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Production of Nutritional Cataract in Trout.

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In 1931 an investigation showed that, in many of the hatcheries of New York State, practically every trout 6 months of age or older had distinct opacities in both lenses (bilateral cataract). The lenses were not the only organs in the fish that were affected. The different fins, including the tail fin, were abnormal and showed signs of alternating periods of partial degeneration followed by partial regeneration. The iris of the eyes in the older fish showed degenerative changes. The scales likewise showed degenerative changes in these older fish. All fish that had well developed cataracts were dark colored, a condition known to occur in fish that are blind.

This investigation was undertaken to determine whether the cataract in these fish was due to a contagious infection or whether such other factors as diet, light and heredity were the cause.

The methods employed here were much the same as those used in previous work (Hess[1]). Sixteen standard size rearing troughs were used, and were operated at the Caledonia fish hatchery under standard conditions. Fish of 2 different age groups were used, approximately 2½ and 4 months old respectively. There were 2 groups of the younger fish. One (Exps. 4 and 5) were hatched from trout seined from Seneca Lake. The other (Exps. 6, 7, and 8) as well as the older fish used in Exps. 1, 2, and 3 were from hatchery stock. Each trough contained 5000 fish at the beginning of the experiment. Only rainbow trout *(Salmo irideus)* were used.

To test the possibility of contagion 200 trout with cataract were placed for 4 months in a small pond with 400 trout without cataract and fed the control diet of liver and heart.

The older fish at the hatcheries where cataract was so prevalent had been fed exclusively on pig spleen. The fish in the experimental troughs of Exps. 1-7 were therefore given this same diet. In the corresponding control troughs a diet of equal parts of beef liver and beef heart was used. In experiment 8 the fish were fed a mixture of 2 parts of pig spleen and one part of beef liver and beef heart. All fish were fed an abundance of food 6 times daily. It so happened that previous to the experiment the young fish that were used had also been given a diet composed chiefly of pig spleen.

[1] Hess, W. N., *J. Exp. Zool.*, 1935, **70**, 187.

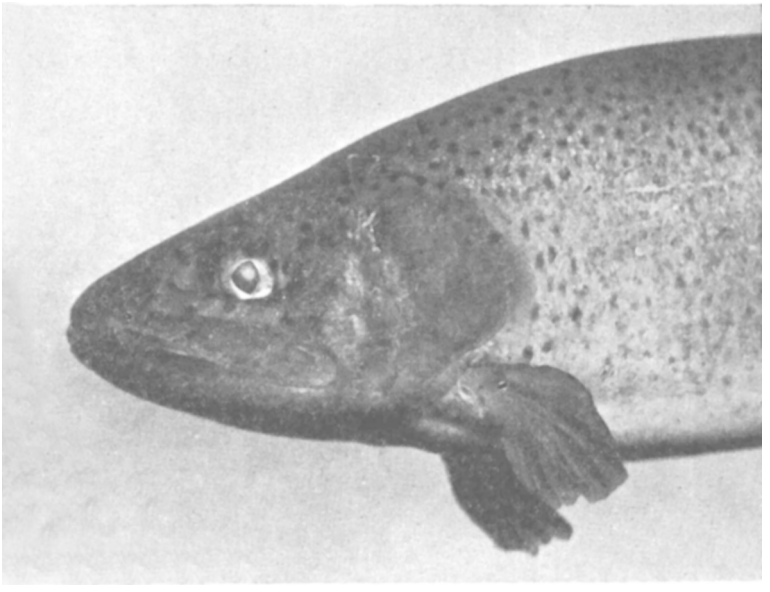

FIG. 1.
Photograph of living rainbow trout showing late stage of cataract. Photographed for the author by G. C. Embody.

In order to test the possible effect of light, some troughs were covered, others were left uncovered, and 2 uncovered troughs were painted white on the inside. All others were painted black. To expose the fish still further to light, the water in some troughs was kept at a depth of 3 inches while in others it was kept at 8 inches.

To test the possibility of a hereditary factor being involved some of the fish (Exps. 4 and 5) were hatched from eggs that had been obtained from trout seined from Seneca Lake. All others were obtained from hatchery trout, a race that had been at the hatchery for years.

Since after 4 months none of the 400 cataract-free trout which had been placed with the 200 trout with cataract had developed cataract, and since histological sections showed no flukes or other parasites in the lenses, it seems clear that the type of cataract under investigation is not of a contagious nature.

In computing the percentage of fish with cataract at the end of the experiment, 200 were taken from each trough and examined under a binocular microscope for evidence of lens opacities.

By consulting Table I it will be seen that cataract appeared in all groups that were fed exclusively on spleen. On the other hand, none of the liver-heart-fed fish, irrespective of other conditions, showed

TABLE I.
Effect of Diet and Light on Development of Cataract in Rainbow Trout.

No. of exp.	No. of trough	Food	Trough covered or uncovered	Depth, water, inches	Av. wt., gm., June 2d	Av. wt., gm., Sept. 2nd	% that survived	% survivors with cataract
1	A	*	covered	8	.64	2.41	82.22	26
	B	†	"	8	.64	3.89	95.96	0
2	C	*	uncovered	3	.64	2.40	60.69	6
	D	†	"	3	.64	3.61	71.46	0
3	E	*	" painted white	3	.64	2.21	13.76	9
	F	†	" " "	3	.64	3.18	68.65	0
4	G	*	covered	8	.27	1.52	35.69	31
	H	†	"	8	.27	2.05	92.96	0
5	I	*	uncovered	3	.27	1.29	27.39	17
	J	†	"	3	.27	1.84	79.77	0
6	K	*	covered	8	.32	1.49	55.49	11
	L	†	"	8	.32	3.07	95.55	0
7	M	*	uncovered	8	.32	1.91	56.53	22
	N	†	"	8	.32	2.61	75.46	0
8	O	2 parts* 1 part†	covered	8	.32	2.58	80.31	0
	P	2 parts* 1 part†	uncovered	3	.32	2.46	71.73	0

*Pig spleen.
†Beef liver and heart.

the least trace of cataract. The older fish were used in Exps. 1-3. Of these, those that were fed pig spleen exclusively showed an average of 13.7% with cataract. The younger fish were used in the other experiments. Of these, those fed on spleen exclusively showed an average of 20.2% with cataract. From this it would seem that the younger the fish are when they are placed on an exclusive diet of spleen, the larger will be the percent of fish that develop cataract in a given time. No opacities appeared in the lenses of fish given the spleen-liver-heart diet (Exp. 8).

Since, as Table I shows, more fish with cataract were found in the covered troughs than in the uncovered troughs, it seems quite clear that exposure to light cannot be considered to be a cause of cataract in these fish.

Since the incidence of cataract was greater among trout obtained from wild stock (Exps. 4 and 5) than among those from hatchery stock, it appears that trout from wild stock are fully as susceptible to cataract as those from hatchery stock.

Hence, we must conclude that cataract in these fish is due to an unbalanced diet. The data above show that a dietary deficiency is responsible rather than any toxic substance since an exclusive spleen diet causes cataract while spleen in combination with other foods does not cause it.

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Pancreatic Diabetes in the Rabbit.*

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The diffuse distribution of the pancreas in the rabbit and the attending problems of surgical removal have prevented the study of pancreatic diabetes in this animal. In fact, it has been pointed out that "in rabbits the operation itself is impossible, because of the spread-out condition of the pancreas."[1] However, a method for

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[1] Macleod, J. J. R., *Carbohydrate Metabolism and Insulin*, 1926, p. 78.