Vol. V, No. 13. Washington, D. C. Aug. 11, 1885.

47.—COMPARATIVE EXAMINATION OF CULTIVATED AND UNCULTIVATED OYSTERS, WITH THE VIEW TO DETERMINE THE NUMBER WHICH, DURING THE FIRST YEAR, TOOK PART IN REPRODUCTION.*

By Dr. P. P. C. HOEK.

I have already mentioned in this report that in my investigations of the genital organs of the oyster I had not had an opportunity to ascertain the number of individuals which produce young ones during the first year. At the same time I advanced the opinion that it was very likely possible that in this respect there was a noticeable difference between cultivated and uncultivated oysters.

Baron Groeninx van Zoelen and Baron G. H. Clifford, oyster cultivators on the East Schelde, after reading my statement, offered me a sufficient quantity of oysters of both kinds for making comparative studies. This offer, which was particularly agreeable to me, and which I could not appreciate too highly, was eagerly accepted by me. Toward the end of June, 1883, I received 200 oysters from a locality where cultivated oysters had uninterruptedly been planted for a number of years; and also 200 oysters gathered in waters† belonging to an oyster region which they had rented for years, but where no oysters had ever been planted. I confined my investigations to these 400 oysters, although more were offered me. In my opinion a larger number—say 800—would not have formed a more reliable basis for my conclusions; and, moreover, my time was too limited to extend these investigations very much. They have, therefore, only a comparatively small value as regards the comparison between cultivated and uncultivated oysters. I nevertheless determined to publish the results of my investigations, because I deem it important to ascertain exactly the condition of the sexual organs of a certain number of oysters at the beginning of the period of reproduction.

I am by no means the first to appreciate the importance of similar investigations, nor am I the first to make them. Not to go back to older authors, I must refer to Mr. Gerbe‡ and Professor Möbius. Mr. Gerbe

* "*Vergelijkend onderzoek van gekweekte en in het wild opgegroeide*" *oesters, ingesteld ter bepaling van het aantal dat per jaar aan de voortplanting deelneemt.* From *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, Supplement No. 1, Leyden, 1883–84. Translated from the Dutch by HERMAN JACOBSON.

† These waters are called "Geul;" they are situated northeast of Yerseke, and their depth is about 33 feet.

‡ Z. Gerbe: "*Aptitude qu'ont les huîtres de se reproduire dès la première année,*" in *Revue & Magas. de Zoologie pure et appliquée*, 3d series (Guérin-Méneville, Paris), IV, 1876.

endeavored to solve the problem whether oysters already produce young ones during the the first year of their life, and he found among 435 one-year-old oysters 35 which had spawn in their branchiæ, 127 which had eggs in the ovaries, and 189 having spermatozoa; there were, therefore, only 84 which during this first year did not show a pronounced sexual development. (It remains to be seen whether the oysters containing eggs or spermatozoa would exercise the sexual functions during the year when the investigation was made.) Professor Möbius* examined 300 oysters taken on May 25, and found 18 per cent in a stage of sexual development approaching one of the two sexes, while of the remainder (82 per cent) one half contained eggs, and the other half spermatozoa. He does not state what method he pursued, which is to be regretted, because the value of the results obtained depends entirely on this method. I have, therefore, deemed it necessary to follow the somewhat difficult method described below.

First of all I ascertained the age of every oyster that I examined, and noted at the same time whether it had been taken from a tile, from a shell, or from a stone. I gave a number to each oyster, while a piece of each was put in alcohol for further examination. Later I took a small fragment of each piece and stained it, for microscopic examination.

The oysters examined by me were opened between the 16th and 28th of June, and as the piece taken from each was immediately put in alcohol, my examination enabled me to judge of the condition of the sexual organs on the day the oysters were opened. I must confess that the preparation of a similar fragment frequently did not answer the purpose and did not always yield a decisive result. Some oysters had spawn in the beard; they had exercised the functions of females in the course of the year. Others contained a large number of mature or nearly mature eggs, and would have deposited these eggs in a few days during the following month or later.† Others again contained mature or nearly mature spermatozoa; they evidently were going to participate in the spawning process during the season. On the other hand, oysters containing young cells producing eggs, and mother cells of spermatozoa, possessing, therefore, the two elements in a rudimentary state of development, are in a stage when it is extremely difficult to ascertain whether they will take part in the spawning process of the season, and what their function will be. According as the male or female element seemed to prevail, I determined them as being inclined to become either males or females. There were finally some oysters (their number was not very large) whose sexual organs were but little developed; it was impossible to state with certainty if these oysters had already performed sexual functions, or whether they were in a sick or feeble con-

*Karl Möbius: "*Die Auster und die Austernwirthschaft*," Berlin, 1877, Wiegandt, Hempel, & Parey.

†There is no doubt that the temperature of the water either accelerates or retards the spawning process.

dition. The presence in the organs of sexual products in small quantity and in a weak state of development made it still more difficult to reach a conclusion; one thing, however, seemed to be certain, that they had not yet performed the functions of males.

Of 200 only 10 were lost, which 10 either appeared dead when the shells were opened, or whose shells contained nothing but sand, or else the piece that was laid aside spoiled because of the evaporation of the alcohol before the microscopic examination could be made.

The results obtained by an examination of 190 oysters of each kind are given in the following table:

Condition of sexual organs.	Cultivated oysters.	Uncultivated oysters.
A. Oysters with white spawn	11	19
B. Oysters with black spawn	17	12
C. Oysters with mature or nearly mature eggs	21	42
D. Oysters with mature or nearly mature sperm	75	94
E. Oysters with organs inclined to become female	11	7
F. Oysters with organs inclined to become male	17	6
G. Oysters with organs little or not at all developed	38	10
Total number of oysters examined	190	190

Of the number of 190 cultivated oysters, at least 49 performed the functions of females, and of the uncultivated at least 73. These figures show an excess of 12½ per cent of uncultivated oysters. The specimens classed under E, which are more numerous as regards the cultivated oysters, should, however, properly be classed among the females, and the difference would therefore be less. As, moreover, among those of class G several had doubtless already performed the functions of females, and as therefore there must be more of these among 38 than among 10, the difference as it presents itself at first loses all significance. The same applies to the oysters with sperm. The excess is on the side of the uncultivated oysters, but this excess is so small that any conclusion based on these data would not be reliable.

In consulting this table one thing will at once become apparent, namely, that at a certain period of the season the cultivated oysters are ahead of the uncultivated, as regards their development. Generally an equal number of each kind was sent to me, so that they may be considered as having been opened at the same time. Presuming that of those classed under G one-half had performed the functions of females, the oysters which had already performed these functions and those which were about to perform them should be classified as follows:

	Cultivated.	Uncultivated.
Oysters with ripe or nearly ripe eggs	21	42
Oysters with white spawn	11	19
Oysters with black spawn	17	12
Oysters which had deposited spawn	19	5

The table shows sufficiently that in the specimens which were examined the cultivated oysters exceeded the uncultivated. This observation is confirmed by the assertion of oyster cultivators, namely, that uncultivated oysters deposit their spawn later than the cultivated. In oyster regions where it is certain that the large mass of spawn to be gathered comes from uncultivated oysters, the tiles are laid some time after those placed in regions destined for cultivated oysters.

As regards the age which is necessary for reproduction, my investigations did not lead to any definite result, because nearly all the oysters which I received were of the same age. The majority were three or four years old, and some two or five years old. Even if there had been a greater difference of age, the number of oysters would have been much too small to yield absolutely certain results as regards this question.

In conclusion, I must state my opinion as to the manner in which these investigations should be carried on in order to reach a sure result. The investigations should commence in March and be continued till October. Every month about the same date a sufficiently large number (at least 100) of oysters, two, three, and four years old, should be opened—an equal number of each kind, cultivated and uncultivated. An incision which will solve all doubts as regards the sexual organs should be made in each oyster. Only such a process would furnish figures which could allow a comparison.

Supposing for a moment that the result would be that the number of females did not differ much in each kind, it would still be incorrect to judge therefrom that the great mass of spawn floating about had not been produced by uncultivated oysters. The spawn of these latter may be stronger than that of the cultivated oyster; and I think I may admit that the quantity of spawn produced by an uncultivated oyster is larger than that produced by a cultivated one.

We see, therefore, that many so-called facts are only more or less weak probabilities, and that very few of these facts have been proved. The great value of earnest and accurate investigations would, especially in the beginning, not consist in proving many facts, but rather in pointing out the direction in which these investigations should be made. We have experienced sufficiently the truth of this in studying the mode of life and the physiology of that mysterious little animal, the oyster, and any one who has taken the trouble to gather some knowledge of the complicated processes of reproduction will not be surprised at this statement.