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Oslofjord, which runs in a north-south direction, is about 100 km long from the open sea to Oslo Harbour. About 30 km south of Oslo, where the fjord narrows at Drøbak, there is a threshold with a depth of 19.5 m. Inside (that is, north of this threshold) the maximum depths are 150 m.

Oslofjord is characterized by highly stratified water masses, especially during summer. At that time of year a heavy primary and secondary pollution by sewage from Oslo influences the amount of dissolved oxygen in the water so that sometimes the oxygen content varies between saturation (or even supersaturation) in the surface layers to little or no oxygen at 10 to 20 m. With these hydrographic conditions, the usual methods of water sampling and analysis at specific depths do not provide satisfactory information. Thus it has been necessary to seek methods for recording continuously the variations that exist.

Some years ago we succeeded in developing two types of apparatus: the densigraph and the oxymeter. The densigraph (Føyn, 1953) measures the density, in situ, by means of a balancing liquid and connecting tubes. The level of the liquid is photographed continuously on a plate that is moved by water pressure as the apparatus descends. The plate, when developed, then provides a curve that shows the variations in density with depth. The oxymeter (Føyn, 1955), which measures the oxygen content of water electrically, is fitted with an insulated cable that is connected to a recorder on the boat. (Previously it was connected to a microammeter). The oxygen curve is recorded directly on paper that is moved by electrical pulses from the meter wheel. Since the paper moves one millimeter for each meter of descent or ascent of the apparatus, this instrument thus provides a continuous oxygen curve as it moves down and up through the water. Thus the data obtained on the
way down are checked on the way up, as shown in Fig. 1. Often
distinct oxygen maxima and minima are registered, and it is there-
fore possible during a short time to determine the depths which may
be of special interest in hydrographic and biological work.

Use of these instruments in Oslofjord has given new details of
conditions there. Fig. 2 shows density and oxygen curves obtained
in August 1954 at two stations in the fjord, one about 10 km south
of the Drøbak threshold and another north of the threshold. The
density curve (solid line) shows that a surface layer of relatively
light water floats on top of the heavy bottom water. The discontin-
uity layer dividing these water masses has such a sharp increase
in density with depth that the density curve slopes only slightly,
giving a variation in $\sigma_t$ of several units per meter. The oxygen curves (dotted lines), especially the one from the station north of the Drøbak threshold, shows a remarkable oxygen minimum exactly in the discontinuity layer. This probably results from sewage disposal in the fjord, since fertilizing elements from pollution induce a heavy production of algae in the upper layer during summer. As organic particles sink, they accumulate in the discontinuity layer, where the density increases rapidly. This layer, then, acts as a false bottom where decomposition and oxidation take place with a resultant decrease in oxygen content.

Such great variations in oxygen content as are observed in Oslofjord will naturally influence biological conditions there. For example, Sundnes (1957) found that codfish had a critical level at an oxygen content of 2.7 ml $O_2$/l. Under natural conditions this level

![Figure 2. Density and oxygen curves obtained in August 1954 at two stations in Oslofjord, one about 10 km south of the Drøbak threshold, the other north of the threshold. Solid lines, density; dotted lines, oxygen.](image-url)
might be lower than that, but north of Drøbak in the inner part of Oslofjord the oxygen content may often go far below 2.7 ml/l.

Fig. 3 illustrates the distribution of oxygen north of Drøbak in August 1957. Isolines for the value 2.7 ml O₂/l are drawn from St. 1, about 25 km below Oslo Harbour, to St. 4, about 10 km inside the

![Figure 3. Oxygen conditions in Oslofjord north of the Drøbak threshold in August 1957. Hatched area shows where density was less than 2.7 ml/l.](image)

Harbour. Oxygen values of less than 2.7 ml/l are hatched. Thus the illustration shows the areas and depths where codfish might find either favorable or unfavorable conditions. Obviously it is of interest for fishermen to know just where low oxygen concentrations are likely to be found, since they can then more profitably devote their efforts to other areas where the fish are likely to be living.

**REFERENCES**

**Føyn, Ernst**


**Sundnes, Gunnar**