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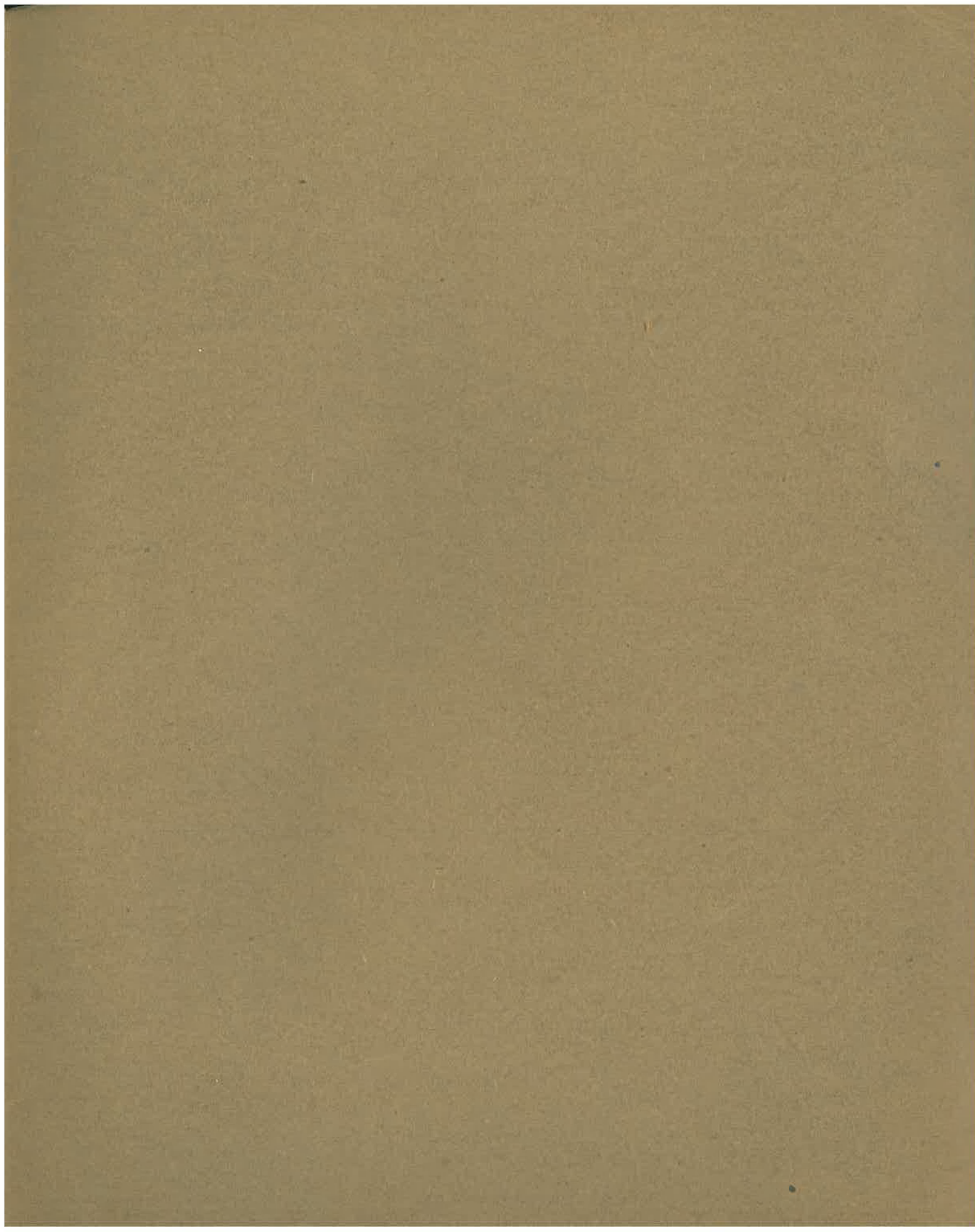
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## Recent Observations on spent Herrings and Remarks on Forecasting.

By

31140

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An interesting shoal of herrings accumulates every year between the middle of December and the first days of March, along the continental coast, between Cape Gris-Nez and the mouth of the Schelde. They are nearly all "spent" at HJOERT's stage VIII—II. In 1930—31, 97.51 % were at that stage and none at all were "full". Although spent herrings are of inferior commercial value an important fishing on the Belgian coast is due to this appearance. In 1931, the quantity landed at Ostend amounted to more than 18 million kg. sold by auction for the sum of 12,616,891 fr. This successful fishing amounted to more than 217 mill. individuals caught. The average weight of one fishing was 8,338 kg. (ships of all sizes included).

We have been following, without interruptions, the three successive fishing seasons 1930—31, 1931—32 and 1932—33, and found that whilst the first was remarkably rich the two latter were among the poorest ever recorded.

## Spent Herrings — Ostend.

Season	Quantity in kg.	Number of individuals	Average weight of one fishing
1927—28....	3,857,383	44,745,643	4,739
1928—29....	12,121,953	140,614,655	11,545
1929—30....	11,282,163	130,873,091	7,302
1930—31....	18,360,596	217,002,545	8,338
1931—32....	3,353,455	34,976,536	5,435
1932—33....	2,673,185	29,405,035	4,515

The results of these daily observations, during the said seasons, lead us to some remarks on forecasting in fishery matters, which I shall try to expose very briefly.

The forecasts that one may attempt to formulate in the case of a local herring fishery are three kinds:

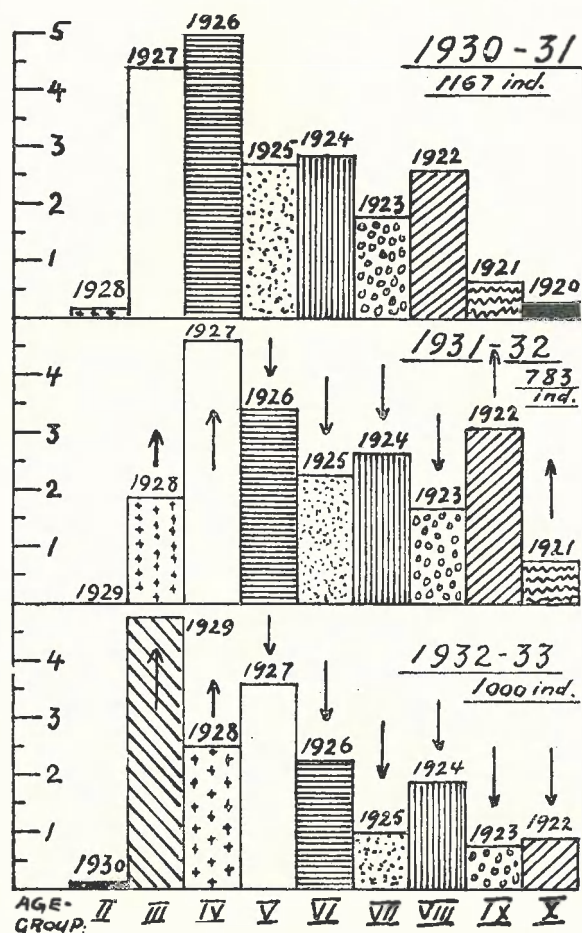
- 1) Forecast of the relative proportion of each of the year classes for the next season; this may be called qualitative forecasting.
- 2) Forecast of the abundance or density of the shoal that is expected to concentrate in the region in the course of the next season.
- 3) Forecast of the abundance of the same concentration which is expected to return three years after the season considered. The last two may be called quantitative forecasting.

Let us take an instance of each of the three kinds of forecasts out of the diagram called "Biological Scale" of spent herring.

Each of the three steps of this scale corresponds to one yearly season; the columns are the percentage of individuals in each class, that is the proportion of each class in a hundred herrings supposed to have

been caught at random from the shoal. Six classes have played an important part in the concentration of the season 1930—31; they are the classes born in the years 1922 to 1927. Herrings 3 and 4 years old were enormously predominating, whilst a good proportion of older herrings was still present, one column only being rather poor: that of the 1923 class which has always been a notoriously bad class all over the Southern North Sea, as clearly shown in several memoirs by JEAN LE GALL.

1. — Based on the figures of this diagram we have predicted that the diagram of the next season would also show an important percentage of young herrings one year older, i.e. 4 and 5 years old respectively,





and a moderately high percentage of older fish (6 to 9 years).

The second step of the scale 1931—32 shows that the forecast was successful. It shows also that a new group of three years old herring appears in one shoal with a fairly good proportion. From this second step of the diagram we could also foresee that the third season would still have a good, although reduced, proportion of young herring 5 and 6 years of age and a decreasing percentage of the older classes.

In fact, we find in the season 1932—33 a still good percentage of the two classes 1927 and 1926, that were predominating in the two previous seasons, and all the older classes, on the right, greatly diminished. A peculiar feature that could not have been foreseen has appeared in the composition of the shoal: the unusual importance of the new class of 3 years old herring: 24 %. The column of 4 years has also increased notably. The decrease of the six older classes is partly a consequence of the increase of the percentage of the young ones (balancing of percentages).

2. — About quantitative forecasting let us remember first of all that the figures, in the material we are dealing with, are all percentages and these percentages cannot forecast anything but percentages. No quantitative prediction can be directly drawn from our diagrams. However, we may obtain probabilities out of this kind of diagrams when we have positive information about the history of certain classes. If some of the classes have played an important part in one or more good seasons passed, we may infer that there has been, actually, an important number of individuals of those classes at that time in the sea, and that the survivors of that great shoal will still be numerous during the next season.

As regards the season 1931—32: two classes, 1927 and 1926, having played an important part in the extremely rich season of 1930—31, we could reasonably forecast, not only a high percentage of young fish, but also a considerable, absolute quantity of herring and a good fishing.

In fact, however, the season 1931—32, immediately following one of the richest concentrations on record, was an extremely poor one. The relative proportion of young herring was certainly in accord with the forecast; but the average weight of one fishing, which is the only criterion of the abundance of fish in a shoal, dropped from 8,338 kg., in 1930—31, to some 5,000 kg. in 1931—32.

This is undoubtedly a remarkable instance of the possible perturbations in the normal course of a biological phenomenon. Its causes are unknown to us but some may easily be guessed at: one may be found in the magnitude of the transgression of Atlantic water of high salinity pointed out by the British hydrographers. The encounter of repulsive plankton, *Phaeocystis* or others, might also have turned the herring from their usual way back to the breeding grounds.

Another possible cause of the poverty of the concentration of 1931—32 may have been the intense

fishing of 1930—31. The destruction of more than 217 mill. individuals may have heavily affected a community of herring which appears to be a relatively small one, never equal in size to the immense shoals of Northern North Sea. It seems possible that the concentration of 1930—31, although an extremely rich one, was too heavily taxed by the excessive destruction in that fishing season.

3. — The second kind of quantitative forecasting is that of the abundance of herring in the third year after a season just finished. This seems to be somewhat safer than the predictions for the immediately following season, especially when the two intermediate seasons are also known and analysed. The reason is that the first generation to appear as a notable element of a returning shoal, is the class of three-year old herring, so that a given class is always largely dependent on the conditions of breeding in the season three years before.

### Forecasts for the Season 1933—1934.

Although feeling very little inclination towards making predictions, I consider it expedient to call attention to certain signs that seem to forecast an abundance of young spent herrings in the next season along our coast.

The main consideration for this forecast is that the next season will be the third after the excellent concentration of 1930—31. We may safely admit that the extremely numerous, spent, herring of that rich season had given birth, previously to their coming to our coast, to an immense number of larvae. These are likely to come back as young mature herrings to breed in their turn and to accumulate afterwards for several weeks along our coast as spent herrings.

We may also consider in the diagrams the two intervening seasons 1931—32 and 1932—33, when two young classes, 1928 and 1929, were very well represented by percentage in their first appearance, which is always a promising feature.

### Reservations.

It must, though, be kept in mind that hitches are always possible and that no prediction is infallible. Although the number of progenitors, and consequently the number of eggs, was enormous in the season 1930—31 we cannot be certain that the breeding has been a success. As long as quantitative data are not obtained about the larvae in the Straits of Dover and in the South of the Southern Bight there is room for doubt about the success of fecundation and hatching. Another uncertainty looms over the actual thriving of the larvae after the frail creatures have been carried away by the currents. Salinity, temperature, plankton and currents may have been unfavourable, both at the time of hatching and afterwards, and mortality may have been very great.

Let us remember also that coastal concentrations in a narrow passage of the sea are subject to great

irregularities resulting from different causes, among which may be mentioned the intensity and variability of tidal currents in the Straits, the variable mixing which they cause between the different masses of water, of plankton, of larvae and even of adult herring belonging to the two varieties neighbouring in the boundary area. Conditions more favourable to forecasts are prevailing in open seas like the East Anglian region or the broad part of the Channel.

However, perturbations, like the above mentioned, of what may be considered to be the normal course of annual displacements are possible everywhere. They show the necessity of continuous hydrographical observations and they teach us, objectively, how cautious we must be when we decide to turn prophets, if sincerely we wish to guide the fisherman to success and not to run the risk of leading him dangerously astray.

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