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AN AIR BLADDER DISEASE IN LAKE TROUT FINGERLINGS*

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The air bladder of fish does not seem to be particularly subject to infection. Davis devotes only one brief paragraph to this organ in his "Care and Diseases of Trout", mentioning a roundworm which has been reported in the air bladder of wild salmonids. The standard German reference (Plehn, 1924) mentions several sporozoan and worm parasites found on or in the air bladders of fish, but they do not seem to occasion any great mortality in their hosts. One paragraph in Plehn's book is, however, particularly pertinent to the discussion which follows and is worth quoting in full (page 427):

> "In a general infection caused by Bacterium cyprinicida, the causative organism of red plague (Rotseuche), there can occur an infection of the air bladder and a thickening of its wall. The inside of the bladder than contains a creamy mass which consists of a bacterial culture - sometimes a pure culture. Probably other bacteria can also produce similar effects."

The disease to be described here occurred during the winter of 1934-35 at the Rome, New York fish hatchery, and was confined to small lake trout fingerlings averaging about 3 cm. in length. The fish were 63 days old from the time of hatching and had been feeding 38 days when the investigation was started. Mortality had started rising about a week before this and continued quite high for about three weeks. The loss was distributed throughout all the troughs containing lake trout but did not spread to any

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* Investigation made while employed by New York State Conservation Department.

of the brook or brown trout which were at that time in troughs at the same hatchery.

It was a peculiar circumstance that the larger fish contracted the disease to a greater extent than the smaller. Diseased individuals sank to the bottom of the trough where they rested quietly until they died. While the disease was at its peak almost every fish taken from the bottom of the trough showed the typical symptoms.

Dissection of diseased specimens showed that the air bladder was more or less deflated in all cases, usually containing no air whatever. Thus diagnosis did not even require the aid of a microscope. The shrunken stub of an air bladder could easily be removed, and when macerated and examined under the microscope a teeming mass of motile, rod-shaped bacteria was observed. These bacteria were found to be particularly numerous in the mass of loose connective tissue surrounding the air bladder and could always be obtained, often in pure culture, from this tissue.

Laboratory facilities for a positive identification of the bacterium were not available, but the organism proved to belong to the fluorescent group and was tentatively identified as Pseudomonas fluorescens.

In figure 1 a normal air bladder is shown in cross section. The wall consists of a cuboidal epithelium surrounded by a thin layer of dense connective tissue. Beyond this, and filling the space between the peritoneum, kidneys, and body wall, is a mass of very loose connective tissue. Figure 2 is a cross section through the same region in a diseased fish. It can be seen that the epithelium lining the lumen of the air baldder is columnar, and that much more connective tissue is present around the bladder.

A structure present in all the diseased specimens sectioned was a posterior opening in the air bladder. In figure 3 this opening is shown in cross section and in figure 4 in longitudinal section. It will be seen that the high columnar epithelium which lines the inside of the air bladder continues through the posterior opening and lines a portion of the outer surface of the bladder surrounding the opening. The peritoneum is unbroken, so that the air bladder does not communicate with the body cavity. It merely opens into the region of loose connective tissue dorsal to the peritoneum. This loose tissue is the substance which was found to contain such a rich culture of bacilli. Its disintegrated condition in the region of the posterior opening is evident in figures 3 and 4.

In the absence of a series of specimens showing the progress of the disease through various stages, we can only speculate as to its course. Since the pneumatic duct remains open in the salmonids it might be supposed that this would afford a chance for bacteria to wander into the air bladder from the oesophagus just as they sometimes do into the human appendix from the intestine. Since Pseudomonas fluorescens is a common water bacterium, not ordinarily pathogenic, it might get into the air bladder rather frequently but cause no particular disturbance there. With the presence of a posterior opening to the bladder, however, this organism could pass through into the loose connective tissue surrounding the structure and there set up a pathological condition resulting in a proliferation of connective tissue and failure of the bladder to expand. The posterior opening alone might prevent the bladder from expanding, even in the absence of a restricting excess of connective tissue.

It is hard to imagine the posterior opening as being merely a structural anomaly. Thousands of fish died from this disease, which did not occur the previous year nor the year following although lake trout eggs from the same source (wild fish from Raquette Lake, New York) were hatched at this same hatchery all three years. Neither did it occur that same year among fingerlings from the same source which were hatched and reared at another hatchery. But if the opening was caused by bacteria, why was the disease confined exclusively to the lake trout? Does the lake trout air bladder have some peculiarity near its posterior end which makes it more susceptible to bacterial attack?

No treatment was discovered for the disease. Salt baths were started before the nature of the infection was known, but these had no noticeable effect. The disease finally subsided and the survivors were normal healthy fish. Whether any of the survivors had recovered, or whether the disease is always fatal is not known.

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Literature Cited

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Explanation of Figures

Gb	Gall bladder
K	Kidney
L	Liver
N	Notochord
Oe	Oesophagus
P	Posterior opening of air bladder
Pn	Pneumatic duct
St	Stomach
Sw	Air bladder

Legends for Plates

Fig. 1. Cross section through normal air bladder of 30 mm. lake trout. x 38.

Fig. 2. Cross section through diseased air bladder of 30 mm. lake trout. x 38.

Fig. 3. Cross section through diseased air bladder, posterior region, showing the posterior opening. x 38.

Fig. 4. Longitudinal section through posterior half of diseased air bladder showing posterior opening. x 38.