

VII.—PRELIMINARY REPORT FOR 1873-'74 ON THE HERRING AND THE HERRING-FISHERIES ON THE WEST COAST OF SWEDEN.

BY AXEL VILHELM LJUNGMAN.¹

To the committee appointed to investigate the herring-fisheries on the west coast of Sweden :

Having been informed, on the 3d June, last year, by the secretary of the Royal Academy of Sciences, that, by a letter of His Majesty the King, dated March the 28th, I had, at the suggestion of the Royal Academy, been intrusted with the continued prosecution of the investigations regarding the herring and the herring-fisheries on the west coast of Sweden, I went to Stockholm in accordance with the wish of the committee, as expressed by their letter of the 13th of June, and remained there till the end of the month to gather all the necessary information and make every necessary preparation.

In the course of the summer, I visited the most important fishing-stations on the coast of Bohus-län to secure information and to make the necessary arrangements for investigating the fisheries which commence in the autumn. I left for Stockholm on the 23d of September to consult with the members of the committee, and to make myself acquainted with the literature of the subject in the library of the Royal Academy of Sciences. In consequence of sickness, I was compelled to remain in Stockholm till near the end of October, so that I was prevented from making any observations at the beginning of the fisheries. During the months of November and December, I visited all the more important fishing-stations on the central and northern coast,² where the fishing for small herring was carried on.

As soon as I received information, about the beginning of the year, that herring were coming in in great quantities, I went immediately to

¹ Preliminär Berättelse för 1873-'74 öfver de beträffande sillen och sillfisket vid Sveriges västkust anställda undersökningarna. Af Axel Vilh. Ljungman. (Tryckt såsom handskrift.) Upsala, Ed. Berling, 1874. [8vo, 2 p. l. 74, pp. 1 l.] Translated from the Swedish by H. Jacobson. Original "printed as manuscript" by the author, [*i. e.*, not for general circulation,] Upsala, 1874.

² By the *southern coast*, I understand the coast from Salöfjord to Tistlarne, (Reports on Herring-Fisheries, p. 86 fr. 8;) by the *central coast*, the coast from Salöfjord to Soteskär, (counted to the northern coast by the old fishermen; see Act Concerning Blubber-Refineries, pp. 120, 134;) and by the *northern coast*, the coast from Soteskär to the boundary of Norway. A somewhat different division of the coast has been made by *Dubb*, (Reports of the Royal Academy of Sciences for 1817, p. 34.)

Gottenburg, where I had an excellent opportunity for observing the herring-fishermen assembled together from all the neighboring coast. On the 24th of January, I went to Stockholm to consult with the committee, and to inform myself of the financial arrangements made for the observations. From the end of February till the beginning of June, I visited various localities on the coast of Bohus-län, to make observations and gather whatever information I could.

I went to Stockholm again on the 7th of June, at the express desire of the committee, to report on the progress and result of my observations.

Although I had some knowledge of the coast of Bohuslän and its fisheries, much time was, nevertheless, lost by my being unacquainted with many peculiar circumstances of importance for carrying on observations in the easiest and quickest manner. This knowledge can be acquired only by several years' intercourse with the fishermen. All the investigations, which were chiefly of a practical character, were on that very account entirely new to me, and, therefore, necessarily retarded my progress. My investigations were, moreover, impeded by the unusually stormy weather during the autumn and winter, by sickness, and by want of funds and apparatus.¹ Much time has also been consumed in collecting all that has been said on the subject in the very rich herring-literature, which, as far as possible, I endeavored to obtain.

I need scarcely say that the distrust and opposition with which the investigations were met, not only by nearly the whole population engaged in fishing, but even by those from whom assistance might reasonably have been expected, exercised a depressing influence, and will continue to do so in the future, though not, perhaps, to so great an extent. The rigid observance of section 22 of the fishing-law, and the milder ordinance of July 19, 1872, regarding the use of nets with narrow meshes,² increased the excited feelings of the coast-population, especially in the beginning of the year, when the herring came in in great numbers.

The almost uninterrupted journeys, which were especially troublesome in winter, on account of the apparatus which had to be carried along, and the brief stay made in each place, did not permit any thorough anatomical or microscopical observations, since these require a quieter sojourn in a suitable place, where all the necessary apparatus may easily be brought. As I did not consider it desirable and of practical use for the advancement of science to report on the special investigations which have been begun, but have not yet led to any definite result, the cause of the incompleteness of this first report will easily be understood; while this incompleteness was still further enhanced by the fact that the investigations were carried on uninterruptedly till the end of the year, thus leaving but little time for putting my notes into suitable shape.

In conclusion, I must draw attention to the fact that, as the investigations continue and more information is collected, much in this report

¹ See Chapter VIII.

² New Reports on the Herring-Fisheries, p. 3, 56, 59.

will probably have to be modified in future ones. I also hope that I shall then be able to make my report much more complete by means of observations made on the coast of Norway, in the Kattegat, and in the southern portion of the Baltic.

I.—ON THE DIFFERENT SPECIES OF HERRING AND SMALL-HERRING.

Even in olden times different *races* of herring were recognized, or at least names were given to them designating different kinds, as the idea of a variety or race was scarcely known to the traders and fishermen, who by those different names only wished to distinguish one article of trade from some other which was obtained at another place or time, or was considered to have a different value.

Among our Scandinavian naturalists, *Linné* was the first who described a kind of herring called in Swedish “Strömming,” [a sort of small-herring,] as a separate species, under the name of *Clupea harengus* β *membros*.¹

From *Dr. P. Dubb's* observations on the herring fishery of Bohus-Län,² we learn that the Bohus-Län fishermen, during the last great fishery, distinguished the so-called “old” herring, (“gamla” sill,) as it is called at present, as a “real sea-herring” (“rigtig hafssill”) from the spring-herring, which is peculiar to the coast, and belongs to it exclusively. This last-mentioned herring was said to have a smaller head, to be thicker and shorter, and to resemble the Kattegat herring. To judge from an expression of *O. N. Löberg's*,³ the Norwegian herring-fishers likewise make a distinction between the “sea-herring” (“Havsild”) and the “fiord-herring,” (“Fjordstoing.”)

Professor Nilsson, in the year 1832, distinguished, besides the “Strömming,” a large number of different races of herring from the southern and western coasts of Sweden and Norway, all of which, however, he grouped under two heads, viz: *sea-herring* (Hafssill) and *coast-herring*, (Skärgårdssill.)⁴ This division, which was somewhat modified by him

¹ *Fanna Svecica*. Ed. ult., p. 128.

² *Kgl. Vet. Akad. Handl.* f. 1817. p. 35, 44.

³ *Norges Fiskerier*. Kristiania, 1864, p. 89, 90.

⁴ *Prodromus ichthyologiæ scandinavicae*, p. 23, 24. As this work is very scarce, and as the quotation is of special importance, it is given in full:

Clupea harengus Auctorum. Svecis Sill.

Sub hoc nomine latent plures species, vel, si mavis, varietates locales constantes, quæ in duas formas aptius abeunt:

1-mo *Forma oceanica* (sea-herring): capite, oculis et rictu minoribus; orbita $\frac{1}{6}$ — $\frac{1}{2}$ longit. corp.; ventralibus sub anteriori $\frac{1}{2}$ pinnæ dorsalis; distantia a rostro ad pinnas pectorales intervallum æquante ventralium et ani, seu initii pinnæ analis:

1. oeresundica, Nostratibus *Rübosill* (boundary-herring).

2. schelderensis, Nostratibus *Kullasill*.

3. *mojalis*, Nostratibus *Grässill* (grass-herring).

4. *bahustea*, Nostratibus *Aflingsill* l. *Storsill* (great-herring).

5. hiemalis, Nostratibus *Norsk vintersill* (Norwegian winter-herring).

6. autumnalis, Nostratibus, *Norsk höstsill* (Norwegian fall-herring).

subsequently,¹ seems to have been adopted by all the Swedish ichthyologists, but has been questioned by *Professor Krøyer*, who says, in his great work on the fish of Denmark, that he is not convinced of the correctness of *Professor Nilsson's* distinction of different species of herring from the southern Baltic, the Kattegat, and Norway.²

From the western portion of the North Sea, *Yarrell* has described two analogous forms of herring as different species: *Clupea leachii* and *Clupea alba*,³ the latter of which, however, is only a herring in an earlier stage of its development.⁴

In the year 1833, in testimony before a committee of inquiry ordered by His Majesty, the Bohus-län fishermen distinguished the following kinds of herring: 1. The so-called old ("gamla") herring, (which formerly came in every year from the North Sea; 2, the half-grown "lottsil," (so called from the Swedish word "lott," a kind of net,) found both toward the end of the last fishing-period and later, and which neither propagated nor was to be seen in its full-grown state near the coast; and, 3, the "spring-herring," or "grass-herring," belonging to the coast, and caught during the old fisheries as well as since. The distinctive marks assigned by the fishermen were very nearly the same as those which are generally employed by *Nilsson* and other professional ichthyologists in distinguishing the various species of herrings, viz, the size of the head, height of body, length of dorsal and ventral fins, size of scales, and time of spawning. The opinion of the fishermen was attacked by *Professor Nilsson* as being unreasonable, and all the Swedish naturalists adopted his views.⁵

Obs. Pulli omnium harum varietatum sub nomine *Småsill*—small-herring—(et adhuc minores *Anchovis*—anchovies—) venduntur. Nomen vero *Småsill* etiam imponitur varietatibus minoribus formæ insequentis.

2: do *Forma taniensis* (coast-herring), capite, oculis et rictu majoribus; orbita $\frac{1}{2}$ longit. corp.; ventralibus fere sub medio pinnæ dorsalis; distantia a rostro ad pinnas pectorales multo longiore quam a ventralibus ad anum, et æquante distantiam a ventralibus ad medianam analem:

1. *Clupea Cinbrica*. Sv. *Kivik-Sill* vel *Cinbrishamns-Sill*. In parte meridionali maris balthici.

2. *Clupea membras*. Sv. *Strömming*. In parte superiori maris balthici.

¹ Skandinavisk Fauna. IV, p. 492-498.

² Danmarks Fiske. III, p. 155-156.

³ British Fishes, 3 ed., I, pp. 111, 121.

⁴ The *Clupea alba* (subsequently called by Valenciennes *Rogenia alba*) was established by *Yarrell* for the celebrated "Whitebait" of English gourmands, but has been satisfactorily demonstrated to be nothing more than the young of the herring.—S. P. B.

⁵ It does not, however, seem at all unreasonable to suppose that during the old Bohus-Län fisheries the great herring came from the North Sea, and that its descendants, the young herring, visited the coast of Norway, (see *Boeck*, Om Silden, p. 130; *Tranströmsacten*, p. 173,) presuming that the small herring (*lotsill*) coming to the coast of Bohus-Län from the sea, was descended, e. g., from the Kattegat herring, spawning in autumn, or from the Limfjord herring, spawning in spring. *G. O. Sars's* investigations regarding the young or so-called summer-herring caught in Norway, are very instructive in this respect, as they point to very similar results.

Axel Boeck, who, in May, 1870, visited the coast of Bohus-Län for the purpose of investigating the herring-fishery on that coast, maintains that the herring which spawns there is "certainly only a coast-herring," which, moreover, is distinguished from the "old herring" by spawning in spring, the latter spawning in autumn, and that it must be supposed to have come from the North Sea, and possibly had some connection with the Scotch-Dutch herring.²

G. von Yhlen, who, during five years' fishing, had abundant opportunity for making observations on the matter, has, in his memorial of November 16, 1870,³ addressed to the royal governors of Göteborgs-län and Bohus-län, given the result of his own experience in the following two assertions, viz: 1. That "that in none of those years had there been in the schools of herring coming in from the sea any mature herring capable of propagating; that therefore they could not be herring spawning in autumn like the so-called 'old herring;' and that 'the great mass of herrings have not remained till the beginning of the spring-spawning season;'" 2. "That the herring of one year differ in shape and size from those of another," which observation is said to be "indisputable" and "valuable." *Von Yhlen* thinks that he is able to verify by his observations the testimony of the fishermen made before the committee in 1833, that the so-called sea-herring does not spawn on the coast of Bohus-Län and is not of the same breed as either the coast-herring or the "old" herring, as well as the assertions made by himself that the sea-herring are not of the same breed each year, and do not come from the same place, and that "they possibly may be young herring from various parts of the Kattegat and Skagerack, which are drifted along by marine currents till those able to spawn go to their various spawning-places."⁴ In his report of 1870 on the salt-water fish of Bohus-län, he says, furthermore, that as "herring have nowhere been found to spawn on the outer coast," it would appear from this circumstance "that those herring which in autumn showed themselves in such enormous numbers on the outer coast, do not come from the small schools which are annually found spawning in the fiords."⁵ In his report for the preceding year he supposes that the large number of sea-herring caught during that year (90,800 bushels) came from young herring which migrated from the fiords in September, 1867.⁵

The fishermen of Bohus-län, as was shown in the report on the herring-fisheries, published in 1843, have distinguished several races of herring by different names, most of which, however, only indicated differences

¹ Om Silden og Sildesfiskerierne. Christiania 1871, p. 126.

² Tidskrift for Fiskeri. V, p. 21-54.—Göteborgs och Bohus-läns Hushållnings-Sällskaps Qvartalskrift. October, 1870, p. 123-160.—Om Silden og Sildesfiskerierne, p. 121, 122, 126.

³ Nya Handl. rör. Sillf., p. 11-17.

⁴ Nya Handl. rör. Sillf., p. 12.

⁵ Göteborgs och Bohus-läns Hushållnings-Sällskaps Qvartalskrift, July, 1870, p. 16.

of age, or size, or a greater development of the sexual organs in one and the same kind, or such as are found at the different seasons when the herring are caught, and which the fishermen themselves by no means always understand. The more experienced among them, however, generally make a distinction between—1, the *spring* or *grass herring*; 2, the *sea-herring*, (lottsill;) and, 3, the *wandering-herring*, (stråksill,) which last is by some thought to be only a full-grown sea-herring. Concerning the three races thus recognized, and which have not been admitted from interested views, I shall give whatever I have been able to gather from the literature on the subject as well as from conversations with the most experienced and reliable fishermen, reserving for a future report all the facts I could gather from personal observation. I shall make it a special object to enter into a fuller examination than has been hitherto done of the various assertions made before the committee of inquiry in 1833, as these are viewed from such different stand-points, and are urged by the partisans of conflicting opinions.

THE SPRING-HERRING (“*Vårsill*”).

(*Clupea majalis*, Nilss.)

This *coast-herring*, which is found in the Skagerack, along the coast from Holland Point to Cape Lindesnæs, is distinguished by its comparatively small head and plump shape, and by its spawning on the coast in March, April, and May. Whether the Limfjord-herring, which likewise spawns in spring, belongs to the same race, I have not been able to ascertain.¹ The spring-herring is chiefly found near the mouths of the large rivers flowing into the Skagerack, where it is also caught with stationary nets. This race, which is distinguished from the larger one that has sometimes visited Bohus-Län in enormous numbers and has caused the famous “great” fisheries, is either entirely overlooked or considered incorrectly as the former “old” herring’s insignificant descendant. It is chiefly caught in spring, during the spawning-season, but likewise, though in smaller numbers, at the end of summer and in the autumn and winter, while its young are caught at all seasons of the year, though rarely in any great number.

The spring-herring was during the old fishery, and even some time afterward, known by the collective name of “lottsill,”² but began to be gradually distinguished from it as a separate race.³ The most common and oldest name for this race is *spring-herring*, (*Vårsill*.)⁴ According to Nilsson⁵ and Ekström⁶ it is said, after having finished spawning;

¹ See Handl. rör. Sillf., p. 107 fr. 24.

² Handl. rör. Sillf., p. 88 fr. 23, p. 89 fr. 30, p. 100 fr. 13, 14, p. 102 fr. 25, p. 119 fr. 9, p. 127 fr. 19.

³ See Handl. rör. Sillf., p. 107 fr. 24.

⁴ Dubb, Kgl. Vet. Akad. Handl. f. 1817, p. 34. Handl. rör. Sillf., p. 90 fr. 31.

⁵ Handl. rör. Sillf., p. 63 fr. 136.

⁶ Praktisk afhandling, p. 10.

to lose some of its scales, and appear of a more greenish-color, and become inferior in quality, at which time it is called *grass-herring*, (Gräs-sill.) This name was generally understood by the fishermen at the inquest of 1833;¹ this is still the case, as they always understand thereby a herring which frequents and is caught on grassy bottoms, although at present this name is perhaps more generally used in another sense. On the northern coast of Sweden, as well as in the neighboring portions of Norway, the young of more than one year of the coast-herring are called by this name. By *May-herring* we understand smaller, but often very fat specimens of the spring-herring, which toward the end of spring are caught in the same places where formerly the great spring-herring was caught. It is often filled with insects, and therefore becomes easily damaged, which circumstance no doubt accounts for Nilsson's report as to its poor quality.² It is called *summer-herring* when caught toward the end of summer.³ By *autumn-herring*⁴ they understand on the northern coast the same herring, if caught during the beginning of autumn. Some see in this herring a different race from the spring-herring, although they can mention no other difference than that the autumn-herring is somewhat larger and probably spawns somewhat earlier (in February.) Autumn-herring seems to be only a more recent name, which has replaced that of "summer herring." By "*ganesill*"⁵ the same fish as the summer or autumn herring is understood. The name "*Istersill*"⁶—lard-herring—is synonymous with "summer-herring," although other herring are sometimes called by that name. "*Knubsill*"⁷—plump-herring—is a name given to the coast-herring, on account of the short and plump form of its body. "*Fetsill*"⁸—fat-herring—the coast-herring is called when it has fully-developed sexual organs,⁹ a reminiscence of the old fisheries, when the full-grown herring was fattest and most valuable, on which account it also, toward the end of the fishing period, got the name "*Väljesill*"—select herring.⁸ "*Aflingsill*"⁹ means the same as "fat-herring." "*Höljesill*,"¹⁰ or, as the Norwegians call it, "*Fiordstøing*"¹¹—fiord-herring—is another name given to the coast-herring, because it sometimes frequents the deep fiords. By the

¹ Handl. rör. Sillf., p. 119 fr. 9, 10, 16, p. 126 fr. 16, 17, 18, 22, 23.

² Handl. rör. Sillf., pp. 131, 136.

³ Handl. rör. Sillf., p. 107 fr. 25, p. 127 fr. 19. *Ekström*, Öfvers. af Kgl. Vet. Akad:s Förhandl. f. 1846, p. 20.

⁴ It seems that formerly the sea-herring or so-called "old-herring" was sold under this name. See *Dubb*, Kgl. Vet. Akad:s Handl. f. 1817, pp. 35, 44.

⁵ Handl. rör. Sillf., p. 89 fr. 30, p. 119 fr. 9, pp. 45, 136.

⁶ Handl. rör. Sillf., p. 127 fr. 19, pp. 131, 136.

⁷ *Ekström*, Praktisk afhandling, p. 11.

⁸ Handl. rör. Sillf., p. 98 fr. 5, p. 112 fr. 17. There seems, therefore, not to have been any fishing of "May-herrings"—so-called "maatjes"—during the old fishery, and the word "fat-herring" has therefore in Bohus-Län got quite a different meaning than in Norway and other countries. *Ekström*, Praktisk afhandling, pp. 10, 11.

⁹ *Nilsson*, Handl. rör. Sillf., pp. 16, 45, 46, 62, 70, 134.

¹⁰ *Yhlen*, G. von, Göteborg. o. Boh. läns Hush. Sillsk. Quartaleskr., July, 1867, p. 51; 1873, p. 205.

¹¹ *Loberg*, Norges Fiskerier, p. 89.

name "*Tjogsill*," or score-herring, (in Norway "*Snesesild*,") all herrings of such a size as can be sold by the score are understood.¹

The young of the coast-herring are called "*Sillögon*,"² (herring-eyes), "*Sillmör*," or "*Sillmyr*,"³ (tender-herring,) and "*Sillstagg*,"^{4, 5}—in the neighboring portion of Norway "*Sildemaur*," or "*Sildegnu*,"⁶—till they are one year old, when they are called "*Grässill*," (grass-herring,) "*Smäsill*," (small-herring,) and "*Smälodda*,"⁸ (small "lodda,") till at the age of two years they reach a length of five to six inches, when they begin to be caught in the large nets, and are known by the general name of "*Lottsill*,"⁹ or "*Halfsill*," (half-herring.)¹⁰ The coast-herring is said to be fatter and plumper than the sea-herring, from which, according to some, it is known by the same characteristics which distinguish the mature spring-herring from the sea-herring of the same size.

THE SEA-HERRING ("*hafslottsill*").

The kind of herring called "sea-herring," which during winter comes in great numbers to the coast of Bohus-län—more regularly, however, on the southern coast and the southern portion of the central coast—is distinguished by its comparatively large head, its more elongated shape, and the great size; all of which characteristics are, however, only distinctly discernible in the larger specimens, (called "*storlodda*," i. e., "great lodda,") which are found in small numbers among the medium-sized, two-year-old herring, in respect to whose relation to the other herring, however, opinions are divided.¹¹

It is by some supposed to spawn at the beginning of autumn, (like the "old" herring of former times,) because the larger specimens which have been caught were usually empty, and would, consequently, when it comes to the coast of Bohus-län, be nearly half a year older than the coast-herring. At the meetings held by the committee of inquiry in 1833, the fishermen of the Bohus-län coast unanimously declared that the "sea-herring" ("*lottsill*") "goes away from the coast" before it gets mature;¹² and some of them were, therefore, of opinion that it

¹*Rasch, H. & Berg, B. M.* Betænkning og Indstilling afgiven af den til Fiskeriernes Undersøgelse i Christiania—og Langesundsfjorden ved Kongel. Resol. af 28 de Mai 1852, nedsatte Commission, p. 32.

²*Ekström, Praktisk afhandling*, p. 9.

³*Nilsson, Handl. rör. Sillf.*, pp. 45, 70.

Ekström, Praktisk afhandling, p. 10.

⁴*Nilsson, Handl. rör. Sillf.*, pp. 63, 70, 134.

Ekström, Praktisk afhandling, p. 10.

⁵These and some of the following names are merely differences of dialect, and therefore almost untranslatable.—*Translator's note.*

⁶*Rasch & Berg, Betænkning og Indstilling*, p. 32.

⁷*Nilsson, Handl. rör. Sillf.*, p. 46.

⁸*Nilsson, Handl. rör. Sillf.*, p. 137.

⁹*Nilsson, Handl. rör., Sillf.* pp. 70, 63, 66.

¹⁰*Nilsson, Handl. rör. Sillf.*, p. 46.

¹¹See what is said regarding the "*Stråksill*"—the "wandering-herring."

¹²*Handl. rör. Sillf.*, p. 102 fr. 24, p. 112 fr. 15, p. 117 fr. 14, p. 129 fr. 33. *Nilsson, Handl. rör. Sillf.*, p. 47.

spawned "out in the sea," whither it went on leaving the coast,¹ while others maintained that it was a small kind of herring which never got any larger² and never propagated its race, but was a "direct production of the water;"³ views which are still held by some people.⁴ Its spawning-places, the parts of the sea whence it comes and whither it goes, are thus not known; but if it should really come from another race of herring than that belonging to the Skagerack, it could not come from any other place but the North Sea, the Limfjord, or the Kattegat. The fact discovered by *G. O. Sars* that the young herring descended from the Western Norwegian winter-herring stays generally much farther toward the north, near the northwestern coast of Norway,⁵ furnishes an example of a young herring or sea-herring, like that found on the coast of Bohus-Län, paying regular visits to a coast where it is not born and where it does not spawn.

The Swedish word "*lottsill*" is supposed to be derived from the old fisheries, and originally meant a smaller kind of herring, or one of uneven size, not suitable for an article of trade,⁶ in contradistinction to the more even-sized herring, which was sold to the salting-establishments or herring traders. "*Lottsill*" was consequently a collective name, and meant not only half-grown herring, but also larger herring of another kind than the good herring,⁷ and therefore, following the example of others, I have used the term to distinguish it from the other races of herring, although it ought in course of time to be exchanged for a better one, since it has not become popular, and is perhaps even based on false premises. Nowadays, since the "old" herring has been forgotten, the term "*lottsill*" is often used by the fishermen to distinguish a kind of herring different from the spring herring.⁸ It is even called *hallsill*, (half-herring),⁹ and the few large ones found among them "*storlodka*," (great lott-herring.)¹⁰

THE WANDERING-HERRING, ("*Strålsill*.")

A large, but thin species of herring, which is found in small numbers late in autumn and in winter, and which is distinguished from the

¹ Handl. rör. Sillf., p. 111 fr. 10.

² Handl. rör. Sillf., p. 91 fr. 38, p. 92, p. 95, p. 106 fr. 21, p. 107 fr. 26, p. 112 fr. 15.

³ Handl. rör. Sillf., p. 103 fr. 33.—*Nilsson*, Handl. rör. Sillf., p. 37.—*Wright*, W. von,

Handl. rör. Sillf., p. 168.

⁴ Quite a different opinion, viz, that the "*lottsill*" was descended from our coast-herring, seems to have been quite common on the coast of Bohus-Län. See *Lundbeck*, O., *Anteckningar rörande Bohuslänska Fiskerierna, i synnerhet Sillfisket*. Göteborg, 1822, p. 27.—*Rosen*, A. von, *Anförande i Commerce Collegii underd. Förslag till nyt, Reglemente för Fiskerierna of d. 17 Aug., 1840.*—Handl. rör. Sillf., p. 95.

⁵ *Indberetning för 1873*, p. 54.

⁶ *Nilsson*, Handl. rör. Sillf., p. 63.

⁷ Handl. rör. Sillf., p. 88 fr. 19, 23, p. 100 fr. 12, p. 119 fr. 9, p. 127 fr. 19, &c. The "*Lottsill*" is still called "*lottsill*" when it becomes larger than about seven inches, as is erroneously thought. *Nilsson*, Handl. rör. Sillf., p. 135. *Nya Handl. rör. Sillf.*, p. 65.

⁸ See Handl. rör. Sillf., p. 107 fr. 24.

⁹ *Nilsson*, Handl. rör. Sillf., p. 46.

¹⁰ *Nilsson*, Handl. rör. Sillf., p. 137.

spring-herring by the same marks as the sea-herring, and which is said to resemble in its appearance the Norwegian herring. On the coast of Bohus-Län it is never found with fully-developed sexual organs, but is by some considered to be full-grown sea-herring. *Ekström* thought that they were barren spring-herring;¹ and this opinion was shared by *von Yhlen*.² Some years ago this kind of herring came to the northern coast in much larger numbers than usual,³ and according to some reports they are said to have staid till the end of May, when they got fat; but this last-mentioned kind, caught in May,⁴ is said by others to have been mostly autumn-herring, a race which is supposed to be distinct from the wandering-herring. The wandering-herring is not liked by the fishermen, because it is almost valueless, and is believed, if appearing in larger numbers, to chase away the other herring and eat up the young ones,⁵ so that its arrival often indicates the close of the herring-fisheries. On the Strömstad coast one occasionally hears the opinion expressed that the wandering-herring is of the same kind as the "old" herring, or at least resembles it. The wandering-herring is not spoken of in the reports of the "old" fisheries, so that in this respect they seem to be different from the fisheries on the west coast of Norway, which generally commenced with the fishing of wandering-herring.

The name *Stråksill* (wandering-herring) seems to have been given on account of its wandering about the coast in comparative loneliness, without occurring in regular schools and producing any fisheries. On the northernmost coast it is called *Bensill*, (bone-herring,) because it is thought to have more numerous and larger bones than any other herring.⁶ In the neighboring portion of Norway it used formerly to be called *Jernsvensk sill* (Iron Swedish herring.)⁷ Its proper Norwegian name, however, is *Straalsild*, (ray-herring,) *Straaksild*, (wandering-herring,) *Solhovedsild*, (sun-head herring),⁸ as well as *Blodsild* (blood-herring.)⁹ This last-mentioned name seems to indicate that even in Norway the fishermen consider the wandering-herring to have more blood than any other herring.

¹ Öfvers. af Kgl. Vet. Akad: s Förhandl. f. 1844, p. 26.—Praktisk af handling, p. 8.—Later, however, he came to the conviction that the wandering-herring was identical with the Norwegian herring.—Öfvers. af Kgl. Vet. Akad: s Förhandl. f. 1846, p. 20.

² Göteborgs och Bohusläns Hushållings Sällskaps Quartalsskrift, July, 1872, p. 50; 1873, p. 205.

³ *Sars, G. O.*, Indberetning. Morgenbladet f. 1871, n:o.

⁴ Handl. rör Sillf., p. 90 fr. 31.

⁵ Handl. rör Sillf., p. 88 fr. 21.—*Ekström*, Öfvers. af Kgl. Vet. Akad:s Förhandl. f. 1846, p. 20.

⁶ *Bocck, A.*, Tidskrift for Fiskeri, VII, p. 26.

⁷ *Yhlen, G. von*, Göteborgs och Bohusläns Hushållings Sällskaps Quartalsskrift, 1873, p. 205.

⁸ *Løberg*, Norges Fiskerier, pp. 23, 24.—*Bocck*, Om Silden, pp. 23, 24, 48.

⁹ *Sars, G. O.*, Indberetning til Departementet for det Indre om de af ham i Aarene, 1864-1873, anstillede, praktisk videnskabelige Undersøgelser. Christiania, 1869 and 1874. Indberetning for 1873, p. 59.

HERRING SPAWNING IN AUTUMN.

Herring spawning in autumn are said to have been caught sometimes near Tjörn, where, some years ago, small quantities of this same fish were caught at the end of summer or in the beginning of autumn. *G. von Yhlen* thinks that this herring is related to the Dutch herring.¹

THE LARGE HERRING, OR THE SO-CALLED "OLD" (GAMLA) HERRING.

(*Clupea bausica*, Nilss.)

It is frequently maintained, though not as often now as formerly, both by old men who remember the old fisheries, and by young persons, that herring of the same kind as the "old" herring, or at least resembling it very much, are caught among the other herring, or are observed in the open sea. I therefore feel it my duty to contribute my share toward ascertaining the truth of this assertion, and to increase our knowledge of this remarkable kind of herring by gathering all the information on the subject scattered in books and reports, giving a review of the different opinions regarding its appearance and disappearance on the coast of *Bohus-län*.

The "old" herring ("gamla" sill) was, during the period it visited the coast of *Bohus-län*, generally called "*samsill*,"² in order to distinguish it from a smaller and less valuable kind. It was also called "*storsill*," (great-herring,)³ by which name people, as they do in Norway at the present day, intended to distinguish a kind of herring excelling the others in size,⁴ and "*vadsill*,"⁵ (net-herring,) signifying a herring too large to stick in the meshes of a net; as well as "*höstsill*," (autumn-herring.)⁶

As there are no specimens of the "old" herring in any of our museums, it was necessary, in order to get some idea of its nature, to collate accurately the different accounts regarding it obtained from the fishing period when it was caught, or from the time near its close, when everything was still fresh in the memory of men.

If we examine the answers which were given to the committee of 1833 by the fishermen, we find that they *unanimously* declared that⁷ the herring which spawned in spring and which was peculiar to the coast was

¹ Göteborgs och Bohusläns Hushållnings Sällskaps Qvartalskrift, July, 1867, p. 51.—Here, as well as in *A. Boeck's* report, (Göteb. och Boh. läns Hush. Sällsk. Qvartalskr. Oktob., 1870, p. 28; Tidskrift för Fiskeri, V, p. 131.) and his more extensive work, "Om Silden og Sildefiskerierne," (p. 122,) the word *Holländska*" (Dutch) should be substituted instead of "*Halländska*."

² *Wright, W. von*, Handl. rör. Sillf., p. 171.—*Ekström*, Praktisk afhandling, p. 11.

³ *Nilsson*, Handl. rör. Sillf., pp. 45, 46, 62, 70, 134

⁴ Handl. rör. Sillf. p. 88 fr. 23, p. 90 fr. 33.

⁵ *Nilsson*, Handl. rör. Sillf., pp. 16, 62.

⁶ *Dubb, K. Vet. Akad:s* Handl. f. 1817, p. 35.

⁷ Only two salters, of whom one, however, could only remember the great fishery from his childhood, were of a different opinion. Handl. rör. Sillf., p. 112 fr. 16, p. 127 fr. 17.

certainly different from the "old" herring, and stated that it differed from it partly by variation in form,¹ and partly by staying near the coast "all the year round," (while the "old" herring came near the coast only for a short time,)² and by having (in the beginning of the year and in spring) roe and milt,³ (which during that period was not generally the case with the "old" herring,)⁴ by being not as large when full grown,⁵ by a smaller head and higher body,⁶ by the relative position of the fins,⁷ by a different flavor,⁸ and finally by resembling the Kattegat herring.⁹ As a characteristic distinction, it was mentioned that the herring coming in from the sea had a larger head, and was thinner and smaller, than the "old" herring, and had a different flavor;¹⁰ which assertions, however, have been utterly and indisputably refuted by Professor Nilsson.¹¹ Even from that kind of herring which is now generally called lottsill, (wandering-herring,) and which in size occasionally exceeds the "old" herring,¹² it is said to differ somewhat, as the lottsill was said to resemble more closely the Norwegian gråbensill, (gray-bone herring,) or have smaller scales and proportions slenderer.¹³ The "old" herring was furthermore of a different race from the Norwegian gråbensill, (gray-bone herring,)¹⁴ and the Southern Kattegat and Limfjord-herring.¹⁵ If we now consider everything that is alleged in the reports on the herring-fisheries regarding this matter, we find that the "old" herring, according to the account of the fishermen, differed from the "skärgardsill," (coast-herring,) from the "stråksill," (wandering-herring,) and—though not quite so much—from the "hafslottsill," (sea-herring,) and, finally, also from the herring caught on the western coast of Norway, in the Kattegat, and in the Limfjord, but that it nevertheless bore some resemblance to the "stråksill,"¹⁶ and even to the older and larger "vårsill," (spring-

¹ Handl. rör. Sillf., p. 88 fr. 23, p. 89 fr. 30, p. 90 fr. 31, pp. 95, 102, fr. 25. Also see *Lundbeck, O., Antekningar, p. 27.—Edenhielm, G. Utlåtande till Commerce Collegium af d. 2 Mars 1840.*

² Handl. rör. Sillf., p. 95.

³ Handl. rör. Sillf., p. 90 fr. 31, p. 120 fr. 16, p. 127 fr. 17.

⁴ Handl. rör. Sillf., p. 89 fr. 25, p. 98 fr. 5, p. 120 fr. 12, p. 125 fr. 6.

⁵ Handl. rör. Sillf., p. 120 fr. 13, p. 127 fr. 17 and 23.—See also *Dubb, K. Vet. Akad. Handl. f. 1817, pp. 35, 44.—Lundbeck, Antekningar, p. 27.*

⁶ Handl. rör. Sillf., p. 100 fr. 14 and 15, p. 107 fr. 24, p. 120 fr. 10, p. 127 fr. 23. *Dubb, K. Vet. Akads. Handl. f. 1817, p. 44.—Lundbeck, Antekningar, p. 27.*

⁷ Handl. rör. Sillf., p. 112 fr. 16.

⁸ Handl. rör. Sillf., p. 120 fr. 10, p. 127 fr. 17.—*Lundbeck, Antekningar, p. 27.*

⁹ Handl. rör. Sillf., p. 100 fr. 15, p. 107 fr. 24.—See also *Dubb, K. Vet. Akads. Handl. f. 1817, pp. 35, 44.*

¹⁰ Handl. rör. Sillf., p. 88 fr. 23, pp. 87-88 fr. 19, pp. 92, 108 fr. 32, p. 119 fr. 6, p. 126 fr. 10.

¹¹ Handl. rör. Sillf., pp. 133-135.

¹² Handl. rör. Sillf., p. 90 fr. 33.

¹³ Handl. rör. Sillf., p. 88 fr. 23, p. 90 fr. 33, p. 119 fr. 7.

¹⁴ Handl. rör. Sillf., p. 90 fr. 34, pp. 95, 107 fr. 25, p. 121 fr. 20.—See also p. 121 fr. 21 and p. 100 fr. 16.

¹⁵ Handl. rör. Sillf., p. 100 fr. 15, p. 121 fr. 20.

¹⁶ Handl. rör. Sillf., p. 119 fr. 7, p. 128, fr. 25 and 26.

herring,) as "its head was smaller, the rest of the body fatter, and the fish, when salted, of a better flavor."¹

Regarding the *spawning-season* of the "old" herring, we know (see "*Handlingarne till R. St. Fiskeri-Deputation år. 1764*")² that the herring "was full of roe in the beginning of the fishing-season, but empty in November," and that "another herring, full of roe and milt, came late in autumn and spawned later," which chiefly took place then in September and October, though herring were also caught which spawned later in autumn; a circumstance which reminds one of the spring-herring.³ In the "*Trangrumsact*" it is said, as is well known, "on the first arrival of the herring, especially when it comes early to the coast, it is full of roe and milt, while toward the end of the fishing-season it is thin, empty, and has no roe;"⁴ also, "the usual spawning-season of the herring is on its first arrival, when it is always wild,"⁵ and this, if compared with the accounts of the early history of the herring-fisheries,⁶ points to their spawning in autumn, which seems to have continued thus during the remaining portion of the fishing period, whenever the herring which was caught toward the end of the year is mentioned as having done spawning;⁷ and the inconsiderable quantity of fish with roe which were caught must have been got at the beginning of the fishing-season, in November and December.⁸ In the "*Trangrumsact*" it is mentioned that "in January, 1774, three great boat-loads of herring were caught in the Ellösfjord, near Morlanda, which in size and thickness, with milt and roe, exceeded all the herring which had been caught on the coast of Bohus Län during the previous autumn;"⁹ but I know of no reliable account that the "old" herring should, toward the end of the fishing-period, have delayed spawning till far in spring, and nothing similar is known from Western Norway, (where the great fishery was very similar to that of Bohus-Län,) or from any other place where herring-fisheries are carried on.

As regards the place where the "old" herring staid when not an object of fishery on the coast of Bohus-Län, opinions are much divided, which is quite natural, as there was very little personal observation to

¹ Handl. rör. Sillf., p. 88 fr. 19, p. 92, p. 123 fr. 30.

² *Sundevall*, C. J., Stockholms läns Kgl. Hushållnings-Sällskaps Handlingar. VI, Stockholm, 1855, p. 153.—*Cederström*, G. C., Fiskodling och Sveriges Fiskerier. Stockholm, 1867, p. 130 och 226 anm.

³ See chapter II of this report.

⁴ *Trangrumsacten*, p. 163.

⁵ *Trangrumsacten*, p. 183.

⁶ *Trangrumsacten*, pp. 129, 130, 133, 134, 139, 146, 147, 150.

⁷ *Svensson*, Berättelse om Sillfisket i Bohuslän, Göteborg. 1822, p. 18.—*Handl. rör Sillf.* p. 140.—*Nilsson*, *Handl. rör Sillf.*, pp. 41, 42.—*Sundevall*, *Handl. rör Sillf.*, p. 158.

⁸ Even during the last period of the "old" fishery did fishing commence about a month before Christmas, and herrings were often observed long before this, although they could not be taken with nets. (See *Handl. rör. Sillf.*, p. 104 fr. 3, p. 119 fr. 4.—*Cederström*, *Fiskodling och Sveriges Fiskerier*, pp. 203-214.)

⁹ *Trangrumsacten*, p. 146.

serve as a guide, but simply more or less well-founded suppositions. In *Doctor Fagréus's* work, "*Anmärkningår rörande sillfiske och trankokeri,*" which is embodied in the "*Trangrumsaet,*"¹ it is supposed, (as *Dodd* and *Anderson* first suggested, and after them *Pennant* and others,) that the herring had a common place of sojourn near the north pole, from whence large schools emigrated every year to those places where herring-fisheries were carried on.² This supposition was eagerly taken up by the oil-refiners and other comparatively educated persons on the coast of *Bohus-Län*,³ but did not coincide with the opinion of the uneducated fishermen. These latter, who distinguished the "old" herring as a "regular sea-herring"⁴ from the kind of herring peculiar to the *Skagerack*, seem to have considered the North Sea as its proper home;⁵ an opinion which *Professor Nilsson* considered so entirely without foundation, that he did not think it worth refuting.⁶ This opinion of the *Bohus-län* fishermen has been taken up by Norwegian naturalists, who had made a specialty of the study of the herring and the herring-fisheries.⁷ *Professor Nilsson*, on the other hand, and those who unconditionally followed him, supposed that it only went a short distance from the west coast of Sweden, "and certainly never went beyond the *Skagerack.*"⁸ This opinion of *Professor Nilsson* was based on the supposition that the herring, when not an object of fishery on the coast, lived at the bottom of the deep-sea valleys or basins outside the coast; and he maintained his view chiefly by the fact that herring are often found in the stomach of the codfish.⁹ Even *Axel Boeck* approved of this last-mentioned opinion,¹⁰ against which subsequently well-founded objections have been raised by *G. O. Sars*¹¹ and *G. C. Cederström*,¹² which, doubtless, will lead to an entirely different view regarding this most important point in the question of the herring-fisheries.

Closely connected with this is the question regarding the fate of the old herring after abandoning the spawning-places on the coast of *Bohus-län*. Thirty or forty years ago our most prominent zoologists supposed that the whole race of herrings, with the exception of the young left on the coast from last year's spawning, were probably scattered

¹ *Trangrumsaeten*, pp. 95-150.

² *Nilsson*, *Handl. rör. Sillf.*, pp. 24-28.

³ *Trangrumsaeten*, pp. 162, 163.—*Dubb*, *K. Vet. Akad:s Handl. f. 1817*, pp. 43.

⁴ *Dubb*, *K. Vet. Akad:s Handl. f. 1817*, p. 44.

⁵ See *Handl. rör. Sillf.*, pp. 53, 57.

⁶ *Handl. rör. Sillf.*, p. 68.

⁷ *Boeck*, *A.*, *Om Silden og Sildefiskerierne*, pp. 37, 45, 46.—*Sars*, *G. O.*, *Indberetning f. 1873*, p. 58.

⁸ *Handl. rör. Sillf.*, pp. 8, 68.—*Nya Handl. rör. Sillf.*, p. x.

⁹ *Handl. rör. Sillf.*, pp. 7, 8, 42, 43.—*Skandinav. Fauna*, iv, pp. 503-508.

¹⁰ *Om Silden og Sildefiskerierne*, p. 47.—*Tidskrift for Fiskeri*, VII, pp. 18, 19.

¹¹ *Indberetning f. 1869*, pp. 60-61; *f. 1873*, pp. 46-51.

¹² *Naturhistoriska betraktelser och iakttagelser innefattande hänvisningar till lämpligt sätt att forska för att kunna tillförlitligt utreda sillfiskarnes tillhåll och vandringsar.* Stockholm, 1871. Tillägg, pp. 1-3.

or destroyed in the sea,¹ or perished in the depth of the ocean, or in an unsuitable climate,² though there have not been wanting suppositions regarding spawning-places which it was said to visit afterward. Thus *Professor Nilsson*, in his report of November 11, 1826, seemed inclined to suppose that the herring, in consequence of the injudicious treatment which it experienced among us, turned toward Jutland and Læsö;³ and *Axel Boeck* thinks there was a connection between the Bohus-län and the Scotch-Dutch fisheries.⁴ *Oscar Andersen* mentions a supposition of *O. N. Löberg*, according to which "the northern great herring would be of the same kind as the old Bohus-Län herring," and would therefore, at a later period, "have turned toward the north."⁵ Among the professional men, the opinion seems at first to have been common that the herring, at least in the beginning, had gone to the southeastern part of the North Sea;⁶ and afterward the opinion seems to have gained ground that there was some intimate connection between the Norwegian spring herring-fisheries and the Bohus-län autumn herring-fisheries.⁷

As regards the causes of the *re-appearance* of the old herring on the coast of Bohus-Län in 1747, after a long absence, there has scarcely been any dispute, although the solution of this problem would be of great importance.⁸ *Professor Nilsson* and his followers suppose, according to the views expressed in *Handlingar rörande Sillfisket*, that those herring which had remained over from the last great fisheries on the coast of Bohus-län staid undisturbed near the coast, "which, through war and pestilence, had become depopulated," and increased gradually, unnoticed, so that when they were "suddenly" discovered, they produced an extremely rich fishery, lasting sixty years.⁹ Those who suppose that the large kind of herring are possessed of an innate desire for roaming about, see of course in this the only cause of its coming to the coast and leaving it again.¹⁰ Among the fishermen on the coast of Bohus-län the opinion seems to have been very common, at the beginning of the former fishery-period, that the herring were attracted by the large number of marine articulates, which, as is well known, they prefer to any

¹*Nilsson*, *Handl. rör. Sillf.*, p. 68.

²*Sunderall*, *Handl. rör. Sillf.*, p. 156.

³*Handl. rör. Sillf.*, p. 16.

⁴Beretning om Fiskeri-Udstillingen i Aalesund, 1864, p. 34.—Om Silden og Silddefiskerierne, p. 129.

⁵*Andersen*, O., Bohuslens Fiskerier. Frederikshald, 1869, pp. 10, 11.

⁶*Lundbeck*, O., Antekningar rörande Bohuslänska Fiskerierna, i synnerhet sillfisket. Götheb., 1832, p. 35.

⁷*Handl. rör. Sillf.*, p. 85, p. 101 fr. 22, p. 141.—Nya *Handl. rör. Sillf.*, p. XXVIII.

⁸*Boeck*, Om Silden og Silddefiskerierne, p. 83.

⁹*Nilsson* Förnyad nderdånig berättelse om fiskerierna i Bohus Län. Stockholm, 1823, p. 28, *anm.*

¹⁰*Dubb* thought a periodicity in meteorological and hydrographic events was the cause.—K. Vet. Akad:s *Handl. f.* 1817, p. 46.

other food;¹ an opinion which has recently been more fully developed by *G. O. Sars*.²

Regarding the causes of the "old" herring's *disappearance* from the coast of Bohus-län there has been a great variety of opinion, and the dispute has often waxed hot. At a very early period of the "old" fisheries it was expected that they would some time come to an end,³ and people, therefore, discussed the question of the possible causes of such an event, and the means which should be used to prevent such a national calamity, and laws were passed with a view to such a contingency.⁴ Passing over the more mythical causes of the disappearance of the herring, which were given from time to time, and which, doubtless, found the greatest favor among the common people, the following may be assigned as the chief causes of such an event:

1. *That the herrings were gradually destroyed*, so that the schools became smaller and smaller toward the end of the fishing-period⁵—by "excessive fishing,"⁶ by catching the young herring in nets with narrow meshes;⁷ by preventing the herring from reaching the most convenient spawning-places;⁸ and by the consequent destruction of the roe;⁹ and by unfavorable weather, "an unusual appearance of fish of prey, birds of prey," "want of food," &c., &c.; "and other influences injurious to the roe, the young, and the full-grown fish."¹⁰

2. *That the herrings were "slowly and persistently driven away,"*¹¹—by noise;¹² by the excessive number of fishermen;¹³ by the use of injurious

¹R. St. Fiskeri-Deputations Handlingar, 1760-1772.—Enl. *Cederström*, Fiskodling och Sveriges Fiskerier, p. 141.

²Indberetning for Aaret, 1873, p. 58.

³R. St. Fiskeri-Deputations berättelse om fiskeriernas tillstånd i Riket gifven vid Riksdagen d. 18 Maj 1772.—Enl. *Cederström*, Fiskodling och Sveriges Fiskerier, p. 192.

⁴Traugrumsacten, pp. 151, 152, 166.

⁵Handl. rör. Sillf., p. 98, fr. 8.

⁶*Nilsson*, Förnyad underdånig berättelse om Fiskerierna i Bohus Län. Stockholm, 1828, pp. 22, 29.—Handl. rör. Sillf., p. 47.—Skandinavisk Fauna, iv, pp. 505, 514.—*Wiedegren*, Handlingar och upplysningar rörande Sveriges Fiskerier, i, p. 51; iv, pp. 12, 36.—*Nyö* Handl. rör. Sillf., pp. 32, 33, 38, 39.

⁷*Nilsson*, Skandinav. Fauna, iv, pp. 507, 514.—*Wright, W. von*, Handl. rör. Sillf., p. 174. See also, *Krøyer*, H., Danmarks Fiske, iii, p. 161.

⁸*Nilsson*, Förnyad underdånig berättelse om Fiskerierna i Bohus Län. Stockholm, 1828, p. 30.

⁹Traugrumsacten, pp. 163-164, 171.—*Nilsson*, Skandinav. Fauna, iv, p. 515.—Förnyad underd. berättelse. Stockh. 1828, p. 30.

¹⁰*Cederström*, G. C., Fiskodling och Sveriges Fiskerier, pp. 208, 213, anm., 216.—*Krøyer*, Danmarks Fiske, iii, pp. 162, 163.

¹¹*Nilsson*, Handl. rör. Sillf., pp. 17, 73-74, 138.—*Sundevall*, Handl. rör. Sillf., p. 152, 154.—*Lovén*, Handl. rör. Sillf., p. 163.

¹²*Nilsson*, Handl. rör. Sillf., pp. 17, 18, 41, 138.—Skandinav. Fauna, iv, p. 505.—*Lundbeck*, Antekningar, pp. 34-38.—Handl. rör. Sillf., p. 87 fr. 16, p. 99 fr. 10.—*Sundevall*, Handl. rör. Sillf., p. 152.—*Wright, W. von*, Handl. rör. Sillf., p. 172.

¹³*Nilsson*, Förnyad underd. berättelse, Stockh. 1828, p. 28, anm.—Handl. rör. Sillf., p. 17.—Skandinav. Fauna, iv, p. 505.—*Wiedegren*, Nya Handl. rör. Sillf., p. 33.—*Boeck*, Om Silden og Sildefiskerierne, p. 85.

fishing-implements;¹ by interfering with the spawning-process;² by interfering with the spawning-places generally,³ and particularly by dragnets,⁴ or by throwing offal in the water;⁵ by leaving dead herring at the bottom of the sea;⁶ by throwing the guts and gills of fish into the water;⁷ by polluting the water through offal of blubber and similar matter;⁸ by the increasing number of the enemies of the herring.⁹

3. That the herrings left the coast from an innate desire of roaming.¹⁰

4. That the herrings were obliged to leave, because there was no longer a sufficient supply of food.¹¹

The validity of these causes has been disputed almost immediately after they had been put forward, and even now there is not one of them which has been unanimsly recognized as the probable cause of the repeated disappearance of the great Bohus-län fisheries.¹² It was thus, e. g., denied at the inquest of 1833 that the herring was destroyed through too much fishing,¹³ and that it was driven away by noise,¹⁴ offal of blubber,¹⁵ &c.

A more extensive and valuable criticism of these supposed causes has been given by *Króyer*,¹⁶ *O. N. Löberg*,¹⁷ *Axel Boeck*,¹⁸ and others.

¹ Nilsson, Handl. rör. Sillf., pp. 17, 138.—Skandinav. Fauna, iv, pp. 501, 505.—*Widgren*, Nya Handl. rör. Sillf., p. 33.

² Nilsson, Handl. rör. Sillf., p. 51, n. b.—*Lovén*, Handl. rör. Sillf., p. 161. Nya Handl. rör. Sillf., p. 64.

³ Nilsson, Handl. rör. Sillf., p. 51, n. b.—*Sundevall*, Handl. rör. Sillf., p. 153.—*Widgren*, Nya Handl. rör. Sillf., p. 33.

⁴ *Lovén*, Handl. rör. Sillf., pp. 161, 162.—*Ektström*, Praktisk afhandling, pp. 7, 19.

⁵ Nilsson, Skandinav. Fauna, iv, pp. 514-515.—*Widgren*, Nya Handl. rör. Sillf., p. 33.

⁶ *Tranmgrumsacten*, pp. 158, 161, 163, 164, 167, 186-187.—*Nilsson*, Handl. rör. Sillf., p. 41.—*Skandinavisk Fauna*, iv, p. 514.—*Sundevall*, Handl. rör. Sillf., pp. 152, 153.—*Lovén*, Handl. rör. Sillf., p. 161.—*Ektström*, Praktisk afhandling, pp. 7-8.

⁷ Handl. rör. Sillf., p. 99 fr. 10.—*Lundbeck*, Antekningar, pp. 32-33.—*Wright*, *W. von*, Handl. rör. Sillf., p. 174.—*Sars*, *G. O.*, Indberetning f. 1873, p. 45. *Tranmgrumsacten*, pp. 177, 182.

⁸ *Lovén*, Handl. rör. Sillf., p. 161.

⁹ Nilsson, Handl. rör. Sillf., pp. 41, 138.—*Skandinav. Fauna*, iv, pp. 505, 514.—*Lundbeck*, Antekningar, p. 31.—*Lovén*, Handl. rör. Sillf., p. 161.—*Wright*, *W. von*, Handl. rör. Sillf., pp. 172-174.—Handl. rör. Sillf., p. 94, p. 116 fr. 9.—*Tranmgrumsacten*, pp. 153, 154, 155, 165, 172, 176, 183, 185, 186, 188.

¹⁰ *Dubb*, *K.*, Vet. Akad. Handl. f. 1817, p. 45.

¹¹ Handl. rör. Sillf., p. 94, p. 99 fr. 9, p. 111 fr. 7, p. 128 fr. 24.—*Farrell*, *British Fishes*, 3 ed., i, p. 101.—*Boeck*, *Om Silden og Sildefiskerierne*, p. 85.

¹² *Sars*, *G. O.*, Indberetning f. 1873, p. 58.—*Cederström*, *Fiskodling och Sveriges Fiskerier*, p. 213 anm., 216. *Tranmgrumsacten*, pp. 164, 167.—*Lundbeck*, Antekningar, p. 26.—*Rosen*, *A. von*, Yttrande till Commerce-Collegium d. 8 Juli 1829.

¹³ *Boeck*, *Om Silden og Sildefiskerierne*, p. 85.

¹⁴ Handl. rör. Sillf., p. 87 fr. 15 p. 98 fr. 8, p. 110 fr. 4, p. 122 fr. 23, p. 128 fr. 24.—*Nilsson*, Handl. rör. Sillf., pp. 137-138.

¹⁵ Handl. rör. Sillf., p. 92, 95, 99 fr. 10, p. 115 fr. 8, p. 122 fr. 23, p. 128 fr. 24.

¹⁶ Handl. rör. Sillf., p. 99 fr. 10, p. 105 fr. 13, p. 110 fr. 5, p. 115 fr. 9, p. 121 fr. 23, p. 128 fr. 24.

¹⁷ *Danmarks Fiske.*, iii, pp. 164-167.

¹⁸ *Norges Fiskerier*, pp. 8, 9.

¹⁹ *Om Silden og Sildefiskerierne*, pp. 86-102, 119.

The enormous masses in which the herrings appear must doubtless, if they select a narrow bay as their spawning-place, produce quite a change in the nature of the coast, both by their becoming with their roe and young ones the food of numerous marine animals, and by the food which they and their young ones eat, which change may finally assume such dimensions that the coast becomes unsuitable as a spawning-place. On the coast of Bohus-län unfavorable weather has contributed not a little toward bringing about such a change. Because a temperature of $+3^{\circ}$ C. has no destructive effect, it cannot be maintained that a still lower temperature, with its consequent formation of bottom-ice, will not prove injurious.¹ Not sufficient attention seems to have been paid to the very destructive effect which several severe winters, following close one upon the other, must have had on the spawning-places of the herring, especially on the outer coast.

Another question which is closely related to that of the disappearance of the "old" herring is, why, during the fishing-period, the herrings came to the coast at different seasons of the year. Already during the first half of the last fishing-period, it was observed in Bohus-län that the herrings commenced to come later, and people began to fear "that the herrings, as had happened repeatedly in former times, to the irreparable injury of the province and the whole kingdom, would leave the coasts of Sweden."² People began to inquire into the possible causes of such an event, and attempts were made through various laws and regulations to prevent so dire a calamity.³ After the herring-fisheries had ceased in the year 1808, people thought that in this circumstance they had a proof that the herring had been driven away by the coast-population, and the same causes were given for it as were supposed to have brought about the stoppage of the fisheries. By *Axel Boeck's* investigations this whole question entered upon a new phase. He showed that there always had existed, in this respect, a very remarkable similarity between the great Bohus-län fisheries and the Norwegian spring-herring-fisheries,⁴ a circumstance which gives increased weight to the point in question, and possibly contains the key to the question of the periodicity of the great Scandinavian herring-fisheries. *Boeck* has not, however, attempted to assign any cause for the later arrival of the herring during the fishing-period, but this has recently been done by *G. O. Sars*.⁵ Regarding the appearance of the herring on different places of the coast during the fishing-period, *Boeck* seems to have pointed out the

¹ *Boeck, A.*, Om Silden og Sildofiskerierne, p. 119.—*Widegren*, Nya Hundl. rör Sillf., p. 38.—*Cederström*, Fiskodling och Sveriges Fiskerier, p. 216.—*Edlund*, Öfvers. af kgf. Vet. Akad:s Förhandl. f. 1863, p. 372; f. 1865, p. 209.

² R. St. Fiskeri-Deputations berättelse om fiskeriernas tillstånd i Riket afgifven vid Riksdagen d. 18 Maj. 1772.—Enl. *Cederström*, Fiskodling och Sveriges Fiskerier, p. 192.

³ *Trangrumsacten*, pp: 151-154, 158, 166.

⁴ Om Silden og Sildofiskerierne, pp. 102-110.

⁵ *Iudberetning for Aaret 1873*, pp. 55-56.

similarities to the Norwegian spring-herring-fishery, and passed by the differences. With regard to the Bohus-län fishery, this fact may be explained by well-known meteorological and hydrographic conditions. It is also evident, that if fishing, as is done near the coasts of Scotland, had been carried on with floating nets, the above-mentioned facts would not have become prominent as they are now in consequence of fishing with stationary nets.

Nothing remains now, in conclusion, but to account for the assertion that herring "*resembling*" the "old" herring had been caught near the coast of Bohus-län, or in the open sea near that coast, and to examine this assertion a little more closely.

At the meetings held by the committee of inquiry in 1833, the opinion of the fishermen that "herring resembling the old" herring had been caught among the other herring was upheld by a majority of those present only at two places, viz, in Strömstad¹ and in Klädesholmen.² If we compare the reports given by the fishermen at the former of these places with those given on the same occasion by Mr. *Norberg*, a wholesale dealer, we find that the coast-herring, although distinctly different from the "old" herring, was still thought to *resemble* it in some cases,³ and that the larger herring, which was otherwise caught, was the so-called stråksill, (wandering herring,)⁴ which latter race is still declared to be the same as the "old" herring, or, at least, is said to resemble it very much, by old men in Strömstad. It does not, therefore, seem improbable that either of these species of herring was meant by the answers given to the nineteenth question put by the committee. If we further compare the latter of the above-mentioned answers with those received in the same place to the seventh question, it also appears that another kind of herring was thought to resemble the "old" herring. The answer to the thirtieth question,⁵ however, undoubtedly implies the coast-herring.⁶ As the answers given by the salters *Schiller* and *Mjöberg*⁷ were disputed by all the fishermen present, and as the former of these men had only witnessed the "old" fisheries when very young, and both evidently meant the coast-herring, these answers may chiefly have been called forth by the conviction—discarded at a later time—of the correctness of Professor *Nilsson's* views. *Mjöberg* was the *only* person who, at the inquest of 1833, positively asserted that herring was constantly being caught on the coast of Bohus-län which not only resembled the "old" herring, but was of the same kind. If we compare the answers received at

¹ Handl. rör. Sillf., p. 87-88 fr. 19.

² Handl. rör. Sillf., p. 123 fr. 30.

³ Handl. rör. Sillf., p. 92.

⁴ Handl. rör. Sillf., p. 95.

⁵ Handl. rör. Sillf., p. 123.

⁶ See *Norberg's*, *Schiller's*, and *Mjöberg's* similar answers: Handl. rör. Sillf., p. 92, p. 112 fr. 16, p. 127 fr. 17.—*Ekström*, Öfvers. af Kgl. Vet. Akad. Förhandl. f. 1848, p. 84

⁷ Handl. rör. Sillf., p. 112 fr. 16, p. 127 fr. 17, p. 128 fr. 26.

Fjellbacka and Gullholmen regarding herring "resembling" the "old" herring, which were taken from the stomachs of cod-fish,¹ with the answers received at Grebbestad, where herring found under the same circumstances were described in such a manner as to leave no doubt that coast-herring were meant,² (which is also confirmed by *W. von Wright's* report on the herring-fisheries in Bohus-län during the winter 1842-'43,³) and with the answers received at Klädesholmen and Kalfsund, (where herring obtained under such circumstances were declared to have been of different size⁴ or altogether sea-herring,⁵) and if we take into consideration the fact that it is always more or less difficult to ascertain to what kind of herring a badly-preserved specimen belongs, such accounts can scarcely be considered as of any great importance. Still less weight can be attached to the accounts received at Fjellbacka, that herring resembling the "old" herring had been seen in the Kattegat,⁶ as the fishermen on the northern coast, neither at that time nor later, have carried on any great fisheries, and as entirely different accounts were received from the central and southern coasts,⁷ where such fisheries were carried on. It must also be remembered that although the correctness of the minutes of these meetings was certified, still there might have been expressions used which might have been misunderstood by a clerk not entirely familiar with the coast population, a case which seems still more probable, as the questions were, perhaps, not always propounded in a form most intelligible to the fishermen. During the more productive sea-herring-fisheries it happens not unfrequently that some old person who either remembered the "great" fisheries, or has, in his youth, heard some lively traditions regarding them—and who, consequently, is considered more knowing in such questions than other persons—asserts that herring of the old kind have been caught,⁸ which joyful news then goes the round of the papers, awakening anew among a portion of the coast-population the hope that another great herring-fishery is near at hand.⁹ Thus it happened last winter that an old woman, who could well remember the former fisheries, declared most emphatically that she recognized "great" herring among the larger herring caught with the sea-herring. The mackerel-fishers occasionally observe schools

¹ Handl. rör. Sillf., p. 107 fr. 22, p. 108 fr. 31, p. 117 ir. 13.

² Handl. rör. Sillf., p. 100 fr. 15.

³ Handl. rör. Sillf., p. 166.

⁴ Handl. rör. Sillf., p. 119 fr. 8.—*Nilsson*, Handl. rör. Sillf., p. 46.

⁵ Handl. rör. Sillf., p. 126 fr. 15.

⁶ Handl. rör. Sillf., p. 107 fr. 22, p. 108 fr. 31.

⁷ Handl. rör. Sillf., p. 116 fr. 13, p. 119 fr. 8, p. 126 fr. 15.

⁸ *Wright, W. von*, Handl. rör. Sillf., p. 172.—*Ekström*, Öfvers. af Kgl. Vet. Akad:s Förhandl. f. 1848, p. 84.

⁹ *Lundbeck*, Antekningar, p. 24, 25.—*Edehjeltn, G.*, Utlåtande till Commerce-Collegium af d. 2 Mars 1840.—*Ekström*, Öfvers. af Kgl. Vet. Akad:s Förhandl. f. 1844, p. 26.—*Yhlen, G. von*: Göteborgs. och Bohusläns. Hushållnings-Sällskaps. Kvartalskrift Juli 1870, p. 16.—*Nya Handl. rör. Sillf.*, p. 11.

of large sea-herring, but I have been unable to obtain any account regarding it, which would not have been the case if such fish really were found in any considerable numbers in the Skagerak.¹

Among the *small herring* different kinds are also distinguished, and the eminent ichtyologist *Kröyer* has described one of these as a separate species under the name of *Clupea Schoneveldi*.² Professor *Nilsson* has distinguished "a longer and small northern variety" from the southern, to which the *Clupea Schoneveldi* Kr. belongs.³ *Von Yhlen* has, on the Bohus-län coast, distinguished "small herring coming from the sea" and "small herring belonging to the coast," without, however, asserting that they are two different species.⁴

My personal observations have not yet enabled me to explain fully whether the different herrings and small herrings are in reality different species or not. From what has been said it will be seen that this whole question can only be answered satisfactorily after the most careful observations have been carried on for years, and by a critical comparison of specimens of every age obtained at different seasons of the year. At the first superficial glance the difference of species seems easily decided, but on a closer examination one difficulty after the other presents itself. And still, if the question of the herring-fisheries is to be answered satisfactorily and practically, these difficulties must be so completely overcome, that a sufficient knowledge is obtained of the period when each of these species is generally caught on the coast, and of the quantities which are caught.

II.—OF THE PROPAGATION AND GROWTH OF THE HERRING AND SMALL-HERRING.

The spawning of the spring-herring goes on during the months of March, April, and May,⁵ in suitable places on the coast, of which only a few are generally known, because the fishing with stationary nets, which are the most convenient for catching spawning-herring,⁶ is not common in Bohuslän; and also because drag-nets can be used only in exceptional cases in those places where the herrings spawn. A bottom free from stones and rocks, and perfectly even, is very seldom found on the coast of Bohuslän, since, over a hilly bottom, which offers the best places for spawning, the drag-nets cannot generally be drawn. It seems that the herring also often spawns on a clayey bottom, overgrown with aquatic plants. Of well-known spawning-

¹ *Sars, G. O.*, Indberetning f. 1873, p. 54.

² *Danmarks Fiske*, iii, p. 138.

³ *Skandinavisk Fauna*, iv, p. 518-520.

⁴ *Göteborgs och Bohusläns Hushållnings-Sällskaps Qvartalsskrift*, Juli 1871, p. 52; Juli 1872, p. 50-51.

⁵ It is supposed, however, that the larger spring-herring spawns somewhat earlier on the northern and central coasts, beginning even in February; *Dubb*, however, maintains that the herring on the southern coast continues to spawn till some time in June. (*Reports of the Royal Academy of Sciences for 1817*, pp. 35, 44.)

⁶ See *Journal of Pisciculture*, VII, p. 20.

places, there may be mentioned *Björnsund*, in *Dynekilen*, where the herring spawns on a hilly bottom, and is caught in stationary nets; *Ozevik*, and other places in the sound between *Bokenäs* and *Orost*,¹ *Ulkehålet*,² and *Hummersund*,³ and several localities near *Tjörn*, as well as the farms of *Hästevik*, *Andal*, *Ardal*, and *Gäsesund*,⁴ on the *Hisingen* coast, &c.⁵ The herrings which spawn in March and April are generally larger than those spawning in May; the latter being considered the younger, and spawning for the first time.⁶ This so-called May herring is often found among those two years old, sometimes even with those one year old, and sometimes with still younger herring. After mild winters and in favorable weather, the spawning begins somewhat earlier than otherwise,⁷ though the spawning-time of the spring-herring seems to have been invariably the same, if we may judge from what can be inferred with any degree of certainty from the more or less clear accounts concerning the fishing for spring-herring and its spawning, found in the "*Trangrums Act*"⁸ concerning the blubber-refineries, in *Dubb's* report on the herring-fisheries in Bohuslän,⁹ in the reports on the herring-fisheries,¹⁰ and in *Ekström's* reports.¹¹

The young herring generally begins to make its appearance in the early part of May, and grows so rapidly that toward the end of the year it has reached a length of from 2½ to 3½ inches.¹² Having measured a large number of herring which were caught during the latter half of May, I found the most of them can be divided into three groups, according to their size, viz, those measuring about 4 inches in length, which must be considered as one year's fish; those of from 5½ to 6 inches, probably two years' fish; and those of about 6½ inches, which were supposed to be three years old, and had completely developed sexual organs. Some fish were occasionally found with flowing spawn, measuring only about 2½ inches; and some measuring somewhat more, but not yet ripe for spawning the same year. Larger fish,

¹ *Wright, W. von*, Reports on Herring-Fisheries, p. 166.

² *Wright, W. von*, Reports on Herring-Fisheries, p. 166. *Ekström*, Review of the Reports of the Royal Academy of Sciences for 1844, pp. 26, 82.

³ *Nilsson*, Scandinavian Fauna, IV, p. 509.

⁴ *Dubb*, Reports of the Royal Academy of Sciences for 1817, pp. 35, 44.

⁵ Compare, also, *G. von Yhlen*, Quarterly Journal of the Gottenburg and Bohuslän Economical Society, July, 1871, p. 51.

⁶ This, possibly, was also the case with the "old" herring during the former great fisheries. Compare "Reports to the Royal Fishing Deputation for the Year 1764;" also, *Sundervall*, Reports of the Royal Economical Society of Stockholm, Län VI, p. 153; and *Cederström*, The Propagation of Fish and the Swedish Fisheries, pp. 130, 226.

⁷ *Ekström*, Reports of the Royal Academy of Sciences for 1844, p. 120. Practical Essay, p. 8.

⁸ *Trangrums Act*, pp. 76, 77, 78.

⁹ Reports of the Royal Academy of Sciences for 1817, pp. 35, 44.

¹⁰ Reports on the Herring-Fisheries, pp. 64, 66, 90, fr. 31; p. 117, fr. 16, 17; p. 120, fr. 11, 16; p. 126, fr. 27. New Reports Concerning the Herring-Fisheries, pp. ix, x.

¹¹ Reports of the Royal Academy of Sciences for 1844, p. 120. Practical Essay, p. 8.

¹² Counting from the point of the lower jaw to the root of the caudal fin.

measuring about 8 inches, are probably four years old. The spring-herring sometimes reach a length of more than 12 inches, but even specimens of 9 $\frac{1}{4}$ inches are rare. The Bohuslän herring seems, therefore, to spawn as early as at the age of *three*, although I do not wish to convey the idea that all the herring sprung from the same year's spawn begin to spawn at that age; but it seems rather as if one portion did not reach their maturity till their fourth year. The circumstances that the herring spawns during three whole months, and that therefore there is a considerable difference in the ages of those that are produced first and those produced last, that some have better chances for securing food than others, taken in connection with other more or less accidental circumstances, explain the fact that fish of all possible sizes are frequently taken from the same net.

As to the age at which the herring spawns for the first time, opinions have been much divided, both among Scandinavian naturalists and those persons who have devoted their life to the herring-fisheries. Professor *Nilsson*, from information received from "trustworthy fishermen," assumes that "no fish spawns in the second year," and that "the herring does not spawn till the fifth or sixth year."¹ Dean *Ekström* considers those herring which measure 6 inches (counted from the point of the nose to the anal fin) to be two years old; those measuring from 10 to 13 inches, from four to five years old; and adds that "the herring found in Bohuslän does not spawn till it measures from 7 to 8 inches, counting the whole length."² Prof. *C. J. Sundevall*, who has made observations on the growth of the herring on the coast near Stockholm, thinks that it becomes capable of spawning when it is from three to four years old.³ Mr. *Widegren*, superintendent of fisheries, thinks that the herring is fit to spawn when it is "about three years old."⁴ *Axel Boeck* was inclined to think "that the youngest herring when spawning is scarcely less than three years old, and certainly not more than four," although he could not give any sufficient reason for this view,⁵ but at the same time said that persons who had been long employed in fishing had told him that the herring, when able to spawn, must be from six to eight years old.⁶ *G. O. Sars*, also, seems to have been of the

¹ Report on the Herring-Fisheries, pp. 45, 47, 51, 59.

² Practical Essay, pp. 10, 11.

³ Reports of the Royal Economical Society of the Stockholm District, vol. VI, pp. 105, 151.

⁴ Some Remarks on the Herring and its proper Preparation for an Article of Commerce, Stockholm, 1871, p. 4.

⁵ On Herring and Herring-Fisheries, pp. 36, 37. Piscicultural Journal, VII, p. 20.

⁶ On Herring and Herring-Fisheries, p. 36. Piscicultural Journal, VII, pp. 20, 21. In the Morning Journal, of November, 1872, *Boeck* gives a fuller account of similar information given him by a professional man, *Dahl*, regarding the six years' development of the herring. According to this, it is called on the west coast of Norway "musse," when it is one year old; "leaf-herring," when two years; "Christiania-herring," when three years; "middle herring," when four years; "merchants' herring," when five years; and "spring-herring," when six years old; all which terms seem to be very old in Norway.

same opinion as Professor *Nilsson*, and at first thought that the herring became capable of spawning at the age of five years, but afterward assigned the age of six years.¹

Fishermen generally assume that the *small-herring* has roe and milt during the spring and early summer, and some of them have observed the young of the small-herring some time after spawning. The spawning of the small-herring may, like that of the herring proper, be delayed or hastened by the weather, but otherwise does not seem to change as to the time when it takes place. In the reports of Mr. *P. Clancey*, made in his capacity of superintendent of herring fisheries, to the Royal Chamber of Commerce, it is said, *e. g.*, that on the 11th March, 1811, "herring and small-herring were caught having both roe and milt,"² which implies that spawning would have taken place at most from three to four months later. Hence we may conclude that one cannot assume any advance in the spawning-time of the small-herring, in order to explain *Nilsson's*, *Wilhelm von Wright's*, and *Ekström's* different views, since these men take the autumn to be the spawning-season of the small-herring.³ Prof. *C. J. Sundevall* has found that the small-herring on the coast of the Stockholm district spawns at the end of June and in July,⁴ and therefore about the same time as in Bohuslän. *Krøyer* says of the *Clupea sprattus* that "its spawning-season is mostly in August, but that it begins as early as the latter half of June, and sometimes extends to September,"⁵ and of the *Clupea Schoneveldi* that "in males caught early in the spring the milt was found to be considerably developed,"⁶ which points to a somewhat earlier spawning season for the last-named variety.

The few observations which I have been able to make on this point prove that the spawning of the small-herring on the central coast begins at the end of May or the first of June. Its spawning-season may, possibly, begin somewhat earlier on the northern coast and a little later on the southern coast.⁷ Small-herring caught in the autumn or winter never have any roe or milt, a circumstance which could easily be ascertained in the preparation of the so-called boneless anchovies; and yet they are not very thin either, which shows that they cannot have spawned immediately before the commencement of the fisheries. The small-herring which I had occasion to observe during the spring is

¹ Report for 1872, pp. 38, 39; Report for 1873, p. 44, note.

² *Cederström*, Fish-Culture and the Swedish Fisheries, p. 215.

³ *Nilson*, Prodrömus Ichthyologiæ Scandinaviæ, p. 22. Scandinavisk Fauna, IV, p. 521. *Wright, W. von*, Reports on the Herring-Fisheries, pp. 167, 175. *Ekström*, Practical Essay, pp. 9, 103; Review of the Transactions of the Royal Academy of Sciences, for 1844, p. 26.

⁴ Reports of the Royal Economical Society for the District of Stockholm, VI, pp. 109, 185-187.

⁵ Denmark's Fish, III, p. 191.

⁶ Denmark's Fish, III, p. 201.

⁷ *Nilsson*, Scandinavisk Fauna, IV, p. 521.

smaller, and is more like the variety *Schoneveldi Kr.* than those which I saw caught on the northern coast toward the end of last year.

It is said that the young of the small-herring begin to show themselves in the northernmost portion of the coast about midsummer, or in the beginning of July. I cannot give any information gathered from other persons, as to how rapidly the small herring grows, and how old it is when it spawns for the first time; and the observations made by myself are still too few and incomplete to draw from them any accurate conclusion. But as I have, in the mean time, received from Kalfsund small-herring, measuring not quite 100 millimeters, (96-97,) whose sexual organs were considerably developed; and as most of those which I procured at Tjorn during May, and which were capable of spawning, only measured from 100 to 110 millimeters, it seems to me not improbable that the small-herring can spawn for the first time when it is two years old; although I believe that this is by no means the case with all the fish born during the same season. The largest small-herring which I could get measured 149 millimeters, but even specimens measuring 140 millimeters are very rare.

III.—OF THE HERRING'S AND SMALL-HERRING'S MODE OF LIFE; ITS MIGRATIONS, AND THE DEPENDENCE OF THESE LATTER ON METEOROLOGIC AND HYDROGRAPHIC CIRCUMSTANCES.

As I was able to make but few personal observations on these points, I endeavored to ascertain from experienced fishermen on the coast what they had observed, and then compared their observations with all the literature on the subject which was accessible to me, in order to find how far discrepancies existed.

The herring and small-herring are usually found in separate schools and do not intermingle. They seem not to get on well together, and must be considered rather as enemies of each other. If, therefore, herring are caught in any considerable numbers during the small-herring fisheries, it is considered an unfavorable omen. When the larger spring-herring goes to its spawning-places in great schools, it is not generally found consorting with any small-herring.¹ The large herring is considered dangerous to the young-herring,² and is said, when found in any large numbers, to drive away all the other herring, and is therefore disliked by fishermen on the northern coast.

In seine-fishing, the herring generally seems to be very much afraid of the seine,³ and cannot often be caught in this manner. The different degrees of clearness of the water plays an important part in this operation, and seine-fishing by daytime can, at present, be carried on only on the southern coast, where the more turbid water from the rivers⁴

¹ Report on the Herring-Fisheries, p. 111 fr. 8.

² Ekström, Review of Transactions of the Royal Academy of Sciences for 1846, p. 20.

³ H. Raach and B. M. Berg, Memorial and Petition, pp. 10, 33.

⁴ F. Ekman, On the Sea-Water on the Coast of Bohuslän, p. 25.

prevents the herring from noticing the seine till it is too late. The large herring is not near as bold a fish as the small-herring, and does not make any serious attempts to escape; while the latter, as soon as the seine is hauled on land, boldly pushes against the meshes trying to get out, resembling somewhat in this respect the pilchard.¹

The chief food of the herring on the coast of Bohuslän consists of small insects, ("Ganeskar,") which are found, especially during the warm season,² in great numbers.

The herring seems to like those gulfs into which some large river empties; and the Skagerack spring-herring is consequently found in very great abundance near the mouths of the Göta River and the Glommen, (where it has been caught with stationary nets from time immemorial.) This may arise from the facts that it finds more food there, and because the less salty and more turbid water offers a better protection, especially upon the part of the young fish against enemies.³

In former times, the large herring often ascended the river as far as Göteborg, and once it was found near Tingstad, a mile from Nya Ellsberg.⁴

The herring is found at a greater depth in cold than in warm weather;⁵ and when there is ice, it has sometimes been observed to pass under it.⁶ Near Kallsund, it has been found that there is frequently good herring-fishing immediately after the breaking-up of the ice.⁷ This always implies a change from land-wind and cool weather to sea-wind and milder weather.

When the water grows warmer, the young herring move to the shallow places; but when cold weather sets in, they move to deep water. It has been observed, near Hisingen, that during the summer the young herring like to come to the mouth of the river when there is an east wind,⁸ but otherwise they follow the stream out on the coast. After mild winters, and during particularly mild spring weather, the spring-herring begin to spawn somewhat earlier, and the fisheries consequently begin at an earlier period than otherwise.⁹

At the beginning of the "old" fisheries, when the herring still came near the coast during the warm season, the land-wind was considered most favorable to the fisheries; but since the herring have begun to

¹ *Farrell*, British Fishes, 3d ed., I, pp. 143-144.

² *Ekström*, Review of the Transactions of the Royal Academy of Sciences for 1846, pp. 181-182.

³ *Dubb*, Reports of the Royal Academy of Sciences for 1817, pp. 35, 44. *Nilsson*, Reports on the Herring-Fisheries, pp. 57, 59, 64.

⁴ Act concerning Blubber-Refineries, p. 93.—*Dubb*, Reports of the Royal Academy of Sciences for 1817, p. 35.

⁵ *J. M. Mitchell*, The Herring, its Natural History and National Importance, Edinburgh, 1864, p. 28.

⁶ *Cedarström*, Fish-Culture and the Swedish Fisheries, p. 211.

⁷ Reports on Herring-Fisheries, p. 129 fr. 28.

⁸ *Nilsson*, Reports on the Herring-Fisheries, p. 64.

⁹ *Ekström*, Review of the Transactions of the Royal Academy of Sciences for 1844, p. 120.

approach the coast during the cold season, this is no longer the case.¹ This change has been attributed to the blubber-refining establishments. An east wind increases the saltness and purity of the sea-water,² but it retards the current coming from the North Sea toward the gulfs, and consequently lowers its temperature during the cold season, and favors the formation of ice. As to the most favorable time for fishing, (which, as is well known, is chiefly carried on during the warm season,) the old saying holds good: "*fine and steady weather with high water*"³ is best. A land-wind and low water are generally considered unfavorable;⁴ while a change, indicated by rising water and falling weather, is considered good.⁵ On the Fjellbacka coast, and in several other places, it has been noticed that the herring goes out from the coast "to meet storm and foul weather;"⁶ but that after the storm fishing is very good again.⁷

During the spring-herring fisheries near Hisingen, the herring are said to move, during the land-wind, farther up toward the mouth of the river, and there is then good fishing near Gåsesund and Ardal, and near Ny-Elfsborg; while during the west and south wind, the best fishing is near Andal and Hästevik. Very mild winters, with continuing violent sea-winds, are thought to drive the sea-herring to the coast.⁸

Although I think it proper not to increase the number of suppositions regarding the herring and the herring-fisheries, (which, by the way, is easy enough, even with only a very superficial knowledge of the herring-literature,) I deem it best not to omit noticing in this place the similarity between the approach of the so-called sea-herring to the coast of Bohuslän, and the direction which the current of the sea takes from the North Sea to the Skagerack. This current flows from Skagen toward the Paternoster Rock, just outside of which it turns toward the north, and then follows the coast.⁹ Fishing for those herring which come from the sea usually commences near Tjörn and the Marstrand Islands, from which the herring spread toward the south and north.¹⁰ In this latter case, they follow the current of the sea, and as this leaves the

¹ Act Concerning the Blubber-Refineries, pp. 176, 177.

² *Ekman*, On the Sea-Water on the Coast of Bohuslän, p. 26.

³ Act Concerning the Blubber-Refineries, p. 84.

⁴ *Dubb*, Reports of the Royal Academy of Sciences for 1817, p. 46.

⁵ *Mitchell*, The Herring, p. 33.

⁶ Act Concerning the Blubber-Refineries, p. 73. *Wright, W. von*, Report concerning the Herring-Fisheries, p. 167. *Mitchell*, The Herring, pp. 97-98.

⁷ *Dubb*, Reports of the Royal Academy of Sciences for 1817, p. 46. *Mitchell*, The Herring, p. 93.

⁸ Act Concerning Blubber-Refineries, p. 177. Report on the Herring-Fisheries, pp. 86 fr. 11, p. 113 fr. 22, p. 128 fr. 27. *Mitchell*, The Herring, pp. 28, 33.

⁹ *Klint, G. af*, The Bohus Bay and the Kattegat, Stockholm, 1840, p. 89. *Arwidsson, Th.* The Bohus Bay and the Kattegat, Stockholm, 1869, p. 3. *Ekman, F.*, On the Sea-Water near the Coast of Bohuslän, p. 23.

¹⁰ Reports of the Fishery-Commission, 1760-72. *Cederström*, Fish-Culture and the Swedish Fisheries, p. 131. Act Concerning Blubber Refineries, p. 6. *Dubb*, Reports of the Royal Academy of Sciences for 1817, p. 34. *Wright, W. von*, Report on the Herring-Fisheries, p. 174.

coast north of Sotenäs the sea-herring fisheries on the northern coast have been less certain and comparatively less productive than those on the central and southern coasts.¹ The reason why the "old" herring, in the beginning of the fishing period, moved farther south, and toward the end of the same period more toward the north, must be found, no doubt, in the uneven temperature of the respective portions of the sea toward the end of the summer and the beginning of autumn on toward winter. It is possible that the so-called "deep trough," from which there is a branch toward the Marstrand Bay, has likewise some influence on the route which the herrings take when they approach the coast.

The current of the sea, which enters the Skagerack with considerable violence, of course facilitates the movement of the herring, and by maintaining a more even temperature has doubtless great influence on their migrations.

IV.—OF THE HERRING-FISHERIES, THEIR TIME AND PLACE.

The common *coast-herring* fishery is, in Bohuslän, generally of but little importance, and is carried on mostly for the every-day supply of the inhabitants of the coast; but, by the combination of several favorable circumstances, it is sometimes more productive and even quite remunerative. This fishery is carried on along the whole coast of Bohuslän, although it is only important in the northern portion, and near Hisingen. During the autumn, especially in October, small quantities of the so-called "autumn herring" are caught between Hafstensund and the Sücke Bay. A few fish of this kind have been caught occasionally, even on the Fjellbacka coast. From the beginning of March on through the spring, so-called spring-herring have been taken with stationary nets in Dynekilen, (a bay,) and in the Ide Bay, and such fish, with loose roe and milt, have been sold during March in Strömstad for 12½ cents a score. This herring-fishery, although of no great importance, is carried on even with small drag-nets, in several localities both on the northern and central coasts, but chiefly on the latter, where, in some places, *e. g.*, Ulkaehälet and Hakenäs, both belonging to the district of Tjörn, it has furnished an ample supply for the households of the fishermen; while, in other places, *e. g.*, Hummersund and Stockeviken, both situated on the southern side of the Tjörn Promontory, the fishing has been exceedingly poor. Fish for household-supply have also been caught with stationary nets in some other places on this coast. Near Hisingen, the spring-herring fisheries have, this year as well as during previous years, been very good. This fishery commences about the middle of March, and is generally continued till the middle of June. The first herring caught, which are the proper spring-herring, are somewhat larger, and much less mixed with other herring than those caught during May and the beginning of June, (these being called "May herring,") and are generally fatter and better. Fishing is chiefly carried

¹ Reports on the Herring-Fisheries, p. 106.

on here with so-called spring, or two-men's, nets, but also with stationary nets. Herring here sell from 25 cents to 28 cents a score, but when they are very plentiful they only bring 12½ cents. The two-men's nets have, during the last year, generally caught from \$56 to \$112 worth of the fish, and one of them is said to have yielded its owner the sum of \$224.

The one and two years' old young coast-herring are caught in smaller numbers in the beginning of the autumn on the southern coast and on some portions of the central coast, and are occasionally found among the small herring when these are taken. During the winter and the beginning of spring, some are likewise found among the so-called sea-herring. The so-called May herring, which is caught toward the end of the spring and the beginning of summer, is often mixed with similar small-herring. From the end of April till the end of summer, more sea-herring are caught during the small-herring fisheries north of Orost. Quite young herring, which are sometimes found in enormous quantities, are caught as bait for the eel-boxes¹ near Hisingen and some other places on the coast with "dog-nets," (nets with very narrow meshes.)

Fishing for *sea-herring*, coming from the sea to the coast in large numbers, begins near Klädesholm between the New-Year and the 13th of January, and almost at the same time near Marstrand and Hermanö. On the southern coast, it begins somewhat later; on the Fjellbacka coast, about the middle of January; and, near Strömstad, toward the end of the same month, and is everywhere very productive. On the southern coast, the fisheries continue, with short interruptions, till the middle of March; and, on the northern coast near Fjellbacka, till near the end of February; but, near Strömstad, they continue one month longer. Near Tjörnekalf and on the southern coast, the great herring nets are taken to pieces about Easter, as the fisheries during the latter half of March are not very productive; but there have been years when fishing with the large nets has been continued till the beginning of May. The sea-herring caught during winter are generally of an excellent quality and bring a good price, so that the fishermen earn a very good living. The largest income from any single net was \$2,520.

Herring, spawning in the autumn, have not, as far as my knowledge extends, been caught anywhere during this year on the coast of Bohuslän.

Fishing for the herring proper is mostly carried on with nets of different description, and in some places with stationary nets. Other kinds of nets are rarely used, although occasionally good hauls are made with them by poor fishermen.

The sea-herring when tolerably small is occasionally made into *anchovies*² by less conscientious traders, although this has not happened this year on the coast of Bohuslän. It scarcely pays to salt the spring-her-

¹This is also done in Norway. *Rasch and Berg*, Memorial and Petition, p. 37. *Sars*, G. O., Report for 1872, p. 35.

²*Nilsson*, Scandinav. Fauna, IV, p. 522.

ring, and if it is done, it is only for home-consumption or when the herring are so plentiful that the market is overstocked with fresh fish. Even the fresh sea-herring brings so good a price that salting, for which it is otherwise well suited, does not pay, and has therefore been done only with small quantities. It is well adapted for smoking, although, of course, but very few have been thus prepared.

V.—THE SMALL-HERRING FISHERIES, THEIR TIME AND PLACE.

The autumn and winter fisheries.—Not many small-herring are caught on the southern coast, and these during the autumn are mostly mixed with the sea-herring, while but few small-herring are found among the sea-herring when these are caught later in the season.

On the central coast, near Marstrand and south of Tjörn, good-sized and fat small-herring were caught all through the autumn from October, and these were almost entirely free from sea-herring, which but seldom occurs on this coast; and some small-herring were caught later among the sea-herring. Near Oxevik, at Brofjord, not far from Northern Grundsund, as well as in many other places, fine and unmixed small-herring have been caught during the entire autumn from October till Christmas, when the fisheries ceased, and most of the nets were taken to pieces. The same was also the case near Hunnebo Strand, and in the Battnafjord, where the small-herring fisheries are not very important.

On the Fjellbacka coast, the fisheries commenced in October and continued, with brief interruptions, till the end of the year, and the fish caught were nearly all fine specimens and not mixed with other herring; but in other years, it has happened that the fisheries commenced even as early as September, and the small-herring were, on an average, of a less size. The largest number caught at a single haul was about five hundred bushels. By witnessing and examining numerous hauls, I convinced myself that the fish were not at all mixed with young small-herring or sea-herring. In a haul of from twenty-five to fifty bushels, scarcely a score of sea-herring could be found, and small-herring, measuring less than 100 millimeters, could not be found at all. Some sea-herring are said to have been found in the beginning of the fisheries, and toward the end of the year they became more frequent. During the sea-herring fisheries, more or less small-herring were caught, occasionally in such numbers that it paid to pick them out and pickle them.

On the Strömstad coast, the small-herring fisheries commenced in October and continued in very inconsiderable hauls till Christmas, when the small-herring became more or less mixed with the sea-herring, although even then an occasional haul was found to be entirely unmixed. The month of January yields the largest quantity of small-herring on this coast, although last year this was not the case.

In the Sække Bay, the small-herring fishery proved almost an entire failure; but near the Hval Islands, Norwegian fishermen caught small-

herring, which were mostly sent to Sponvigen and pickled there. The fisheries this year, however, were by no means as productive in the boundary-waters of Sweden and Norway as they usually are.

Small-herring were generally sold, during the autumn fisheries, for from 56 cents to \$1.40 a bushel.

As the sea-herring greatly predominate on the southern coast, so do the small-herring on the northern coast, where a successful haul of sea-herring is considered a rarity.¹ Even among the largest hauls of sea-herring on the northern coast, the small-herring were found in considerable numbers; and, in 1843, the last year of the first half-century of the great fisheries, (of which we possess without a doubt a faithful and reliable account,) it was estimated that about half the income from the fisheries came from the small-herring.² *Wilhelm von Wright* deserves great credit for having first drawn attention to the importance of the small-herring and its common appearance on the northern coast.³ Professor *Nilsson*, on the other hand, has so completely underestimated the importance of the small-herring fisheries on the coast of Bohuslän that he proposed, in order to prevent any sea-herring from being caught among them, to forbid this fishery entirely,⁴ or at least with any other nets than drag-nets or stationary nets;⁵ an opinion which, as is well known, was shared by the Royal Academy of Sciences, and which, by an ordinance of His Majesty of June 29, 1852, became a law.⁶

G. von Yhlen's opinion that those herring which have been caught in good fish-years during the last sixty years, especially in 1812, 1817, 1831, 1840, and 1843, were, as far as he could ascertain, chiefly small-herring, possibly mixed with some larger herring,⁷ does not seem to me correct, either as regards researches made by myself among old acts or as regards information gleaned from old fishermen, all of whom maintained that the sea-herring were those which appeared in the largest numbers

¹ Reports on the Herring-Fisheries, pp. 101, 106 fr. 17. Professor *Nilsson's* and others supposition that it is different, (Reports on the Herring-Fisheries, pp. 55, 65; *Ekström's* Practical Essay, p. 29; note, New Reports on the Herring-Fisheries, p. xiv,) and his underestimate of the small-herring's importance and numbers created the belief on the coast that our naturalists consider the small-herring to be only the young of the herring proper.

² *W. von Wright*, Report on the Herring-Fisheries, p. 169

³ Reports on the Herring-Fisheries, pp. 167, 168, 169.

⁴ Reports on the Herring-Fisheries, p. 18.

⁵ *Ekström*, Practical Essay, p. 112. *Fähræus, O. I.*, Memorial regarding the Petition of Several Fishermen in the Parish of Tanum to have the Royal Ordinance of June, 1852, changed; presented November 9, 1853.

⁶ New Report on the Herring-Fisheries, pp. ix, xv, xx, xxi. *O. I. Fähræus*. Memorial regarding the Petition of Several Fishermen in the Parish of Tanum to have the Royal Ordinance of June, 1852, changed; presented November 9, 1853. Letter of His Majesty the King, dated February 25, 1855, to the Governors of Göteborg and Bohuslän, regarding certain regulations for making the fisheries on the coast of Bohuslän more productive. New Report on the Herring-Fisheries, pp. 53, 59.

⁷ Quarterly Journal of the Göteborg and Bohuslän Agricultural Society, July, 1867, p. 52; April, 1868, pp. 43, 44. New Report on the Herring-Fisheries, p. 11, 12

whenever they came near the coast.¹ In the large fisheries which are carried on in the boundary-waters between Sweden and Norway, and in which the Swedes have taken a part only during the last twenty or thirty years, the small-herring are said to have always predominated, with the exception, perhaps, of the last weeks of the fishing-season.

The spring and summer fisheries.—Near Ulkehälet, in the sound between Mjörn and Tjörn, a few small-herring have been taken, which had fully-developed sexual organs. At Orost, in the parish of Torp, small-herring have usually been caught during the spring, which likewise had fully-developed roe and milt.

During these fisheries, the small-herring have often been found mixed with sea-herring, and so-called “grass-herring,” (herring one year old.) During the last great fishing-period, the small-herring seem to have been more numerous during the summer than is now the case.²

The small-herring fisheries on the coast of Bohuslän are carried on entirely with nets, as all the other fishing-implements would yield too little result. I know only one fisherman on the coast of Bohuslän who fishes with a purse-net, and only one who fishes with stationary nets.

More than 5,000 tons of small-herring have been prepared during the fishing-year as *anchovies*, especially at Strömsstad, Fjellbacka, Grafvarne, Lepekie, Uddevalla, Gullholmen, Nösund, Kyrkesund, and Marstrand. The smaller kind are considered the best for making anchovies, because they have a finer flavor and smaller bones. Young small-herring are, in Norway, made into anchovies, and they are particularly well suited for this purpose; but, as in a fresh condition they cannot stand the long journey to the salting-establishments, they are very seldom used for this purpose by our manufacturers.

VI.—OF FISHING-IMPLEMENTS, THE MANNER IN WHICH THEY ARE USED, AND OTHER MATTERS CONNECTED THEREWITH.

Nets properly so called.—*Large herring-nets.*—These nets, which, at least on the southern coast, are used for catching the herring coming in from the sea, and which are very much like the nets used for catching herring during the “old” fisheries, are now almost confined exclusively to the southern coast, only a few being found on the central and northern coasts.³ These nets are generally 120 fathoms long and 12 fathoms deep. On the southern coast, they have usually 18 meshes to the yard; but, on the central and northern coasts, they have 22 meshes. On the southern coast, all the meshes are equally fine; but, on the north-

¹ In the Report on the Salt-Water Fish of Bohuslän for 1869, von Yhlen mentions the frequent occurrence of “fjord herring.” See Quarterly Journal of the Göteborg and Bohuslän Agricultural Society, July, 1870, p. 16., which may be compared with the July number, 1871, p. 52, of the same journal.

² Act Concerning Blubber-Refineries, pp. 73, 75.

³ The nets used in the northern portion of the central and northern coasts correspond both in their construction and the manner in which they are used more with the middle-sized nets used for fishing for small-herring.

ern coast, the outer ends (wings) have larger meshes. For each wing, they have 500 fathoms of line on the southern coast; while, on the central and northern coasts, they have shorter lines. On the southern coast, the line is hauled in by a winch, and the stone weights are likewise brought up in this manner. On the southern coast, twenty men usually belong to a net, while, on the northern coast, only fourteen. Before the net is cast, the current is examined, but no search is made for the herring. The nets can only be hauled on land in a few places on the coast of Ockerö, *e. g.*, (where these places are most numerous, from 12 to 15 only, in number,) where there is deep water close up to the coast. The net while being dragged moves along the bottom, and its position is indicated by floats, which are fastened to long ropes. Fishing is carried on in about the same manner as Ekström has described it.¹

Middle-sized nets.—On the whole central coast and on the northern coast, with the exception of its northernmost portion, these nets, which are mainly intended for the small-herring fisheries, are in common use. They are from 50 to 100 fathoms long, and from 21 to 29 yards deep, having from 20 to 24 meshes to the yard. Generally, however, there are 22 meshes to the yard. They are hauled in with winches, and their lines vary in length from 100 to 300 fathoms. On the Fjellbacka coast, they are usually brought on land in boats.

Small herring-nets.—On the southern portion of the central coast—*e. g.*, near Tjörn—these nets are much used for catching spring-herring, sea-herring, small-herring, mackerel, and other fish to be used either for bait or in the household. They are from 35 to 40 fathoms long and from 12 to 16 yards deep. Their meshes are fine, generally from 18 to 22 to a yard. In hauling them in, a winch is used, employing generally four men. As to their nature and the manner in which they are used, they seem to correspond with the “mackerel-nets” mentioned in several places in the “Act Concerning Blubber-Refineries.”² On the northern coast north of Håfstensund, similar nets are used, and are called in Swedish “Bolke” nets. They are generally 40 fathoms long, and from 4 to 6 fathoms deep. Four men haul them in, and no winch is employed.

Half-nets.—This kind of net is, as far as I am informed, used only near Hisingen, where there are said to be four such nets, chiefly used for catching sea-herring. They are about 100 fathoms long and 9 fathoms deep, and their meshes have the same size as the large herring-nets.

Nets for small-herring.—These nets, chiefly intended for catching small-herring, were introduced twenty or thirty years ago from Sponvigen, in Norway, where they have been in use for a long time.³ In the neighboring portions of Norway, they were formerly called “herring-

¹ Practical Essay, pp. 21–24. *Dubb*, Reports of the Royal Academy of Sciences for 1817, pp. 36–39.

² Act Concerning Blubber-Refineries, pp. 73, 77, 79–81.

³ Ekström, Practical Essay, p. 29, note. *Rasch and Berg*, Memorial and Petition, p. 33.

nets," to distinguish them from the large nets; and this name they have kept both there and on the coast of Bohuslän. These nets are generally from 40 to 45 fathoms long, and from 8 to 10 fathoms deep, and they have 30 meshes to the yard. They are only slightly weighted down with stones, so that they are easily buoyed up by the floats when lowered to a great depth. The lines to each wing measure about 100 fathoms. They are, properly speaking, intended for fishing in the deep Säckebay, with its steep shores, where other nets could not well be used.

Two-men's or spring nets.—These are used on the southern coast for catching spring-herring, from the middle of March till near midsummer. Besides herring, other fish, such as cod, salmon, &c., are caught with them. They are from 65 to 80 fathoms long and 12 yards deep, (only 7 at the end of the wings.) A wooden pole is fastened, by means of two lines, some distance from the wing; and to the middle of this pole is attached the line for hauling in, measuring about 100 fathoms in length. The meshes in these nets are generally very fine.

So-called "dog-nets."—These nets, which are small and have very fine meshes, are used on the southern coast for catching very young herring for bait, but also for catching salmon and other fish. They are used during the spring and summer.

On the northern coast, north of Häfstensund, a similar but somewhat deeper net is used, generally from 25 to 30 fathoms long and 4 fathoms deep in the middle and tapering off toward the wings. With these nets, three or four men have made from twenty to forty successful hauls during the night. As the use of these nets has been for some years prohibited in the above-mentioned portion of the northern coast,¹ many of them have been altered into nets resembling the small-herring nets,² but even these were forbidden by a royal ordinance of July 19, 1872.³

Stationary nets.—These nets, which have been used on the coast of Bohuslän from time immemorial,⁴ are well known to the fishermen in those parts, although they are not much in use now, since they prove remunerative only in exceptional cases. On the southern coast of Hisingen, near Ny-Elfsborg, about 200 such nets are said to be in use, each yard having about 14 meshes. Herring-fishing is likewise carried on with such nets outside the mouth of the Northern River. On the Ockerö coast, fishing for autumn-herring⁵ with these nets seems of late years to have ceased altogether. Excepting the few stationary nets here and there on the coast, there is no fishing with these nets worth mentioning north of the Northern River, as far as Dyrkilen and the Idefjord, where, however, such nets are used in the spring for catching spring-herring.

¹ New Report on the Herring-Fisheries, pp. 7, 16.

² New Report on the Herring-Fisheries, p. 52.

³ New Report on the Herring-Fisheries, pp. 3, 58.

⁴ All the great Bohuslän herring-fisheries, with the exception of this last-mentioned one, have been carried on exclusively with such nets.

⁵ See New Reports on the Herring-Fisheries, pp. 10-11, 43.

Small herring are, so far as I am aware, caught with these nets by one fisherman only on the coast of Bohuslän.

Drag-nets.—At the expense of a Göteborg merchant, *Aron Anderson*, experiments have been made with such nets which were brought from Blekinge, Skåne, and Norway, and taken out by a mackerel-boat from Koster; but these experiments have, I believe, been unsuccessful.

Purse-nets are used in some portions of Norway for catching herring and small-herring.¹ In Sweden, they are, as far as I am aware, only used near Strömstad, where they have been in use for a long time for catching salmon, and occasionally during May and June for catching small-herring.

Other fishing-implements are but rarely employed in catching herring.

As it has been stated that the large nets now in use in Bohuslän have much finer meshes than those used thirty or forty years ago,² and that the nets used during the great fishing-periods have meshes measuring from 1 to 1½ inches;³ and as this is of great importance in answering the question how a suitable net should be constructed, I deem it necessary to adduce some additional facts which I have gathered.

As to the nets used during the latter part of the last great fishing-period, it is well known that these generally, at least on the southern coast and the southern portion of the central coast, had sixteen meshes to the yard;⁴ but at the beginning of this fishing-period, the fisheries are said to have been carried on with mackerel-nets having wider meshes,⁵ according to information received during the year 1833, by the investigating committee, from the northern coast. As there is, however, no detailed information regarding this matter, it is impossible to obtain an accurate idea of the size of the meshes of these mackerel-nets. This much only is certain, that these nets, on account of the great size of their meshes, were considered useless in fishing for the large herring, (although they were not mixed with other herring);⁶ that mackerel-nets with meshes measuring more than one inch are unknown in Bohuslän; that catching fine and fat mackerel presupposes meshes narrower than these; and that these nets, both during the old fishing-period and in later time, have had narrower meshes, at least in the southern portion of the central coast, where they are continually used for catching bait and other small fish.⁷ Even in the neighboring portions of Norway, there are no mackerel-nets in use whose meshes measure more than

¹ *Rasch and Berg*, Memorial and Petition, p. 34.

² *New Report on the Herring-Fisheries*, pp. 24, 66.

³ *New Report on the Herring-Fisheries*, pp. 24, 63, 66.

⁴ *Ekström*, Practical Essay, p. 20, note 2. *Dubb*, Reports of the Royal Academy of Sciences for 1817, p. 36.

⁵ *Report on the Herring-Fisheries*, pp. 86 fr. 9, p. 98 fr. 7. *Nilsson*, Reports on the Herring-Fisheries, p. 12.

⁶ *Nilsson*, Reports on the Herring-Fisheries, p. 63.

⁷ Act Concerning Blubber-Refineries, pp. 73, 77, 79-81. *Ekström*, Practical Essay, p. 110.

seven-eighths of an inch, the general size being only one-half of an inch.¹ As the herring during the old fisheries were persecuted by fish of prey, even in the inlets, smaller meshes were necessary to increase the strength of the net and to prevent the herring from sticking fast in the meshes, and this even when the fishing was going on during the daytime, and help could easily be secured.

When Professor *Nilsson*, more than forty years ago, made his observations on the salt-water fish of the west coast of Scandinavia, the nets on the southern coast had the same sized meshes as at present, *i. e.*, 18 meshes to the yard,² and they were, therefore, about the same size as that prescribed for the small-herring nets by the royal ordinance of July 19, 1872, while their meshes are somewhat narrower than those prescribed by the law of December 29, 1857, for the fisheries in the Limfjord, (Denmark.) In the nets used in the southern portion of the central coast, where the small-herring begins to be of importance for the fisheries, there were, thirty years ago, 20 meshes to the yard, and this is still the case.³ On the northern coast, near *Ejellbacka*, where the nets are chiefly adapted for catching small-herring, the meshes, in consequence of a royal ordinance of 1833, are made very narrow, "scarcely an inch from kuot to knot."⁴ This does not mean, as has sometimes been supposed, that the meshes scarcely measured an inch; but that the distance from knot to knot, when stretched, was scarcely an inch. In olden times, the word "mesh," when used in Bohuslän, always meant the stretched mesh; and this meaning has been retained by *Ekström* in his often quoted "Practical Essay." The *Ejellbacka* nets are, therefore, not any narrower than they were forty years ago, but they are now generally less deep and long. If the nets had had meshes measuring scarcely an inch, herring from 3 to 6 inches long, as well as small-herring, could not have been caught in them to any considerable extent;⁵ and the complaint so often heard that the nets had meshes too narrow would have been unfounded.⁶ The report made at the *Strömstad* meeting that the meshes "are so large that the thumb can scarcely be pushed through,"⁷ proves that the herring-nets used in that portion of the northern coast were not narrower than the *Ejellbacka* nets, nor had they larger meshes than those used on the southern coast.

The method of using the nets in former times is supposed to be very

¹ *Rasch and Berg*, Memorial and Petition, pp. 28, 29.

² *Nilsson*, Reports on the Herring-Fisheries, p. 64.

³ *Ekström*, Practical Essay, p. 20, note 2, p. 107. (The information that the nets should be from 15 to 20 fathoms deep is based on a mistake of the printer.)

⁴ Report on the Herring-Fisheries, p. 107 fr. 28.

⁵ Reports on the Herring-Fisheries, pp. 18, 64-66, 69, 136, 157.

⁶ *Nilsson*, Reports on the Herring-Fisheries, pp. 18, 64, 89, 143. *Scandinavian Fauna*, IV, p. 507, 514. *Sundevall*, Reports on the Herring-Fisheries, p. 156. *Wright, W. von*. Reports on the Herring-Fisheries, p. 174.

⁷ Reports on the Herring-Fisheries, p. 91 fr. 36.

nearly the same as that in present use,¹ except, perhaps, that during the old fisheries the greater experience and the more unfavorable localities, where fishing was carried on,² made the fishermen more practical and venturesome, and taught them many a crafty ruse in placing and managing them, which is now forgotten. In this respect, the inhabitants of the northern portion of Bohuslän gained great fame.³ During the great fishing-periods of the olden time, fishing was mostly carried on by daytime, which at present is only possible on the southern coast, where the water, at least near the surface, is less transparent.⁴ The use of so-called "locks" is, at present, not known in Bohuslän.

As the large and deep nets cannot be hauled on land except on a steep coast, and cannot be dragged along if the bottom is not perfectly even and the water comparatively deep, it will readily be seen that these nets cannot injure the spawning-places of the herring on the coast of Bohuslän. These spawning-places consist either of a stony bottom overgrown with *algæ*, or of a clayey bottom overgrown with *zostera*,⁵ over none of which can the nets be dragged. Neither do these nets bring up any large quantity of *algæ* and sea-weeds, and for reasons which can easily be understood, the fishermen are very particular in using them and in keeping them in repair. The places where they can be used are comparatively few in number, and at the present time, at least, it may be said that the portion of the coast over which they may be safely dragged is exceedingly small. In consequence of this fact, the ignorance of the fishermen concerning the spawning-places of the herring is very great, and has often been mentioned in the reports on the herring-fisheries. On the other hand, smaller and shallower nets can be used everywhere on an even bottom overgrown with sea-weeds, or merely covered with sand; and even these nets bring up sea-weeds and small fish, especially during the summer. In the spring, when the herrings spawn, the sea-weeds are shorter and adhere more firmly to the ground, so that the light spring-nets do not do much injury to the grassy bottoms. As to the injury which they may possibly inflict by disturbing the spawn, I have not sufficient information. The number of places where they can be hauled on land is also very limited.

It is not necessary to say anything more with regard to the so-called "dog-nets," (the fish caught in them being mostly used for bait,⁶) since these, as well as the small nets and two-men's nets, have become lawful for the coast of Bohuslän, by a royal ordinance of February 23, 1855.

¹ *Dubb*, Transactions of the Royal Academy of Sciences for 1817, pp. 36-39. *Ekström*, Practical Essay, pp. 21-24.

² Act Concerning the Blubber-Refineries, p. 176.

³ *Dubb*, Transactions of the Royal Academy of Sciences for 1817, p. 36.

⁴ *Dubb*, Transactions of the Royal Academy of Sciences for 1817, p. 39.

⁵ *Dubb*, Transactions of the Royal Academy of Sciences for 1817, p. 33.

⁶ *Dubb*, Transactions of the Royal Academy of Sciences for 1817, pp. 45, 54.

With regard to the use of other fishing-implements, and the harm which they may possibly do, as well as all other matters pertaining to this subject, I respectfully refer to the memorial of *Rasch* and *Berg* treating of the fisheries on the coast of Norway, from the Swedish boundary-line to Langesund, which, on account of the similarity of the localities to the coast of Bohuslän, I consider to be of special value.¹

So far as *Baron Ugglas* proposition is concerned, that, for the small-herring fisheries, nets of the same size should be used as for the herring-fisheries,² experience has sufficiently proved how disadvantageous, not to say impracticable, such nets must often be, the use of which would only seem to be required when extraordinarily large schools of herring come in, the small-herring caught being prepared anchovies; and this same opinion would hold good with regard to Counselor *O. I Fåhræus's* proposition that small-herring should be fished for with drag-nets and stationary nets.³

The size of the meshes prescribed by a royal ordinance of July 19, 1872, for the small-herring nets to be used on the coast of Bohuslän (about 18 meshes to the yard) has called forth several petitions from the fishermen on the central and northern coasts,⁴ asking for delay in carrying out this ordinance, and setting forth numerous reasons for retaining the present size of the meshes. As this question is doubtless of considerable importance, I thought it my duty to gather as much information as possible on this point from the most experienced and best informed fishermen, and to report what I heard.

With meshes measuring one-half an inch, the smaller kind of small-herring, which are mostly used for anchovies, cannot, it is said, be caught, as they, unless hindered by larger small-herring clinging in the meshes, can easily escape through meshes of the above-mentioned size; while the larger herring remain in the meshes, which, in particularly rich hauls, produces several inconvenience, such as—

1. That the herring which are fast in the meshes hinder, through their weight, the hauling-in of the net. On the southern coast, where the large herring-nets have meshes of very nearly the prescribed size, the small-herring frequently remain in the meshes in such numbers that the net looks like a silvery fur when it is drawn out of the water; and as a net, of course, weighs much heavier when so many fish are con-

¹ *H. Rasch* and *B. M. Berg*, Memorial and Petition drawn up by the Commission appointed by Royal Ordinance of May 28, 1852, for Investigating the Fisheries in the Bay of Christiania and in Langesund; Christiania, December 31, 1853.

² New Reports on the Herring-Fisheries, p. 43.

³ Royal Reply to the Petition of some Fishermen in the Parish of Tanum with regard to the change of section 22 of the fishery-ordinance concerning the implements to be used in the herring fisheries. *Ekeström*, Practical Essay, pp. 103, 112.

⁴ As long as twenty years ago, a similar petition was sent to the king by the fishermen of the Tanum parish, asking to be allowed the use of other nets than those mentioned in the royal ordinance for catching small-herring. At the suggestion of the governor of Göteborg and Bohuslän, this petition was not granted.

finned in the meshes, it is maintained that the introduction of the prescribed size of meshes obliges the fishing-companies on the northern and central coasts to employ more men for each net than is now the case, and thereby diminishes their income, which, in poor or even in tolerably good years, is small enough; as, *e. g.*, an income of \$84 from one net near Strömstad presupposes that it has caught \$336 worth of fish; an equal income from one net near Kalfsund presupposes that it has caught \$1,680 worth. An increase of the number of men employed on one net from fourteen men (which is considered sufficient near Fjellbacka) to twenty (which is the number required at Kalfsund) of course diminishes the income considerably; and with the small-herring nets used in the Säckefjord this is said to be even more noticeable. As on the Fjellbacka coast the nets are seldom taken up on the shore, but in the boats, the inconvenience becomes still greater, as there is not room enough for several men to work; and, furthermore, because the winch cannot be used for hauling in the net unless the boats are very much larger and consequently more expensive.

2. That the net, weighed down by the herring clinging to the meshes, drags too much along the bottom while it is being hauled on land, and, becoming filled with mud and sea-weeds, is found to be unusually heavy and difficult to manage.¹

3. That the herring in the meshes cause the net to sink by their weight, and allow some of the fish to escape. Near Kalfsund, this difficulty is obviated by the great care taken to have enough men employed to manage the nets.

4. That it requires much labor to withdraw the herring from the meshes and therefore delays the fisheries to a considerable degree.

5. That the larger-sized small-herring, which are stronger than the others and first rush to the meshes, by remaining in them, hinder other useless fish from escaping.

It is also said that the small-herring when plucked from the meshes are of scarcely any value, because they have been in most cases considerably damaged. They do not keep fresh so long in this condition, nor do they present so good an appearance.

It is further maintained that when the meshes are large, any opening occasioned by tearing becomes still larger, and that on the whole the strength and durability of any net is considerably increased by having finer meshes.

It is quite possible that several of these reasons adduced by the fishermen for proving the necessity of finer meshes are based on prejudices, and on selfish desires to obtain a larger number of fish; but, on the other hand, it is also clear that it is very difficult to root out such old and deep-seated prejudices, and that the only way to do this with any hope of success would be to prove the superiority of nets with wider meshes by a long series of experiments. The large herring-nets used on the southern

¹ Ekström, Practical Essay, p. 109.

coast have meshes of the same size, or only a very little smaller than those prescribed for the small-herring nets by the royal ordinance of July 19, 1872, but these nets are intended for catching the larger herring, and could scarcely be as advantageously employed for catching small-herring as the nets used at Fjellbacka and Säckefjord, although during the autumn a considerable number of small-herring was caught on the southern coast.¹ Near Fjellbacka I had the opportunity of seeing how small-herring, measuring 100 millimeters, and some even larger, squeezed through the meshes, and that only very few small-herring measuring less than 100 millimeters could be found among the large number of fish in the nets.

In the Limfjord, (Denmark,) where people have had such a long experience in making laws concerning the use of the various fishing-implements, the meshes in that portion of the net where the fish are gathered measure only 0.55 of an inch, even in nets destined for catching herring, to be in keeping with which the meshes in the Swedish small-herring nets should measure only 0.05 of an inch.

Even when the old fisheries on the coast of Bohuslän were in their most flourishing condition, when fishermen only now and then caught the immature herring, as it was considered unfit for use by salters and oil-refiners,² nets with nearly as narrow meshes as those in use at present were employed,³ partly in order that the herring should not remain fixed in the meshes and so make the net heavier, and partly in order to give the necessary strength to the nets.

Wherever net-fishing is carried on on a large scale, the fishermen seem to maintain the opinion that the size of the meshes does not necessarily imply that any considerable number of fish should remain in the meshes;⁴ and *Mitchell* relates that sometimes during the great herring-fisheries in the North Sea the nets become so crowded with herring that they have to be abandoned;⁵ and it is said to be no unusual occurrence in those parts that nets sink down on account of the large number of fish in them.

A question, intimately connected with that of limiting the use of fishing-implements, is that of supplying the demand for bait. The greater importance which the so-called winter-fisheries on the southern and central coasts have gained during the last twenty years, on account

¹ It is a very different question whether an implement *can* be used, or whether it *can*, under certain given conditions in a certain place, be used with the sure hope of gain. If an implement is very practical in its mechanical application, it by no means follows that its use will pay, and an implement which is suited to one place may be entirely unsuited to another.

² *Nilsson*, Reports on the Herring-Fisheries, p. 63.

³ *Dubb*, Transactions of the Royal Academy of Sciences for 1817, p. 36. *Ektström*, Practical Essay, p. 20. *Wright, W. von*, Reports on the Herring-Fisheries, p. 169.

⁴ *Mitchell*, The Herring, p. 105. *De la Blanchère*, La Pêche et les Poissons, Paris, 1863, p. 725.

⁵ The Herring, p. 39.

of the rise in the price of fish and the greatly-increased means of communication, has enlarged this demand very much,¹ which, even twenty years ago, called forth, at the request of the fishermen, a limitation of section 22² of the royal fishing-ordinance, in consequence of which nets with narrow meshes continued to be used.³

The larger portion of the demand for bait⁴ is supplied by the large herring-nets, from which bait can usually be obtained all through the winter. When the great herring-nets are laid up, bait-herring are obtained from the two-men's nets, and from other small nets used for catching spring-herring. During the summer, when the demand for bait is less, since most of the fishermen are employed in the mackerel-fisheries, sea-needles, which can be obtained in great quantities from the island of Læsö, mackerel, and small crustacea (as long as these can be secured) are used as bait. In the autumn, some bait-herring are procured on the southern coast from the "half-nets;" and on the central coast small-herring can then usually be obtained. It is most difficult to obtain bait at the end of summer and the beginning of winter, and there is then occasionally an actual scarcity of it.

The supply of crustacea can only fill a small portion of the demand for bait, since a great many are used, and because their favorite places, near the mouth of the Göta River, have been much disturbed by dredging-machines; and, also, because the severe winters destroy many of them. If these animals were more protected, their number could certainly be increased. This, however, is scarcely to be expected, in consequence of the changes wrought in the fisheries (at least as far as Bohuslän is concerned) by the recent fishing laws.

Stationary nets can be used in Bohuslän with advantage only for catching spring-herring,⁵ while they spawn, (as also in the beginning of

¹ The oft-repeated saying of the fishermen that they would not be able to make a living if they could not catch herring, contains, therefore, much more truth than people are willing to acknowledge; and the strict carrying into effect of section 22 of the royal fishing-ordinance, and of the royal ordinance of February 23, 1855, would have been a severe blow to the inhabitants of the coast. See *O. J. Fähræus*, Memorial of December 22, 1854, regarding the Promotion of the Fisheries on the Coast of Bohuslän.

² Ordinance of February 23, 1855, for the Better Management of the Fisheries on the Coast of Bohuslän.

³ *E. J. E. Uggla*, Report on the Salt-Water Fish of Bohuslän for 1859, p. 14; 1860, p. 49; 1861, p. 56; 1862, p. 7; 1864, p. 110; 1865, p. 5. New Reports on the Herring-Fisheries, pp. 40, 41. *G. von Yhlen*, Report of the Meeting of Fishermen at Lysakil, Göteborg, 1859, pp. 20, 59. *O. Andersen*, The Fisheries of Bohuslän, Frederikskald, 1869, p. 14.

⁴ *Baron Uggla's* proposition (New Reports on the Herring-Fisheries, p. 43) is, therefore, not practicable, because, under present circumstances, the demand for bait can be filled by the proposed small nets only in exceptional cases, and at a very exorbitant price.

⁵ The assertion which, during the first half of the present century, was often made, that it was difficult or impossible to make the use of stationary nets on the coast of Bohuslän general, is proved to be incorrect, among other things by the circumstance that all the great Bohuslän herring-fisheries, with the exception of the last, have been carried on with such nets.

autumn;) and this only in those places where they are found in large numbers, and where, being sold fresh, they can command a higher price. Stationary nets, moreover, cannot compete with the other nets used during this period, either in cheapness or in the variety of ways in which they can be used; for, with the other nets, mackerel, codfish, salmon, and other fish are caught in addition to herring and small-herring; and they can also be used during those seasons when herring are not caught. Oft-repeated experiments with stationary nets, which have been made from time to time, *e. g.*, on the coast near Kalfsund, have not been able to extend their use, as they have been too little remunerative to warrant the fishermen in using them. It is said that at present scarcely any herring can be caught on the coast of Bohuslän with stationary nets having meshes of the size proposed by Professor Nilsson,¹ ($1\frac{1}{2}$ of an inch,) because the herring on that coast reach only in exceptional cases, a size which prevents them from slipping through the meshes. As regards the oft-repeated assertion that, by introducing stationary nets, the herring-fisheries are improved, it must be said that this kind of net is supposed to have a much more injurious influence on the herring-fisheries on a comparatively shallow coast like that of Bohuslän than the large herring-nets, a fact which has also been directly acknowledged by several persons who recommended the exclusive use of the stationary nets.

Ever since Bohuslän became a province of Sweden, it has been repeatedly said that the inhabitants of that province ought, like the Dutch and the Scotch, to carry on their herring-fisheries in the open sea with floating nets; and several attempts, even with very favorable privileges or contributions from the king, have been made in this direction, without, however, having led to any satisfactory result. The best managed attempts of this kind were, doubtless, those which were made with boats and nets brought from Holland. Less fortunate, and showing want of knowledge of the subject in hand, is a proposition made in 1774 in the journal "*Hvad Nytt*" (What News) to catch herring with Bleking (another province in the south of Sweden) nets, three or four miles out in the open sea.² Rev. *Ekström*, who is so well versed in everything pertaining to fisheries, has recently, in his excellent book and in a very practical manner, made propositions in this direction, pointing out the best way for carrying on the open sea fisheries,³ which could be done without any great outlay.

For carrying on fishing with floating nets off the coast of Bohuslän, boats and nets of the same kind as those used in Scotland would, doubtless, be required. It has been found in that country that the better covered and more seaworthy the boats are, the greater protection they offer to the fishermen, and all the safer and more productive will be the

¹ Reports on the Herring-Fisheries, pp. 81, 8

² Act Concerning Blubber-Refineries, p. 139.

³ Practical Essay, pp. 16, 93, 98, 99.

fisheries.¹ Weak and uncovered boats, and incomplete nets or other implements, used in the open-sea fisheries, show that the fishing is yet in a somewhat primitive condition.² It must also be mentioned that, in the Skagerak, during the dark season of the year, there are far greater meteorological and hydrographical impediments to net-fishing than in any other sea of Northern Europe where such fisheries are carried on.

To make such fishing-methods pay, it is necessary that, during the milder season, a considerable number of larger herring should be found near the coast, which, however, does not seem to be the case.³ If the herring are to be caught farther out, no other method seems more practicable than the *Dutch method*; but this, as is well known, requires a great outlay of money, special experience, and good nautical knowledge.

VII.—SCIENTIFIC OBSERVATIONS AND SCIENTIFIC AS WELL AS PRACTICAL EXPERIMENTS NECESSARY FOR CONTINUING THE INVESTIGATIONS AND BRINGING THEM TO A SATISFACTORY END.

In order to carry on the investigations which have been begun to the extent mentioned in the "Transactions of the Royal Academy of Sciences," March 12, 1873, the co-operation of several men⁴ is doubtless required, and has been expressly insisted upon, for one person cannot, with sufficient accuracy, follow the course of the fisheries on the different fishing-stations, much less carry on the necessary hydrographical, morphological, physiological, and biological experiments, &c., which must be made.

The Skagerak and Kattegat are, from a hydrographical point of view, almost unknown, and in order to attain this knowledge, it would be necessary (if it is to be at all exhaustive) in a work of such dimensions and importance, to have a separate investigation by men specially selected for the purpose, and much time in which to do the work. In order to compare the hydrographical and meteorological facts with the course of the herring-fisheries and the migrations of the schools of herring, a very complete series of simultaneous observations would be required on these three fields, which a single person constantly traveling from one place to another could not possibly make, even if he had some assistance.⁵

¹ Thus, some of the larger boats in Scotland realized during the year 1872 an annual income of from £100 to £550 per boat; while the smaller, uncovered boats, made only from £60 to £160.

² The mackerel net-fisheries, which at present are carried on in the Skagerak by Swedes and Norwegians, must be considered, as regards the seaworthiness of the boats, the excellence of the nets, and the result of the fisheries, the best in the whole of Scandinavia.

³ Practical Essay, p. 32. Nilsson has never proposed that any such net-fisheries should be carried on near the coast. See New Report, Stockholm, 1828, p. 31.

⁴ New Reports on the Herring-Fisheries, p. 73.

⁵ In Norway, the investigations of the herring-fisheries have been very much aided by the overseers of fisheries, and by information given in the journals, while this has not been the case with us.

Accurate anatomical observations on the development of the sexual organs, and their condition at different ages and periods, require, in order to satisfy the claims of scientific accuracy, uninterrupted opportunity, a constant supply of fresh material, and all the necessary scientific apparatus. Well-arranged aquaria would also be of the greatest value for some of these investigations.

While occupied with the observations which I had been commissioned to make, I soon became satisfied that, in order to obtain an entirely satisfactory and decisive result, it would be necessary to establish a complete station for scientific observations of the ocean in some convenient place on the coast; which station ought to be furnished with the required meteorological, hydrographical, botanical, and zoological working force, and with a full set of scientific apparatus. That such a station would, moreover, contribute much new and valuable information to this branch of natural science, and would also become really indispensable in this respect, is just as evident as that its observations would and ought to extend far beyond the range of the present investigations.

As the so-called "great old" fishing-period has, during the whole discussion regarding the best method of carrying on the fisheries in Bohuslän, been presented as an interesting and instructive example, and as being intimately connected with the present fisheries, a complete and accurate *history* of this period would be of great importance, and this the more so as the facts we possess concerning it are too few, and have been collected mostly from sources dating after the end of this period. Even those works and public reports from 1809 to 1855 which treat of the present Bohuslän herring-fisheries and other subjects connected with them, ought to be searched much more carefully than has yet been done, in order to furnish a complete epitome of their contents.¹

In order to observe satisfactorily the migrations, mode of life, and place of sojourn of the herring during the fishing-season, as well as their course in the water under different temperatures, &c., experiments with floating and stationary nets, having different-sized meshes, should be made at all seasons of the year, both near the coast and in the open sea; for the use of one sort of nets furnishes data unlike those yielded by the use of another kind.

It is furthermore necessary that continued experiments with floating nets should be made for a considerable time, in a seaworthy boat furnished with all the required implements, so as definitely to answer the question whether the "old" herring have altogether left the coast of Bohuslän, (as is maintained by many,) or whether they continue to spawn on the outer coast, which would, of course, make fishing in the open sea a remunerative occupation.

¹ Professor Nilsson has drawn attention to the fragmentary condition in which these reports have been published, (Scandinav. Fauna, IV, p. 501, note 1,) and there is no doubt that a new and complete edition of these reports would be of the greatest importance to all who wish to study this subject.

VIII.—OF THE IMMEDIATE CONTINUATION OF THE INVESTIGATIONS AND THE SUMS REQUIRED FOR THIS PURPOSE.

My time during the coming year might be most advantageously employed in correcting and completing the information thus far gathered and in extending my observations to the herring and small-herring fisheries of the South Baltic, the Kattegat, and Southern Norway; although it would certainly be a great advantage if, before any fishing-experiments were made, the observations which are independent of the fisheries were more advanced than they now are or can be. Nevertheless, these experiments ought not to be delayed too long, even if in the beginning they must be made on a less extensive scale and in a shorter time.

I dare not renew the request which I made last year that I might receive scientific assistance for the carrying-on of these investigations, as long as the members of the committee do not express a desire to have these investigations made on a larger scale, and with greater dispatch than heretofore. But as the apparatus for carrying on these investigations, and which I furnished from my own means, has proved entirely insufficient,¹ and as the sums which were at my disposal have been expended in buying the necessary books, I feel justified, from my experience of last year, in making a request for the following sums, both for buying apparatus and for meeting other expenses incurred during the course of these investigations:

1. For glass vessels and alcohol	\$224
2. For scientific apparatus	84
3. For buying and hiring nets and paying the fishermen, supposing that these observations can begin next year.....	420
4. For paying assistants, who are to take notes on the fisheries in the most important fishing-stations	392
	<hr/>
Total	1,120

AXEL VILHELM LJUNGMAN.

TJÖRN, June 4, 1874.

¹The want of suitable vessels for keeping the herring of different seasons, locations, ages, and sizes separate has been particularly felt.

TABLE OF CONTENTS.

	Page.
Introduction	123
I. Of the Different Species of Herring and Small Herring	125
II. Of the Propagation and Growth of the Herring and Small Herring.....	143
III. Of the Herring's Mode of Life, its Migrations and their Dependence on Meteorologic and Hydrographic Conditions	147
IV. Of the Herring-Fisheries, their Time and Place.....	150
V. Of the Small-Herring Fisheries, their Time and Place.....	152
VI. Of the Implements used in the Herring-Fisheries, the Manner in which they are used, and other matters pertaining thereto.....	154
VII. Of the Scientific Researches and Experiments, and the Practical Fishing-Experiments necessary for continuing these investigations and bringing them to a satisfactory end	165
VIII. Of the Immediate Continuation of these Experiments and the Sums required for this purpose.....	167