

town of Quimper. Like Roscoff, it can be easily reached by the way of Southampton and St. Malo or from Havre *via* Paris. Fishing and sardine packing are the principal industries of the place. The port and the surrounding country are so picturesquely beautiful that many artists make their permanent residence in the vicinity.

The laboratory is chiefly devoted to fish culture and the study of fishes, although work at the station is by no means restricted to this group. The building has two floors; the first story is devoted to the scientific apparatus, to spacious private rooms for a small number of investigators, a library and a dark room for photography; and the basement contains large stone tanks and other aquaria, provided with running seawater. Large vivaria, designed for holding fish, lobsters, etc., for scientific purposes and for the use of fishermen, adjoin the laboratory and extend out into the sea. The station is well equipped for scientific research. Here Selenka and other eminent zoologists have done much of their best work.

The plankton at Concarneau is said to be very rich, and certain forms of invertebrates which inhabit a sandy shore and which do not occur at Roscoff are found in abundance at Concarneau.

Finally, it should be said that the Directors of these and of other marine stations in France which it has been the good fortune of the present writer to visit are most hospitable and generous to American zoologists. One may be assured that if he goes to the coast of France to study he will receive a hearty welcome.

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STAZIONE ZOOLOGICA,
NAPLES, December 8, 1898.

NOTES ON THE TIMES OF BREEDING OF SOME
COMMON NEW ENGLAND NEMERTEANS.

SEVERAL papers by Professor Bumpus have appeared in this JOURNAL on the

times of breeding of invertebrates at Woods Holl, Mass. In connection with these the following notes on the nemerteans may prove of interest to some who may desire to carry on researches on the embryology of this neglected group of worms.

It does not seem to be generally known that the eggs of some of our nemerteans can be obtained in abundance at almost any season of the year; that those of many species can be artificially fertilized, and that they will develop readily in confinement. Even in the case of those which undergo an indirect course of development the embryos can readily be reared to the early pilidium-stage. The eggs of some of the common species, moreover, are so very transparent that many of the phenomena involved in maturation, fertilization and cleavage can be followed in the living ovum without the use of stains. For these reasons they afford most promising objects for embryological and cytological investigation.

1. The eggs of *Amphiporus ochraceus* Verr. are laid during the months of May and June (or sometimes earlier) in the vicinity of New Haven. Worms which are kept in captivity sometimes deposit their ova in clusters of forty or more imbedded in a common mass of mucus. They develop readily in confinement, and the young worms may be kept alive until they attain a considerable size. As in most other Hoplonemerteans the development is direct.

2. *Amphiporus virescens* Verr. Eggs mature at Woods Holl in July and August. They develop readily when laid in captivity, although the number of eggs produced by a single worm is small.

3. *Tetrastemma candidum* Oersted. Mature in July and August at Woods Holl and New Haven.

4. *Tetrastemma vermiculus* (Quatr.) Stimp. Common on piles at Woods Holl with ripe ova in August.

Several other species of *Tetrastemma* and *Amphiporus* have been found mature in mid-summer.

5. *Emplectonema giganteum* Verr. has been found by Professor Verrill with large eggs in August.

6. *Lineus viridis* Johnson = *L. gesserensis* Müller = *Nemertes obscura* Desor = *Lineus obscurus* Barrois. On the Coast of Maine Verrill* has found the eggs of this species very abundant under stones at low-water mark. These were imbedded in mucus and were deposited in mid-summer. At Woods Holl during three summers I have examined thousands of specimens but have found no eggs. On the northern coast of Europe the eggs are mature from March to May. The development of this species was studied by Desor† as early as 1848 from material which he collected near Boston in February. Barrois‡ and, later, Hubrecht§ have published detailed descriptions of its embryology.

7. *Lineus socialis* (Leidy) Verr. The eggs mature in mid-winter at New Haven, and are sometimes deposited in captivity in masses of mucus. They develop readily at least to the stage of swimming gastrulæ.

8. *Lineus bicolor* Verr. Specimens dredged in Vineyard Sound in July, 1898, contained mature genital products.

9. *Micrura affinis* Verr. Specimens taken off Salem by Professor Verrill contained fully developed eggs and spermatozoa in mid-summer.

10. *Micrura cæca* Verr. Matures its genital products at Woods Holl during August. The eggs of this species are beautifully clear and transparent and develop readily when artificially fertilized. The cleavage

is of the regular spiral type, of which these eggs furnish an almost ideal illustration. The pilidium which results will live two weeks or more in confinement.

11. *Cerebratulus lacteus* Verr. The eggs are ripe at New Haven during February, March and April. On the coast of Maine the species is said to breed in early summer. I have never observed that the eggs are deposited in captivity. Specimens filled with eggs have been kept alive in the laboratory for more than two months after the time of full maturity of the sexual products without discharging their eggs. Whether they would be capable of normal development after this length of time I was unable to determine, because all the males which could be obtained had long since discharged their spermatozoa. The worms attain an enormous size (up to 22 feet in length and an inch in breadth, according to Verrill) and consequently produce an immense number of ova. I should estimate the number to be obtained from a fair-sized worm—say, 5 feet long—to lie between fifty thousand and a quarter of a million. A single individual, or even a small fragment, will thus furnish all the material required for an elaborate investigation. The eggs are easily fertilized artificially, and will develop into the pilidium-stage without difficulty.

12. *Cerebratulus Leidyi* Verr. Breeds commonly at Woods Holl in July and early in August. In 1898 the majority of the individuals which I found at Woods Holl had discharged their genital products earlier than July, and in 1894 a few specimens at New Haven retained their ova as late as October. Among the nemerteans that I know, the eggs of this species are equalled in beauty and regularity of development only by those of *Micrura cæca*. The first division occurs about one hour and ten minutes after fertilization, or in 55 minutes if the eggs have been allowed to

* *Trans. Connecticut Acad.*, Vol. 8, 1892.

† *Boston Journ. Nat. Hist.*, Vol. 6, 1848.

‡ *Recherches sur l'embryologie des Nemertes*. Lille, 1877.

§ *Proeve eener Ontwikkelingsgeschiedenis van Lineus obscurus*. Utrecht, 1885.

remain in the water until the formation of the first polar spindle, before being fertilized. The second cleavage takes place about 24 minutes later; the third cleavage occurs after 30 minutes more; the fourth after another 35 or 40 minutes; and after a further lapse of about 50 minutes, or in a little less than $3\frac{1}{2}$ hours after fertilization, the fifth division, with its resulting 32 cells, is completed. A very symmetrical blastula appears about $7\frac{1}{2}$ hours after the eggs are fertilized, and in $1\frac{1}{2}$ hours more the embryos begin to swim. The third cleavage, which is distinctly right-handed, shows the first differentiation of the cells in regard to size; the upper four, or those next to the polar bodies, being slightly, though perceptibly, *larger* than the lower four. The cleavage is typically spiral and almost perfectly regular. There are only the slightest indications of a vitelline membrane, so that the polar bodies are lost at an early stage. The near equality in the size of the blastomeres also tends to increase the difficulties encountered in following out the details of the cell-lineage. The pilidium with peculiarly short side-lobes, which develops from these eggs, will live for two weeks or more in the laboratory, although I have never seen the young nemertean develop within it.

13. *Cerebratulus luridus* Verr. Specimens collected in Cape Cod Bay by Professor Verrill contained apparently ripe eggs in August.

14. *Carinella pellucida* Coe ripens its sexual elements in July at New Haven and Woods Holl.

15. *Parapolia aurantiaca* Coe. Genital products mature in August at Woods Holl.

16. *Valencinia rubens* Coe. A single specimen found at Woods Holl in August 1894 was filled with ripe spermatozoa.

17. *Cephalothrix linearis* Oersted. At Woods Holl this species commonly matures its genital products in August. The eggs may be artificially fertilized. The

development is direct and may be readily followed. McIntosh* has published figures of the embryos of this species.

The above includes merely those dates at which genital products have been found mature, and should by no means give the impression that they may not be found in some of the species at other times, both earlier and later than is here indicated. The times when the eggs are normally deposited is certainly liable to considerable variation. *Amphiporus ochraceus*, for example, has on one occasion been found mature as early as January, although the eggs are produced more abundantly four or five months later. In this respect the nemerteans agree with many other invertebrates. In some others, as *Cerebratulus lacteus*, the time during which the eggs can be fertilized lasts for a few weeks at the most, and this period, at New Haven, varies from February to April according to some undetermined peculiarity of the season.

It will be seen that of the common species recorded here nearly all become sexually mature on the southern coast of New England during the summer months. Only one lays its eggs in mid-winter and only two in the very early spring.

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THE COLUMBIA MEETING OF THE SOCIETY
FOR PLANT MORPHOLOGY AND PHYSIOLOGY.

THE second annual meeting of this Society was held in conjunction with the meetings of the American Society of Naturalists and the Affiliated Societies at Columbia University, December 27 to 30, 1898. On the evening of December 27th a reception was tendered to the members of the Society and visiting botanists by the Torrey Botanical Club of New York, and the Society

* British Annelids; Part I., Nemerteans. Ray Society, 1873.