

VII. Investigations on Herring in the Southern North Sea.

By

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I. Young (and adult) herrings in the Southern Sea entrances of Holland.

Since the last five or six years a rather extensive fishery on young herrings of 1—2 years old has been carried on in this country. In this fishery stow-nets (the same that are used in the smelt and eel fisheries) placed at the surface catch shoals of such herrings when they are being carried along by the strong tides. The scales of the fishes are brushed off with brooms and used for the fabrication of artificial pearls. After some time North Sea fishermen, alarmed by the large quantities (in 1926—27 about 724,000 kg.) of young herrings, destroyed in this way, argued that these fisheries were detrimental to the time-honoured method of herring catching and demanded that some measure might be taken.

The Government entrusted Dr. HAVINGA and the present writer with the task of investigating into the matter.

Fishing of young herrings for the sake of their scales takes place in the winter

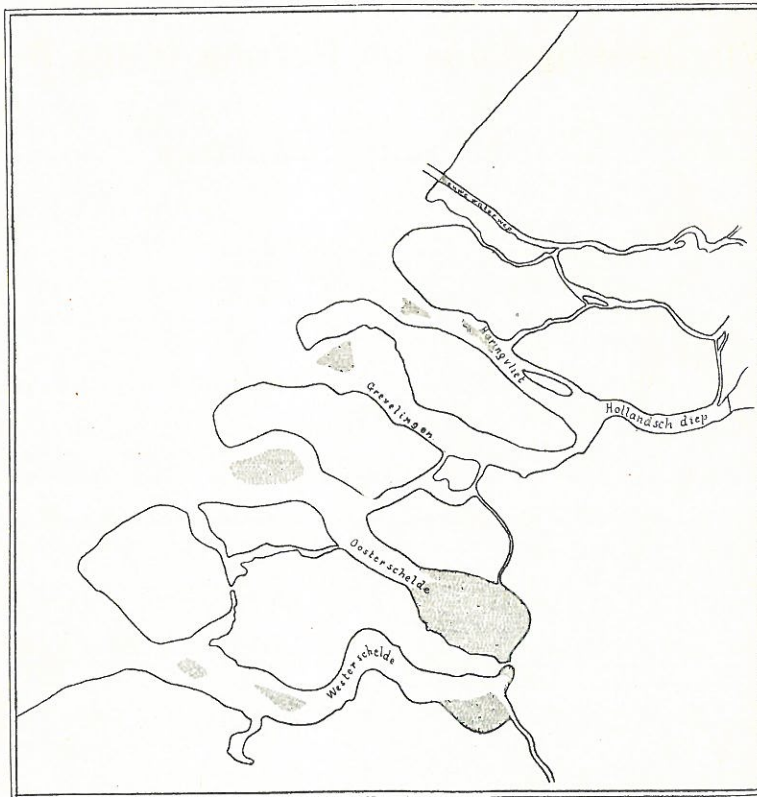


Fig. 1.

months in the following regions: Haringvliet (Z. H. Stroomen), Grevelingen, Ooster-Schelde and (partly) Wester-Schelde.

The localities named are to be gleaned from the chart here given (Fig. 1). Only the Haringvliet, however, has a regular fishery (from Nov. till March), in other waters, though sometimes large quantities are secured, it is much more incidental. Apart from statistics, which do not interest us here, our chief aim was to find to which race these young herrings belong.

Characteristics used throughout in our investigations were:

- vert. (Vert.),
- præhaem. vert. (P. H.),
- keeled scales between pelvic fins and anus. (K_2),
- rays of pectoral fins (P.), each fin taken separately.

We counted independently from each other, each taking 25—50 ind. from the same sample. On comparing our results afterwards the differences turned out to be of minor importance. Samples were received from January 1926 till April 1927, chiefly in the winter months.

A. Haringvliet.

Young herrings of 1—2 years old.

From this locality we obtained the following results, taking all samples together:

Vert.		P. H.		K_2		P.	
N.	Fr.	N.	Fr.	N.	Fr.	N.	Fr.
54.....	1	22.....	10	13.....	9	14.....	9
55.....	18	23.....	124	14.....	80	15.....	71
56.....	162	24.....	161	15.....	174	16.....	84
57.....	207	25.....	36	16.....	53	17.....	39
58.....	25	26.....	3	17.....	8	18.....	2
				18.....	2		
n.....	413		334		326		205
m.....	56.57		23.69		14.96		15.77
σ	0.68		0.74		0.78		0.84
σ_m	0.034		0.040		0.043		0.059

Incidentally only we got adult herrings; the analyses were as under:

Vert.		P. H.		K_2		P.	
N.	Fr.	N.	Fr.	N.	Fr.	N.	Fr.
55.....	3	22.....	3	13.....	1	14.....	4
56.....	39	23.....	33	14.....	17	15.....	8
57.....	44	24.....	34	15.....	48	16.....	60
58.....	1	25.....	9	16.....	19	17.....	53
		26.....	5	17.....	3	18.....	10
						19.....	2
n.....	87		84		88		137
m.....	56.49		23.76		15.07		16.46
σ	0.53		0.91		0.77		0.88
σ_m	0.057		0.099		0.081		0.075

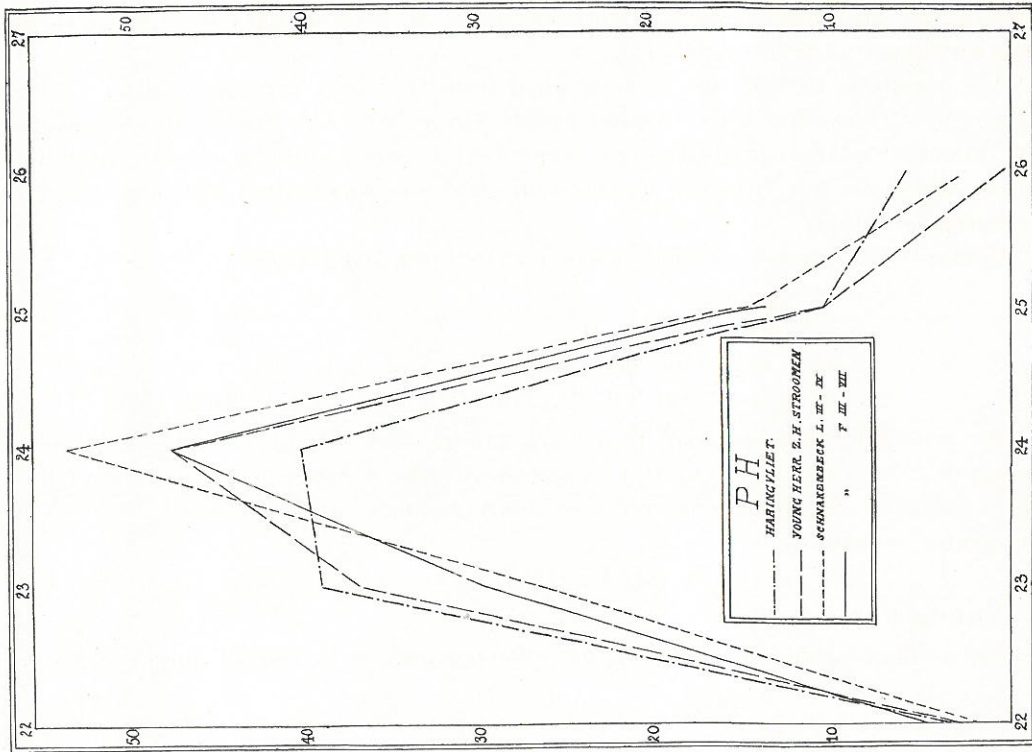


Fig. 3.

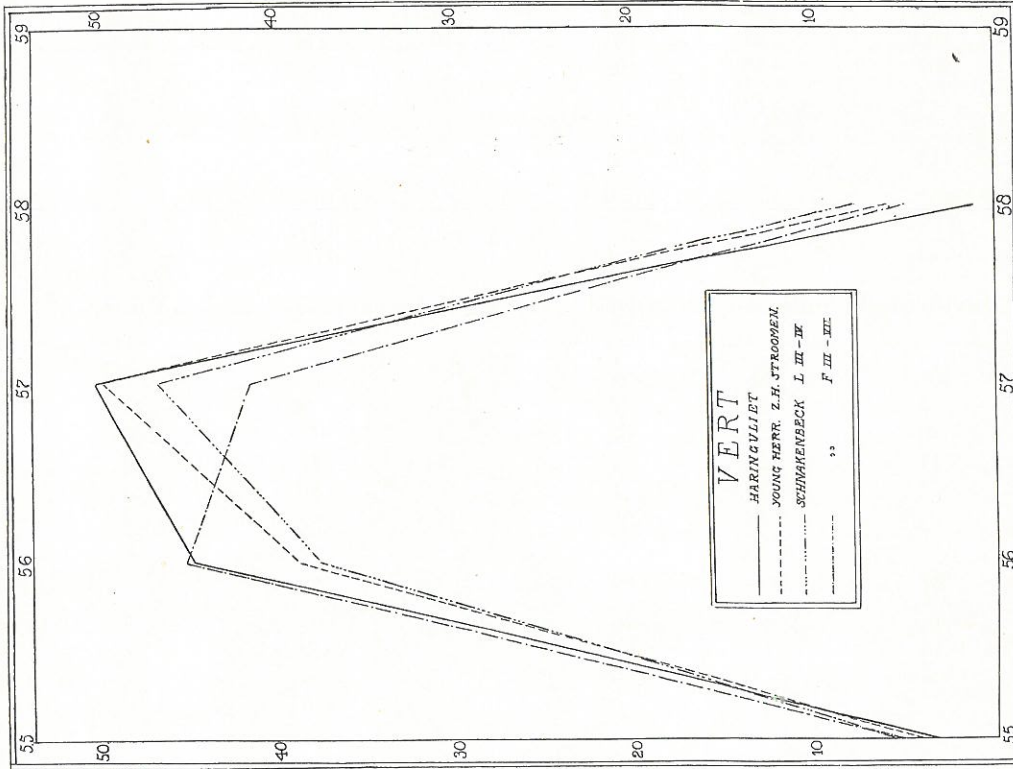


Fig. 2.

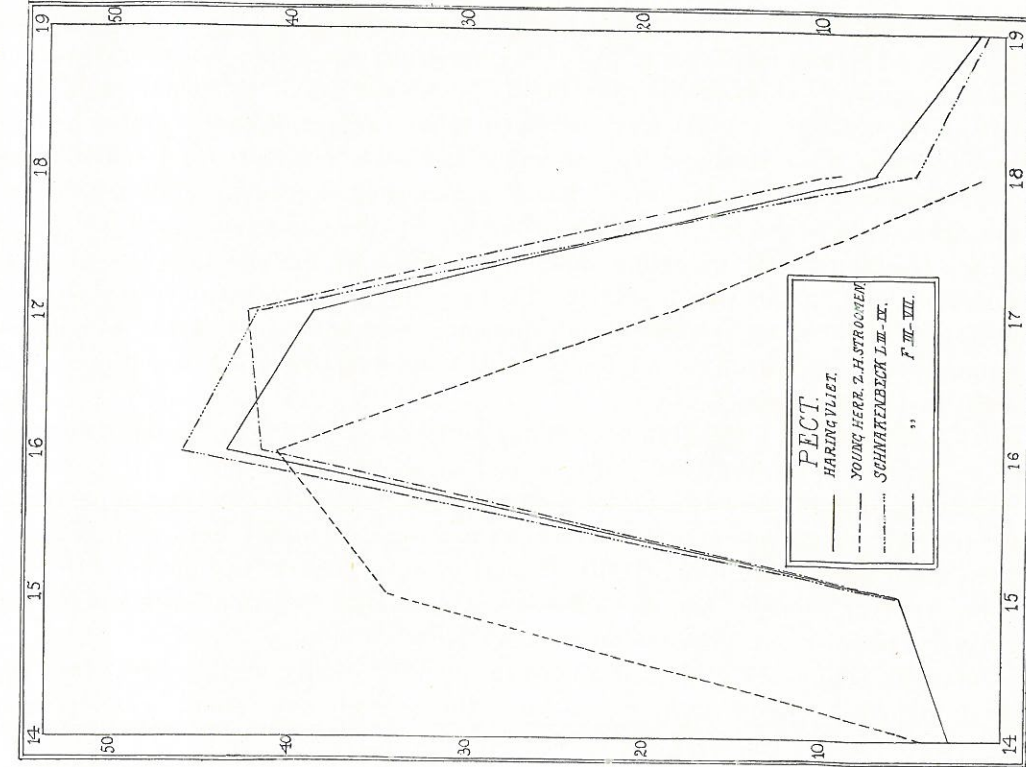


Fig. 5.

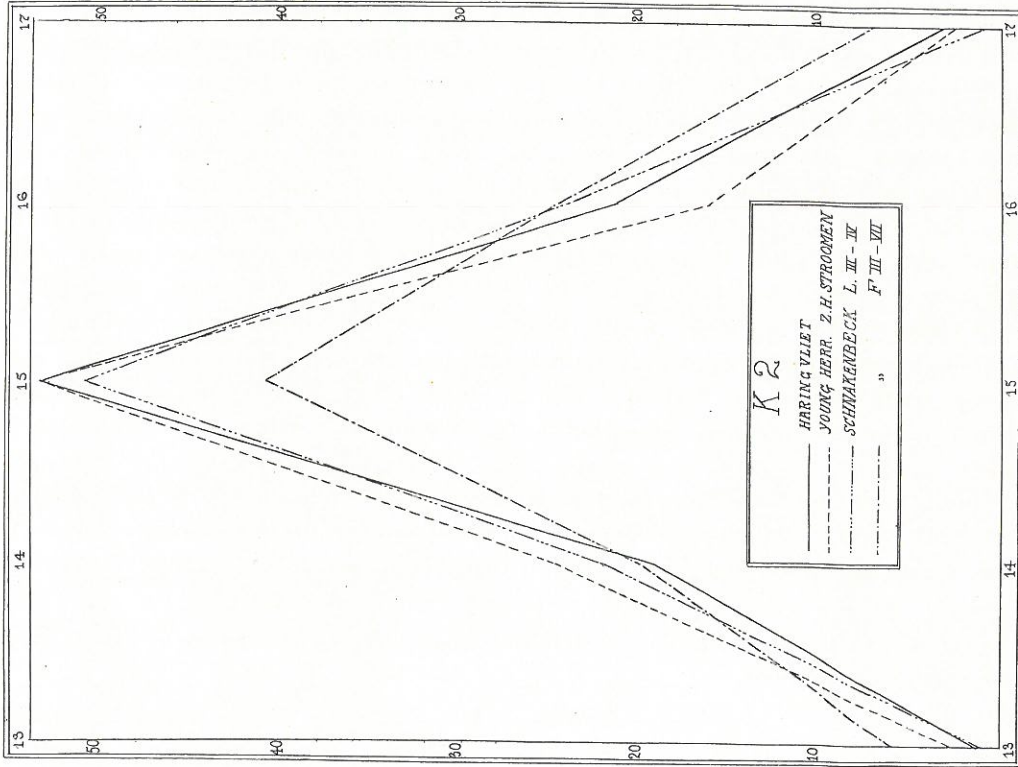


Fig. 4.

These averages both for young and adult herrings agree so well that we may consider these herrings to belong to the same race. On comparing the graphs constructed on the percentual frequencies (Figs. 2—5) with those of SCHNAKENBECK (Fladenground, stage III—VII and Lowestoft (III—IV) we find such a fair agreement that we may assume that these herrings of the Haringvliet, both young and adult, belong to the Bank Herring.

The rays in the pectoral fins do not, however, agree in young and in adult individuals. As a rule these rays were less in number in the case of the young ones, and we cannot account for this constantly occurring difference, unless we assume that the smallest, most hindmost, ray in the young herrings has frequently been overlooked (or was not yet developed?) The same remarkable phenomenon was not found in the samples of the genuine spring herring of the Zuiderzee, the young stages of which sometimes occur plentifully in the Haringvliet.

If we shift in Fig. 5 the graph for young herrings one figure to the right (to make up for the difference mentioned) we arrive at a good coincidence.

The only author who has counted pectoral fin rays is SCHNAKENBECK in his recent treatise; the only young herrings (immature) he investigated (in all more than 700 ind.) were from the mouth of the Elbe. Of his 10 samples only the first two included the first year class (ranging from 12 cm. onwards) which are called "Spitzen" in German; and in these very samples the pectoral fin rays were not counted.

Our material on the other hand consisted nearly wholly of this first year class (the great majority ranging from 9—12 cm.), the second year group (called "lange Heringe" in Germany) being by far in the minority.

A thorough re-examination of this puzzling question (which, as mentioned, was not observed in the first year offspring of spring-herrings) is much needed.

Herring larvae of about 25—30 mm. make their appearance each year at the end of February in the Haringvliet. About 4 weeks later their lengths have increased to somewhat like 40 mm.¹⁾ and it has become possible to count the vertebrae which turn out to give an average number of 56.60—56.64. These averages also point to the Bank herring race. We may assume that such larvae are hatched in the months of November—December and that they originate from shoals, spawning rather late in autumn near our coasts. The adult Bank herrings caught in the Haringvliet are nearly all recently spent in December—January, a few only being recovering spents (stage II).

In this water we not unfrequently meet with larvae of another North Sea herring, which, though not differing appreciably in length from those of the Bank herring, show a higher average number of vertebrae (56.72, 56.84, 56.91, 56.94), and not only here, but also in other sea entrances, like the Ooster-Schelde. We will speak of these larvae later on.

Finally there is a third race, the spring herring *viz.* the genuine one of the Zuiderzee, the first year class of which sometimes occurs abundantly in the catches of the Haringvliet. These young herrings seem to keep together in shoals apart from those of the

¹⁾ On 29.—30. March 1926 we measured three samples (467, 134 and 368 sp.) and always found the same mean length: 39 mm.

young Bank herrings and are of course distinguished by their characteristic low average number of vertebrae (55.2). In February and partly in March 1926 these young spring-herrings were so numerous that nearly 50 per cent. of the catches in ind. belonged to this race. They are, however, of very irregular occurrence (in the winter 1926—1927 they were almost entirely absent) and patronise not only the Haringvliet but also the more southern waters, from which latter places they, partly at least, probably originate. The adult stages of this spring herring, which is of very modest economical importance, are frequently caught in the weirs of the Ooster-Schelde.

B. Ooster-Schelde.

Though also in other sea entrances (Grevelingen, Wester-Schelde) fishery on young herrings is carried on during the winter months, they are of no great importance; in the mouth of the Wester-Schelde at this time the principal fish is the sprat, and in the other waters sometimes also yield mixed catches of herrings and sprats. Comparatively speaking the bulk of the herring fishing is to be found in the Ooster-Schelde.

The catches of young herrings in winter are as a rule most irregular in this region and seem to depend upon the strength of the tides and on meteorological influences in general.

The following analyses were made of young herrings from the Ooster-Schelde:

Vert.		P. H.		K ₂		P.	
N.	Fr.	N.	Fr.	N.	Fr.	N.	Fr.
55.....	17	22.....	12	13.....	3	14.....	39
56.....	156	23.....	159	14.....	124	15.....	230
57.....	316	24.....	258	15.....	301	16.....	365
58.....	44	25.....	77	16.....	85	17.....	80
59.....	2	26.....	12	17.....	8		
		27.....	3				
n.....	535		521		521		714
m.....	56.73		23.86		14.94		15.68
σ	0.66		0.82		0.70		0.74
σ_m	0.029		0.036		0.031		0.028

We naturally should expect to find Channel Sea or Lowestoft herring in these waters, but on examining the average of K₂ we see that our material could not possibly be assigned to this race. The Lowestoft herring, we remember, has a very low number of keeled scales between pelvic fins and anus (about 14, according to various authors), whereas we constantly found a high average of about 14.90 in the young of the Ooster-Schelde.

On the other hand, if these fishes were no Lowestoft herring, they could not belong to the Bank herring either, as the average of vert. (56.73) is too high.

The only race with which our averages agree is the West Channel or Plymouth herring, as typified by ORTON'S and SCHNAKENBECK'S investigations.

These authors found the following averages:

	Vert.	P. H.	K ₂
ORTON.....	56.77	23.75	14.71
SCHNAKENBECK (P. II—III).....	56.85	23.94	14.87

The principal differences, as compared with Bank herring (SCHNAKENBECK), are that these averages for vert. are higher, that of K₂ lower in Plymouth herring.

If we turn to the graphs (Figs. 6—9) on which the young herrings of the Ooster-Schelde are compared with ORTON'S and SCHNAKENBECK'S data we find a satisfactory agreement, so that we are compelled to assume that these young herrings really belonged to the Plymouth race.

In the case of the pectoral fins we are again confronted with the same discordance in the number of finrays in young individuals as compared with adult ones (the graphs for the latter were obtained in simply dividing the total number for each individual into 2, as these were recorded by the above named authors), — a difficulty already discussed in such young stages of Bank herring from the Haringvliet. Here, again, if we shift the graph for young herrings one figure to the right, we get a perfect agreement.

Taking all characteristics together it must be admitted that the differences of Bank and Plymouth herring are really slight, though sufficient to discriminate them. The most reliable item is the number of vertebrae which not only show a higher average but also a much better pronounced maximum in the latter race.

Adult North Sea herrings were rarely met with in the Ooster-Schelde; the only adult herrings, as were caught in weirs in sufficient numbers, turned out to be brackish water herring, the same as the well known Zuiderzee race.

In early spring herring larvae are drawn in by the tides in Grevelingen Ooster-Schelde and Wester-Schelde; in the first named region they were carried sometimes as far as Saeftinghe near the Belgian frontier.

The lengths of these larvae did not markedly differ from that of Bank herring larvae, such as were caught in the Haringvliet at about the same time, but the average number of vertebrae (56.72, 56.84, 56.91, 56.94) agrees better with Plymouth herring. Similar larvae were also now and then met with in the Haringvliet, as mentioned above. These facts led us to believe that the brood of the Plymouth herring, as well as the first year class, are mechanically carried by strong tides into the sea entrances and especially in the Ooster-Schelde.

Curiously enough we never succeeded during the summer and autumn months in detecting larvae of the brackish-water race, though many adult individuals of stage IV—VII are caught in the spring in the Ooster-Schelde. The first year class, again, of this herring was occasionally as abundant in the Ooster-Schelde as in the Haringvliet. Individuals of the second year class were as a rule rather rare.

To resume this chapter: in the Haringvliet the young North-Sea herrings,

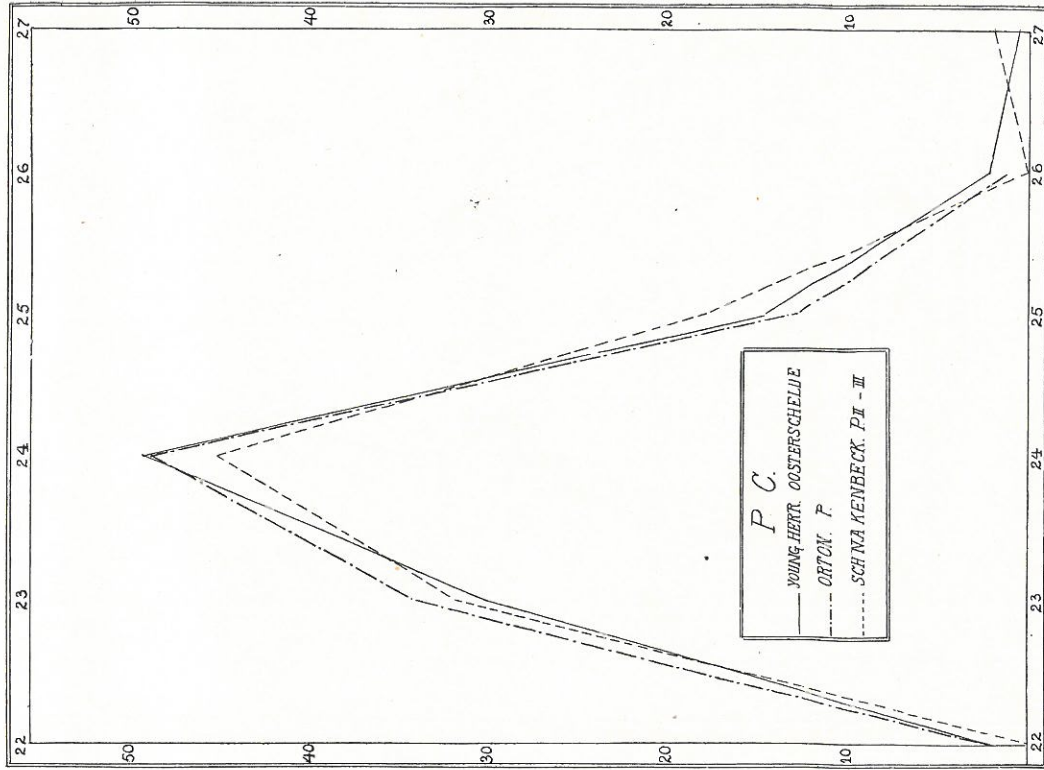


Fig. 7.

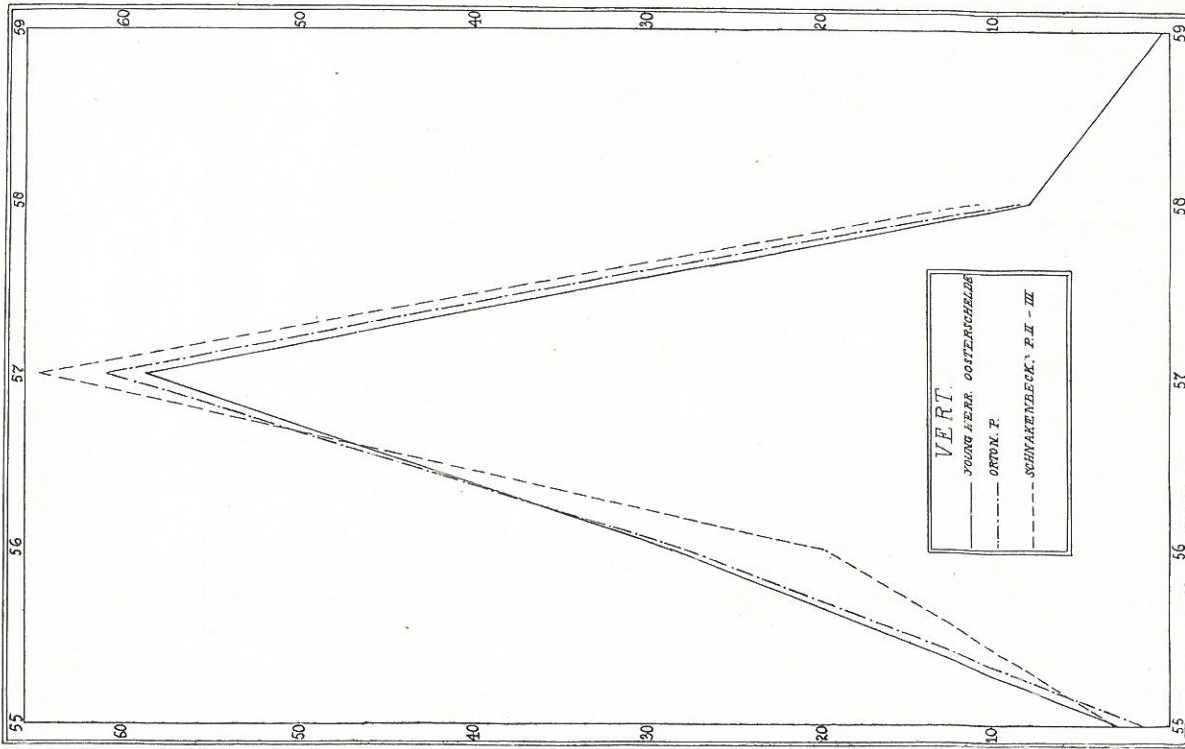


Fig. 6.

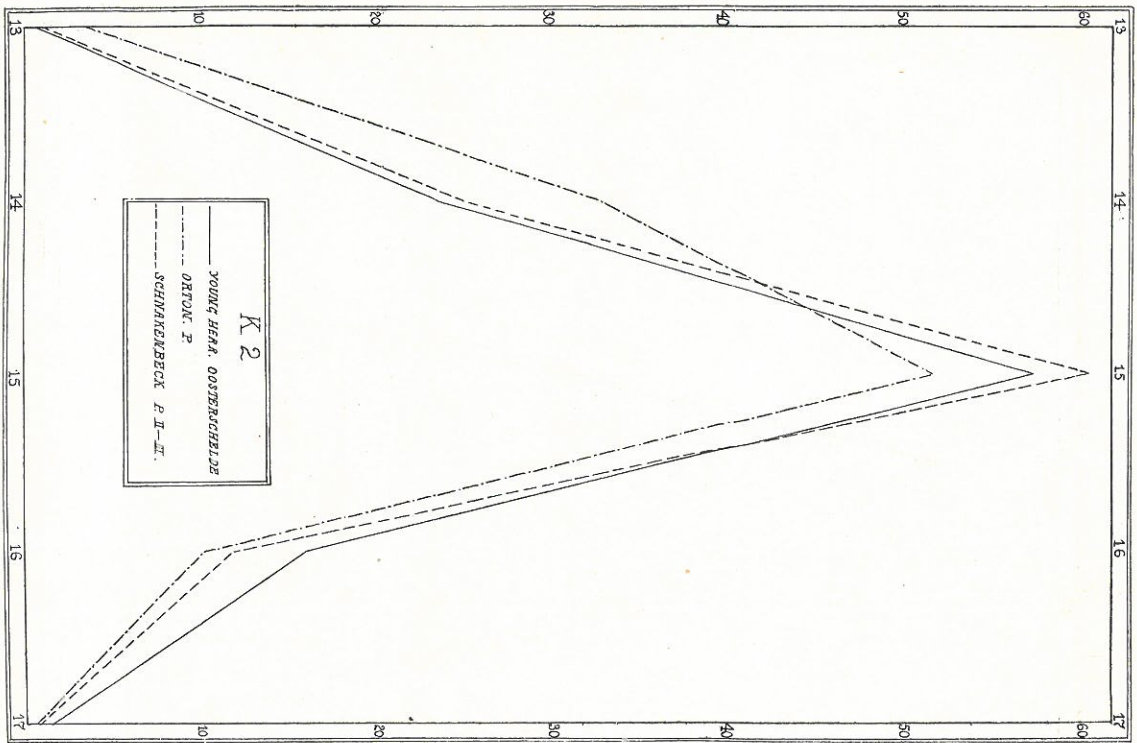


Fig. 8.

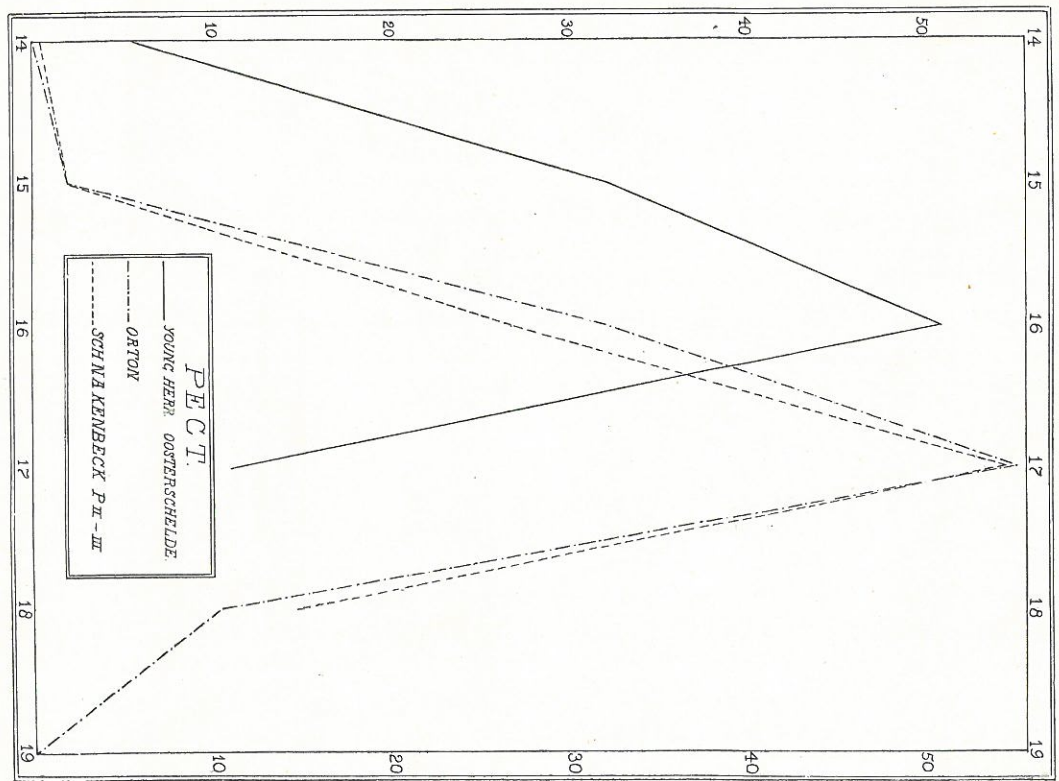


Fig. 9.

mostly about 1 year old, and of a length of 9—11 cm. in winter, belong to the Bank herring; in the Ooster-Schelde (and also in Grevelingen and Wester-Schelde, where young herrings are far less abundant) such herrings are to be assigned to the West Channel or Plymouth race. Nowhere during our researches, extending over two winters, did we come across the Channel Sea or Lowestoft herring.

II. Herrings from the Southern North Sea and the Eastern Channel.

Puzzled by the entire lack of genuine Lowestoft herring in our samples, as stated before, we proceeded to investigate adult herrings from catches of drifters in December and January in the Southern North Sea and the eastern part of the Channel.

The following samples were examined:

- 1) 125 ind. caught 50 miles N. W. of Ymuiden, 1. Dec. 1926.
- 2) 90 ind. caught off Dieppe, 16. Dec. 1926.
- 3) 100 ind. caught off Sandettie L. V., 23. November 1927.
- 4) 200 ind. caught off Smith Knoll, 30. Nov. 1927.
- 5) 200 ind. caught off Smith Knoll, 9. Dec. 1927.
- 6) 200 ind. caught 15 miles N. W. of Dieppe, 13. Jan. 1928.

The large majority of these herrings were in the stages V or VII, as is seen in the following table.

Sample	1	2	3	4	5	6
Maturity						
II.....	1	..	1	10	2	..
III.....	..	..	2	4	..	1
IV.....	..	1	34	58	10	1
V.....	58	39	60	102	185	144
VI.....	3	9	..	4	2	..
VII.....	13	1	3	22	1	54
Total...	75	50	100	200	200	200

Practically all individuals were full or spent and so suggest a spawning time in the months of December and January. Individuals of stage II and III were so few in number that treating them separately was not worth while.

We investigated the same race characteristics as we had done in the case of the young herrings in our sea entrances, as discussed in Chapter I, only the one item: haemal vert. (H. V.) was added.

The analyses of our samples yielded the following results:

Vert.

Sample	1	2	3	4	5	6
Number						
54.....	..	..	..	..	..	..
55.....	1	..	1	1	7	4
56.....	53	31	40	71	65	67
57.....	65	52	53	110	114	110
58.....	5	7	5	17	13	17
59.....	1	..	..	..	1	..
Total...	125	90	99	199	200	198
m.....	56.62	56.73	56.63	56.72	56.68	56.71
σ	0.62	0.60	0.60	0.63	0.67	0.65
σ_m	0.06	0.06	0.06	0.04	0.05	0.05

P. H.

Sample	1	2	3	4	5	6
Number						
21.....	..	..	..	..	..	..
22.....	3	1	1	3	7	10
23.....	46	29	41	61	53	57
24.....	61	46	44	103	103	94
25.....	14	13	10	29	33	34
26.....	1	1	2	1	2	2
27.....	..	..	1	2	..	1
Total...	90	90	98	199	198	198
m.....	23.70	23.82	23.70	23.85	23.85	23.82
σ	0.68	0.73	0.75	0.78	0.77	0.85
σ_m	0.07	0.08	0.08	0.06	0.05	0.06

H. V.

Sample	1	2	3	4	5	6
Number						
30.....	..	..	..	1	1	1 (28)
31.....	2	4	4	7	10	8
32.....	20	10	24	62	56	54
33.....	36	28	45	80	93	88
34.....	14	8	25	45	30	40
35.....	3	..	..	4	8	6
36.....	..	..	..	..	..	1
Total...	75	50	98	199	198	198
m.....	32.95	32.84	32.93	32.87	32.83	32.97
σ	0.87	0.81	0.82	0.89	0.91	0.92
σ_m	0.10	0.11	0.08	0.06	0.06	0.07

K₂.

Sample	1	2	3	4	5	6
Number						
13.....	3	4	3	8	4	4
14.....	29	20	36	46	60	58
15.....	54	54	43	101	102	110
16.....	24	11	17	38	28	24
17.....	4	1	1	5	6	2
Total...	114	90	100	198	200	198
m.....	14.97	14.83	14.77	14.93	14.87	14.81
σ	0.87	0.71	0.80	0.83	0.79	0.71
σ_m	0.08	0.08	0.08	0.06	0.06	0.05

P.

Sample	1	2	3	4	5	6
Number						
14.....	2	2	..	..	1	1
15.....	13	9	7	16	17	12
16.....	120	49	78	165	150	142
17.....	104	95	106	189	200	211
18.....	9	14	9	29	31	31
19.....	..	..	..	..	..	2
Total...	248	169	200	399	399	399
m.....	16.43	16.66	16.59	16.58	16.69	16.65
σ	0.69	0.78	0.64	0.69	0.56	0.70
σ_m	0.04	0.06	0.04	0.03	0.03	0.03
M ¹⁾	32.92	33.26	33.17	33.42	33.39	33.33

¹⁾ These figures indicate the averages of both pect. fins together in the same individual.

The high averages of K₂ in all these samples (14.77—14.97) precludes at once the possibility that we have to deal with the genuine Channel Sea or Lowestoft herring, though this race was reasonably to be expected in the southern North Sea at this time of the year (Nov.—Jan.). Its mean for K₂ is according to SCHNACKENBECK 13.99, REDEKE 14.16 and 14.38, SAUVAGE and CANU 14.23.

As a matter of fact our samples belong to two other races, viz. Bank herring and West Channel or Plymouth herring, and these are the very races we found as young herrings of 1—2 years old, even as larvae, in the southern sea entrances of Holland.

For comparison we again give the averages for the various characteristics as laid down by ORTON and by SCHNAKENBECK (P. II—III, Fladenground, stage III—VII and L. III—IV).

	Vert.	P. H.	H. V.	K ₂	P.
Plymouth herring					
ORTON	56.77	23.75	33.02	14.71	33.52
SCHNAKENBECK (P. II—III).....	56.85	23.94	32.91	14.87	33.63
Bankherring					
SCHNAKENBECK (Fladenground stage III—VII)	56.48	23.80	32.68	15.03	33.12
SCHNAKENBECK L. III—IV.....	56.55	23.88	32.67	14.99	32.99

These averages would seem to afford fairly good characteristics for discrimination between the two races. Yet ours do in some respects not quite fit into those of the authors named. If we, however, construct graphs of percentual frequency we can discern in our samples, that nos. 1 and 3 must be assigned to Bank herring, nos. 2, 4, 5 and 6 to Plymouth herring. This holds good at least in the case of vertebrae and pectoral fin rays; in other features the two races agree so closely that discrimination is a most difficult matter. In Fig. 10 (vertebrae) sample 1 and 3 are compared with those of SCHNAKENBECK from Fladenground and Lowestoft. This graph for Bank herring is very characteristic: the maxima at 56 or 57 may vary, but they never greatly differ. Thus we are justified in regarding our samples 1 (50 miles N. W. of Ymuiden) and 3 (off Sandettie L. V.) as belonging to the Bank herring.

Fig. 11 represents the graphs of vertebrae of samples 2 (Dieppe) 4—5 (taken together, as they originate from the same locality (Smith Knoll) and are taken within an interval of ten days only) and 6 (Dieppe), compared with those of ORTON and SCHNAKENBECK for Plymouth herrings. Here again we may satisfy ourselves to arrive at a good agreement. There is a very distinct maximum at 57, whereas the ordinate at 56 is much lower than in the Bank herring.

Other features: praehaemal vert., haemal vert. and keeled scales were in the same way tested but yielded no satisfying results; the graphs of both Bank herring and Plymouth herring agree so closely that a reliable distinction was not to be detected. The pectoral fin rays, again, provided some indication of a practical means to recognition (Fig. 12 and 13).

In Fig. 12 we compare the rays of the pectoral fins in sample 1 and 3 with SCHNAKENBECK's L. III—IV and Fladenground stage III—VII.

We see, then, that the curve of sample 1 (50' N. W. of Ymuiden) fits very well into those of SCHNAKENBECK, which were assigned to the Bank herring. That of sample 3 (Sandettie L. V.) is not so satisfying, but at least the ordinate at 16 (39 per cent.) is higher than in the case of the Plymouth herring, where this ordinate is at most 36 per cent.

In Fig. 13 graphs of our samples 2 and 6 (both from Dieppe) and 4—5 (Smith Knoll) again agree with those of genuine Plymouth herring as exemplified by ORTON's investigations and SCHNAKENBECK's (P. II—III).

That stray shoals of Bank herring, spawning late in the season, are met with in

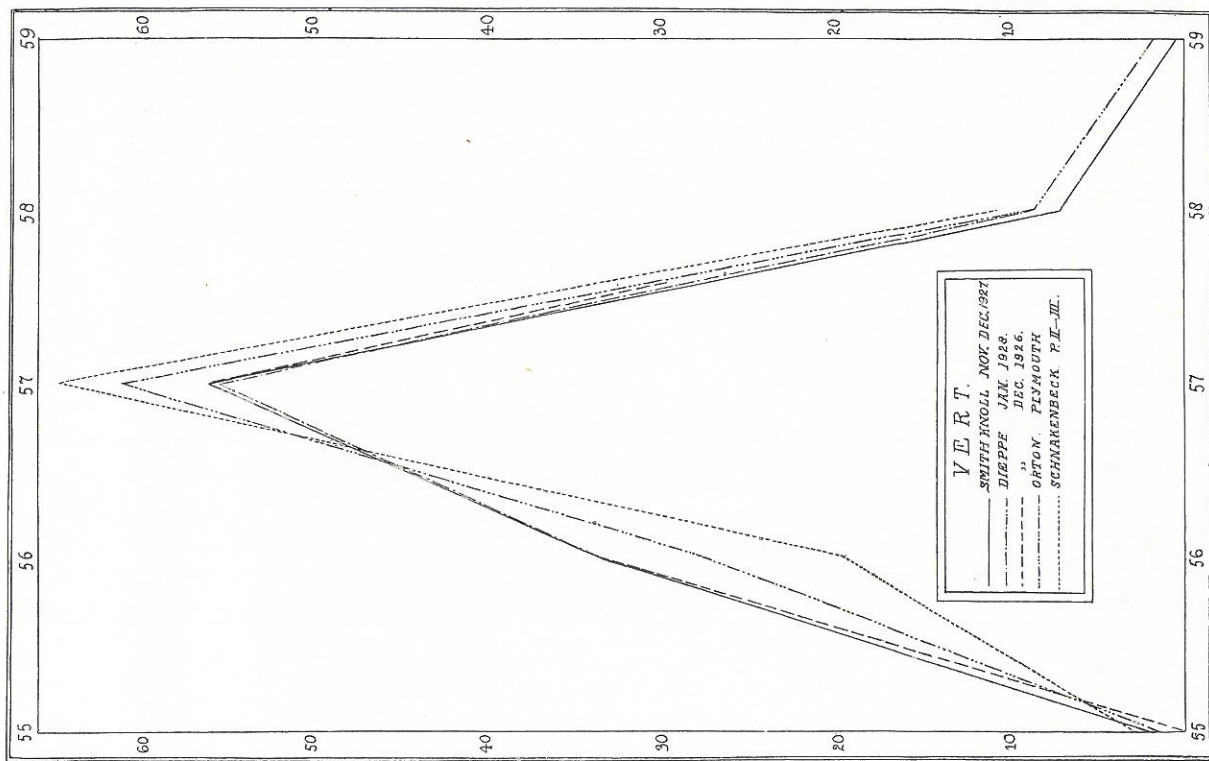


Fig. 11.

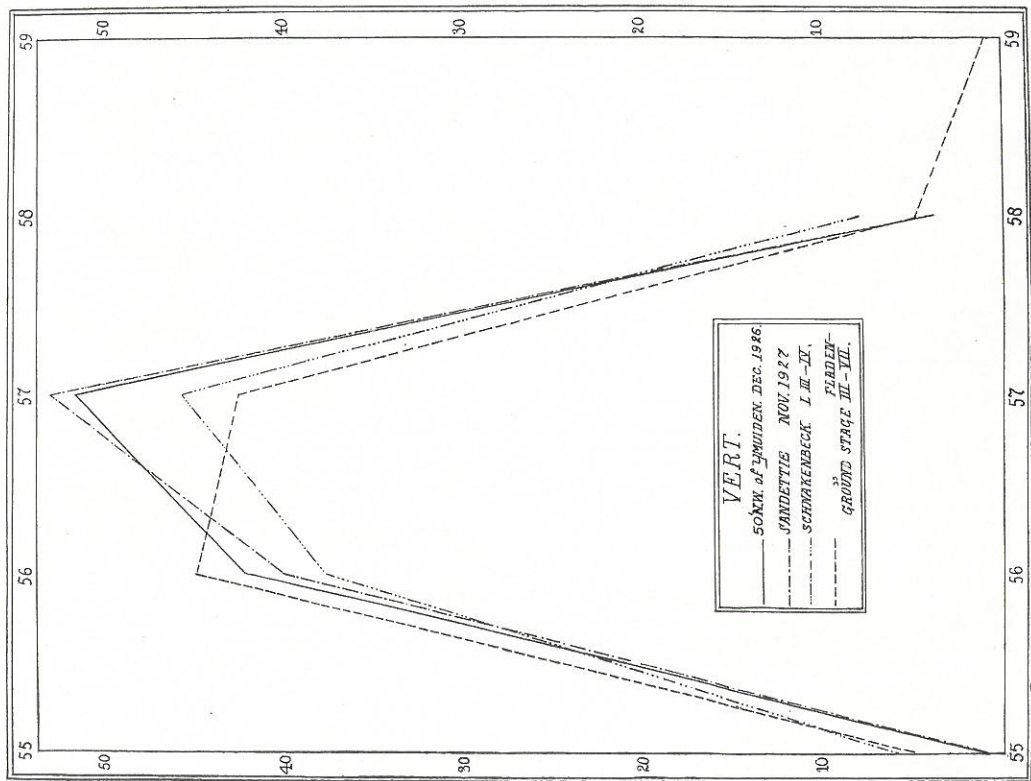


Fig. 10.

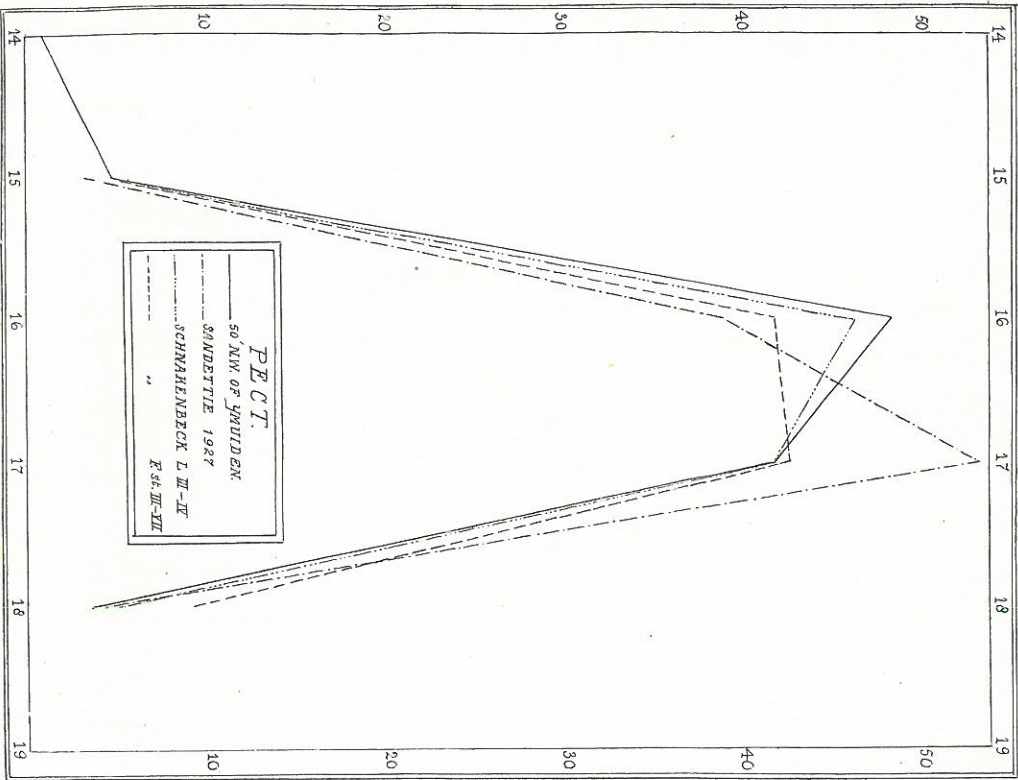


Fig. 12.

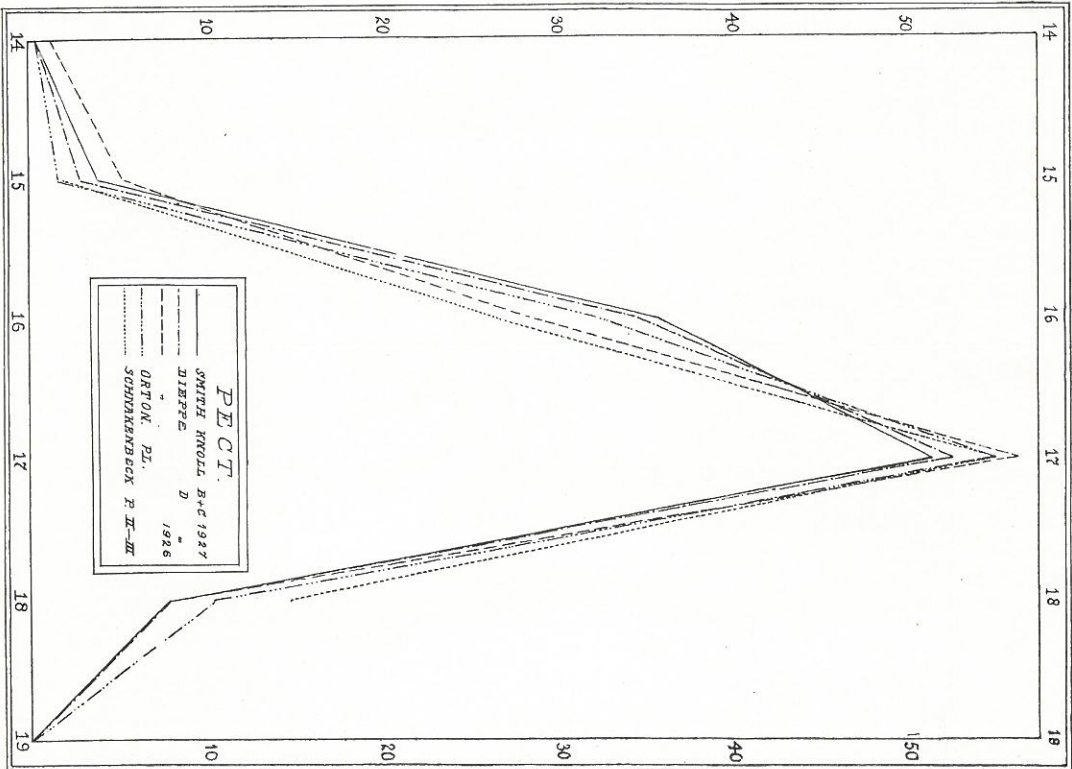


Fig. 13.

the Southern North Sea is not a very surprising fact; indeed not only SCHNAKENBECK got Bank herring from Lowestoft, but also REDEKE did so, whose sample of only 25 individuals, caught in Nov. 1906 at 53°06' N. and 3°0' E., showed an average for vertebrae of 56.56 and for K_2 of 15.00, and this last feature induced JOHANSEN to regard these herrings as Bank herring ("a late spawning branch") and not to the Channel Sea herring, to which REDEKE originally had assigned them. That Bank herrings, as our sample 3 (which is, however, perhaps not quite pure) proves, penetrate as far to the south as Sandettie L. V. is in this respect not devoid of interest.

But much more important is the fact that typical Channel Sea herrings were quite absent in our samples, and that their place seems to be occupied by another race which we would not expect in the Southern North Sea, viz. the West Channel or Plymouth herring. The two samples from the classical fishery locality for Lowestoft herring (Smith Knoll), as well as both samples from Dieppe contained beyond doubt no Lowestoft herrings, but the Plymouth race.

Thus we are forced to arrive at the following conclusions (affirming those arrived at in the first chapter about the young herrings of 1—2 years old in the southern sea entrances of Holland):

1. In the last two winters (1926—1927 and 1927—1928) our race investigations on herrings of the Southern North Sea and the Channel (off Dieppe) have revealed no trace of genuine Channel Sea or Lowestoft herring.

2. In the first named winter the only sample of the Southern North Sea (50 miles N. W. of Ymuiden) belonged to the Bank herring, another sample from Dieppe to the West Channel or Plymouth herring.

In the last winter an overlapping of the two races seems to have taken place to a large degree: two samples from Smith Knoll, as only one from Dieppe turned out to be Plymouth herring; on the other hand a sample from Sandettie L. V. belonged to the Bank herring, though the analysis of this sample was the least satisfying, probably owing to the fact that it was somewhat mixed.

3. It will be of great interest to continue these researches. If it proves to be right that in some herring seasons at least the herring driftnet fisheries in the Southern North Sea and the eastern part of the Channel, from November till January, do not depend on Lowestoft herring but on stray shoals of late spawning Bank herring and on Plymouth herring, our views as to the importance of the Lowestoft race must of necessity undergo some alteration.
