September, 1892 (Gorham, Bean, and Woolman).

Lake Pend d' Oreille at Sand Point, Idaho, August 7 (Evermann and Jenkins).

Upper Columbia River: Kettle Falls, August 16 (Evermann and Jenkins), and at the mouth of Pend d'Oreille River, September 23, 1892 (Gorham and Bean).

Colville River from Meyers Falls to its mouth, August 16 (Evermann and Jenkins).

Spokane River in the vicinity of Spokane, September, 1892 (Gorham and Bean), and August 18 to 21 (Evermann and Jenkins).

Little Spokane River below Dart's Mill, September, 1892 (Bean), and near Dart's Mill, August 18 (Evermann and Jenkins).

Cœur d'Alene River at Wardner, August 19, and Cœur d'Alene Lake at Cœur d'Alene, August 21 (Gilbert, Thoburn, and Rutter).

Hangman Creek near Spokane, September, 1892 (Bean), and at Tekoa, August 18 (Gilbert, Thoburn, and Rutter).

Lower Columbia River: Pasco, Wallula, Umatilla, Dalles, Portland, and Astoria, August 11 to 27 (Rutter and Thoburn).

Walla Walla River near Wallula, August 23 (Thoburn and Rutter).

Mill Creek near Walla Walla, August 14 (Thoburn and Rutter).

Umatilla River near Pendleton, Oregon, August 12 (Gilbert, Thoburn, and Rutter), and at Umatilla, August 11 and 23 (Thoburn and Rutter).

Des Chutes River at its mouth, August 24 (Rutter).

Yakima River near North Yakima and Ellensburg, August 23 and 24 (Jenkins).

Natchess River near North Yakima, August 24 (Gilbert and Jenkins).

Cowlitz and Toutle rivers near Castle Rock, August 28 and 29 (Gilbert and Jenkins).

Newaukum River near Chehalis, August 28 (Gilbert and Jenkins).

Skookumchuck River near Centralia, August 27 (Gilbert and Jenkins).

Lake Washington at Seattle, June 25, 1892 (Evermann).

Snoqualmie River at Snoqualmie Falls, June 26 and 27, 1892 (Evermann).

INVESTIGATIONS WITH REFERENCE TO THE SELECTION OF A SITE FOR A SALMON HATCHERY IN THE STATE OF WASHINGTON.

Every stream and every point visited was considered with regard to its fitness for salmon-hatching purposes. The majority of the places are, however, not suited at all to such ends, and only such locations as seem to possess most or all the required physical and biological conditions need be treated in detail in this report.

LOWER COLUMBIA.

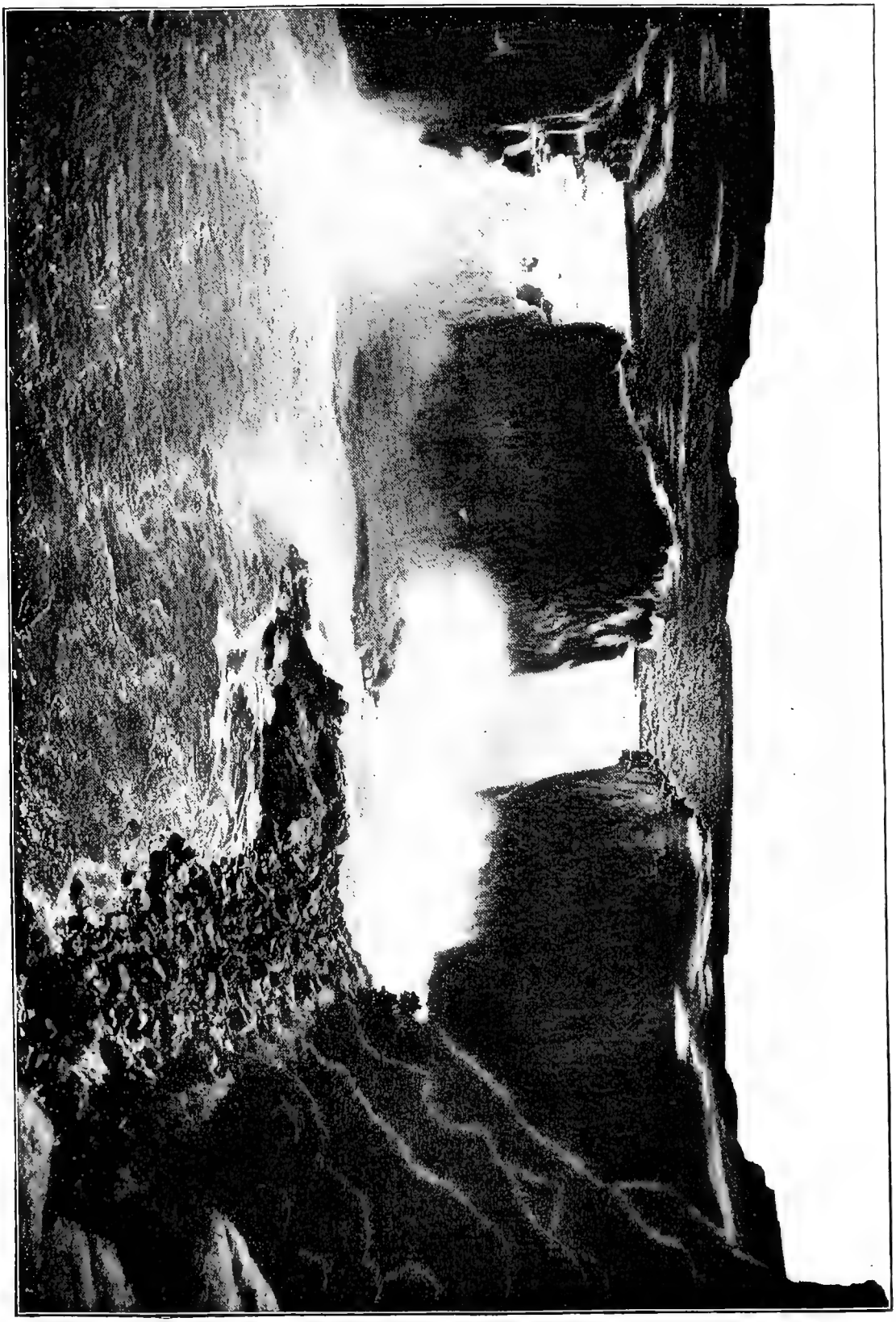
There are several reasons why a salmon hatchery would be better located on some tributary of the Lower Columbia rather than the Upper Columbia or the Snake. The supply of salmon would be more certain and the condition of the salmon better. So far as is known to us, salmon which enter the Columbia in the spring pass by the mouths of the lower tributaries and press on higher up the stream. It is probably these fish which arrive in the Upper Snake in the vicinity of Glen's Ferry and Salmon Falls in the latter part of August and in September. All observers on the Upper Snake agree that they arrive at this time and spawn from September 1 on to October or November. The fish of the fall run enter the Columbia a short time only before they are ready to spawn. So far as we now know, the most of these turn directly into streams near the mouth of the river and spawn a short time after their entrance into the Columbia.

A second point in favor of such a location for a hatchery would be, perhaps, that the young fish when turned into the stream would stand a better chance of reaching salt water than they would if they had the whole course of the river to traverse, during which time they are exposed to the attacks of all their fresh-water enemies.

A third point in favor of such a location is the accessibility of various points in Washington along the lower course of the Columbia.

Two streams were selected for examination, the Yakima River and the Cowlitz. Both of these rise in the high mountain region of southwestern Washington, and receive their waters largely from the snows of Mount Ranier, Mount Adams, and Mount St. Helen. They run through regions very different in their physical characteristics and in their climate. The Yakima lies to the east of the Cascade range and runs down through a dry valley covered with sagebrush and devoid of trees, except along the immediate vicinity of the stream itself. The summer season is very hot and the winter correspondingly cold. So far as the character of the stream itself is concerned, it seems admirably adapted for a hatchery. At North Yakima the stream is perfectly clear, flows rapidly in an open valley over gravel and sand, and had a temperature of 64° August 23. It receives an important tributary, the Natchess, 1 mile above the town. At its mouth this stream is about 75 feet wide with an average depth of 2 feet, and with a current of 1½ feet per second. The temperature was 57½° at 9:30 a. m. Were other conditions favorable, no better stream could be found for a hatchery than the Natchess.

While salmon used to ascend the Yakima and its tributaries in large numbers, they have greatly fallen off of late years. It is now very doubtful whether a hatchery located at any point on this stream could depend for spawn on the fish which ascend



TWIN FALLS, SNAKE RIVER. TOTAL DESCENT ABOUT 180 FEET.

the stream itself. If it were considered desirable to ship spawn to such a hatchery, the Natchess might be favorably considered.

In considering the possibility of establishing a hatchery on the Yakima or its tributaries, it should be borne in mind that the stream flows through a wide valley, only partially under cultivation. Extensive canals are now being constructed with a view to irrigating the entire valley. Recent litigation seems to show that more water has been claimed on behalf of these canals than the stream will be able to furnish. It seems probable, therefore, that the entire supply will be withdrawn from the river during the summer and fall.

Toutle River.—The Toutle River is a tributary of the Cowlitz. Near its mouth, near Castle Rock, an excellent site for a salmon hatchery can be found. This is a beautiful, clear, and cold stream, furnishing an abundance of water, which is never likely to be required for other purposes. The temperature of the water at 11 a. m. August 27 was 59.5°. The Toutle is a natural spawning-ground for the salmon, which still come into it in large numbers. They could be taken in the deeper pools in gill nets, and the character of the stream is such as to permit seining. The time at our disposal could not permit us to make a very thorough investigation of this stream and entirely prevented our visiting the Upper Cowlitz. From what we saw, however, we are inclined to recommend the Toutle River as being the best suited for hatchery purposes of any stream in Washington.

THE UPPER COLUMBIA.

Near Kettle Falls, Wash.—The Colville River flows into the Columbia at the town of Kettle Falls, about 2 miles below the Kettle Falls of the Columbia. An abundance of excellent water can be obtained from the Colville River, and plenty of suitable land can probably be had for nothing, as the people there are much interested in securing the hatchery. This site is about 2 miles from Meyers Falls, a station on the Spokane and Northern Railroad. The only objection to it is the uncertainty of getting a sufficient number of spawning salmon conveniently near.

As already stated, salmon were abundant in the Columbia at Kettle Falls as late as 1878. Since then there has been a great decrease. They have been scarce since about 1882; since 1890 there have been scarcely any at Kettle Falls. The Meyers brothers say they have been almost unable to buy any salmon for their own table from the Indians for three years. Certain Indians with whom we talked at Kettle Falls said salmon were once very abundant there, but that very few are seen now. Other persons testified to the same effect. Essentially the same information was obtained regarding the decrease of salmon in other parts of the upper tributaries of the Columbia, viz, at Spokane, in both the Big and Little Spokane rivers, and in the Snake River and its various tributaries.

On the Little Spokane River, near Spokane, Wash.—This river, as elsewhere stated in this report, possesses all the natural conditions necessary for this purpose; and it has the advantage of having excellent shipping facilities in the numerous railroads centering at Spokane. The uncertainty of being able to obtain spawning salmon in sufficient numbers is, however, a fatal objection to this point, unless shipping the eggs from the Lower Columbia might be regarded as feasible.

SNAKE RIVER IN SOUTHWESTERN IDAHO.

If the station does not necessarily have to be in Washington, a very good site can be found on Snake River in Idaho near Salmon Falls. Salmon seem still to ascend to that point in considerable numbers. For detailed description of this place see portion of this report pertaining to the Snake River.

SUMMARY.

In summing up the facts brought out by these investigations it may be said, first, that the absence of salmon from the Pend d'Oreille River is not necessarily due to the presence of falls in that stream, but to other causes, chief among which is the excessive catching of salmon in the Lower Columbia; second, that while it is true that the salmon are shut out by falls and dams from a large area, especially in the Upper Snake River basin, and that these limitations are increasing as the streams become useful for irrigation and mining purposes, it is nevertheless certain that the decrease in the salmon has been even greater and that the accessible waters suitable for spawning purposes are still more than ample to meet present needs; and, third, that the desirability of establishing another salmon hatchery at some point in the Columbia basin will depend largely upon the nature of the fishery legislation in the States of Washington, Oregon, and Idaho.

It must be understood, however, that our knowledge regarding the present abundance of salmon, their relative abundance as compared with former years, and the location and extent of their spawning-grounds, is of the most general kind. While valuable so far as it goes, the information which we now possess upon these important questions is chiefly useful in indicating the nature of the investigations which must be carried on for several seasons before a thorough understanding of the salmon question can be reached.

DETAILED ACCOUNT OF THE VARIOUS WATERS EXAMINED.

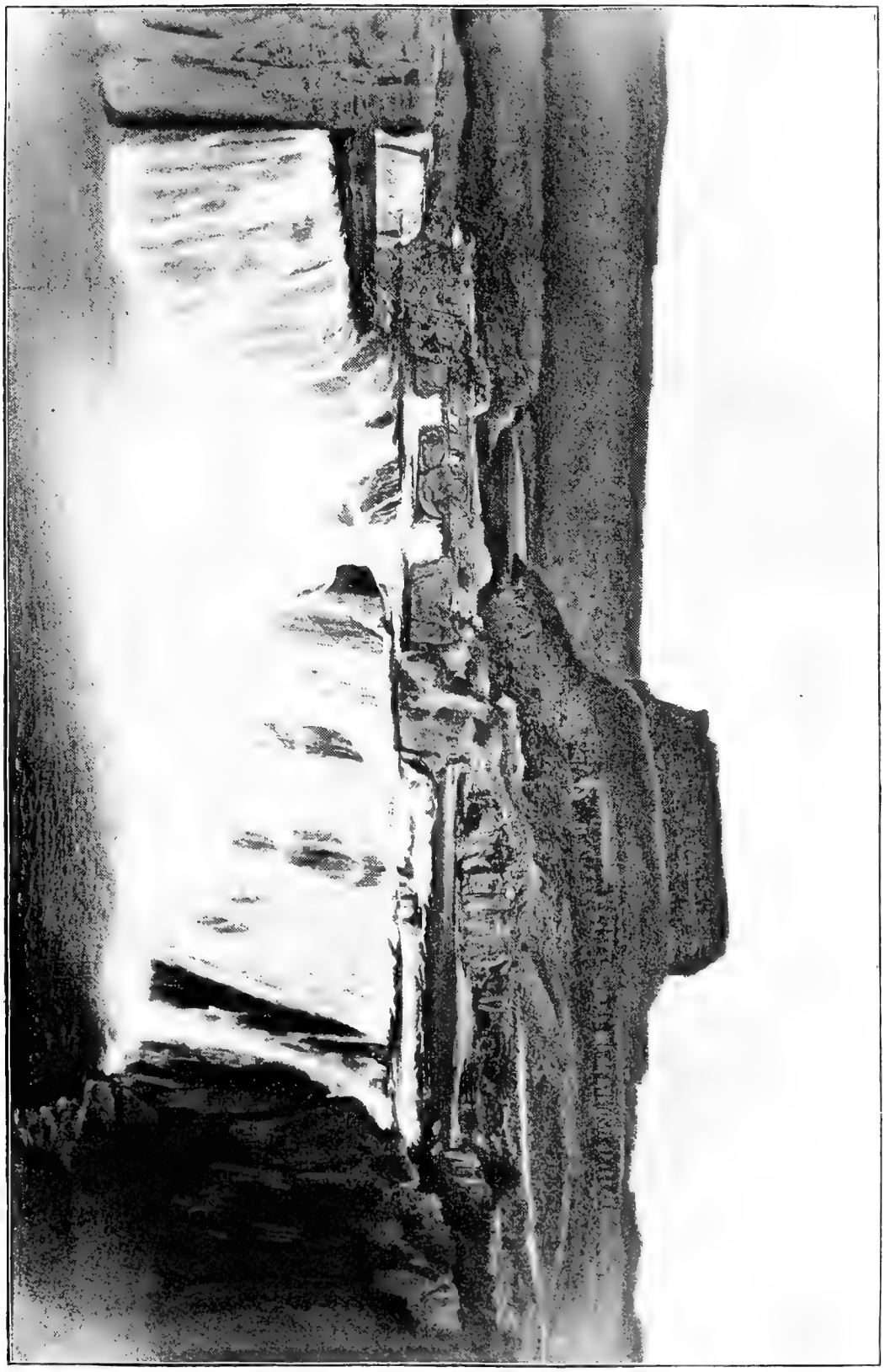
SNAKE RIVER.

This river has been visited by us at the following points: President Camp, near the southern boundary of the Yellowstone Park; Idaho Falls; American Falls; Shoshone Falls; Twin Falls; Auger Falls; Blue Lakes; Upper and Lower Salmon Falls; at mouth of Boise River; at Caldwell, Payette, and Lewiston. The observations made at these various places are here given in order, beginning with the point farthest upstream which was visited.

President Camp.—Snake River here flows through a wide meadow, grassy and open on the right side, but covered with a heavy growth of chapparal on the other. It is here a beautiful river with clear, cold water and gravelly bottom. The banks in the immediate vicinity of the camp are low, not exceeding 3 or 4 feet. In the main stream the current was pretty strong, but there are quiet nooks and coves where there was considerable water vegetation. The temperature of the water at 9 a. m., August 14, was 62.5°. Fishes were found to be abundant here, the red-horse sucker (*Catostomus ardens*), dace (*Rhinichthys cataractæ dulcis*), chubs (*Leuciscus hydrophlox* and *Leuciscus lineatus*), whitefish (*Coregonus williamsoni*), cut-throat trout (*Salmo mykiss*), and the blob (*Cottus bairdi punctulatus*) being the species thus far known from the Snake River at that point.*

Idaho Falls, Idaho, August 4 and 5, 1893.—At this point the river has cut its channel through the immense lava bed of that region. The banks of the stream are abrupt or vertical but broken and jagged walls of lava, reaching in some places as many as 15 to 20 feet or more above the surface of the water. Large, detached masses of lava are frequent in the stream, and in the banks or bounding walls are many immense potholes, by far the largest and finest we have ever seen. The river is here confined to a relatively narrow channel, through which it rushes in a series of foaming rapids. There

* See Evermann: Explorations in Montana and Wyoming, Bull. U. S. Fish Comm. for 1891, 22.



SHOSHONE FALLS, SNAKE RIVER. TOTAL DESCENT ABOUT 210 FEET.

are many comparatively quiet nooks, however, in the broken, irregular walls, and the water is very deep, perhaps 20 to 50 feet. While these rapids are quite turbulent, trout and even other species of fishes have no trouble in ascending them. Trout (*Salmo mykiss*) are common here, and in a large race which has been cut through the lava for milling purposes we obtained many specimens of dace, chubs, and suckers (*Catostomus ardens*).

American Falls, Idaho.—At American Falls the Snake River is about 750 feet wide and flows but little below the general surface of the country. The shores have no abrupt banks, the northern shore only being followed by a low, rounded bluff 100 to 200 feet high. This was apparently composed of gravel, as no lava could be seen projecting from it. The outline of the American Falls is very irregular. Its position is determined by a basaltic ledge crossing the river. The position of the edge of this ledge is now marked by a series of islands, between which the river flows and below which it falls. This same ledge can be traced for some distance along the edge of the cañon below the falls and is there seen to be underlaid by a layer of sandstone. At the falls, however, this seems not to be the case, the rock being lava from top to bottom. The western end of the falls is probably 200 to 300 yards farther upstream than the eastern end. The front of the falls is located, therefore, very obliquely to the course of the stream. They show nowhere any great vertical height, 15 feet being probably near the maximum. In several places the falls are so broken down as to present only a short stretch of steep rapids, with gentler rapids above and below. Below the falls the water becomes immediately deep, but the rapids above are, at the stage of water seen, extremely shallow. On the eastern side of the stream, especially, is a long stretch of these shallow rapids, in which the water averages not more than 6 inches deep, and it is here that the greatest obstacles to the ascent of fish would be found. When water is high in the spring, trout are seen to pass over the falls in large numbers, and it is probably true that even at a lower stage of water, as in the fall, fish can succeed in passing this obstacle. A fishway could be made here at very little expense were it considered desirable.

The stream here, as elsewhere in Idaho, flows through a country covered with sagebrush and the usual desert vegetation, bordered more or less thickly with willows. In the rapids at American Falls the rocks are thickly covered with green filamentous algæ, and among the rocks are found very numerously crawfish, caddis worms, and other suitable food for fish. At American Falls the river descends about 70 feet and enters a cañon, the surface of the country remaining about the same level, and from this point to below Shoshone Falls the stream descends deeper and deeper into its cañon by a succession of falls and rapids. It flows here through what is known as the "Lava Beds" of the Snake River, and the walls of its cañon are composed of successive lava flows. But few streams find their way into the Snake River from the mountains of the north. As will be seen from the map, the greater number of these on flowing down from the mountains sink into the lava and are lost. Of this kind are Birch Creek, Little Lost River, and Big Lost River. There is thus a great stretch of country bordering the river on the north entirely without surface water. Towards the west the Malade or Wood River is the first stream to find its way into the Snake from the north. The water which thus sinks near the base of the mountains apparently reappears inside the cañon of the Snake, coming out as great springs at the base of the cliffs. The best-known of these lie between the Shoshone Falls and Glen's Ferry. They emerge from the foot of the cliffs often as large streams and are used to irrigate the bottom lands which border the river on the north at that point.

The water of these streams is beautifully clear and cold; trout abound in them, and the smaller minnows run up from the Snake into them. Crawfish (*Astacus gambelii*) also are very abundant. The temperature of the streams averages about 60°, and they would be admirably adapted for hatchery purposes. The salmon visit this part of the river in sufficient numbers to furnish roe for hatching, and this is probably the most available point where suitable water and an abundance of fish can be found for such a station in Idaho.

Unnamed Falls.—The next falls in the course of the stream were not visited by any member of the party, as nothing was heard of them until we had passed that region. They seemed to be unnamed. According to Mr. J. L. Fuller, of Bliss, Idaho, the river has a vertical fall of about 40 feet a short distance above the mouth of Dry Creek, the latter a small stream coming in from the south, nearly midway between American and Shoshone Falls. Mr. Fuller worked a mining claim at the mouth of Dry Creek at one time, and is therefore well acquainted with the falls, which he states to be vertical and impassable to any kind of fish.

Shoshone and Twin Falls.—The great obstacles to the passage of salmon up the Snake are found in Shoshone and Twin Falls, both of which are vertical and of great height. The erection of fish-

ways to permit the passage of salmon seems wholly impracticable. Both Shoshone and Twin Falls are formed by layers of more compact and lighter colored lava, which the stream wears away with great difficulty. Shoshone Falls can be reached by a stage ride of 28 miles from the town of Shoshone, on the line of the Union Pacific. The cañon at this point is high and composed of black columnar basalt, which rises from the river's edge as vertical cliffs, estimated to be about 800 feet high. The falls are said to be 210 feet high. The middle of the falls is higher upstream than either end, giving it a somewhat horseshoe-shaped appearance, and the front of the falls is about 1,200 feet wide.

Twin Falls are 4 miles above Shoshone Falls and would be fully as serious an obstacle as the latter, even if fish were able to reach their foot. An island divides the stream here into two portions, both of which, however, fall nearly vertically a distance said to be 180 feet. On the north side of the stream the vertical portion of the falls is somewhat lower, the upper portion having worn back to form very strong rapids, through which no fish would be able to pass. We were not able to learn that salmon reached the foot of Shoshone Falls, although it is very probable that they do so. The stream immediately below the falls is deep and flows at the bottom of a very steep cañon, and even if the salmon were there and spawned in the bed of the stream, it might be difficult to detect them.

Four miles below Shoshone Falls is the first of the large springs already referred to. These rise near the northern shore of the river in what are known as Blue Lakes (see p. 27), and one of these springs forms a large river. The Snake River at this point has widened out and flows over a succession of shallows, and has a considerable expanse of bottom lands, which can be cultivated whenever water can be put upon them.

Auger Falls.—A gentleman living at Blue Lakes is of the opinion that salmon do not come above Auger Falls, which is found 4 miles below Blue Lakes. This was found to consist of a stretch of very strong rapids. At Auger Falls the river runs for a distance of at least 250 yards, hemmed in between basaltic walls, which vary in distance from 50 to 250 feet. As nearly as could be estimated, the stream falls in this distance about 50 feet, the last 20 feet of which is nearly vertical. In this entire stretch of 250 yards there is no resting-place for a fish, and the water dashes through it in whirls and eddies in such a way as to make it doubtful whether a salmon could sustain the long-continued effort necessary to pass the rapids. It is, however, certain that no single stretch of these so-called falls is insurmountable. Both salmon and sturgeon are frequently taken below Auger Falls, but apparently not above them. At Auger Falls it was estimated that the current averaged 15 feet a second. Marks on the rocks show that at high water the stream was at least 15 feet above the level seen at this time.

Upper and Lower Salmon Falls.—From Auger Falls down to Salmon Falls the valley of the Snake widens and the cliffs become broken down and more and more rounded, as though glaciated. On each side of the stream are found in places extensive deposits of water-worn gravel, which are washed for gold. At the Upper Falls the stream flows over another lava ledge, the southern end of the fall being farthest down stream, and is there broken down into rapids, which present no serious obstacle to the ascent of the fish. This is also the case at various points along the front of the falls. The maximum vertical descent is about 20 to 25 feet. Salmon are known to go over these falls in large numbers. Indians encamp yearly on the island immediately below the falls, and spear the fish as they pass over the ripples. Well-known spawning-beds are said to be in the river about 2 miles above the falls, and salmon are known to ascend Salmon Creek, a tributary entering 2 or 3 miles higher up. A white man has been in the habit of catching salmon with a seine each year, and could obtain more than he could find market for. It seems evident, then, that a hatchery located near this point and drawing water from one of the many large spring-fed streams which enter here would have no difficulty in securing fish.

The Lower Salmon Falls are about 6 miles below the Upper. We are informed that a man can descend this stretch of the stream in a small boat, although there are numerous shallow places and short rapids. The Lower Falls are very similar to the Upper. The river at this point falls over a lava shelf, for the most part vertically, and with a total descent of about 20 feet. The front of the falls is very wide, probably over a quarter of a mile, and runs obliquely, the northern end being farthest upstream. By far the greater part of the water falls over the southern half of the falls, so little coming over the northern part as to prevent the ascent of fish, except, perhaps, at one point. At the extreme southern end the falls are much lower. Here, and also near the center, the fish would apparently have no difficulty in ascending. To sum up what was learned about the salmon in this part of Snake River, it is certain that they visit Glen's Ferry and the stretch of the stream between

there and a point 2 or 3 miles above Upper Salmon Falls in large numbers, and spawn mainly in the bed of the stream, some of them entering Salmon Creek, as before said. It is not known to us how far they ascend towards Auger Falls from the Upper Salmon Falls They appear late in August, and spawn in the bed of Snake River and the smaller tributaries from September on to November.

Snake River below the various falls.—A short distance below Shoshone Falls, as already indicated, the valley of the Snake changes its character. The bluff recedes, leaving the valley several miles wide in places, and becomes, at the same time, less abrupt, and the lava walls are often entirely concealed by slopes of water-worn gravel and soil. The valley varies in width, but preserves this general character as far as the town of Huntington. It is along the upper part of this widened valley that the extensive springs already mentioned are found. The first of these are at Blue Lakes. Here they rise in the bottom of a lake at the base of the basaltic cliffs which forms the cañon wall. The outlet of this lake, after running a short distance, widens into a second very deep lake, in which the water again sinks into the lava. This water, together with a much larger supply, reappears at a lower level as a very large spring, from which flows a small river of beautifully clear blue water. This finds its way among the lava bowlders down a rather gentle incline to the Snake. Farther down the valley at intervals appear other similar springs. The streams that flow from these are used to irrigate the bottom lands, which are naturally covered with sagebrush and other desert vegetation. On the application of water they become very fertile, raising large crops of alfalfa and other hay, of garden vegetables, and fruit. If the supply of salmon were assured, these springs would offer model sites for a hatchery. They are located from 6 to 10 miles above Bliss, Idaho, and are reached by good roads. The most extensive of these springs empty into the lower course of the Malade or Wood River, which empties into the Snake a short distance from Bliss. (*See* p. 26).

The long stretch of the Snake River which lies between Huntington and Lewiston was not visited by any member of the party. The stream was described to us as flowing for the greater part of this stretch through a deep cañon in which were numerous rapids. A steamer once passed through this cañon at high water, but arrived at Lewiston so battered and broken that none has dared attempt the passage since. No falls occur along this stretch of the stream, and there is nothing that can be considered an obstruction to salmon. But this part of the country is almost uninhabited and the river is difficult of approach. At Lewiston and below, the stream flows again through a comparatively open country, the cañon walls being rounded and the slopes covered for the most part by deposits of water-worn gravel and soil. Mr. W. M. Stockton, of Glen's Ferry, Idaho, who has resided there twenty-three years, says that the Snake River is usually highest in June, falls until the winter rains set in, and is lowest in October. Salmon caught in large numbers at Glen's Ferry; speared. The run begins in September and lasts six weeks or two months. More numerous in former years than now, but plenty were caught last year, 1892. Indians spear them, salt and dry them for winter use. They spawn on the gravel beds in the river at and near Glen's Ferry in water so shallow that the dorsal fins are out of the water. Knows of no obstructions in the river below Salmon Falls. Has heard that Salmon Falls is an obstruction; does not know so. The sturgeon are caught at all seasons of the year; more numerous in summer. Has seen and caught salmon in Payette River and has seen them spawning there and in the Snake River on the ripples. The Boise is highest in June and lowest in October. Knows nothing definite about the redfish. Says they are a landlocked salmon. They are caught in Payette Lake and shipped to Caldwell and sold as food-fish during September.

TRIBUTARIES OF SNAKE RIVER.

Ross Fork of Snake River.—This is a small stream flowing into the Snake above Pocatello. It was examined on the Fort Hall Indian Reservation about 12 miles north of Pocatello. The stream there was about 15 feet wide, 10 inches deep, and had a very slow current—not over 6 inches per second, but somewhat swifter on the riffles. The water was somewhat muddy and the bottom of the stream was chiefly of mud, with gravel in some places. There was an abundance of *Nostoc* and other algoid vegetation in the water, and the banks were well covered with willows and small cottonwood bushes, but no large bushes of any kind. Fishes, including trout, were abundant in this stream, and it was here that the types of a new sucker (*Catostomus pocatello*) were obtained. The temperature of the water at 1 p. m., August 4, was 72.5°, when the air in the shade was 93°.

Port Neuf River.—This stream has its rise in southeastern Idaho, on the low divide which now separates the Salt Lake Basin from that of the Upper Snake River, and flows into the Snake a few miles west of Pocatello. At Pocatello this stream averages about 30 feet wide, 6 inches deep, and

flows about 1½ feet per second. There are many deep holes or pools with mud bottom, while in the shallower reaches the bottom is of gravel and the current is more swift. The banks are usually low and of clay, with occasional rocky places. The water is rather clear and cool, the temperature being 76° at noon, August 2, when that of the air in the shade was 90°. There appeared to be very little algæ or other water vegetation in this stream. The banks were covered with a dense growth of willows, while back from the stream a short distance on either side are sagebrush plains.

A few dead bivalves (*Margaritana margaritifera*) were found, but molluscous life seems to be rare in this stream. Crawfish (*Astacus gambelii*) were found in considerable abundance. Not many species of fish were found here. By far the most abundant species is *Leuciscus hydrophlox*, the next most common are the western dace (*Rhinichthys cataractæ dulcis*) and the chub (*Leuciscus lineatus*). Suckers (*Catostomus catostomus*) and blobs (*Cottus philonips*) were also found, the latter in considerable numbers. No trout were seen here, but we were informed that they are sometimes taken in the river near Pocatello, and that they are found rather plentifully further up the stream. The temperature and other characters of the water are fairly suitable for trout, and no doubt plants of such fish would prove successful in this river.

Mink Creek.—This is a small stream flowing into the Port Neuf about 6 miles above Pocatello. Near its mouth it averages about 6 to 8 feet wide, 2 feet deep, and has a 2-foot current. The water at the time of our visit was pretty clear and the temperature 59° at noon, August 3, when that of the air in the shade was 92°. The bed of the stream was of mud and sand in the more quiet portions and of gravel on the riffles. The banks were overhung by a heavy growth of willows. This is a typical trout stream, and we found the cut-throat trout to be quite common. About the same species of minnows and suckers which were found in the Port Neuf at Pocatello were also found here. Crawfish, toads, frogs, and mussels were also obtained here.

The Port Neuf River at the mouth of Mink Creek is a clear, cool stream with gravel and lime-deposit bottom in the shallower parts and mud and sand where deeper and more quiet. The same species of fishes were obtained here as elsewhere in this river.

Salmon Creek.—The uppermost tributary of Snake River to which salmon have access is Salmon Creek, emptying into the river 3 or 4 miles above the Upper Salmon Falls. This was not visited by us, and little seems to be known about the general character of the stream. Mr. J. L. Fuller has seen salmon in the lower 2 or 3 miles of the stream, but does not know how far they ascend.

Malade River.—The next stream is the Malade or Little Wood River, already mentioned. This was fished near Shoshone by Messrs. Thoburn and Rutter, August 5. Width, 25 feet; depth, 3 feet; current, 2 feet; temperature at 7 a. m.: air, 70°; water, 62.5°. During dry seasons the Malade becomes dry for the lower 40 or 50 miles of its course and is prevented from being a salmon stream by inaccessible falls near its mouth. As seen by us in its lower course, it runs on the surface of the country until a point about 4 miles above its mouth. Here it leaves the surface and enters a narrow cleft in the rocks by a succession of falls and rapids, two of which are designated the Upper and the Lower Falls. This cleft in the rock soon deepens and widens into an extensive cañon, which seemed to be from 500 to 800 feet deep in its lower part. At the lower falls the stream descends vertically about 40 feet, shooting out of the cañon, which is here a mere cleft 20 to 30 feet wide, and falling into a deep pool at the bottom. As Mr. Fuller stated, it looks very much like the stream out of the spout of a teakettle. During high water the stream rises so as to obliterate these falls, and in the spring trout have no difficulty in ascending from the Snake into the Upper Malade. In autumn, however, these falls are an impassable obstacle to the salmon. It is below these falls that the large springs already referred to enter the Malade. These increase the size of the stream many times, so that even during the lowest stage of water in autumn the Lower Malade flows full—this even at times when the upper stream is entirely dry. According to Mr. Fuller, who based his statement upon the reports of engineers, the Lower Malade at its lowest stage is a stream averaging 7 feet deep, 72 feet wide, having a current 15 miles an hour. It descends rapidly in its lower course and would offer a fine site for a hatchery. Salmon are seen as far as the base of the Lower Falls, i. e., 2 or 3 miles above its mouth.

Bruneau River.—The next considerable tributary is the Bruneau, which enters from the south about opposite the town of Mountain Home. This was not visited by any member of the party. A large number of men were interviewed who were acquainted with the stream; these all agreed that it was a natural salmon stream. Mr. Fuller has seen the salmon spawning in the headwaters of the Bruneau, in October. Recently a dam has been placed in the lower course of the stream for irrigation purposes. The dam is without fishway, and salmon are now absolutely prevented from ascending.

Owyhee River.—The Owyhee River is a large stream rising in the mountains of Nevada and flowing into the Snake at the boundary between Idaho and Oregon, south of Huntington, Oreg. The salmon are said to enter this in quantity, and are well known to the miners on the headwaters of the stream. This is a river of much importance, to which nearly all the streams of northern Nevada are tributary.

Boise River.—Examined August 8, one mile west of Caldwell, Idaho. Width, 200 to 400 feet; depth, 2 to 5 feet; current, 2 feet; temperature of water at 10 a. m., 66°. The bed of this stream is mostly sandy, with occasional patches of gravel. There is a riprap dam about 2 miles above Caldwell, belonging to the Howard Sebree Company. The lower slope of this dam is about 6 feet, and there is no fishway.

Dr. J. B. Wright, of Caldwell, tells us that he caught salmon in the Boise, near Caldwell, in 1864, and that they were very numerous then. In 1865 placer mining began on the Upper Boise and but few salmon have been caught since. Occasionally he catches one in the upper waters of the Boise, but they are very rare. He further says that salmon trout enter this river in the spring, when the waters are high, and that he has caught them full of eggs in July in the Upper Boise. The dam already mentioned has been in five years, but he does not think it has affected the run of fish. Dr. Wright says that the salmon run up Snake River in September, the run lasting until the middle of October. He has not noticed any decrease in recent years. We were also told that at Glen's Ferry there is a run of salmon trout in April and May.

Payette River.—Examined August 9, three-fourths of a mile southeast of Payette, Idaho, near its mouth. Average width 360 feet; depth, 3 feet; current, 1½ feet; temperature of water, 63° at 5 p. m. Water clear; bottom sand and gravel. The Payette at this place is a rather shallow stream flowing rapidly over numerous shallows and much divided by gravelly islands. It flows over sand and coarse waterworn gravel. The river seems to be suitable for salmon, but no one in the vicinity seemed able to give us any notes of value as to their occurrence.

Salmon River.—This is, except the Snake, the largest and most important and is certainly the least known river of Idaho. It has its headwaters in the mountains forming the divide between Montana and Idaho, and enters the Snake where the latter is passing through its deep cañon, near the northeast corner of Oregon. We were informed that the lower course of the Salmon River itself is through a deep narrow cañon, which renders it difficult of access. It is claimed that salmon still ascend this stream in large numbers, and spawn in all the little creeks high in the mountains. Little, however, is known with certainty regarding the salmon or other fishes of this stream.

Clearwater River.—Examined August 15 and 16 at various points from its mouth to 5 to 7½ miles above Lewiston, Idaho, to the mouth of Potlatch Creek. It is there a clear, cold stream flowing over very large round bowlders. This kind of bottom makes it almost impossible to use a net, and salmon could not be obtained by this method if the stream were otherwise suitable for a hatchery. The temperature of the water was 83.5° when the air was 83.5° at 4 p. m., and 63.5° when the air was 63° at 10 a. m. As in all of these larger, clear, cold streams, we found fishes very scarce. The smaller minnows and suckers could be obtained only at the rate of two or three to a haul. Fish may be more abundant in the deeper parts of the stream, or the numbers may be kept down by the trout, which could easily pursue the smaller fishes in the clear water.

Potlatch Creek.—This is a small stream flowing into the Clearwater, near Lewiston. It was examined August 16 near its mouth.

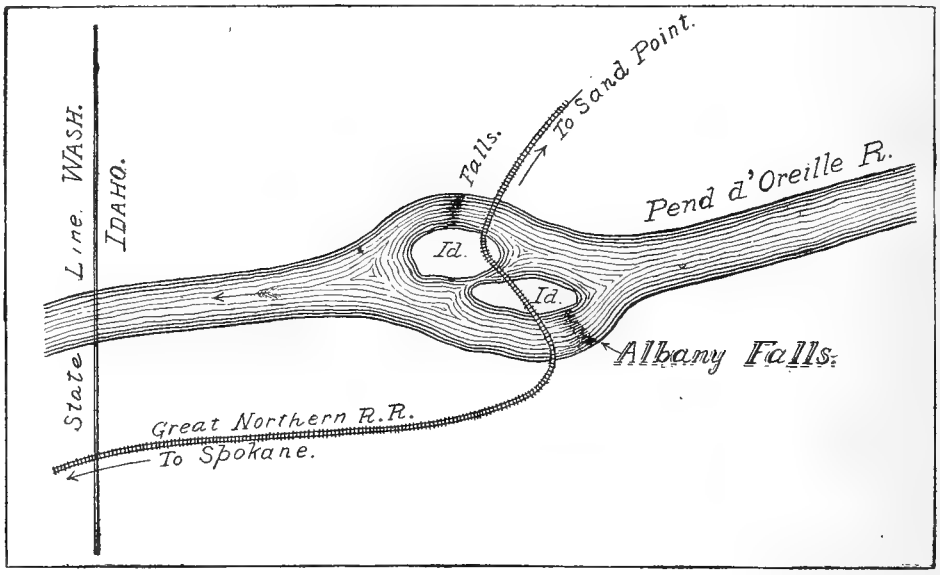
Palouse River.—This is a considerable stream rising in western Idaho and flowing westward through southeastern Washington to the Snake River north of Walla Walla about 45 miles. It was examined near Colfax, Wash., August 17. At this place the stream was quite low, being reduced to pools. Temperature of water 74°.

Grande Ronde River.—This river rises in eastern Oregon, flows northeast, and joins Snake River near the forty-sixth parallel. It was examined near La Grande August 11. According to Mr. J. B. Foley, of La Grande, salmon are very numerous in this river in September and October, coming as far as the dam 1 mile above La Grande. They try to jump this, but do not succeed. They are speared in large numbers by the Indians and boys, but are so worn and cut up by their trip up the river that they are of little value as food fish. The dam is of logs with two 4-foot steps on the lower side, and has no fishway. There are no dams below—that is, between La Grande and the Snake River. Plenty of salmon trout come in the spring in April and May. These can get over the dam in high water. Water lowest in August and September. There is placer mining in the upper parts of the river, and the water is milky. Trout are plentiful at Meacham, in the upper Grande Ronde River, and in the side streams.

Pataha River.—This stream was examined at Starbuck August 14. Temperature at 4 p. m., 68°; air, 66°. Width, 50 feet; depth, 1 foot; current, 2 feet. The Pataha is of some importance and is well supplied with the common fishes of the region.

Pend d'Oreille River.—There are two important lakes which are drained by this river—Flathead Lake, in Montana, and Lake Pend d'Oreille, which is in Idaho, near the Washington State line. Examinations were made at Flathead Lake* in 1891 by Evermann and Jenkins, and in 1892 by Gorham and Woolman, who found the "falls" in Flathead River near the outlet of Flathead Lake to consist simply of a series of rapids, which do not interfere in the least with the free movements of fish. From this point down Flathead River possesses no falls or obstructions of any kind, and there is none in Clarke Fork until near Lake Pend d'Oreille.†

Not far above Lake Pend d'Oreille, in Clarke Fork proper, and near a station on the Northern Pacific called Thompson Falls, are some small rapids which are no more serious than are those in Flathead River. This is according to Dr. Gorham and Mr. Woolman. We did not deem it necessary to revisit these two places, as Dr. Gorham's notes and the information which we gained through conversations with a number of persons who were familiar with that part of the river convinced us that there are no obstructions of any importance above Lake Pend d'Oreille.



We examined this river pretty carefully from the outlet of Lake Pend d'Oreille to near its mouth, or where it joins the Columbia just across the British Columbia line. While that portion of the river above Lake Pend d'Oreille is still spoken of as Clarke Fork, the portion below Lake Pend d'Oreille is, in that region, known only as the Pend d'Oreille River. From Sand Point, Idaho, which is at the outlet of Lake Pend d'Oreille, to the Washington line is about 25 miles. In this portion of the river there is only one fall or rapid, and that is Albany Falls, sometimes known as Villard Falls or Seniaquoteen Falls. These falls are about 1½ miles above the little town of Newport, Idaho. The falls are divided by a small, rocky island, upon which is built one of the piers of the railroad bridge which is used by the Great Northern in crossing the river at this place.

The relative position of the bridge and the falls is shown in the above diagram.

These falls are scarcely more than pretty steep rapids and would not interfere at all with the ascent of salmon. The part to the left of the islands (going down stream) is just above the bridge.

* For information concerning the upper waters of this system see Evermann, in Bull. U. S. Fish Commission for 1891, pp. 1–90.

† In 1883 Mr. Livingston Stone, under the direction of the U. S. Commissioner of Fish and Fisheries, made an extended exploration of Clarke Fork and the Columbia River with reference to the selection of a suitable site for a salmon-breeding station. In Mr. Stone's interesting report (Report U. S. Fish Comm. for 1883, 237–255) is given much valuable information regarding the upper portion of Clarke Fork and the Big and Little Spokane rivers. He found, what our own inquiries confirm, that salmon never reach Lake Pend d'Oreille, but thought they were probably kept back by the falls at the mouth of the Pend d'Oreille.

At the time of our visit (August 9) the total descent was probably 10 feet, but as a rapid, not in a vertical fall. During low water the descent would be somewhat greater. The fall on the right side is of the same character and presents no greater difficulties.

Just below Albany Falls the river is perhaps 1,000 feet wide and 20 to 30 feet deep in the channel. The stream was up, however, at this time, and would probably fall at least 10 feet before reaching low-water mark, according to the captain of the *Dora*, a small steamer which makes irregular trips between Newport and the head of Box Cañon. On August 9 we took this steamer and went down the river to Box Cañon, a distance of about 60 miles, although the steamer people call it 80 miles. Throughout this distance the Pend d'Oreille is a beautiful, clear stream, with a good strong current, and varying in width from 500 to 1,000 feet.

Box Cañon is a narrow gorge about 1½ miles long. The walls are quite close together and the river rushes through the narrow passage with a very strong current. There is, however, no fall in the cañon and small boats have on several occasions been taken through without injury. There is nothing here to stop the ascent of salmon.

Metaline Falls.—These falls are just below the Metaline mining camp, or 7 miles below the foot of Box Cañon. The river between Box Cañon and Metaline Falls has a good strong current, but no falls or rapids. The falls are over a ledge of limestone, through which the river has cut, and are the largest and most important of any found in this river. The total fall is perhaps as much as 30 feet, but it is in a series of rapids, there being no vertical drop at all. The stream is here inclosed between high rocky walls and is very turbulent for some distance. Salmon could probably ascend these falls without much difficulty. A little blasting near the left (west) wall would make it still easier for fish to get up. Just above Metaline Falls, Sullivan Creek flows into the Pend d'Oreille from the right bank.

From Metaline we walked down the river about 14 miles farther, on August 10, to the head of what is known as the Big Eddy Cañon. This cañon is about 3 miles long and is quite narrow, the limestone walls being so close together that in one place a fallen tree lies across from one wall to the other. The river rushes through this cañon with great fury, but there are no falls, and we do not believe that the ascent of salmon would be seriously interfered with. If it should be shown that salmon can not swim against such a strong current for so great a distance, we see no easy way by which it could be made less difficult. There are some relatively quiet nooks or eddies here and there, however, in which salmon would be able to rest and we therefore do not consider Big Eddy Cañon a serious obstacle to the ascent of fish. Lime Creek, a small but fine trout stream, flows into the river at the head of this cañon.

The river between Metaline Falls and Big Eddy Cañon is quite swift, but contains no falls or rapids worth mentioning. The lower end of Big Eddy Cañon is but a short distance from the British Columbia line, just north of which the Pend d'Oreille turns abruptly westward and runs approximately parallel with the international boundary until it flows into the Columbia, a distance of about 27 miles from where it leaves the United States. We did not visit this part of the river for two reasons: (1) Dr. Gorham's notes and Mr. Bean's report upon the obstructions were sufficiently full to enable us to judge of its character; and (2) several persons familiar with it, and with whom we talked, all agreed that there are no obstructions *below* Big Eddy Cañon which are nearly as serious as Big Eddy Cañon or Metaline Falls. All agree that Metaline Falls is the most serious obstruction found anywhere in the Pend d'Oreille.

From Mr. Bean's report and from our conversations with prospectors and others living along the Pend d'Oreille, it appears that there is a series of rapids near the mouth of the river and another just above the mouth of Salmon River, which empties into the Pend d'Oreille just above the Washington line. These are all said to be rapids rather than falls and probably would not interfere with the ascent of salmon in the least. From the foregoing it therefore appears that there are no serious obstructions in Clarke Fork of the Columbia which would prevent salmon from reaching Lake Pend d'Oreille and Flathead Lake, or other parts of that river basin.

The Pend d'Oreille River is one of the most beautiful and picturesque in America. It is a magnificent river, probably averaging over 1,000 feet in width and being very deep throughout most of its course. In most places there is a good, strong current, becoming dangerous rapids in the narrower places. The water is clear and pure and cold—an ideal trout stream. The depth varies greatly, high water occurring in July from melting snows. Late in August or September the water is many feet lower than in July. High mountain slopes ascend abruptly from the river's banks throughout most of its course, and these are covered with a heavy evergreen forest and a dense growth of underbrush.

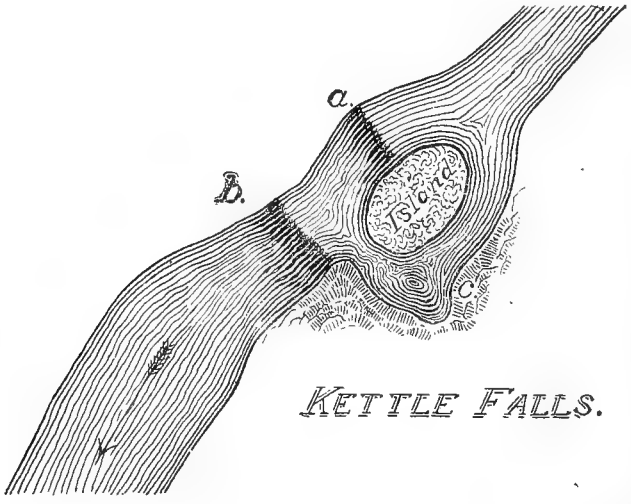
In other places, as at Usk, La Claires, and Metaline, the river bottom widens out and there are many acres of excellent farming land. During high water large areas of this level land are covered by water, but when the waters subside these tracts become valuable meadow lands.

Trout are abundant in this river; salmon trout are also quite abundant, and both bite readily. We know of no stream which offers finer opportunities for sport with the rod than the lower Pend d'Oreille. Deer, wild geese, and ducks were also seen in considerable numbers. From the Big Cañon below Metaline we were compelled to walk back to Newport, a distance of about 75 miles. As there was no trail for the greater part of this distance, except a cattle trail, which was used by cattle only later in the summer and which was now under water, we found the trip a very difficult one, attended by many hardships. We reached Newport early in the morning of August 15, where we took the train for Colville, Washington.

THE UPPER COLUMBIA RIVER.

The Upper Columbia River was visited only at Kettle Falls, Washington, but several of its tributaries were examined, notes upon which are given in the following pages.

Kettle Falls, about 9 miles from Colville, Washington, are the only falls in the Upper Columbia that need mentioning in this connection. At this place the river cuts through a ledge of highly crystalline rock, the strata of which have a gentle dip upstream. A large island divides the river into two parts, as shown in the following diagram:



At the present stage of water we judged these falls to have a vertical fall of 12 to 15 feet each, but they are not of equal height throughout their entire width. The upper falls (*a*) was at least 14 feet vertical near the island and in the middle, but toward the right bank it seemed to be lower and less vertical. The lower fall (*b*) is probably 15 feet high in its highest places, but at the right shore it, too, is not so high nor so nearly vertical. At *c* is a seething whirlpool, the water coming around the left side of the island, having to make an abrupt turn in order to get out. The upper fall is probably not of great importance in this connection, for, when salmon have once gotten above the lower falls they can go around to the right (going upstream) of the island where there are no serious obstructions, but they are seen to swim up over the upper falls. George E. and Jacob A. Meyers are two intelligent and well-informed men who have lived at Kettle Falls for 23 years, and are quite familiar with the falls and their relation to the salmon. From them we obtained the following information: Up to 1878 salmon were very abundant in this part of the Columbia; "millions were seen ascending the falls every season." The run would begin in June and continue until October, the biggest run being in the last half of August. The run toward the end of June was also large, but while there was

LOWER KETTLE FALLS, COLUMBIA RIVER.

a decrease in the number from then until late in the summer, some salmon were to be seen all along; so that there were not two distinct runs, but one continuous run from June to November with two periods of great numbers—June and August.

The salmon caught early in the season are regarded as the best. The salmon have no trouble getting up Kettle Falls; indeed, they usually swim right up the current, seldom having to jump out of the water. The time when it is hardest for them to get up is during a medium stage of water; it is easy at high water, as the fall is then wiped out to some extent; it is also easy at low water, as there are eddies and pools then in which the fish can rest.

Salmon formerly spawned in great numbers just below Kettle Falls. The spawning beds were toward the right side of the river on gravel bottom, usually just above a riffle. A great many spawned in the Colville River just below Meyers Falls.

The Colville flows into the Columbia from the east just below Kettle Falls a short distance. Meyers Falls is in the Colville 2 or 3 miles above its mouth. The height of the lower Meyers Falls is 80 feet, that of the upper about 26; the total descent, including rapids, being about 125 feet. The width of the falls is about 150 feet. Salmon still enter Colville River and spawn on the gravel beds below Meyers Falls, but they are very rare. A fishway could be placed here which would enable salmon to ascend the Colville, which is, so far as the other features are concerned, an excellent stream for salmon and trout.

The temperature of the water at the falls, August 16, was 62°.

While we think the evidence shows that salmon are able to ascend the Lower Kettle Falls, the evidence that they have ever gone much, if any, farther, is not conclusive. Indeed, one of the earliest accounts of these falls which we have seen, states positively that no salmon are taken above these falls. In volume IV of the Narrative of the United States Exploring Expedition under Captain Wilkes we find the following:

"The Kettle Falls are one of the greatest curiosities in this part of the country. They are formed by a tabular bed of quartz that crosses the river, and which, being harder than the rocks, either above or below, has of course suffered less by abrasion, and thus formed a basin that renders the name appropriate. The total descent of the water is 50 feet, though the perpendicular fall in no place exceeds 15 feet, which is, however, more than sufficient to prevent the passage of boats. At the foot of the falls the breadth of the river is 2,330 feet, and the rate of the current is 4 miles an hour. This breadth is somewhat narrowed by an island, about midway of which is the first fall, which is almost entirely unbroken. Thence the river forces its way over a rocky bed until it reaches the main fall, where the water is thrown into every variety of shape and form, resembling the boiling of a kettle, from which the falls derive their name.

"There is an Indian village on the banks of the great falls, inhabited by a few families, who are called "Quiarlpi" (Basket People), from the circumstance of their using baskets to catch their fish (salmon). The season for the salmon fishery had not yet [in June ?] arrived, so that our gentlemen did not see the manner of taking the fish; but as described to them, the fishing apparatus consists of a large wicker basket supported by long poles inserted into it and fixed in the rocks. The lower part, which is of the basket form, is joined to a broad frame, spreading above, against which the fish, in attempting to jump the falls, strike, and are thrown back into the basket. This basket, during the fishing season, is raised three times in the day (twenty-four hours), and at each haul, not unfrequently, contains 300 fine fish. A division of these takes place at sunset each day, under the direction of one of the chief men of the village, and to each family is allotted the number it may be entitled to; not only the resident Indians, but all who may be there fishing, or by accident, are equally included in the distribution.

"At the lower end of the falls are large masses of quartz rock, on which the Indians dry their fish. Few of the salmon, even if able to pass the lower fall, ever get by the upper one, being generally caught between the two falls; consequently, above this place no salmon are taken. A short distance below the Kettle Falls are the Thompson Rapids, which begin at the mouth of Mill River, and extend for some distance below that point."

This visit to Kettle Falls and eastern Washington was made by Captain Wilkes in 1841.*

Spokane River.—The Spokane River has its source in Cœur d'Alene Lake, in Kootenai County, Idaho. From the northern end of the lake the river flows approximately due west about 30 miles to

* Narrative of the United States Exploring Expedition, during the years 1838, 1839, 1840, 1841, and 1842; by Charles Wilkes, U. S. Navy, commander of the expedition. In five volumes. Vol. IV, pp. 444 and 445. Philadelphia, Lea & Blanchard, 1845.

the city of Spokane, where it turns to the northwest and flows into the Columbia, about 45 or 50 miles distant. The total length of the Spokane River probably exceeds 125 miles, as its course is extremely winding. For a considerable part of its course it flows through vast fields of lava, into which it has cut a deep and picturesque channel. The stream is large and in most places quite deep; the bed in many places is strewn with large granite bowlders or large irregular masses of lava, which render seining next to impossible.

About 6 miles below Cœur d'Alene Lake are Post Falls, which probably do not interfere with the free movement of fish.

In the city of Spokane, where the river breaks through a lava flow, there are several very beautiful falls and rapids, which have been modified in various ways in utilizing the water power for milling purposes. These obstructions, natural and artificial, are impassable to fish. Salmon find no obstructions in the Lower Spokane and ascend as far as these falls. Formerly salmon were said to be abundant as far up as the falls,* but now they are seldom seen farther up than the mouth of the Little Spokane. This stream was examined in and near the city of Spokane by Mr. B. A. Bean in October, 1892, and by Profs. Evermann and Jenkins August 19 and 20, 1893.

The water is clear, cold, and pure. The only contamination is that from the city of Spokane, and that does not seem to be at all serious as yet. An abundance of fish food, such as insects and their larvæ, small mollusks, and crawfish, was noticed in this river.

Cœur d'Alene Lake.—This is one of the largest and most picturesque lakes in Idaho. It is very irregular in shape, occupying, as it does, a narrow mountain valley together with its lateral ramifications. Its greatest length from north to south is probably not less than 22 miles, while its average width is less than 3 miles. The Cœur d'Alene, St. Joseph, and other mountain streams are tributary to this lake, the outlet of which is Spokane River. Trout are abundant and of excellent quality in the lake, but salmon are not known to occur in it. The numerous falls in the Spokane River in the city of Spokane undoubtedly prevent the ascent of salmon to Cœur d'Alene Lake.† This lake was fished August 21 near the outlet, 1½ miles west of Cœur d'Alene. Temperature of water at 4 p. m., 75°; air, 86°.

Hangman Creek.—This is an unimportant stream, tributary to the Spokane. It was examined in the vicinity of Tekoa, Wash., where it was found to be a small, rather filthy stream, not suitable for trout or other food-fishes, but well supplied with minnows and suckers of several species.

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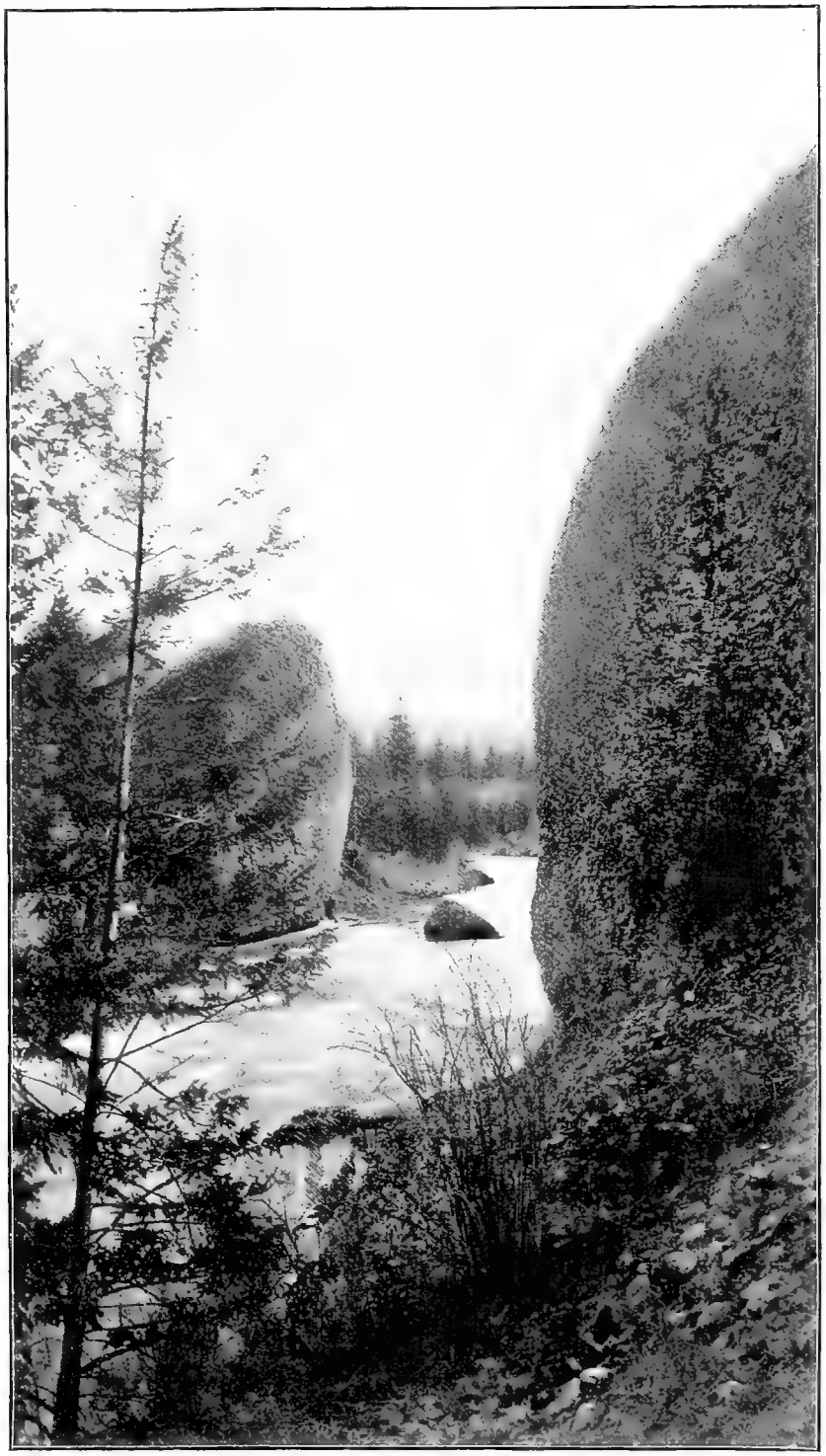
* Regarding the salmon fishing at these falls in 1841, Capt. Wilkes has the following:

"The number of Indians actually resident about the falls is 150; but during the height of the fishing season there are often nearly 1,000, consisting of all the Spokane tribe, who are generally included under the name of the Flatheads. They subsist for the most part on roots, fish, berries, and game. At the opening of the spring, in March and April, or as soon as the snow disappears, they begin to search for a root resembling the cammass, which they call pox-pox. This lasts them till the beginning of May, when it gives place to a bitter root, termed spatylon. This is a slender and white root, not unlike vermicelli in appearance, and when boiled it dissolves into a white jelly, like arrow-root. It has a bitter but not disagreeable flavor, and is remarkable for growing in gravelly soils where nothing else will thrive. In June the itzwa, or cammass, comes in season, and is found in greater quantities than the others all over the country, particularly in the meadow grounds. This root was thought by many of us to have the taste of boiled chestnuts. Before this fails the salmon make their appearance, and during the summer months the Indians enjoy a very plentiful supply of food. While the men are employed fishing, the women are busy digging the cammass, which may be termed the principal occupation of the two sexes. They devote a portion of their time to the collection of berries, a work which is principally the duty of the younger part of the tribes.

"In September and October the salmon still claim their attention, although they are, after having deposited their roes, quite exhausted and about to perish, yet these are dried for their winter consumption, and unless they had recourse to these much want would ensue, which is always the case if the salmon should be scarce."

† The Indian legend given in Wilkes' Narrative, vol. IV, p. 449, is interesting, in that it shows that the falls at Spokane have always been regarded by the Indians as a barrier to the ascent of salmon to Cœur d'Alene Lake.

"They have, in common with the other tribes, many traditions connected with the rivers and remarkable features of their country. In these the prairie wolf bears always a conspicuous part. This wolf was not an object of worship, but was supposed to be endowed with supernatural powers, and to exert them in many ways. On one occasion it is related that the wolf was desirous of having a wife, and visited the tribes on the Spokane for that purpose, demanding a young woman in marriage. This request being granted, he promised that the salmon should be abundant, and for this purpose he raised the rapids, that they might be caught with facility. After he had been gratified in this first instance he made the same request of the others, among them of the Sketsui (Cœur d'Alene) tribe, who were the only ones to refuse. He thereupon formed the great falls of the Spokane, which have ever since prevented the fish from ascending to their territory."



CAÑON OF SPOKANE RIVER, THREE MILES BELOW SPOKANE, WASHINGTON.

Little Spokane River.—This was visited by Mr. Barton A. Bean in 1892, and by us August 18, 1893. The Little Spokane rises among the low hills in a system of small streams and lakes in Stevens County, Wash., only 4 or 5 miles from the Pend d'Oreille River. Fed, as it is, by numerous springs, its water is very clear and cold. It flows through a narrow, fertile valley, the low meadows bordering it having a black loamy soil. The immediate banks are for the most part covered with a network of brushes. High hills rise on either side of the valley and they are sparsely covered with pines. Such trees as cottonwood, maples, and alders are common along the banks.

At Dart's mill, where the Little Spokane was examined by us, it averages about 40 feet wide, 20 inches deep (on the ripples), and had a current of 2½ feet per second. The temperature at 2 p. m., August 18, was 63°. The bottom there was of coarse gravel in most places. Just above the dam the water was, of course, deeper and the bottom is of sand and soft mud. Here we found such water vegetation as *Ranunculus aquatilus trichophyllus*, and *Myriophyllum* in abundance. A single species of Unionidæ, *Margaritana margaritifera* was not uncommon at this place. Fishes were also rather abundant, some 8 or 10 species being obtained. The Little Spokane is an excellent salmon and trout stream, as is fully evidenced by the great abundance of salmonoid fishes which we found. The cut-throat trout was abundant, as were also young whitefish. Large whitefish (*Coregonus williamsoni*) were seen at the dam at the mill, where Indians were spearing them with fair success. Salmon are said to enter the Little Spokane in considerable numbers even yet, but much less abundantly than formerly. The dam at Dart's mill interferes with their farther ascent and a fishway should be put in. Salmon were quite abundant in this stream in 1882, as reported by Mr. Lane C. Gilliam, of Spokane, to Mr. Livingston Stone.*

Mr. Gilliam says:

"I have just completed my second trip to the Little Spokane, and as yet no salmon to speak of are running. The Indians, who are encamped here in great numbers, anticipating a large run, are uneasy and fear the fish are not coming. Yesterday morning they caught eight, which was the largest number taken at any one time as yet. A white man living in the neighborhood told me that last year he made a rough estimate of the salmon taken by the Indians. He thinks they had between 40,000 and 50,000 drying at one time, about October 1. I will make another investigation about October 1."

In the same letter reporting this information to Prof. Baird, Mr. Stone says:

"The result of my researches on the Snake River are that no salmon ascend as high as the crossing of the Utah and Northern Railroad, and that there are no salmon as high as the foot of the American Falls on the Oregon Short Line. The salmon probably can not get over Shoshone Falls. In the spawning season there are a great many salmon at the foot of these falls, 27 miles from the Oregon Short Line Railroad."

It should be added that the character of this stream is being materially changed by the advent of civilization, a fact which is, or has been, true of most streams of this country. The cutting away of the timber and brush on the immediate banks and the cultivation of the land within the drainage area of the stream have greatly increased the surface erosion and, in consequence, the impurities of the stream.

LOWER COLUMBIA RIVER.

Very little work was done by us on the Lower Columbia. Some fishing was done August 22 at Pasco, near the railroad bridge 1 mile east of town, where we made twelve hauls on sand and gravel bars on both sides of the river in water from 1 to 5 feet deep. Took very few fish. Water very clear and cold. Rocks nearly free from algæ. Mr. John E. Gantenheim, an educated and intelligent fisherman of Pasco, says that he fishes every year at the mouth of the Snake and Yakima rivers. The salmon bite readily at a spoon and are in good condition for eating. They are caught by trolling only, and bite greedily, even when full of eggs. Their stomachs are always empty. They spawn on the ripples near the mouths of the Snake and the Yakima rivers. Mr. Gantenheim caught his first salmon for this season on August 20. It was the first he knew of as being caught this year. It was a silverside (*O. kisutch*?), and he took it from the Columbia River near the mouth of the Yakima. We saw three salmon while at the river. Mr. Gantenheim says that the salmon begin their run about the 20th of August, are at their best during September, and last until the high water in October. The last ones are spent and not good eating. He calls the ones he catches silversides and chinooks. Does not know of other forms. Though many fish are caught, none are shipped to the canneries because of railroad charges. It is probable that some of the salmon which are caught by trolling are steelheads.

* Bull. U. S. Fish Com. for 1883.

Walla Walla River.—This is a river of some importance flowing into the Columbia at the town of Wallula, about 30 miles west of Walla Walla. It was examined August 23, at Wallula, below the railroad bridge. It is here a good-sized stream, 3 to 8 feet deep in the channel, and has a velocity of about one-half foot per second. Temperature at noon, 70°; air, 80°. The bed of the stream was of soft mud, with an abundance of *Chara* and other vegetation in places, and the water was rather muddy. At this place Messrs. Thoburn and Rutter obtained the only specimens of *Columbia transmontana* that were secured by any of us.

Mill Creek.—This is a small stream, tributary to the Walla Walla River near Walla Walla. It was examined August 14 south of Walla Walla one-half mile. Width, 12 feet; depth, 10 inches; current, 1½ feet. Temperature at 8:30 a. m., 56°; air, 73°. The bottom here is of coarse gravel. We could not learn that salmon are ever taken in this stream.

Umatilla River.—The Umatilla River was examined August 23 near its mouth, and on August 12 near Pendleton, Oreg. At Pendleton it had an average width of 25 feet, depth of 14 inches, and a velocity of 1 foot. Temperature at 11 a. m., 70°. The bottom was of coarse gravel covered with algæ, and the water was clear. Mr. Smith, of the Commercial Stables at Pendleton, says that no salmon come as far up the river as Pendleton. He has never known any salmon to occur there. They probably occur in the lower part of the stream, but we could get no reliable information upon the matter.

Des Chutes River.—This is a southern tributary of the Columbia, into which it flows at a distance of 10 or 15 miles above The Dalles. It was visited August 24. The falls of Des Chutes River, located near its mouth, are about 30 feet high in low water; in high water a series of rapids. In the Des Chutes the difference between high and low water marks varies from 40 to 90 feet, according to the width of the river. The highest water is about June 20, the lowest during the coldest part of the winter. Salmon usually find the falls no obstruction. Numerous salmon are said to run up the John Day River. They are caught in large numbers by the Indians, but we find no authentic information concerning their spawning.

Yakima River.—The Yakima is a good-sized stream, rising in numerous lakes near Snoqualmie Pass, southeast of Seattle about 50 miles, and flowing southeast about 150 miles to Pasco, where it joins the Columbia. At Ellensburg and North Yakima, where this river was visited by Dr. Jenkins, it runs through a broad, fertile valley, and its waters are extensively used for irrigation purposes. At Ellensburg the stream is about 160 feet wide and 10 feet deep, and flows about 1 foot per second. The water is clear and cold; its temperature at 9 a. m., August 24, was 60°. At North Yakima the stream is very clear and flows with a rapid current through an open valley, over gravel and sand, and had a temperature of 64°. The Yakima has many important tributaries, in all of which trout are said to abound.

Wilson Creek near Ellensburg had an average width of about 18 feet, depth of 18 inches, and a current of 2 feet per second.

Manistash Creek empties in on the right bank of the Yakima near Ellensburg. For a few miles above its mouth nearly all the water is taken out for irrigation purposes. Six miles from Ellensburg it comes through a cañon into the valley. At this point it is a fine stream, abounding in trout. It is here 25 feet wide, with a velocity of about 3 feet per second. The water is clear and excellent. The temperature at 11 a. m. was 55°. Below this point, about 2 miles from its mouth, where most of the water is taken out for irrigation, the stream was about 6 feet wide, with an average depth of 6 inches and a velocity of one-half foot per second. Temperature, 58° at 9:45 a. m.

The Yakima was visited also at Prossen, at which point there is a low fall of some 3 or 4 feet, with a long gentle ripple above it. The fall would form no obstacle to the ascent of salmon unless at time of very low water. The temperature was 70° at 10 a. m. At North Yakima the Yakima receives one of its principal affluents from the west. This is the Natchess River, which takes its rise among the snowfields of Mount Ranier and Cowlitz Pass. This is a clear, cold stream, admirably suited to trout. In its lower course such common species as the chisel-mouth (*Acrocheilus alutaceus*), *Agosia nubila*, and *Pantosteus jordani* were found. Those acquainted with the facts state that formerly, up to about 1885, salmon of three or four kinds, including the quinnat, ran up the Yakima River to this valley and spawned in the river in great numbers. At present very few make their appearance.

Cowlitz River.—The Cowlitz River, made famous in Dr. Jordan's delightfully interesting "Story of a Salmon," has its sources in the snowfields on the west slopes of Mount Ranier, and flows through the densely wooded country west of the Cascades for more than 100 miles before it joins the Columbia. This region is very moist and is little suited to agriculture, and the stream will never be needed for irrigation. The Cowlitz was visited by us at Castle Rock. It is there a very deep, sluggish stream,

extensively used for rafting lumber. It had a temperature of about 60°, August 25. Salmon ascend the stream in large numbers to and above Castle Rock. They make their appearance in the fall about the first of September, and are caught by the ton at Castle Rock and at numerous points below. We were informed that two kinds of salmon are taken, quinnat and the silver salmon. The quinnat makes its appearance first, and is, according to reports, obtained in great numbers. We do not know how safely one may rely upon the reports of the fishermen, however.

Toutle River.—Toutle River is a fine, clear stream entering the Cowlitz from the east, about 4 miles above Castle Rock. It was visited by us 2 miles above its mouth. At that point it was about 100 feet wide, averaging perhaps 1 to 1½ feet deep, and was flowing rapidly over rounded bowlders and stones of small size. Its current was perhaps 1½ or 2 feet per second. At 11 a. m. the temperature was 59½°. The stream flows through a very sparsely inhabited country. A few miners and a larger number of lumbermen live on its upper course. It flows everywhere through a dense fir forest, in which are some deciduous trees. All agree that the salmon ascend this stream yearly in large numbers.

In addition to the investigations which were made in the Columbia River basin, some little work was done on streams tributary to Puget Sound, or which flow directly into the Pacific. Drs. Gilbert and Jenkins examined Newaukum and Skookumchuck rivers, and in June, 1892, Prof. Evermann spent parts of two days examining Lake Washington at Seattle, and the Snoqualmie River in the vicinity of Snoqualmie Falls.

NEWAUKUM RIVER.

This stream is a small tributary of Chehalis River, into which it flows near the town of Chehalis. It was visited near its mouth August 27.

SKOOKUMCHUCK RIVER.

This river rises on the divide near the headwaters of the Newaukum, and, flowing to the northwest, empties into an arm of Puget Sound near old Fort Steilacoom.

The Newaukum and the Skookumchuck are both interesting as having furnished us many specimens of young dog salmon. They were found in both of these streams in abundance and were evidently the young of the preceding year.

LAKE WASHINGTON.

This lake is a magnificent body of fresh water, extending for more than 20 miles north and south, just east of Seattle. Some collecting was done here on June 25, 1892. Nothing was found, however, except two or three species of *Cyprinidæ* and a number of blobs.

SNOQUALMIE RIVER.

This river rises near Yakima and Snoqualmie passes and, flowing westward, joins the Snohomish, which in turn flows into the Sound. The Snoqualmie was visited June 26 and 27, 1892, and a small collection of fishes obtained. At the falls this river was 150 to 200 feet wide and about 6 feet deep, entirely too deep for seining, only occasional shallow places being found where the seine could be drawn. At Snoqualmie Falls the river descends 268 feet in a single plunge. Trout, however, are abundant both above and below the falls. The only other species obtained were a few minnows and suckers. We were unable to secure any reliable information as to the occurrence of salmon in Snoqualmie River or in Lake Washington.

NOTES ON THE FISHES OF THE COLUMBIA RIVER BASIN, WITH DESCRIPTIONS OF FOUR NEW SPECIES.

In the following notes on the fishes of the Columbia River basin we have included not only those collected by us, but also the small collections made by Messrs. Bean and Woolman in 1892, and the few species obtained in Newaukum and Skookumchuck rivers by Drs. Gilbert and Jenkins, and in Lake Washington and Snoqualmie River in 1892.

The exact status of several of the species of *Salmonidæ*, as well as some of the minnows and suckers and all the *Cottidæ* of this region, is a matter which will require much additional investigation to determine. Most of the forms which have been regarded as good species are but poorly differentiated. The range of variation seems to be very great, and characters which are of undoubted specific value when applied to Atlantic-drainage species, do not possess any such value for classification of Pacific coast fishes. Each so-called species seems to be in a very unstable state of equilibrium, and not to have yet assumed or been able to retain with any degree of permanence any set of specific characters. This is particularly true of the species of *Agosia*, *Catostomus*, *Salmo*, and, possibly, *Oncorhynchus*.

In sequence of species in this paper we follow Jordan's Catalogue of Fishes of North America, 1885.

1. Entosphenus tridentatus (Gairdner). *Three-toothed Lamprey.*

Petromyzon tridentatus Gairdner MS., Richardson, Fauna Boreali-Americana, 293, 1836. Type locality: Falls of Walamet (Willamette) River.

Petromyzon lividus Girard, P. R. R. Survey, 379, 1858. Type locality: Wahlahmath (Willamette) River, Oregon.

Petromyzon astori Girard, loc. cit., 380. Type locality: Astoria, Oregon.

This lamprey was first seen by us at Lower Salmon Falls, on Snake River, on August 8. Over 40 specimens were here found dead on a sand bar below the falls. They had probably died the night before, and had been deposited on the spit, where buzzards were busily feasting on them when we arrived. We were informed that the lampreys in their upward migration reach this point in the river sometime during July, after the water has begun to go down. They are said to make good sturgeon bait, and can be best caught in the evening or in the early morning, when they are found clinging to the rocks at the falls. On August 11, a large number of decayed specimens was found on the banks of the Umatilla River at its mouth. They were high up on the banks, and had apparently died and drifted ashore several weeks before, at a time when the river was higher. They ascend the Umatilla, and are caught by the Indians for food. One dead specimen was seen at Pendleton. A number of larvæ, 1½ to 2 inches long, were taken from débris in the bottom of a pool in the Natchess River at North Yakima.

The lampreys are well known to the owners of salmon-wheels on the Lower Snake and the Columbia, and are universally called eels. At Lewiston, we learned that the lampreys begin their run very early, being already in the stream when the salmon-wheel is first put in place in the spring. They are occasionally caught by these wheels in such numbers as to fill the boat, and are said to be valuable for the oil they contain. This lamprey was seen also by Dr. Eigenmann, at La Grande and Caldwell, in 1892.

2. Acipenser transmontanus Richardson. *Columbia River Sturgeon.*

Acipenser transmontanus Richardson, Fauna Boreali-Americana, III, 278, 1836. Type locality: Columbia River at Fort Vancouver.

The sturgeon ascends the Snake River to above the Upper Salmon Falls, between which and Auger Falls it is frequently taken. We were unable to learn that they passed the Auger Falls, which apparently serve as a barrier to both sturgeon and salmon. We are informed by numerous fishermen that the sturgeon are in the river throughout the year, and can be taken at any season. They are found at Glen's Ferry throughout the year, and we were told of individuals taken there weighing as much as 600 to 800 pounds. No definite information as to their spawning season could be secured.

3. Pantosteus jordani Evermann.

Pantosteus jordani Evermann, Bull. U. S. Fish. Comm. for 1892, January 27, 1893, 51. Type locality: Red Rock River, Red Rock, Montana.

Pantosteus columbianus Eigenmann & Eigenmann, American Naturalist, February 4, 1893, 151. Type locality: Boise River, Caldwell, Idaho.

Recent explorations of the Fish Commission have shown this sucker to be an abundant species in the region about the Black Hills in South Dakota and Wyoming. Dr. Eigenmann was the first to obtain it in the Columbia Basin, he having found it at Caldwell, Idaho, in 1892. During our investigations we found this to be an abundant and widely distributed species in the Columbia Basin. Specimens were obtained by us at the following places: Snake River at Idaho Falls, 1; Ross Fork near Pocatello, 49; Boise River at Caldwell, 4; Payette River at Payette, 13; Umatilla River at Pendleton, 3; Columbia River at Umatilla, 1; Natchess River near North Yakima, 9. A comparison of these specimens with a large series from various places in the Missouri River Basin shows them to be specifically identical. Young examples from Payette, Caldwell, and elsewhere, agree perfectly with Dr. Eigenmann's description of *P. columbianus*. The dorsal rays vary from 10 to 13; the scales from 82 to 107.

4. Catostomus catostomus (Forster).

Cyprinus catostomus Forster, Philos. Trans., 1773, 155. Type locality: Streams about Hudson Bay.

Specimens from Little Wood River, Shoshone, Idaho, 25; Ross Fork near Pocatello, Idaho, 10; Payette River, Payette, Idaho, 2; Cœur d'Alene Lake, Cœur d'Alene, Idaho, 7; Umatilla River, Pendleton, Oreg., 4; Columbia River, Umatilla, Oreg., 1; Pataha River, Starbuck, Wash., 3; Mill Creek, Walla Walla, 81; Creek at Sand Point, Idaho, 38.

D. 11 or 12; scales, 90 to 104.

This species differs from *latipinnis*, *griseus*, and *catostomus* (Evermann; Eigenmann) in its thin and rather narrow lower lip, which is incised for but little over half its depth. Two well-separated series of large papillæ cross the lip between base of incision and sheath.

5. Catostomus pocatello sp. nov. *Moo-gad-ee* of the Fort Hall Indians. (Pl. IX.)

Type locality: Ross Fork of Snake River near Pocatello, Idaho, where 18 specimens were collected August 4, 1893. Type, No. 45385, U. S. Nat. Mus. Co-types, No. 45386, U. S. Nat. Mus., and Nos. 1135 to 1141, Museum Leland Stanford Junior University.

Related to *Catostomus catostomus* (Forster).

Description: Head, 4; depth, 5; eye, $4\frac{1}{2}$; snout, $2\frac{1}{3}$; interorbital width, $2\frac{3}{5}$; D. 10; A. 7; scales, 19–95–14, about 50 before the dorsal. Body moderately stout; head heavy; snout not very pointed; eye rather large—larger than in any related species, its diameter $2\frac{1}{2}$ in snout or $2\frac{1}{6}$ in interorbital width; eye placed high; middle of pupil a little nearer posterior edge o opercle than to tip of snout. Mouth narrow; upper lip rather thick, but not pendent, with three definite rows of papillæ; lower lip incised nearly to base, a single series of small papillæ between sheath and base of incision; lobes of lower lip short and rounded; cartilaginous sheath of lips rather strongly developed. Scales small, crowded, and very much reduced in size on anterior part of body; lateral line imperfect. Origin of dorsal fin midway between tip of snout and base of caudal rays; greatest height of dorsal fin $1\frac{1}{2}$ in head, its free edge very slightly concave. Height of anal a little greater than that of dorsal, $1\frac{2}{3}$ in head; pointed, reaching base of caudal fin. Pectoral about equal to anal; ventral $1\frac{1}{4}$ in head. Peritoneum silvery, with dark punctulations. Air-bladder large.

Color in alcohol, dark olivaceous above, and on sides to below lateral line somewhat mottled with darker; under parts pale. Length, 150 millimeters.

An examination of the series of eighteen specimens shows some variation. Head, $3\frac{5}{6}$ to 4; depth, 5 to $5\frac{1}{6}$; eye, $4\frac{1}{2}$ to 5–4 in young; snout, $2\frac{1}{3}$ to $2\frac{2}{5}$–$2\frac{1}{2}$ in young. The number of dorsal rays is usually 10, but in one example there are but 9. There is considerable variation in number of scales in the lateral line, the number in eleven examples counted being 90, 93, 93, 95, 96, 96, 100, 101, 105, 106, 107, and 108, respectively; the lateral line is frequently irregular and imperfectly developed.

From *Catostomus catostomus*, which this species resembles, it differs in its larger eye, fuller lower lip, and somewhat larger head. These characters may all prove unreliable, however. From *C. griseus* and *C. latipinnis* of the same size it differs in its narrower upper lip and larger eye, as well as in other minor characters.

This species was found only in Ross Fork just above the Fort Hall Indian Agency. It does not seem to be very common, as a day's collecting in this stream resulted in taking only 18 specimens of the species. It apparently does not attain a length of more than 6 to 8 inches. The Indian name *Moo-gad-ee* means *sucker*, or *that which sucks*.

6. **Catostomus macrocheilus** Girard.

Catostomus macrocheilus Girard, Proc. Acad. Nat. Sci. Phila. 1856, 175. Type locality: Astoria, Oregon.

Specimens obtained from Payette River at Payette, 5; Boise River at Caldwell, 17; Clearwater Creek at Lewiston, 2; Hangman Creek at Tekoa, 6; Hangman Creek at Spokane, 1; Pataha River at Starbuck, 7; Walla Walla River at Wallula, 5; Colville River near Colville, 10; Umatilla River at Pendleton, 2; Snake River, at Payette, 2; Columbia River at Umatilla, 1; Skookumchuck River near Centralia, 7; Post Creek, St. Ignatius Mission, Mont., 1; Pend d'Oreille River, Newport, Idaho, 19.

This is the common sucker of the Columbia and Lower Snake rivers, and large numbers were frequently seen feeding in the shallow waters along shore. In 25 specimens the dorsal rays were as follows: Thirteen rays in 1 specimen, 14 in 15, 15 in 8, 16 in 1. Scales 67 to 70. The four specimens reported by Eigenmann from Idaho Falls are more likely referable to *C. ardens; C. macrocheilus* probably does not occur in the Upper Snake.

7. **Catostomus ardens** Jordan & Gilbert.

Catostomus ardens Jordan & Gilbert, Proc. U. S. Nat. Mus. 1880, 464. Type locality: Utah Lake, Provo, Utah.

Six specimens from Mink Creek, near Pocatello, are identified with this species. No adults of *C. ardens* were obtained, and the status of *ardens* and *macrocheilus* in the Columbia can not be determined until a larger series is available for comparison. In all suckers of this type thus far taken from Snake River above the falls, including those from President Camp and from Heart Lake, the dorsal fin is small, containing but 11, 12, or 13 rays; and the caudal peduncle is thicker than in specimens of *macrocheilus* of equal size. Measurements of our specimens are given in the following table:

Coll. No.	Head.	Depth.	Eye.	Snout.	Dorsal.	Anal.	Scales.	Length in inches.
2	$4\frac{2}{5}$	$4\frac{2}{5}$	6	$2\frac{2}{5}$	13	7	10–67–8	10
3	$4\frac{2}{5}$	$4\frac{1}{5}$	6	$2\frac{1}{4}$	13	7	10–67–8	$9\frac{1}{2}$
20	.....	.....	.....	.....	12	.....	71	.....
21	.....	.....	.....	.....	13	.....	70	.....
22	.....	.....	.....	.....	12	.....	66	.....
23	.....	.....	.....	.....	12	.....	66	.....

8. **Acrocheilus alutaceus** Agassiz & Pickering. *"Chisel-mouth."*

Acrocheilus alutaceus Agassiz & Pickering, Amer. Jour. Sci. and Arts, 1855, 99. Type localities: Falls of the Willamette and in Walla Walla River.

Specimens obtained from Payette River at Payette, 53; Pataha Creek at Starbuck, 1; Umatilla River at Pendleton, 15; Natchess River at North Yakima, 2; Walla Walla River at Wallula, Wash., 1; Columbia River at Umatilla, 26; Potlatch Creek, 2 miles above mouth, 19; Snake River at Payette, 17; Boise River at Caldwell, 5.

So far as known this species is confined to the Columbia River basin, where it is one of the most abundant and most widely distributed of the minnows. It has not yet been found in Snake River above the falls, nor is it known from the Pend d'Oreille basin.

9. **Rhinichthys cataractæ dulcis** (Girard). *Western Dace; Mot-to-nut-se* of the Fort Hall Indians.

Argyreus dulcis Girard, Proc. Acad. Nat. Sci. Phila. 1856, 185. Type locality: Sweetwater River, Nebraska.

This widely distributed species is represented in the collection by the following: Mouth of Colville River, 1; Snake River at Idaho Falls, 2; Ross Fork near Pocatello, 64; Little Wood River near Shoshone, 9; Cœur d'Alene Lake, 14; Columbia River at Pasco, 3; Natchess River at North Yakima, 11; Post Creek, St. Ignatius Mission, Mont., 6; Clarke Fork at Thompson Falls, Montana, 2.

This species has hitherto been reported from the Columbia River basin from but one place—Snake River, at President Camp;* it seems, however, to be a pretty common fish throughout that basin. It was obtained by Woolman and Bean in Post Creek and at Thompson Falls, the only places in the Pend d'Oreille system where it has yet been found. The Indian name refers to the motion of the nose in eating.

10. Agosia nubila (Girard).

Argyreus nubilus Girard, Proc. Acad. Nat. Sci. Phila. 1856, 186. Type locality: Fort Steilacoom, Washington.

Since the original description of this species no specimens have until now been taken from near the type locality. The name has been recently used by Jordan and others for the *Agosia* inhabiting the Upper Snake River and the Great Basin in Utah, being thus considered synonymous with the numerous nominal species (*carringtonii, vulnerata, rhinichthyoides, henshavii,* and *novemradiata*) described by Cope from streams tributary to Great Salt Lake. As this identification has been based upon a comparison with the imperfectly preserved types of *nubila,* the present collection is of great interest, containing, as it does, material from 15 localities, distributed between the Newaukum River in western Washington and the tributaries of the Upper Snake River in southeastern Idaho. A study of this material has shown the desirability of recognizing as a distinct subspecies *Agosia nubila carringtonii,* the form found in the Great Basin and the Upper Snake River.

Examination of the annexed tabular statement will show the astonishing amount of variation which this species exhibits. Thus, the crosswise series of scales varies from 47 to 70 in number; the barbel is present or absent; the pharyngeal teeth vary from 1, 4–4, 0 to 2, 4–4, 2; and the dorsal fin varies much in position and somewhat in size. These characters occur in various combinations, and with some of these are often correlated peculiarities of physiognomy and general appearance, all of which may serve to put a certain stamp upon the individuals from a single stream, or even from one locality in a stream. Disregarding such local variations, we find that our material, exclusive of the specimens of *A. nubila carringtonii,* falls more or less clearly into three groups, distributed around certain geographical centers. Whether we are here dealing with subspecies seems doubtful, and can be determined only by more extensive and detailed exploration. The first of these forms, typical *nubila,* is represented in our collection by a large number of specimens from the Newaukum and Skookumchuck rivers in western Washington, very near the type locality of the species. These are all very dark in coloration, and have a jet-black lateral band which extends along sides of head and encircles the snout. This band is absent in our second and third groups, found east of the Cascades, or it is at most only faintly indicated. The darker coloration of the coastwise form may be due to its inhabiting a densely forested area, possessing different climatic conditions from those characterizing the dry semidesert of eastern Washington and western Idaho. Both the typical *nubila* and the lighter interior form which centers about Umatilla are characterized by their coarse scales (averaging 54 along the lateral line) and their peculiar markings. The latter are due to the fact that numerous scattered scales along the back and sides are of a dark slate color, contrasting sharply with the lighter ground.

The third group centers in the Spokane region, and is characterized by smaller scales, the less-marked peculiarities of coloration, and the almost uniform absence of the maxillary barbel. The inconstancy of this important generic character within the limits of the species has been heretofore noticed only by Cope, who in notes on *Apocope vulnerata* † calls attention to its occasional absence. In our specimens from other than the Spokane district the barbel is very rarely lacking.

The significance of the groups above outlined can be determined satisfactorily only by the study of a much more extensive series than that on which this paper is based. An open waterway exists between them, and it is useless to attempt to indicate their value while so large a part of the Columbia and adjacent basins remain unexplored.

11. Agosia nubila carringtonii (Cope). *Mo-sha-pog-gee.*

Apocope carringtonii Cope, Hayden's Fifth Annual Report, 1871 (1872), 472. Type locality: Warm Springs, Utah.

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* Evermann, Bull. U. S. Fish Comm. for 1891 (1892), 42.

† Cope, Zool. Wheeler's Survey W. 100th Merid., 647, 1876.

We include under this name the *Agosia* of the Great Salt Lake basin (exclusive of the Sevier River) and of the Upper Snake River. Our collection contains specimens from Port Neuf River, Mink Creek, and Ross Fork near Pocatello, and from Little Wood River at Shoshone. It differs from *nubila* in its finer scales (average about 65) and in the absence of the sharply marked blackish scales on the sides. The Fort Hall Indians, to whom we showed specimens of this minnow, called it *Mo-sha-pog-gee*, a word which they say describes its eating habits.

12. Agosia umatilla sp. nov. (Pl. IX.)

Type locality: Columbia River at Umatilla, Oregon, where 15 specimens were collected, August 11, 1893, by Messrs. Gilbert and Rutter. Type, No. 45390, U. S. Nat. Mus. Co-types, No. 45391, U. S. Nat. Mus., and Nos. 1142 to 1147 (Umatilla) and 1148 to 1150 (Payette) Museum Leland Stanford Junior University.

Associate type locality: Payette River at Payette, Idaho, where 3 specimens were secured, August 9, 1893, by Messrs. Gilbert, Thoburn, and Rutter.

Related to *Agosia falcata* and *Agosia nubila carringtonii.*

Description: Head, $3\frac{5}{6}$; depth, $4\frac{3}{4}$; eye, 4; snout, 3. D. I, 9; A. I, 7; scales, 14–68–8, about 30 before the dorsal. Teeth, 1, 4–4, 1 hooked. The body is rather slender, the back somewhat elevated; head pointed, narrow; mouth inferior, nearly horizontal, narrow; caudal peduncle compressed, slender, its least depth 2 in head. Origin of dorsal fin slightly behind insertion of ventrals and about midway between base of middle caudal rays and nostril; dorsal fin falcate, the anterior rays nearly as long as head, their tips reaching well behind posterior rays when deflexed; rudimentary ray not enlarged nor spinelike; anal strongly falcate, the anterior rays much produced, about as long as head and more than twice the length of the posterior rays; pectoral not quite reaching ventrals, $1\frac{1}{3}$ in head; ventrals reaching well beyond front of anal, $1\frac{1}{2}$ in head; caudal deeply forked; no ventral stays. Barbel minute; upper lip without frenum. Color in alcohol, olivaceous above, covered with obscure patches of darker; sides with a distinct plumbeous band following the course of the lateral line and extending forward through the eye and around snout; side with a number of dark blotches, usually imperfectly defined, partly covering the plumbeous band; a large dark blotch on base of caudal peduncle, and one or two smaller ones on base of caudal rays. Length, 65 mm.

The range of variation, as shown by the co-types, is not great. Depth, $4\frac{3}{4}$ to 5; eye, $3\frac{1}{2}$ to 4; scales, 13 or 14, 60 to 70–7 or 8: D. 8 or 9. There are slight but unimportant color differences. (For variation in measurements, see table.)

This species is somewhat intermediate between *Agosia falcata* and *A. nubila carringtonii.* From the former it may be distinguished by its notably smaller scales, absence of ventral stays, and smaller eye; from the latter it differs in its longer, more slender snout and larger, strongly falcate fins. As in *A. falcata*, the top of head and anterior portion of trunk are often covered with minute nuptial tubercles. From *Agosia adobe* it differs in the larger eye, which is contained $1\frac{1}{8}$ to $1\frac{1}{2}$ times in snout, while in *A. adobe* it is contained 2 to $2\frac{1}{2}$ times; the fins are higher and more falcate, and the scales below lateral line are larger. The 3 specimens obtained from Payette River do not differ materially from those found at Umatilla.

13. Agosia falcata Eigenmann & Eigenmann.

Ayosia falcata Eigenmann & Eigenmann, American Naturalist for February, 1893, 153. Type locality: Boise River, Caldwell, Idaho.

This interesting species was obtained by us at the following places: Boise River at Caldwell, 97; Payette River at Payette, 27; Snake River at Payette, 1; Mill Creek near Walla Walla, 1; Columbia River at Umatilla, 55; Columbia River at Pasco, 5.

In the following table we give measurements of a number of specimens:

	Boise River at Caldwell.										Payette River at Payette.					
Head	4	4	$3\frac{3}{4}$	$3\frac{5}{6}$	4	4	$3\frac{5}{6}$	$3\frac{3}{4}$	$3\frac{3}{4}$	$3\frac{5}{6}$	$3\frac{3}{4}$	$3\frac{5}{6}$	4	4	$3\frac{1}{6}$	$3\frac{5}{6}$
Depth	$4\frac{5}{6}$	$4\frac{5}{6}$	5	$5\frac{1}{4}$	5	5	$4\frac{1}{2}$	$4\frac{3}{4}$	5	4	$3\frac{1}{2}$	$4\frac{1}{3}$	5	5	$4\frac{3}{4}$	5	5
Eye	$3\frac{3}{4}$	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{5}{6}$	$3\frac{4}{6}$	$3\frac{1}{2}$	$3\frac{3}{4}$	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{5}{6}$	$4\frac{1}{6}$	$3\frac{1}{2}$	$3\frac{5}{6}$	$3\frac{3}{4}$	$3\frac{3}{4}$
Snout	$2\frac{5}{6}$	$2\frac{5}{6}$	$2\frac{3}{4}$	3	3	$2\frac{4}{6}$	$2\frac{5}{6}$	3	3	$2\frac{3}{4}$	$2\frac{3}{4}$	3	3	3	3	3	3
Dorsal	9	9	9	9	10	9	9	9	9	9	9	.....	.....	.....	.....	.....	.....
Anal	7	7	7	7	7	7	7	7	7	7	7	.....	.....	.....	.....	.....	.....
Scales	56	56	53	53	55	55	55	54	56	55	59	.....	.....	.....	.....	.....	.....

One of the most characteristic marks of this species is the presence of two or three membranous stays connecting the inner ventral rays with the skin of the body, thus forming pockets under the ventral fins and holding them down quite firmly. Adults show an extraordinary development of the nuptial tubercles, which are present on top of head, and on back and sides of body. On the body a single tubercle is located on the middle of the free edge of each scale, being formed by a thickening of the integument. On the belly, this thickening involves the entire surface of the scales, giving to this region a mosaic-like appearance. Beneath this thickened epidermis, the scales are often partially absorbed, especially on the breast. Tubercles are also present on the inner (superior) surfaces of the pectoral fins, where they follow the fin rays in single series, branching to correspond with the forking of the ray.

We find the origin of the dorsal fin in this species constantly behind the front insertion of the ventrals. It varies from midway between base of median caudal rays and nostrils (its usual position) to a point midway between caudal and posterior margin of pupil. The variation includes the position of the dorsal assigned as a distinguishing feature in *Agosia shuswap* Eigenmann, this being the only character assigned as distinguishing *shuswap* from *falcata*.*

Table showing variation in species of Agosia.

Locality.	Head in length.	Depth in length.	Eye in head.	Snout in head.	Barbel: + = present, ○ = absent.	Teeth.	Dorsal fin.	Position of dorsal fin.	Anal fin.	Scales.	Average No. of scales in lat. line.	No. of specimens in collection.	No. of examples examined.
Agosia nubila.													
Colville River, Meyers Falls.	3¾–4	3¾–4	4	3	○	1, 4–4, 1	8	To eye	7	52–57	55	10	6
Little Spokane River, Dart's Mill.	4	4 –4½	4½–5	3	○	2, 4–4, 2	8 or 9	To preopercle.	7	52–63	62	77	9
Hangman Cr., Tekoa	3¾–4	4 –4⅓	4⅓	.....	+ in 1 ○	1, 4–4, 2 2, 4–4, 2	8 or 9	Beyond preopercle.	7	51–65	57	50	10
Cœur d'Alene Lake	.....	.....	.....	.....	○ in 34 + in 10	1, 4–4, 2	8 or 9	Middle of pupil.	7	64–70	66	44	9
Clearwater R., Lewiston.	.....	.....	.....	.....	.....	.....	8 or 9	.....	7	.....	.....	9	9
Boise R., Caldwell	4	4¾	3½	3⅛	+	1, 4–4, 1	8	To eye	7	56	56	1	1
Potlatch Cr., Lewiston	3¾–4⅛	3¾–4⅛	4 –4½	2½–3	○	1, 4–4, 0 1, 4–4, 1 2, 4–4, 2	8 or 9	To preopercle.	7	60–66	62	10	10
Pataha R., Starbuck	4 –4¼	4 –4½	4⅛–5	2⅝–3	+	.....	8 or 9	To pupil	7	60–64	62	13	9
Walla Walla R., Wallula.	3¾–4	4	4 –4½	2⅝–3	+	.....	.....	To preopercle.	7	47–55	49	39	15
Mill Cr., Walla Walla.	.....	.....	.....	.....	+	.....	.....	do	7	52–61	55	20	20
Umatilla R., Pendleton.	.....	.....	.....	.....	+	2, 4–4, 2	.....	.....	7	48–58	52	.....	3
Columbia R., Umatilla	3¾–4	4⅛	3½–4	2⅝–3	+	.....	.....	.....	7	48–57	53	7	7
Natchess River, North Yakima.	.....	.....	.....	.....	+	.....	.....	.....	7	53–58	56	.....	.....
Newaukum River, Chehalis.	.....	.....	.....	.....	+	.....	.....	.....	7	53–58	55	.....	.....
Skookumchuck River, Chehalis.	4	4⅛–4½	3¾–4	2⅘–3⅛	+	.....	.....	.....	7	50–57	55	6	6
A. nubila carringtonii.													
Port Neuf River, Pocatello.	4	4⅛	3¾	3¾	○	1, 4–4, 1	8	To eye	7	69	69	1	1
Ross Fork, Pocatello	.....	.....	.....	.....	+	.....	.....	To front of eye.	7	53–72	64	15	13
Mink Creek, Pocatello.	4⅓	4⅓	4	3	+	.....	9	To eye	7	65	65	1	1
Port Neuf River, Pocatello.	.....	.....	.....	.....	+	.....	.....	To pupil	7	61–67	64	4	4
Idaho Falls	4⅓	4⅓	4	3	+	.....	9	To front of eye.	7	62–63	62⅓	2	2
Little Wood River	3⅘ 4⅗	4⅘ 5	4 4⅗	3 –3⅓	+	.....	.....	To eye	7	63–79	71	48	10
Payette R., Payette	3¾	4½	4⅓–5	.....	+	.....	8 or 9	.....	7	60–65	64	6	6
A. falcata.													
Boise River, Caldwell.	3¾–4	4⅛–5¼	3½–4	2⅝–3	+	.....	9 or 10	.....	7	53–59	56	97	11
Payette R., Payette	3¾–4	4⅓–5	3⅓–4⅛	3	+	.....	.....	.....	.....	.....	.....	27	6
Columbia R., Umatilla.	4 –4⅕	4⅗–5	3⅓–4	2⅝–3	+	1, 4–4, 1	9 or 10	To nostril	7	52–58	56	55	8
A. umatilla.													
Columbia R., Umatilla.	3⅓–4	4⅓–5	4	2½	+	1, 4–4, 1	8 or 9	To front of pupil.	7	63–70	66	10	10
Payette R., Payette	3¾	4⅓–5	4⅓–5	2⅝–3	+	1, 4–4, 1	8 or 9	.....	7	60–65	63	6	6

*Eigenmann, American Naturalist, February, 1893, 154.

14. Couesius greeni Jordan.

Couesius greeni Jordan, Proc. U. S. Nat. Mus. 1893, 313. Type locality: Stuart Lake near Fort St. James, British Columbia. (Type, No. 44454, U. S. Nat. Mus.)

In the collection made by Messrs. Bean and Woolman, September 20, 1892, in a small creek at Sand Point, Idaho, we find three examples of this species. In length they measure $2\frac{3}{4}$, 3, and $3\frac{1}{4}$ inches, respectively. Head in length of body, $4\frac{1}{7}$, $4\frac{1}{5}$, $4\frac{1}{7}$; depth, $4\frac{3}{4}$, 5, 5; eye, 4, $3\frac{1}{2}$, $3\frac{1}{4}$; snout, $3\frac{1}{2}$, $3\frac{1}{2}$, $3\frac{1}{2}$; interorbital width, $3\frac{1}{2}$, $3\frac{1}{4}$, 3; D. 8; A. 8; scales, 10–55–6, 11–60–5, 11–60–6; 34 before the dorsal. The origin of the dorsal fin is at a point midway between base of caudal fin and the preorbital (not "preopercle," as given in the original description of *C. greeni*, evidently a misprint for "preorbital"). These Sand Point specimens agree well with the type of *C. greeni* with which we have compared them. This species seems to differ from the *Couesius* of the Upper Missouri basin (*Couesius dissimilis*) in the somewhat larger scales and in having the scales less crowded on anterior part of body.

15. Cyprinus carpio Linnæus. *Carp.* The carp has been introduced into a number of ponds and small lakes of the Columbia basin and from these has escaped into the streams. We saw it in Payette River at Payette and heard of it elsewhere.

16. Mylocheilus caurinus (Richardson). *"Chub"; "Whitefish."*

Cyprinus (Leuciscus) caurinus Richardson, Fauna Boreali-Americana, III, 304, 1836. Type locality: Columbia River, at Fort Vancouver.

Specimens obtained from Pend d'Oreille River at Newport, Idaho, 1; Boise River at Caldwell, Idaho, 19; Payette River at Payette, Idaho, 7; Snake River at Payette, Idaho, 8; Columbia River at Umatilla, Oreg., 16; Walla Walla River at Wallula, Oreg., 13; Blue Lakes, Idaho, 8; Umatilla River at Pendleton, Oreg., 1. An abundant and widely distributed fish in the Lower Columbia basin; not known from Snake River above the falls, and probably does not occur there. Observed to be very abundant in the Pend d'Oreille below Newport.

17. Ptychocheilus oregonensis (Richardson). *"Squawfish."*

Cyprinus (Leuciscus) oregonensis Richardson, Fauna Boreali-Americana, III, 305, 1836. Type locality: Columbia River, at Fort Vancouver.

Specimens obtained from Payette River at Payette, Idaho, 27; Hangman Creek at Tekoa, Wash., 9; Clearwater Creek at Lewiston, Idaho, 2; Potlatch Creek near Lewiston, Idaho, 3; Snake River at Payette, Idaho, 2; Boise River at Caldwell, Idaho, 28; Walla Walla River at Wallula, Wash., 1; Columbia River at Pasco, Wash., 6; Columbia River at Umatilla, Oreg., 4; Umatilla River at Pendleton, Oreg., 6; Natchess River at North Yakima, Wash., 4; Skookumchuck River near Centralia, Wash., 28; Newaukum River near Chehalis, Wash., 8; Mouth of Colville River, Colville, Wash., 6; Spokane River below Spokane, Wash., 10; Lake Pend d'Oreille at Sand Point, Idaho, 1; Pend d'Oreille River at Newport, Idaho, 7; Flathead Lake, Mont., 28. In the Pend d'Oreille River the squawfish is even more abundant than *M. caurinus*. No differences could be discovered between the above-mentioned specimens and others from the Sacramento River basin in California.

18. Leuciscus hydrophlox (Cope). *Po-he-wa.*

Clinostomus hydrophlox Cope, Hayden's Fifth Annual Report, 1871 (1872), 475. Type locality: Blackfoot Creek, Idaho.

Clinostomus montanus Cope, l. c., 475. Type locality: Grass Creek, Idaho.

Clinostomus tænia Cope, Trans. Amer. Philos. Soc. Phila. 1874, 133. Type locality: Utah Lake.

Numerous specimens of this species were collected in the Snake River at Idaho Falls, in Ross Fork of Snake River (on the Fort Hall Indian Reservation), and in Mink Creek and Port Neuf River near Pocatello, Idaho. The Indian name *Po-he-wa* means *striped*. The following tabular statement shows the variation in the number of anal fin rays among the examples collected at these places.

Locality.	Number of specimens collected.	9 anal rays.	10 anal rays.	11 anal rays.	12 anal rays.	Average number of rays in anal.
Idaho Falls	13	.....	1	9	3	11
Ross Fork	52	1	17	37	6	$12\frac{1}{3}$
Mink Creek	5	.....	1	4	.....	11
Port Neuf River	118	.....	41	65	12	11

Numerous specimens (83) obtained in 1891 in the Snake River at President Camp and in a small creek at the head of Jackson Lake, Wyoming,* have 11 or 12 anal rays, 12 being the number in most of the examples counted. In 1892, Dr. Eigenmann obtained specimens at Idaho Falls, 2 of which have 12, 14 have 13, and 4 have 14 anal rays each. Putting these with the 13 collected by us, gives an average of $12\frac{1}{8}$ anal rays for that locality. This species was obtained also by Jordan & Gilbert in 1889 in Heart Lake and Witch Creek, in Yellowstone Park.† The specimens examined by them had 13 anal rays. In specimens from Idaho Falls the scales of lateral line range as follows: 52, 53, 53, 53, 55, 55, 57, 57, 58, 61; from Port Neuf River, 51, 51, 51, 52, 53, 53, 55, 57. Head from 4 to $4\frac{1}{5}$ in length, eye $3\frac{2}{5}$ to $3\frac{3}{4}$ in head. The maxillary scarcely reaches front of eye, and is 3 to $3\frac{1}{5}$ times in head.

19. Leuciscus lineatus (Girard).

Tigoma lineata Girard, Proc. Acad. Nat. Sci. Phila. 1856, 206. Type locality: Not definitely known, but probably somewhere in the Utah basin.

Tigoma atraria Girard, l. c., 208. Type locality: "A spring in the Utah district, near the desert."

Tigoma obesa Girard, Proc. Acad. Nat. Sci. Phila. 1856, 206. Type locality: Salt Lake Valley.

Tigoma squamata Gill, Proc. Bost. Soc. Nat. Hist. 1861, 42. Type locality: Salt Lake Basin.

Squalius cruoreus Jordan & Gilbert, Proc. U. S. Nat. Mus. 1880, 400. Type locality: Utah Lake; young specimens.

Squalius rhomaleus Jordan & Gilbert, l. c., 461. Type locality: Utah Lake; large specimens.

Siboma atraria longiceps Cope. Zool. Wheeler Surv., v, 667, 1876. Type locality: Snake Creek, Nev.

This species was obtained at the following places: Idaho Falls; Port Neuf River at Pocatello; Payette River at Payette. Others were seen at American Falls, in Snake River. Besides the localities given in the above synonymy, this fish has been reported from the following additional points in the Snake River basin: Heart Lake and Witch Creek, in Yellowstone Park (Jordan & Gilbert, 1889); Snake River at President Camp; Jackson Lake and a small creek at upper end of Jackson Lake, Wyoming, (Evermann & Jenkins, 1891); Snake River at Idaho Falls, Idaho (Eigenmann). In the Columbia basin it seems to be entirely confined to the Snake River, and in that stream its occurrence below the falls is exceptional. It is an excessively abundant fish in the Great Salt Lake basin, particularly in Utah Lake.

In the canal at Idaho Falls we easily caught this and the preceding species by placing dough inside a small dip net and allowing it to rest a short time on the bottom; great numbers of the two species, particularly of *L. hydrophlox*, would soon begin feeding on the dough, when they could be easily secured by lifting the net. In all recent papers this species has been listed under the name *Leuciscus atrarius*, but it seems quite certain that *Tigoma lineata* Girard is the same fish; and this, being the older name, must take the place of *atrarius*.

20. Leuciscus aliciæ Jouy.

Tigoma gracilis Girard, Proc. Acad. Nat. Sci. Phila. 1856, 206; not *Cyprinus* (*Leuciscus*) *gracilis* Richardson.

Squalius copei Jordan & Gilbert, Proc. U. S. Nat. Mus. 1880, 461; not *Leuciscus copei* Günther.

Leuciscus aliciæ Jouy, Proc. U. S. Nat. Mus. 1881, 10. Type locality: Utah Lake.

This species was found very abundant in Little Wood River at Shoshone, where 86 specimens were obtained. Slight differences are found on comparison of these specimens with others from the Sevier River, Utah, but these differences are not likely to prove constant and are not more extensive than are frequently found on comparing specimens from adjacent tributaries of the same stream. The eye is a trifle larger, the caudal peduncle rather more slender, the pectoral and ventral fins seem to average a little shorter, and the dorsal may be a little more anterior in position.

This species has been previously known only from Sevier River, Beaver River, and Provo River in Utah. Its occurrence in the valley of the Upper Snake River is one more evidence of the identity of the two faunas. At least 8 of the species of our collection from the Upper Snake River are also found in the Great Salt Lake Basin of Utah. They are *Catostomus ardens, Rhinichthys dulcis, Agosia nubila carringtonii, Leuciscus hydrophlox, Leuciscus aliciæ, Leuciscus lineatus, Coregonus williamsoni,* and *Cottus punctulatus.*

The following is a detailed description of our specimens from Little Wood River: Head, 4 ($3\frac{3}{4}$ to $4\frac{1}{2}$); depth, 4 to $4\frac{1}{2}$; eye, $3\frac{3}{4}$ to 4; snout, $3\frac{3}{4}$ to 4. D. 8; A. 8, in 52 specimens, 9 in 34. Scales, 18–79 to 83–13. Body elongate, moderately compressed; head short and heavy,

* Evermann, Bull. U. S. Fish Comm. for 1891, 44. † Jordan, Bull. U. S. Fish Comm. for 1889, 48.

interorbital width a little greater than snout; snout decurved; mouth wide, oblique, lower jaw very slightly projecting; maxillary reaching to within front of orbit; caudal peduncle long, the distance between anal fin and base of caudal about $1\frac{1}{6}$ in head, least depth of caudal peduncle $2\frac{2}{3}$ in head. Fins small; height of dorsal $1\frac{1}{2}$ in head, its free edge slightly convex; origin of dorsal somewhat behind ventrals, a little nearer base of caudal than tip of snout; anal about size of dorsal; length of pectoral equal to height of dorsal, their tips rarely reaching base of ventrals; ventrals short, equal to snout and eye. Lateral line somewhat interrupted, little decurved; scales crowded anteriorly.

21. Leuciscus balteatus (Richardson).

Cyprinus (*Abramis*) *balteatus* Richardson, Fauna Boreali-Americana, III, 301, 1836. Type locality: Columbia River, presumably at Fort Vancouver, Washington.

Richardsonius lateralis Girard, Proc. Acad. Nat. Sci. Phila. 1856, 202. Type locality: Fort Steilacoom, Puget Sound.

This is one of the most abundant species of the Columbia and Lower Snake River, but appears not to occur in the Upper Snake, where it is replaced by *L. hydrophlox*. The accompanying table shows the stations at which this species was taken, together with the number of individuals from each locality, and the number of rays in the anal fin. It will be seen that the latter vary, in our specimens, from 11 to 22 in number, the averages in the counts from the different localities ranging from 13 to 18.

In a recent paper,* Dr. Eigenmann announces the discovery that in this species the number of anal rays decreases with increasing altitude or that "the higher the altitude the fewer the number of rays and the narrower the limits of variation." To successfully establish such a generalization a very large amount of evidence would be necessary. As a contribution to this question we append the following table, which can not, we think, be interpreted as showing the truth of the theory. In this table we give, (1) the localities from which specimens were examined; (2) the range in variation in anal rays among the individuals; (3) the total number examined from each locality; (4) the average number of anal rays for each locality, and (5) the approximate altitude of each place. Fractions of $\frac{1}{2}$ or more are included in the next higher number:

Locality.	Number of anal rays.													Total No. examined.	Average No. anal rays.	Approximate elevation in feet.
	11	12	13	14	15	16	17	18	19	20	21	22	23	24			
Little Spokane River, Dart's Mill	1	14	30	19	6	....	....	....	....	....	....	....	....	....	70	13	1,850
Colville River, Meyers Falls	....	....	7	5	6	2	....	....	1	....	....	....	....	....	21	14	1,200
Spokane River, Spokane	....	1	1	5	1	3	....	....	....	....	....	....	....	....	11	14	1,910
Revelstoke, B. C. *a*	....	....	....	....	1	....	....	....	....	....	....	....	....	....	1	14	1,475
Browns Gulch, Silver Bow	....	....	2	10	1	1	....	....	....	....	....	....	....	....	14	14	5,344
Umatilla River, Pendleton	....	1	5	10	9	1	....	....	....	....	....	....	....	....	29	14	1,070
Lake Washington, Seattle	....	1	16	11	13	4	1	1	....	....	....	....	....	....	47	14	1
Flathead Lake	....	....	1	1	6	3	....	....	....	....	....	....	....	....	11	15	3,100
Griffin Lake, B. C. *a*	....	....	....	3	7	3	1	....	....	....	....	....	....	....	14	15	1,990
Small Creek at Sand Point, Idaho	....	....	2	19	36	3	6	1	....	....	....	....	....	....	95	15	2,100
Pend d'Oreille River, Newport	....	....	....	5	1	2	....	....	....	....	....	....	....	....	8	15	2,000
Hangman Creek, Spokane	....	....	2	2	5	2	....	....	....	....	....	....	....	....	11	15	1,910
Natchess River, North Yakima	....	1	....	3	1	3	....	....	....	....	....	....	....	....	8	15	1,078
Newaukum River, Chehalis	....	....	....	....	2	1	....	....	....	....	....	....	....	....	3	15	204
Post Creek, Flathead Lake	....	....	....	....	4	1	1	....	....	....	....	....	....	....	6	$15\frac{1}{2}$	3,100
Golden, B. C. *a*	....	....	....	1	7	5	4	1	....	....	....	....	....	....	18	16	2,550
Boise River, Caldwell	....	1	2	5	10	21	12	8	4	2	....	....	....	....	65	16	2,372
Skookumchuck River, Chehalis	....	....	2	....	1	7	2	1	....	....	....	....	....	....	13	16	204
Payette River, Payette	....	....	3	25	29	27	28	25	12	3	2	....	....	....	154	16	2,150
La Grande, Oregon *a*	....	....	....	2	6	11	4	....	....	....	....	....	....	....	23	16	2,786
Potlatch Creek, Lewiston	....	....	....	....	....	1	1	2	....	....	....	....	....	....	4	17	1,200
Sicamous, B. C. *a*	....	....	....	1	3	13	28	8	5	....	....	....	....	....	58	17	1,300
Walla Walla River, Wallula	....	....	....	....	....	2	2	....	2	....	....	....	....	....	6	17	326
Caldwell, Idaho *a*	....	....	....	1	2	6	7	8	7	2	1	....	....	....	34	18	2,372
Clearwater River, Lewiston	....	....	....	....	....	3	5	4	4	....	....	....	....	....	16	18	750
Columbia River, Pasco	....	....	....	....	....	....	1	1	1	....	....	....	....	....	3	18	375
Umatilla River, Umatilla	....	....	....	....	1	1	2	2	5	1	....	....	....	....	12	18	300
Snake River, Payette	....	....	....	....	....	1	1	4	3	1	....	....	....	....	10	18	2,150
Umatilla River, Umatilla *a*	....	....	....	....	....	....	1	5	1	2	1	....	....	....	10	19	300
Mission, B. C. *a*	....	....	....	....	....	2	7	13	25	18	8	2	2	2	79	19	1
Kamloops, B. C. *a*	....	....	....	....	....	....	....	....	....	1	1	....	....	....	2	$20\frac{1}{2}$	1,158

a These are the localities from which specimens were examined by Dr. Eigenmann. The data are those given by him.

* Results of Explorations in Western Canada and the Northwestern United States. Bull. U. S. F. C. 1894, 131.

In the above table we have arranged the data beginning with the lowest average number of anal rays (13), and proceeded from that to the highest (20½). In the table which follows we have arranged the localities in order of elevation, beginning with the lowest.

Table showing the relation of altitude to number of anal fin rays in Leuciscus balteatus.

Localities.	Approximate altitude.	Average No. of anal rays.	No. of specimens on which averages are based.
Lake Washington	1	14	47
Mission *a*	1	19	79
Newaukum River	204	15	3
Skookumchuck River	204	16	13
Umatilla *a*	300	19	10
Umatilla	300	18	12
Wallula	326	17	6
Pasco	375	18	3
Lewiston	750	18	16
Pendleton	1,070	14	29
Kamloops *a*	1,158	20½	2
Potlatch Creek at Lewiston	1,200	17	4
Meyers Falls	1,200	14	21
Sicamous *a*	1,300	17	58
Revelstoke *a*	1,475	14	1
Dart's Mills	1,850	13	70
Griffin Lake *a*	1,900	15	14
Spokane River, Spokane	1,910	14	11
Hangman Creek, Spokane	1,910	15	11
Newport	2,000	15	8
Sand Point	2,100	15	95
Snake River, Payette	2,150	18	10
Payette River, Payette	2,150	16	154
Caldwell *a*	2,372	18	34
Caldwell	2,372	16	65
Golden *a*	2,550	16	18
La Grande *a*	2,786	16	23
Flathead Lake	3,100	15	11
Post Creek	3,100	15½	6
Silver Bow	5,344	14	14

a These data are from Dr. Eigenmann's paper.

Comparing these with Eigenmann's results, it will be seen that the average number of rays from our *lowest* elevation (14 at Lake Washington) is fewer by 2 than the average from his *highest* elevation (16 at La Grande) and that our average for Newaukum River (204 feet elevation) is fewer than any average found by him except at Revelstoke (1,475 feet), where his average is 14, and at Griffin Lake (1,900 feet), where it is 15. The average found by us at sea level (Lake Washington) is identical with that found at Silver Bow,* whose elevation is 5,344 feet, the greatest elevation from which specimens have been examined. When there is absolutely no difference between the averages for the lowest and the highest elevations it is not possible for us to see any reason for the generalization, "the higher the altitude the fewer the number of rays." If the figures show anything, they show that the number of anal fin rays does not decrease with increasing altitude. It is also stated that the greatest range of variation is at the lowest altitudes, but further on it is stated that the "greatest variation in this [the Columbia] system was *not* at the lowest altitude, but at an elevation of 2,372 feet." The range here was found by him to be through 9, or from 12 to 20. We find the same range of variation (from 12 to 20) in our specimens from Payette (2,150 feet.) The range found at the point nearest sea level in the Columbia basin (at Umatilla, 300 feet) was only through 6 (15 to 20), and the average for that place is nearly identical with that at Caldwell. The variation found by Eigenmann among his Mission specimens is through 9 (16 to 24), while that of our Lake Washington specimens is through 7 (12 to 18). The averages for these two places, both of which are at sea level, are 19 and 14, respectively.

We consider *Leuciscus lateralis* (Girard) a simple synonym of *L. balteatus*. Our material covers well the type localities of both (Columbia River at Fort Vancouver and Fort Steilacoom on Puget Sound) and indicates but one form. We are certainly not prepared to consider *lateralis* a subspecies of *balteatus*, occupying the same brook with its parent form, as indicated by Eigenmann.

* *L. gilli*, probably a good species.

22. **Coregonus williamsoni** Girard. (Plate IX).

Coregonus williamsoni Girard, Proc. Acad. Nat. Sci. Phila. 1856, 136. Type locality: Des Chutes River, Oregon.

Specimens obtained from the Payette River at Payette, Idaho, 24; Clearwater River at Lewiston, Idaho, 7; Columbia River at Umatilla, Oreg., 1; Natchess River at North Yakima, Wash., 8; Newaukum River at Chehalis, Washington, 4; Little Spokane River at Dart's Mill, Wash., 6; Flathead Lake, Montana, 2; Post Creek, St. Ignatius Mission, Montana, 9; Clarke Fork at Thompson Falls, Mont., 1; Creek at Sand Point, Idaho, 5; Spokane River, Spokane, Wash., 1.

Abundant and widely distributed throughout the Columbia and Upper Colorado and Missouri basins. Specimens of this fish were obtained by Mr. Bean which are of unusual interest in that they show the breeding colors. Mr. Bean's report upon these specimens is given at the end of this paper.

23. **Oncorhynchus gorbuscha** (Walbaum). *Humpback Salmon.* The humpback salmon was running in great abundance at the date of our visit to Puget Sound (August 26) and was the only species then being handled at the canneries. We were informed that the humpbacks did not run last year, and in corroboration of the fact that this species runs on the Sound in alternate years only, it is recalled that it did not appear in 1880, when one of us visited this region. As is well known, the female humpbacks are plump, symmetrical, silvery fishes of attractive appearance and good flavor. Aside from the traditional requirements as to color of flesh, the species is well adapted for canning purposes. No young of this species were found in the streams.

24. **Oncorhynchus keta** (Walbaum). *Dog Salmon.* The young of the dog salmon were abundant in the Newaukum and Skookumchuck rivers at Chehalis, Wash. They average slightly smaller than young *quinnats*, and are readily distinguished by their larger eyes. They have 12 or 13 branchiostegal rays, 14 rays in the anal fin, 130 to 135 scales in lateral lines, and 7 + 13 gill-rakers. Like the young *quinnats*, these were all nearly uniform in size, and were evidently young of the preceding year.

25. **Oncorhynchus tschawytscha** (Walbaum). *Quinnat Salmon.* Only the young of the Columbia River salmon were seen by us during our short investigation of the Columbia and the Snake. It had not yet reached its spawning beds on the Snake at the time of our visit, and the "close season" prevented its capture later in the lower river. Such facts as we were able to ascertain concerning its run and spawning-grounds are therefore based on interviews with fishermen and others, a kind of testimony which must, in this case, be scrutinized with more than usual care. On the upper river it was repeatedly found that no distinction was seemingly made between the salmon and the steelhead, and of the two species of salmon that almost certainly spawn in the upper course of these streams, no distinctive accounts could be had. A "silver salmon" was, indeed, frequently mentioned, but we were unable to ascertain whether the fish thus distinguished was the female *quinnat* or the blueback (*O. nerka*).

As already indicated in our notes on the streams, salmon ascend the Snake River to and above the Lower and Upper Salmon Falls, and have important spawning-beds in the main stream, both above and below these falls. They are not known above the Auger Falls, and probably do not even reach the foot of the Great Shoshone. They appear first in this portion of the river early in September, or occasionally in the latter part of August, at a time when the streams are so low that falls or dams which would form no barrier earlier in the season now keep them out from otherwise favorable spawning-beds. This fish is not much used for food in the upper waters. The remnants of the various Indian tribes make yearly visits to the spawning-beds and occasionally white men have tried to put them on the market, but without success. Great numbers, are, however, annually killed through mere love of destruction. The advent of the salmon brings out from every town men and boys with pitchforks or other weapons, curious to see how many of these fish they can destroy. It is to be held in mind that these localities in Idaho and in the eastern portions of Oregon and Washington are so remote from the canneries that the people have no interest whatever in the preservation of the salmon. We can not, therefore, depend upon public sentiment to enforce protective legislation.

We give below such information as we possess concerning the distribution of salmon in the Snake and Upper Columbia rivers.

The principal tributaries of that portion of Snake River which is accessible to salmon are the following: Salmon Falls River or Salmon Creek, Malade River, Bruneau River, Owyhee River, Boise River, Payette River, Salmon River, Grande Ronde River, Clearwater River, and Palouse River.

Beyond the fact that the fish enter Salmon Creek and ascend it for a mile or more, we were able to ascertain nothing concerning the value of this stream.

Malade River is effectually shut off by high falls near its mouth. Trout are said to ascend the stream during high water in the spring, but it becomes impassable later. The stream often goes dry for a distance of many miles along the lower part of its course, and has also other impassable falls in its upper course.

Bruneau River was formerly an important stream for spawning salmon, which reached its head waters in October, according to the statement of Mr. J. L. Fuller, of Bliss, Idaho. We are informed that a dam recently constructed in the Lower Bruneau now wholly prevents the ascent of fish.

The Owyhee River is still open to salmon, so far as could be learned from reports. Mr. J. L. Fuller has seen them in the extreme head waters of the Owyhee in Nevada.

Boise River, like the Bruneau, was formerly a salmon stream, but is now partly or entirely closed by a dam near Caldwell, and is unsuitable by placer mining in the upper part of the stream.

The Payette, Salmon, and Clearwater rivers are all available spawning-grounds for the salmon, and we learned of no obstructions in these streams.

The Grande Ronde River is ascended as far as La Grande, where a dam obstructs further progress.

A high falls at the mouth of the Palouse River prevents the ascent of salmon.

The principal streams and lakes tributary to the Columbia River above the mouth of the Snake are: Yakima River, Wenatchee River, Chelan Lake, Okanagan River, Spokane River, Little Spokane River, Cœur d'Alene Lake, Colville River, Kettle River, and Pend d'Oreille River and its numerous tributary streams and lakes.

Up to 1885 the Yakima River was visited by three or four species of salmon, including the quinnat, in great numbers. Important spawning-beds were located in the bed of the stream; but in recent years but few salmon have made their appearance in this river. No artificial obstructions have been interposed, and the decline can hardly be due to any change in the character of the stream.

We were not able to visit Chelan Lake and Wenatchee and Okanagan rivers, and do not know to what extent salmon frequent these waters. Spokane River, below the falls, was formerly an important salmon stream containing large spawning-beds, but salmon are rarely seen there now. The steelhead still occurs in considerable numbers in the Spokane.

The Little Spokane, as already stated elsewhere, was visited by salmon in great numbers in 1882 and previous years, but since 1882 the number has been very few.

Salmon have never been able to reach Cœur d'Alene Lake, Spokane Falls apparently having proved an effective barrier to their ascent.

Only the few miles of Colville River below Meyers Falls can be reached by salmon, and it is certain that this was formerly an important spawning-ground. The portion of Colville River above the falls would prove excellent for salmon, but Meyers Falls form an absolute barrier. Kettle River flows into the Columbia from the west, just above Kettle Falls. It was not visited by us, and we were not able to get any reliable information regarding it.

The Pend d'Oreille River and the numerous important streams and lakes tributary to it have been discussed elsewhere in this paper. The occurrence of salmon in Kettle River and the lower part of the Pend d'Oreille is dependent upon their ability to ascend Kettle Falls. That salmon formerly reached and ascended the Lower Kettle Falls seems pretty well established; but whether they have ever passed the Upper Kettle Falls is not so certain. The Upper Falls, upon examination, do not appear to be as formidable as the Lower. The fact that so little evidence could be secured regarding the occurrence of salmon in any of these waters renders it highly probable that at no time have they ever ascended in any considerable numbers above the Upper Kettle Falls.

While it is true that the salmon are shut out by falls and dams from a large area of the Columbia and especially the Snake River basins, and while it is also true that the limitations are increasing as streams become useful for irrigation purposes and for mining, it is nevertheless certain that the decrease in the numbers of salmon, due to ill-regulated fishing in the lower Columbia, has so far outstripped the decrease in area of spawning-beds that the latter are now more than ample for all the fish that appear. We do not, therefore, believe that increasing the spawning-grounds through the removal of obstructions would materially benefit the salmon industry. In our judgment, the streams can be repopulated only by regulating the fishing in the lower Columbia and at the same time increasing the output from the hatcheries.

The young of this species were taken in abundance at the mouth of the Natchess River, near North Yakima, Wash., and in the Pataha River at Starbuck, Wash. The largest individual seen was 88 mm. long, the smallest 55 mm.; the average is about 70 mm. These are evidently the young of the previous year, and their uniformity in size indicates clearly that all pass out of the brooks to the sea, or at least to the deeper river channels, during the first and second years. We count in these young specimens 133 to 140 scales in the lateral line, 16 or 17 branchiostegal rays, 7 + 12 gill-rakers, and 15 or 16 rays in the anal fin.

26. **Salmo gairdneri** Richardson. *Steelhead.* The steelhead is an abundant fish in the larger streams of the Columbia basin, especially about Spokane and the mouth of the Pend d'Oreille. Several fine examples of this fish were taken with the spoon by Mr. B. A. Bean in September, 1892, near Spokane. These were called "salmon" by the residents, and Mr. Bean is of the opinion that most, if not all, the "salmon" which they take by trolling are really not salmon, but the steelhead. Mr. Bean was also told that the "salmon" about the mouth of the Pend d'Oreille and Salmon rivers are taken by trolling, and it is quite likely that these also are steelheads.

27. **Salmo mykiss** (Walbaum). *Rocky Mountain Trout; "Sa-pen-gue"* of Fort Hall Indians.

A very large series of trout from the Columbia basin has been examined and from widely separated localities. Specimens were not preserved in every case, but an examination was made of trout from the following places: Snake River at Idaho Falls; Ross Fork and Mink Creek near Pocatello; Little Wood River at Shoshone; Pataha River at Starbuck; Little Spokane River at Dart's Mill; Lake Cœur d'Alene; Lake Pend d'Oreille at Sand Point; Pend d'Oreille River at various places between Newport and the mouth of Salmon River; mouth of Colville River; Newaukum River at Chehalis; Green River at Hot Springs.

With every additional collection of black-spotted trout it becomes increasingly difficult to recognize any of the distinctions, specific or subspecific, which have been set up. The present collection adds not a little to the difficulty. We are now convinced that the greater number of the "subspecies" of *S. mykiss* have no sufficient foundation. We find our specimens from the Upper Snake River (Ross Fork and Mink Creek at Pocatello) to be typical *mykiss*, having small scales, in 176 to 180 transverse rows, and a deep red dash on inner side of mandible. The spots are most abundant posteriorly, and the specimens are scarcely to be distinguished from the so-called *Salmo mykiss pleuriticus* of the Colorado River. When taken in the larger river channels the fish is lighter colored, with finer spots and fainter red mark on lower jaw. Between such typical *mykiss* and the form represented in our collection from such coastwise streams as the Newaukum River at Chehalis, Wash., there seems to be a wide difference. The latter has conspicuously larger scales (in 120 to 130 cross rows) and no red streak on lower jaw. The sea-run individuals of this latter kind we believe to be the steelhead (*S. gairdneri*), and between it and the *mykiss* we are now unable to draw any sharp line. Thus the Wood River specimens have fine scales (150 to 163 transverse rows) and usually no red dash under the jaw. Some specimens show traces of the latter, and in such it is usually faint and irregular.

From the Umatilla River at Pendleton, the Natchess River at North Yakima, and the Pataha River at Starbuck the scales are intermediate in size, ranging from 142 to 163 in number, averaging perhaps 148. In these the lower jaw shows no red. Specimens from the Cœur d'Alene region have the red dashes usually very distinct, but vary greatly in size of scales. Wardner examples look much like typical *mykiss*, with 165 to 170 scales. From Cœur d'Alene Lake we find 130 to 166, with the average about 145, while from the Little Spokane River at Dart's Mill specimens with conspicuous red dash on mandibles have the

scales averaging 125 in number. Trout from the Green River at Hot Springs, Wash., and from the Newaukum River at Chehalis have also 123 to 130 scales. We think it not unlikely that the coastwise form should be recognized as *Salmo mykiss gairdneri*, though the question is sadly in need of systematic and thorough investigation.

The Fort Hall Indians call the trout *Sa-pen-gue*, which, they say, means *good fish*.

28. Salvelinus malma (Walbaum). *Charr; "Salmon Trout;" "Bull Trout."*

Salmo malma Walbaum, Artedi Piscium, 66, 1792. Type locality: Kamchatka.

Abundant in the Pend d'Oreille River. At La Claires we saw in the possession of an Indian several fine specimens, the largest of which was 26 inches long, 11 inches in greatest circumference, and weighed 5 pounds and 1 ounce; the length of the head was 6 inches. The people along the river know this fish as the "charr," while in Montana, from Flathead Lake to Missoula, it is called "salmon trout" or "bull trout." One example was obtained by Bean and Woolman from Lake Pend d'Oreille. One specimen of 3 pounds weight was seen at North Yakima, which had been caught in the Natchess River. *Salvelinus malma* has not yet been found in the Snake River, and it is doubtful if it occurs in that basin above the falls. The only *Salvelinus* yet known in that basin is from Henry Lake, and was identified by Dr. Bean as *S. namaycush*.

29. Columbia transmontana Eigenmann & Eigenmann.

Columbia transmontana Eigenmann & Eigenmann, Science, October 21, 1892. Type locality: Umatilla River, at Umatilla, Oregon.

Seventy-three specimens of this very interesting species were obtained in the Walla Walla River at Wallula, Wash., August 23, 1893, by Messrs. Thoburn and Rutter. The largest specimen measures $3\frac{11}{16}$ inches in total length. Diligent search was made for this fish at the locality where the types were obtained, but none was found. The specimens taken at Wallula were found in only one place, about 250 feet below the railroad bridge, on the edge of a large patch of *Chara* and in water about 3 feet deep, where the bottom was somewhat muddy. The temperature of the water here was 70° at 11:30 a. m., when the air was 80°.

Measurements of the larger specimens give the following results: Head, $3\frac{1}{4}$ to $3\frac{1}{3}$; depth, $3\frac{1}{5}$ to $3\frac{1}{4}$; eye, $3\frac{1}{4}$; snout, 3. D. II, 9; A. II, 6; V. 8; P. 10 to 12. Scales 9-43-8.

Ground color pale straw-color, profusely covered with fine dark-brown specks which form irregular blotches along the course of the lateral line and on median line of back, there being 1 at anterior base of dorsal and 3 or 4 on the caudal peduncle; head with fine dark spots on sides; dorsal, anal, and caudal barred with dark. Dorsal and anal spines strong; the first dorsal spine short, less than length of eye, the second much longer, as long as from tip of snout to middle of pupil; first anal spine scarcely as long as first dorsal; second anal spine about one-third length of head; longest dorsal rays about $1\frac{1}{2}$ in head; those of anal shorter.

30. Gasterosteus microcephalus Girard. Abundant in the Walla Walla River at Wallula, in Lake Washington, and in Skookumchuck River near Chehalis, Wash.; not seen elsewhere by us. Specimens taken were found to be extremely variable in the extent to which lateral shields are developed. In a considerable proportion the plates are developed along the entire length of sides of body and the caudal peduncle is sharply keeled. Others have but 4 or 5 plates developed, the caudal peduncle being then without trace of carina. Between these extremes are all possible intermediate conditions, thus establishing a series comparable with that recently reported on by Dr. G. A. Boulenger as occurring in the common European species.

31. Cottus asper (Richardson). A single specimen, 145 mm. long, from the Walla Walla River at Wallula, Wash., and two small specimens from Lake Washington. The dorsals contain 9 spines and 21 rays, and are slightly connected at base. Soft dorsal high, the longest ray $2\frac{1}{3}$ in length of head, the posterior rays reaching base of caudal. Anal fin with 17 rays; pectorals, 16. Interorbital space very wide, equaling diameter of eye, not concave. Prickles coarser and less closely crowded than in the Sacramento River specimens, distinctly visible without the aid of a lens, and directed upwards and backwards. The lateral line is complete, without abrupt angle under last dorsal rays, and contains 38 pores. Anus separated from first anal ray by a space equaling two-thirds diameter of orbit. Band of palatine teeth weak. Anterior nostril in a short tube. The coarser prickles, more anterior position of vent, and flatter interorbital space probably indicate that *C. asper* is separable, at least subspecifically, from the Sacramento River form. Material is not now at hand to settle this point.

32. Cottus rhotheus (Rosa Smith).

This strongly-marked species is abundant in the Spokane region, and was taken at the following stations: Little Spokane River at Dart's Mill near Spokane, and at Chattaroy, Wash.; Columbia River at Colville, Wash; Cœur d'Alene Lake near Cœur d'Alene, Idaho; Clearwater River near Lewiston, Idaho; Walla Walla River at Wallula, Oreg.; Hangman Creek at Tekoa, Wash.; Natchess River at North Yakima, Wash.; Newaukum River near Chehalis, Wash.; Snoqualmie River at Snoqualmie Falls, Wash.

The salient features of this species are: (1) The pointed wedge-shaped profile of head, as viewed from above; this contrasting strongly with the usual broadly-rounded contour of other species. (2) The wide horizontal mouth, quite at lower profile of head. (3) The noticeably concave interorbital and occipital regions. (4) The very broad and long palatine band of teeth. (5) The rather slender body and the extremely slender caudal peduncle, the latter expanding fan-like at base of caudal fin. (6) The dorsals usually separate; when united, at extreme base only. (7) Lateral line complete. (8) Sides usually well invested with prickles, which are triangular and coarse, and less closely placed than in *asper*. They are arranged more or less definitely in oblique series. There is considerable variation in the completeness of the investment, and in one specimen from Chehalis an axillary patch only is present.

The specimens from Chattaroy and from Snoqualmie Falls are referred to this species with doubts as to their identity.

The following table will give an idea of the amount of variation in number of fin-rays, found in this species:

Locality.	Spinous dorsal.		Soft dorsal.		Anal.			Pectoral.		
	VII.	VIII.	16	17	11	12	13	15	16	Lateral line.
Little Spokane River	4	6	6	4	3	6	1	.....	10	32 to 34
Natchess River	.....	2	2	.....	.....	1	1	.....	2	32, 33
Newaukum River	.....	2	1	1	1	.....	1	2	.....	.....
Walla Walla River	1	2	1	2	1	2	.....	.....	3	.....
Colville River	.....	1	1	.....	.....	1	.....	1	.....	.....
Tekoa	1	5	5	1	1	4	1	.....	.....	.....
Cœur d'Alene	1	4	3	2	3	2	.....	.....	5	.....
Lewiston	.....	1	1	.....	.....	1	.....	.....	1	.....

33. Cottus punctulatus (Gill). *Ah-we.*

Cottopsis semiscaber Cope. Hayden's 5th Report, 1871, 476. Type locality: Fort Hall, Idaho.

Numerous specimens from Green River, Wyoming. Comparing these with typical *semiscaber* from the vicinity of Pocatello, Idaho, we can appreciate no difference whatever, except in the matter of armature. None of our Green River specimens show any prickles whatever. About half the Pocatello specimens are also naked and are indistinguishable from typical *punctulatus;* in the others more or less prickles are developed, varying from a few in axil of pectorals to a band covering more than half of the sides. As this is not an unusual amount of variation, we do not consider *C. semiscaber* worthy of recognition. The relations of *C. punctulatus* with the eastern species have not been carefully worked out, and it seems best to recognize it for the present as distinct. Specimens from Green River, Wyoming, and from Mink Creek, Ross Fork, and Port Neuf River, Pocatello, Idaho. The collection contains also two specimens from Thompson Falls and three from Flathead Lake, which seem to be this species. By the Fort Hall Indians this fish is called *ah-we*, a word meaning *horns*.

34 Cottus perplexus, sp. nov. (Plate VIII.)

Type locality: Skookumchuck River, near Chehalis, Wash., where 13 specimens were collected, August 28, 1893, by Drs. Gilbert and Jenkins. Associate type locality: Newaukum River near Chehalis, Wash.; 26 specimens, collected by Drs. Gilbert and Jenkins, August 28, 1893. Type, No. 45387, U. S. Nat. Mus. Co-types, No. 45388 (Newaukum River), U. S. Nat. Mus.; and Nos. 1324 to 1343 (Skookumchuck River), Museum Leland Stanford Junior University. Related to *Cottus punctulatus*.

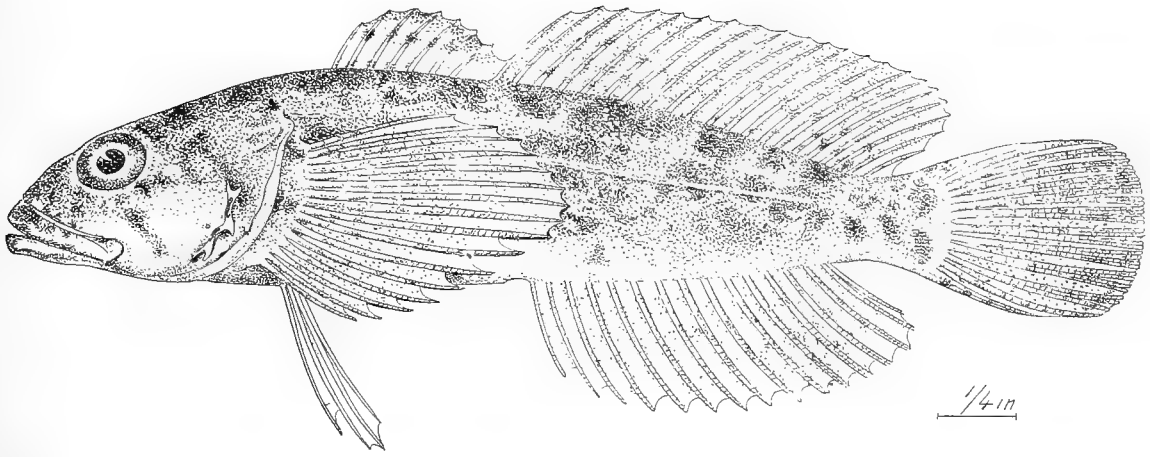


Fig. 1. COTTUS PERPLEXUS, sp. nov. (Type.) Skookumchuck River, Chehalis, Washington.

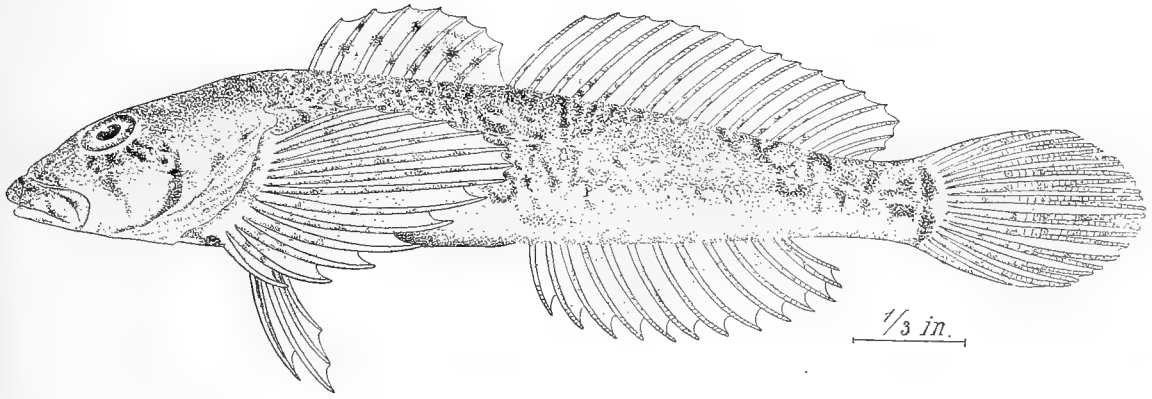


Fig. 2. COTTUS LEIOPOMUS, sp. nov. (Type.) Little Wood River, Shoshone, Idaho.

Description: Head, 3⅛; depth, 4⅛; eye, 4; snout, 4; interorbital width, 5½. D. VII, 21; A. 15; P. 16; V. I, 4. Least depth of caudal peduncle greater than snout, 3⅜ in head; interorbital space rather broad, about 1½ in eye.

The body is deeper and more compressed than in any other species known to us, this being especially noticeable posteriorly; the caudal peduncle is very short and deep, and is entirely overlapped by the posterior dorsal rays which extend beyond base of caudal fin. Length of caudal peduncle from base of last dorsal ray about ⅔ depth of same. Depth of body at origin of anal fin ⅔ length of head. Interorbital space slightly concave; occiput flat or transversely convex. Mouth oblique, the maxillary reaching vertical from posterior margin of pupil, 2½ in head. Teeth in a very narrow crescentic band on vomer, none on palatines. Upper preopercular spine short and broad, curved or simply directed upward; below this two stout, blunt spines directed downward. Body, in the type specimen, entirely naked; lateral line incomplete, not reaching end of soft dorsal.

Spinous dorsal low, the longest spines not greater than length of snout; soft fins all high, the 15th dorsal ray equal to snout and eye; a broad membrane always connecting the two dorsals, the notch inconspicuous. Last rays of anal as well as dorsal extend beyond base of caudal; first anal ray under third ray of soft dorsal; ventral spine and rays slender and weak. Anus midway between base of caudal fin and front of eye

Color in alcohol, back and sides with vermiculations of light and dark, the back with 5 or 6 ill-defined black crossbars, which usually reach the lateral line; the usual black bar at base of caudal, emarginate posteriorly; below the lateral line a number of small, quadrate, dark blotches, arranged in two irregular series; lower parts unmarked except with fine dark punctulations; dorsal, pectoral, and caudal fins crossbarred with dark; anal and ventrals with numerous small dark specks. Length, 91 mm.

The co-types show that this species is subject to some variations which should be mentioned. Head, 3 to 3⅛; depth, 4⅛ to 4½. D. VII or VIII, 18 to 21; A. 14 to 16; P. 14 to 16. While the body is usually entirely naked, there is occasionally an axillary band of prickles, sometimes supplemented by a single irregular series of prickles along base of the dorsal fin. The notch in the membrane connecting the dorsals is usually inconspicuous. In some examples the black crossbars on the back do not reach the lateral line. The small, quadrate, dark blotches below the lateral line are sometimes arranged in a single series parallel with base of anal, sometimes in two irregular series.

The following table gives the fin formula in a number of individuals of this species:

Locality.	Dorsal spines.		Dorsal rays.				Anal rays.			No. of specimens examined.
	VII.	VIII.	18	19	20	21	14	15	16	
Skookumchuck River	3	10	4	5	2	2	6	6	1	13
Newaukum River	3	2	2	2	.....	1	1	3	1	26
Natchess River	4	1	1	3	1	.....	2	2	1	5

From *Cottus punctulatus*, which it most closely resembles, this species may be distinguished by its deeper body, more elongate anal fin, the broad union between the dorsals, the absence of palatine teeth, and the different coloration.

35. Cottus leiopomus sp. nov. (λεῖος, smooth; πῶμα, cover, opercle.) (Plate VIII.)

Type locality: Upper Little Wood River, Shoshone, Idaho, where 2 specimens were collected, September, 1893, by Mr. H. H. Kinsey. Type, No. 45389, U. S. Nat. Mus. Co-type, No. 1151, Museum Leland Stanford Junior University. Related to *Cottus philonips*.

Head, 3½; depth, 5½; eye, 4⅔; snout, 3⅙; interorbital width, 7½; D. VII–17; A. 12; P. 13; V. I, 4. Least depth of caudal peduncle about equal to length of snout; interorbital space very narrow, much less than diameter of eye; mouth small, maxillary reaching vertical from middle of eye, a wide strip visible laterally in the closed mouth. Preopercular spines entirely absent, the preopercular margin evenly rounded throughout, without prominence, and without the least trace of a spine.

Vomer with a very narrow band of teeth; palatines naked; skin wholly naked, lateral line complete. Dorsal fins not joined unless at extreme base; fins all low, the pectorals barely reaching front of anal; front of anal under third ray of second dorsal, its last ray under fourth from last ray of latter. Free portion of caudal peduncle (behind last anal ray) contained $1\frac{2}{3}$ in head; portion behind base of last dorsal ray 3 in head; neither dorsal nor anal reaching base of caudal when depressed.

Color in alcohol: head on sides rather finely vermiculated with light and dark; plain whitish below; not coarsely spotted or blotched as in *philonips;* dorsal bars indistinct; two narrow black lines downward and backward from the eye; an evenly convex dark bar at base of caudal; dorsals, pectorals, and caudal faintly crossbarred.

Length 81 mm.

The second specimen, which is 71 mm. long, agrees closely in every respect with the type.

This species is very closely related to *Cottus philonips*, from which it differs only in the total absence of any preopercular spine. In both specimens, and on each side, the preopercular margin is entirely rounded throughout, without any prominence and without the least trace of a spine. It seems very improbable that the two should agree in being merely abnormal in this respect, and we are forced to conclude that a form exists which is peculiar to the Malade River, a stream otherwise remarkable in its ichthyologic features.

36. Cottus philonips Eigenmann.

This name was proposed as a substitute for *Cottus minutus* Pallas, supposed to be preoccupied, and *Cottus microstomus* (Lockington), not of Hæckel. The first mentioned is perfectly available, but was applied to a specimen from the island of Talek, near Tanisk, in the Okhotsk Sea. It is very doubtful, therefore, whether *C. minutus* should be used for any American species in advance of comparison with the Siberian form. From the Aleutian Island species (*C. microstomus* Lockington), *C. philonips* differs in many important respects, and is undoubtedly distinct. Thus the Alaskan form has the posterior nostrils in short but conspicuous tubes, the preorbital produced into a lobe which conceals all of the maxillary except the extreme tip, and the dorsal fin with 8 or 9 spines and 18 to 20 soft rays.

Cottus philonips is a small-headed form, typically with perfectly smooth skin and unarmed palatines. Like most other species of the genus it occasionally develops a band of postaxillary prickles, which are often accompanied in the same specimens by a small patch of teeth on the palatine bones. The head is less strongly armed than usual, the single preopercular spine being short, the preopercular margin otherwise wholly unarmed. In this respect *C. philonips* differs from all other western species of *Cottus*, except the Alaskan form above mentioned.

The dorsal varies from VII or VIII, 16 to 18; the anal from 12 to 14. The nostrils are without tubes, and the preorbital little produced, exposing the greater part of maxillary in closed mouth.

Specimens were obtained in the Port Neuf River near Pocatello, at Snoqualmie Falls, and in a spring branch emptying into the South Fork of the Cœur d'Alene River, near Wardner, Idaho. We have also seen specimens taken from Birch Creek, in western Idaho, by Merriam and Bailey.

37. Cottus marginatus Bean.

Six small specimens from Mill Creek at Walla Walla (the type locality of *marginatus*) agree with Bean's description and differ from all other western specimens of *Cottus* which we have seen in having but three soft rays in the ventral fins. So far as can be ascertained from our very immature specimens, *marginatus* strongly resembles *perplexus*, with which it agrees in fin rays, naked skin, the incomplete lateral line, and the absence of palatine teeth. *C. perplexus* has constantly 4 soft rays in the ventral fins, and other differences may appear when compared with adult specimens. In our specimens of *marginatus*, the anus varies in position, being sometimes nearer base of caudal fin than snout, sometimes nearer snout. Twenty-two small specimens, collected by Bean and Woolman at Sand Point, Idaho, are for the present referred to this species, though we are not certain that this identification is correct. The ventrals seem to be I, 3, but the body is more or less covered with prickles.

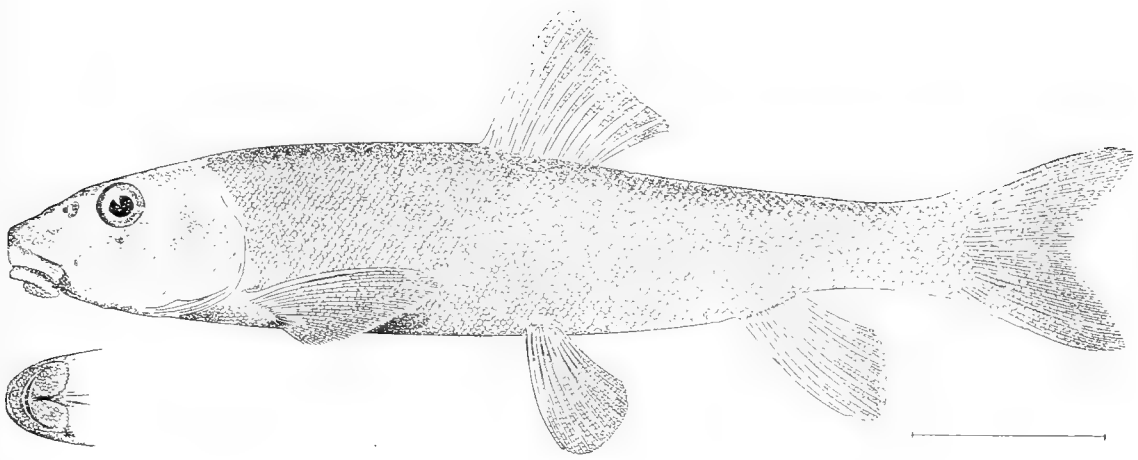


Fig. 1. CATOSTOMUS POCATELLO, sp. nov. (Type.) Ross Fork of Snake River, Pocatello, Idaho.

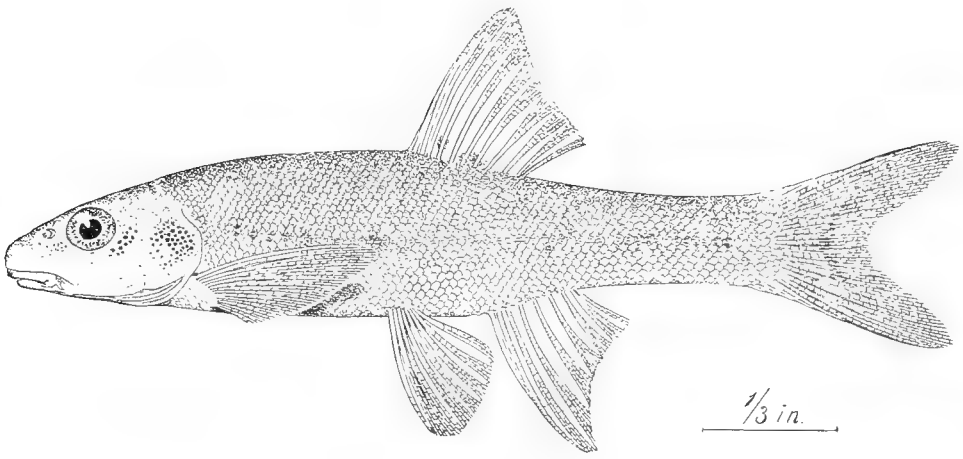


Fig. 2. AGOSIA UMATILLA, sp. nov. (Type.) Columbia River, Umatilla, Oregon.

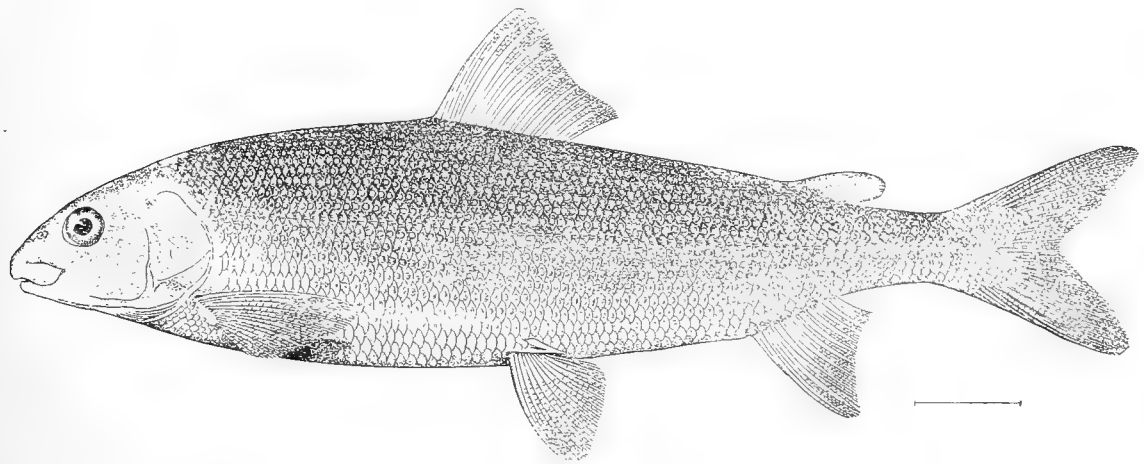


Fig. 3. COREGONUS WILLIAMSONI Girard. Breeding male. Little Spokane River, Washington.

NOTES ON WILLIAMSON'S WHITEFISH IN BREEDING COLORS, FROM LITTLE SPOKANE RIVER, WASHINGTON, AND REMARKS ON THE DISTRIBUTION OF THE SPECIES.

[By Barton A. Bean, assistant curator, Department of Fishes, U. S. National Museum.]

In the fall of 1892, while on an investigation of the streams in eastern Washington with a view of locating a site for a fish-hatchery for the U. S. Fish Commission, the writer had the good fortune to secure a very fine specimen of *Coregonus williamsoni* approaching the breeding condition.

As will be seen in the accompanying illustration (Plate IX) the tubercles on the scales at this time are very prominent, situated on the middle of the scales, milk-white in color, and forming horizontal lines along the body from head to tail. About sixteen of these lines can be counted between the back and ventral edge of the body. The tubercles show on the abdomen, but the color of that portion of the body and of the tubercles being similar, they are indistinct.

Color: Dark on back, sides a lighter steel-gray, and under parts white; all fins tipped with black; caudal and adipose fins steel-blue.

D. 14; A. 13; scales, 9–83–10; pores in lateral line, 80; head, 5; depth, 4; eye, $4\frac{1}{3}$; snout, 3. Gill-rakers short, about 12 below the angle. Mouth very small, the maxilla barely reaching vertical through front of eye. Dorsal fin highest in front, gradually graduated to last ray, which is less than one-half length of anterior rays. The greatest height of the dorsal slightly exceeds its length of base, which equals the length of the ventral fins, being considerably less than the length of the pectorals, but exactly that of the anal fin. Caudal fin deeply forked.

The specimen here described and illustrated measures not quite 11 inches; it is a male and was taken in Little Spokane River near Clark Springs, October 5, 1892.

Another example, a little larger ($12\frac{1}{2}$ inches), was obtained by Mr. A. J. Woolman in the Little Spokane, in September, 1892. The tubercles on this specimen are well preserved, those on the former having disappeared owing to exposure to the air and handling while being drawn.

Mr. Woolman's example has the following characters: D. 13; A. 13. Scales 10–80–10. Head, 5; depth, 4. Adipose fin very long, the length of its base being contained $2\frac{1}{2}$ times in the head's length. Color as in the preceding.

So far as we are aware the breeding whitefish, of any species, has not been heretofore described in America. In Faune des Vertebres de la Suisse, volume V, Hist. Nat. des Poissons, Génève, 1890, Dr. Victor Fatio presents the following note on the breeding colors of *Coregonus exiguus* of Switzerland:

> Adult males differ from the females by a more slender body, larger head, stouter muzzle of snout, the greater development of the paired fins, especially the pectorals, and during the breeding season by a more intense coloration, also by the stronger and more numerous epidermic buttons, and sometimes by the more strongly arched scales on the lateral line.

It is unfortunate that we failed to secure female fish. The whitefish were very abundant in the Little Spokane; large numbers were observed. They were, however, exceedingly shy and difficult of capture, and our efforts to net them were entirely ineffectual.

In most of the streams seined by Mr. Woolman and the writer in western Montana, Idaho, and Washington the young, parr-marked whitefish was taken. These young fish were obtained in several quiet streams, almost sluggish, so weak was the current. In Spokane River at the city of Spokane large numbers of adult whitefish could be seen from the city bridges. They would lie or swim close to the bottom, keeping in the shade of the bridges, and would bite at grasshoppers. The artificial fly seemed to have no attraction for the fish.

This whitefish grows to a length of 15 inches, has excellent flesh, and is by many confused with the grayling, *Thymallus*. The Columbia River chub, *Mylocheilus caurinus* is often called "whitefish." The type of *Coregonus williamsoni* was obtained in the Des Chutes River, Oregon, and described by Dr. Girard in the Proceedings of the Philadelphia Academy of Sciences in 1856, and again in 1858 in the Pacific Railroad Survey reports. Later recorded localities are: Willamette and Columbia rivers, Oregon; the Columbia and its tributaries in Washington; Lake Tahoe, Trout Creek and Truckee River, California; lakes and streams of Idaho, Montana, Wyoming, Colorado, and Utah. The species ranges north into British America and eastward to the mountain tributaries of the Upper Missouri, several of the localities given by Prof. Evermann being east of the Continental Divide.

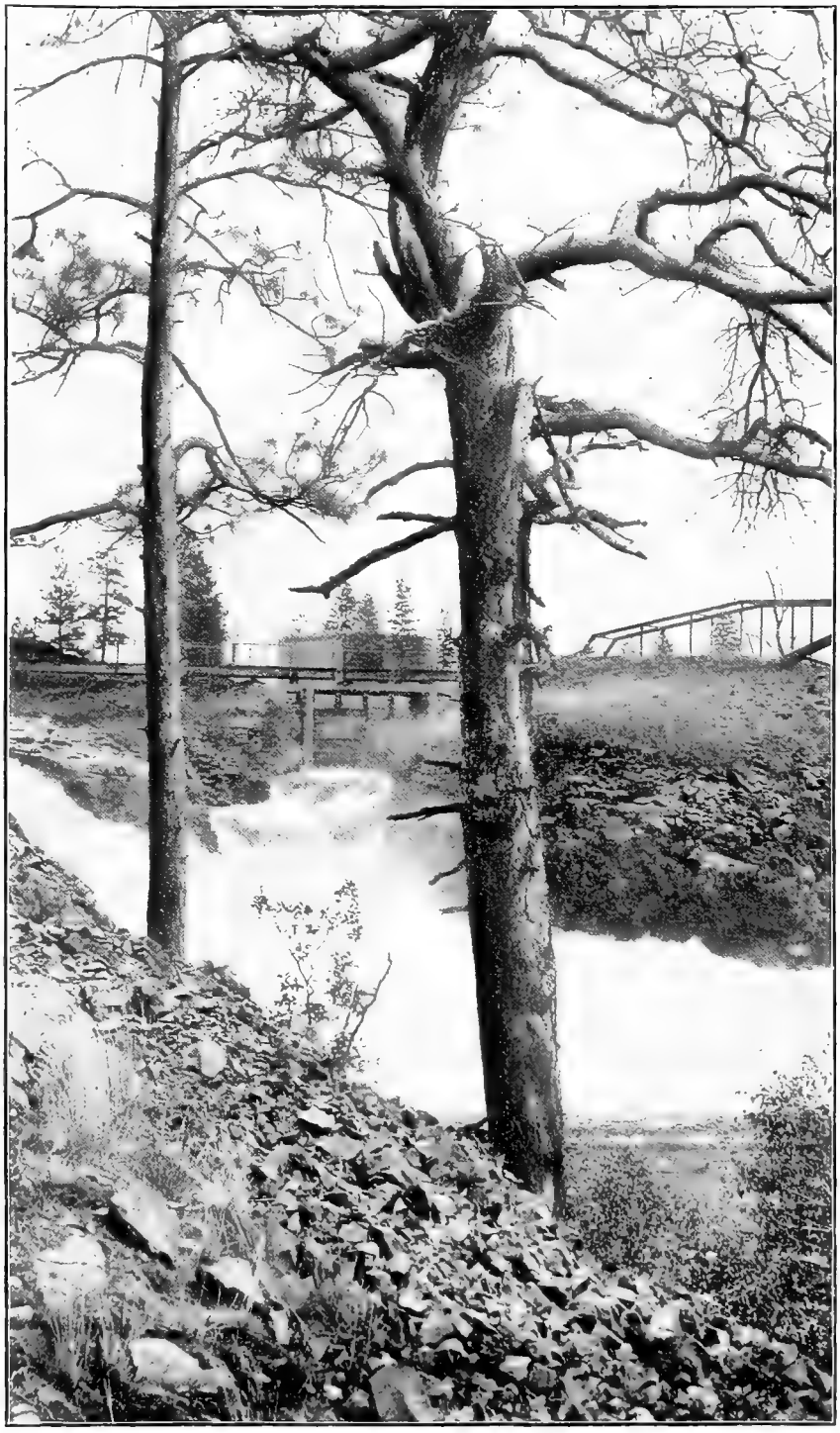
ANNOTATED LIST OF REPTILES AND BATRACHIANS.

[By John Van Denburgh, student, Leland Stanford Junior University.]

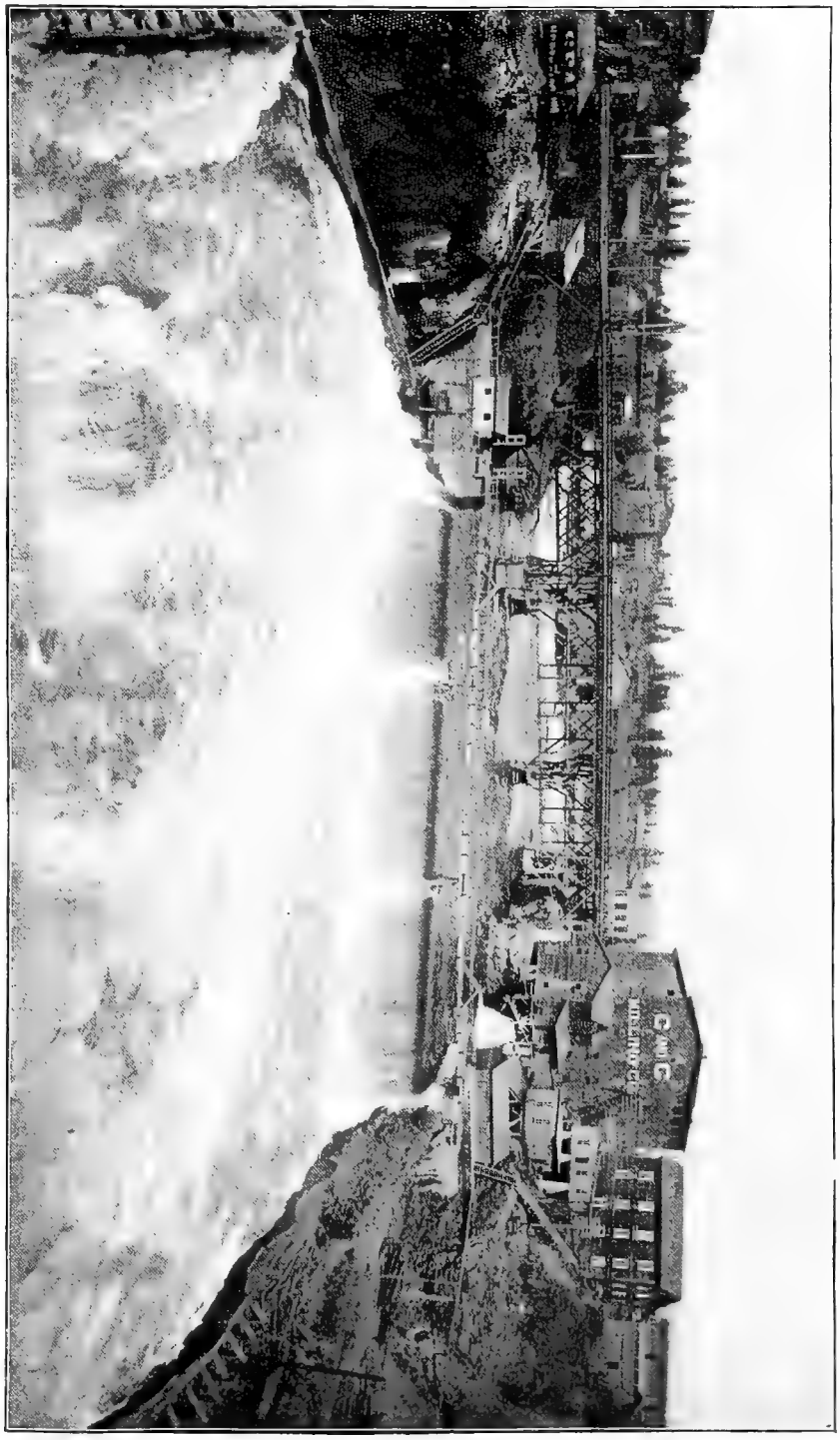
But few reptiles and batrachians were observed by members of the expedition, partly because no special effort was made to collect them, and partly because they were not abundant in most of the region traversed. Both lizards and snakes seemed to be rare on the barren lava plains of the Snake River, where *Sceloporus graciosus*, *Phrynosoma douglassi*, and *Phrynosoma platyrhinus* were the only species seen. The case was different in the bottom lands of the Snake River below Shoshone Falls, Idaho. Here lizards were extremely abundant and in considerable variety. Species of *Uta*, *Crotaphytus*, and *Cnemidophorus* were as numerously represented as on the hot deserts of southern California. Two species of *Sceloporus* were also seen, but of these no specimens were secured. The richness of reptilian life on the sandy floor of the valley contrasted strongly with the reverse condition on the lava plains immediately bordering the valley and but a few hundred feet above it.

1. **Crotaphytus wislizenii** Baird & Girard. Two full-grown specimens collected in the bottom lands of the Snake River near Bliss, Idaho, August 8. With the exception of *Cnemidophorus tigris*, this was the most abundant species observed.
2. **Uta stansburiana** Baird & Girard. A single badly mutilated specimen from Snake River bottoms, near Bliss, taken August 8. The species was not rare, and was usually observed on rocks.
3. **Sceloporus graciosus** Baird & Girard. Six specimens from near Pocatello, Idaho, August 3; two specimens from near Idaho Falls, Idaho, August 5; three specimens from near Umatilla, Oreg., August 11. This species was always observed on the ground, and was seen both among the coarser basalt and on the finer sands and gravels.
4. **Phrynosoma douglassii** (Bell). This pygmy horned toad seemed by no means abundant. The largest specimen, 68 mm. long, was taken at Pocatello, Idaho, August 4. Two other specimens were captured: one on the Clearwater River, 7 miles above Lewiston, August 15; the other at North Yakima, Wash., August 23.

5. **Phrynosoma platyrhinos** Girard. One specimen from Bliss, Idaho, August 8; two—a male and a female—from the lava plains between Shoshone and the Snake River, August 7. In the latter locality the species was abundant. The two specimens there secured have the series of enlarged gulars almost obsolete, it being represented on each side by two or three scales slightly more pointed than the other gulars. The number of femoral pores is 8 in the male, 10 in the female. The tympanum is fully scaled in one, only partially so in the other.
6. **Cnemidophorus tigris** Baird & Girard. The "sand lizard" was the most abundant species in Snake River bottoms. A single specimen was collected near Bliss, Idaho, August 8. This seems not to differ from Owen's valley specimens, and we therefore follow Dr. Stejneger in the use of the above name.
7. **Thamnophis vagrans** (Baird & Girard). Although the six garter snakes brought in by the expedition show considerable color variation, they unquestionably represent a single species. They were collected at the following localities: 1 specimen, Sand Point, Idaho, August 7; 2 specimens, Clearwater River near Lewiston, Idaho, August 15; 1 specimen, Potlatch Creek near Juliaetta, Idaho, August 16; 1 specimen, Wardner, Idaho, August 18; 1 specimen, Umatilla, Oregon, August 23.
8. **Thamnophis sirtalis parietalis** (Say). One specimen of this variety was obtained on the Little Spokane River near Spokane, in September, 1892, by Mr. A. J. Woolman.
9. **Crotalus lucifer** Baird & Girard. A single specimen taken on the Snake River between Twin Falls and Shoshone Falls, Idaho. The rattler is said to be not abundant in that vicinity.
10. **Diemyctylus torosus** (Esch). Two specimens found in Skookumchuck River near Chehalis, Wash., August 28.
11. **Bufo columbiensis** Baird & Girard. One young specimen, Umatilla, Oregon, August 23, and one adult, Pocatello, Idaho, August 3.
12. **Hyla regilla** Baird & Girard. One specimen, Chehalis, Wash., August 28.
13. **Rana aurora** Baird & Girard. Four specimens from Skookumchuck River near Chehalis, Wash., August 28.
14. **Rana pretiosa** Baird & Girard. Seven specimens, Sand Point, Idaho, August 7; 1 specimen, Pendleton, Oreg., August 12; 2 specimens, Colfax, Wash., August 17; 1 specimen, Little Spokane River, Dart's Mill, Washington, August 18; 4 specimens, Cœur d'Alene, Idaho, August 21; 1 specimen, Post Creek, Montana, September 18, 1892; 1 specimen, Thompson Falls, Montana, September 19, 1892; 5 specimens, Sand Point, Idaho, September 20, 1892; 7 specimens, Little Spokane River, Spokane, Wash., September, 1892; 3 specimens, Clark Spring, Spokane, Wash., October 5, 1892.
15. **Rana pipiens brachycephala** (Cope). One specimen of this handsome frog was secured in the Boise River, at Caldwell, Idaho, August 8. The collection made by Messrs. Bean and Woolman contains three specimens from Post Creek, Montana (September 18), and one from Sand Point, Idaho (September 20).

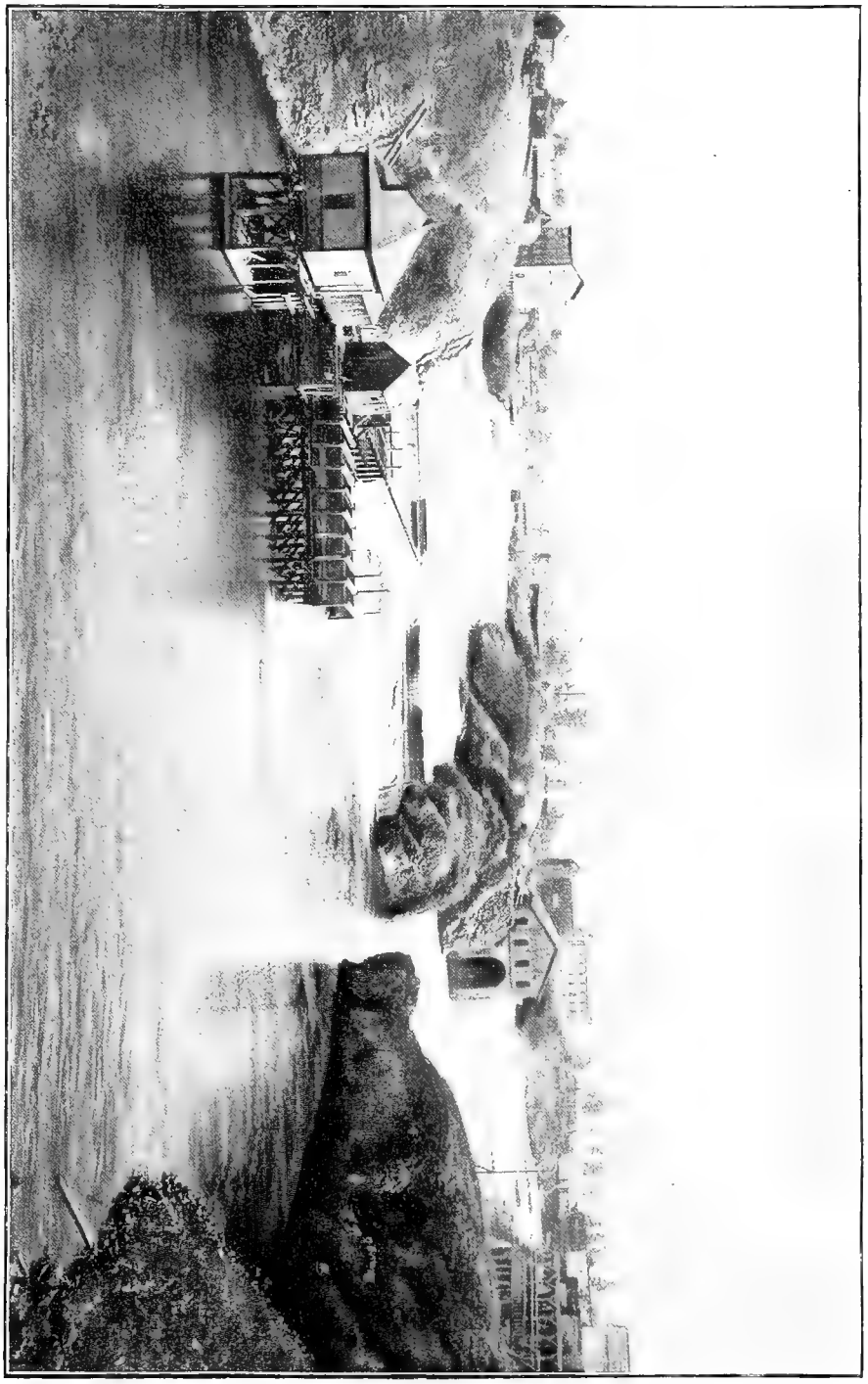


SPOKANE FALLS, SPOKANE, WASHINGTON. PART OF THE UPPER FALLS.

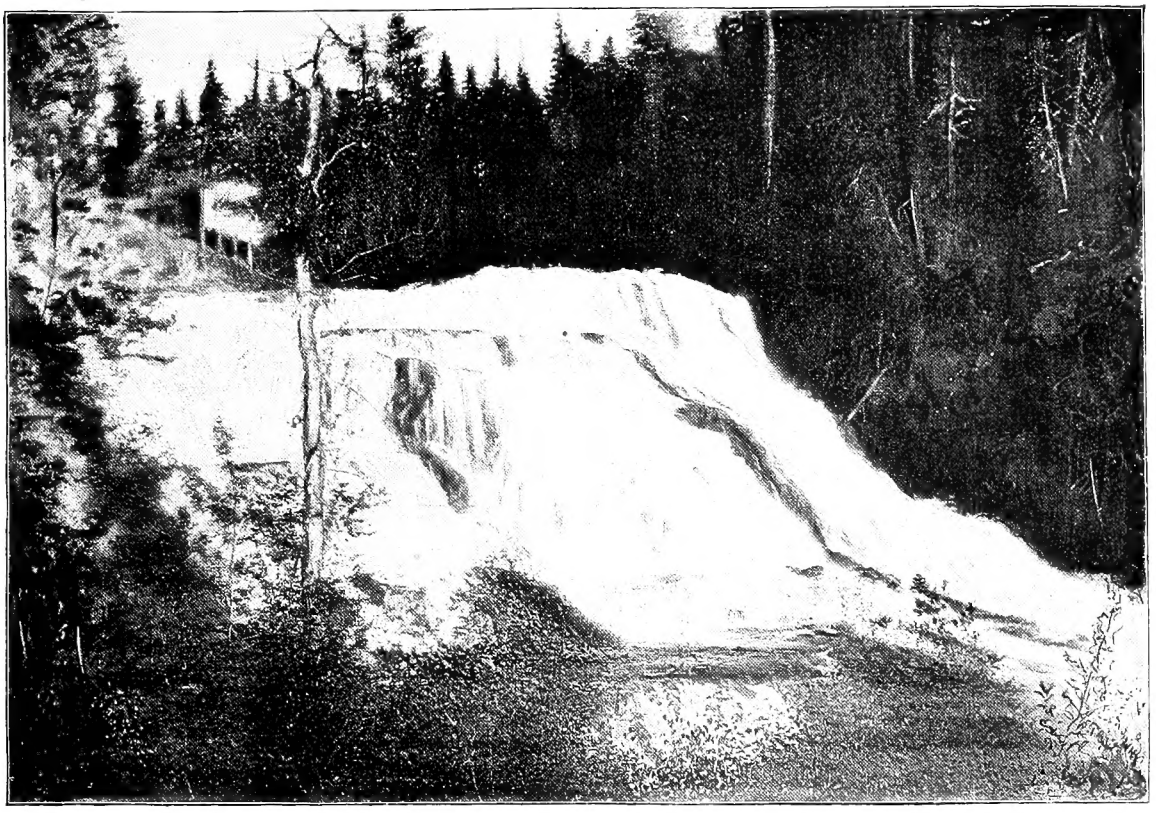


SPOKANE FALLS, SPOKANE, WASHINGTON. FROM MONROE STREET BRIDGE.

PLATE XII.



UPPER SPOKANE FALLS, SPOKANE, WASHINGTON. FROM POST STREET BRIDGE.



MYERS FALLS, COLVILLE RIVER. TOTAL DESCENT ABOUT 80 FEET.

LOWER KETTLE FALLS, COLUMBIA RIVER.