

## SESSIONAL PAPER No. 38b

shows eight fish, all of equal age, viz. 4 years, but from different localities. All are drawn to the same scale and in the size representing the average for their respective localities. The drawings for this and the following figure are taken from two plates prepared by Lea for the Copenhagen Expedition, 1912.

The four races on the left (1 to 4) have their origin in closed waters, whereas the four on the right (5 to 8) were taken in the open sea (North Sea, Arctic ocean, Atlantic ocean). It will at once be seen that the herring from the closed waters are smaller than fish of the same age from the more open waters. Precisely the same impression is obtained on examination of the scales, as shown in fig. 5. These scales

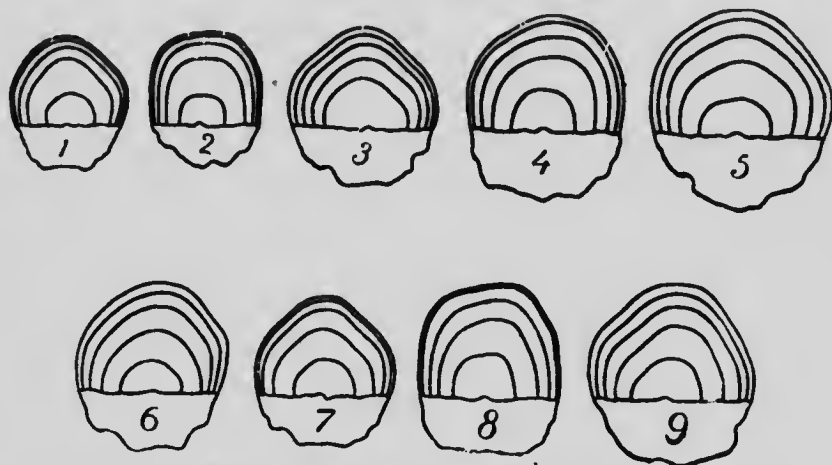


Fig. 5. Normal scales of 5 year old herring from

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|-------------------------------|--------------------|-----------------------------|
| 1. Lysefjorden.               | 2. Zuider Zee.     | 3. Kattegat.                |
| 4. Faeroes.                   | 5. Iceland.        | 6. Norway (Spring herring). |
| 7. Western part of North Sea. | 8. Atlantic Ocean. | 9. Shetlands.               |

illustrate the growth of 4-year old herring from the localities in question. The scales are drawn in proportion to the size of the fish, while the distances between the different winter rings show how they have grown from year to year. A glance at the figure will show that the study of the scales furnishes information not only as to the different waters, but also as to entirely different modes or rates of growth in the periods embraced. Some show meagre growth until the formation of the first winter ring (1 and 2), while others show more rapid growth (3). Some have grown well in their first years, but less favourably later (7 and 8) while others exhibit very satisfactory growth even in their fifth year (5, 6 and 9). The growth may thus exhibit variations so considerable that it is frequently possible, in the case of a loose scale, to determine to what fish it belongs, even though other sorts may have been taken in the same haul.

The material which has been collected from the North American waters, and which I have mentioned above, is now being studied by a similar method, and I shall here confine myself mainly to the results obtained from the study of the three great groups or types, which we have distinguished above.

1. From the Atlantic coast of Nova Scotia, containing oceanic herrings spawning in the fall, characterized by their large size.
2. From the west coast of Newfoundland, containing spring spawners.
3. From the Magdalen islands in the gulf of St. Lawrence, also spring spawners.

Before we try to compare these three types it will be necessary to go into somewhat greater detail concerning the methods for studying the variation of growth in