rived from the same parent. I might cite facts to show that a single laying of eggs may produce individuals which differ from each other in many minor details; this variability is very marked in the plumage of broods of domestic birds, and I am informed by Mr. T. R. Peale that he has met with remarkable instances amongst butterflies, broods of which he had reared artificially from the eggs of a single parent. These well-known facts indicate that still another principle should not be lost sight of; namely, that the hidden constitutions of different germs of the same parent are variable; that the living matter of the germ-producing organs themselves is not similar in its developmental tendencies. It follows from this, that when I say that in the protoplasm of the shad there inhere specific properties which are transferred to and embodied in its germs, I do not mean to say that the living matter of all parts of the body is alike, but that the protoplasm of its parts when compared with the same parts of other species must be unlike the latter. To put the same idea in other phraseology, I would say that not only is the protoplasm of the species specific, but also that, if we consider the facts of variation, the different as well as the same parts of the body of one and the same species must be variable in their hidden and transmissible constitutions. In following out such a train of thought, it is almost impossible not to trench upon Darwin's Hypothesis of Pangenesis, as we have done above; but it is to be borne in mind, if one is faithful to the showings of right reason, that it is scarcely possible to escape such a coincidence.

THE MICROSCOPIC SEXUAL CHARACTERISTICS OF THE AMERICAN, PORTUGUESE, AND COMMON EDIBLE OYSTER OF EUROPE COMPARED.

By JOHN A. RYDER.

In the issue of Forest and Stream of November 30, just past, in an article by the writer, page 351, middle column, it is remarked: "I regard Davaine's observations upon the histology of the reproductive organs [of the European oyster] as of little value, being made before the introduction of improved methods of investigation. His figures of the finer structural details have apparently been made from crushed fragments." In passing this judgment upon Dr. Davaine's work, I have been severer than the state of the case demanded, as will be seen in the sequel, though I do not yet admit that his methods of research were what they should have been, for until now we have had no adequate description of the structures in question. Until recently I have maintained with reservations that the sexes in the European oyster were probably separate as in the American; more recent investigation with more refined methods have proved to me that in this I am in error. In my article in Forest and Stream I also took occasion to refer to a statement in Gegenbaur's Elements of Comparative Anatomy, English edition, p.

380, where he says: "In the oysters we find an intermediate step toward a separation of the sexes, inasmuch as these organs are not active at the same time in the same individual; but the male and female organs alternately so." The writer in commenting upon the above then wrote: "This quotation tacitly admits the unisexuality of the European oyster to which it evidently refers. The last part of the remark, however, is founded upon the slenderest kind of evidence; in fact, upon no evidence except a surmise, as such an alternate activity of the two parts is improbable [for obvious reasons]; besides, it is not possible to demonstrate such an alternation of sexual activity in the same individual. As every one knows, the soft parts of an oyster cannot be examined without opening the shell, which necessarily makes the needed second observation to confirm this alleged alternation of sexual activity a physical impossibility." I am now in a position to go still further and to assert that the first part of the quotation from Gegenbaur is also erroneous, because we may find both eggs and spermatozoa in the same follicle at the same time.

What, then, is the true state of the case? This query we propose answering, but before we set out it will be necessary to give some account of the methods of investigation used in order to arrive at a definite conclusion. Thin sections of those portions of the animal in which the reproductive structures are lodged are of the first importance. After trying various methods, which were found for the most part unsatisfactory, the preparation of sections was finally conducted as follows: After the soft parts were removed from the shell they were thrown into a chromic acid solution of one to two per cent., in which they were allowed to remain for several days, and in some cases the hardening solution was even renewed. This was done in order that the hardening agent might act upon the whole of the soft parts and harden them throughout; unless the chromic acid is allowed some time to act upon the entire animal it will not be uniformly hardened, the center of the body remaining soft. After hardening, the animals should be thoroughly washed and soaked in water for a couple of days to remove all traces of the acid before they are finally put into alcohol for permanent preservation. Hardened material so preserved will make good sections months afterwards.

Portions of the body mass of different individuals should then be cut out; it is best to cut up the body into thick slices or blocks in a transverse direction, large enough to be conveniently held between the fingers. It was also found advisable to take such thick slices of the hardened body mass from several individuals, since it was discovered that scarcely any two had the reproductive glands developed to exactly the same degree of maturity. This point is important, as it has enabled us to follow up the development of the reproductive organs in the connective tissue which invests them. After considerable experiment and disappointment in the effort to imbed these thick, hardened slices so as to cut sections with the microtome, the method of imbedding was abandoned altogether. The thick blocks or slices were entirely freed from alcohol by soaking in water for a day; then removed, after drying them off as much as possible with blotting paper or a soft linen cloth, to a thick solution of gum arabic, in which it is best to allow them to remain twenty-four to forty-eight hours so as to be thoroughly saturated. The superfluous gum may then be poured off and the blocks of tissue, soaked as they are with the gum, covered with strong alcohol. In twenty-four hours the blocks will be found hard enough to cut. The blocks of hardened tissue are simply held between the thumb and forefinger, and the sections made with a section-knife with the free hand. When cutting sections, it is necessary to keep the knife well wetted with alcohol so that the sections may readily slide off on the upper side of the blade. Water should not be used to wet the knife, as it would get on the block of tissue, dissolve the gum, and soften the surface to be cut, and injure the succeeding sections. The sections are lifted from the knife as fast as cut, with a camel's hair pencil, and thrown into a dish of water, in which the gum will dissolve out in a few minutes. The sections are then ready to be stained, and in order to clearly differentiate the hermaphroditic character of the reproductive glands of *ostrea edulis* a special staining reagent must be used. The one which gives the best results and acts most quickly will be given here. Equal parts of dense alcoholic solutions of safranin red and methyle green* are poured together and diluted with about eight times their combined volumes of water, producing a dark purplish solution of about the color of claret wine. Into this the sections may be thrown and allowed to remain until completely saturated with color or until they are opaque; they may remain in the staining fluid from one hour to a day, but two or three hours is a sufficient length of time. When removed from the staining fluid they are too deeply stained to be mounted at once, and must therefore be transferred to 95 per cent. or absolute alcohol and stirred about in it until the safranin red is no longer given off in clouds from the sections; but it is important to note that if the sections remain in the strong alcohol too long the whole of the safranin will be washed out. In order to prevent this, when it is seen that the section has acquired a rosy red hue, combined with a bluish-green tint in the parts stained by the methyle green, the object should at once be removed from the alcohol and thrown into oil of cloves and mounted in balsam or damar. The extraction of the superfluous color requires from five to fifteen minutes, according to the thickness and character of the section, and should on no account be allowed to proceed too far; if it does, the peculiar and important staining effect of the safranin is lost. As first pointed out by Flemming, it has the peculiar property of staining the nucleus and its contents, while it may be totally removed from other parts of the cell; in

*These are both aniline colors; the first is hard to obtain, except from dealers in dyers' colors.

fact, as in the oyster egg, it may be entirely removed from the nucleus and left only in a part of the nucleolus. The methyle green, on the other hand, does not tend to stain the eggs, but rather the spermatozoa and the cells from which they are derived, and it is one of the most astounding facts known to histological chemistry that, although both of these dyes, to begin with, are intimately mixed together in the staining fluid, the different histological elements of the section exert some kind of selective power by which they absorb and hold mainly the one color only. This peculiar property of the two colors, even when mixed together, enables one to distinctly map out the relations of the sexual elements in the reproductive follicles, the nuclei of the ovarian ova being stained red by the safranin, and the heads of the spermatozoa bluish green by the methyl green. The foregoing is mainly the method to which I have had recourse in working out the sexual characteristics of *Ostrea edulis*. Simpler staining methods suffice in the case of *Ostrea virginica* and *Ostrea angulata*. A single color used in staining sections of *O. edulis* is liable to lead to error in consequence of the peculiar mode in which the spermatozoa are packed together in oblong clusters, which are often of about the size of the ovarian ova. This egg-like appearance of the masses of unripe spermatozoa in the follicles of the reproductive organs of the common oyster of Europe misled me when examining sections stained only with eosin or carmine. The monochromatic effect produced by one color only gave no hint as to the real relations of ova and spermatozoa in the follicles until high powers were used with special manipulation of the light.

The characteristics of the reproductive organs of *Ostrea edulis*, *O. virginica*, and *O. angulata* are sufficiently marked to be very precisely described and figured so as to enable any person to appreciate the differences, especially between the first and last two. *O. edulis* is essentially hermaphroditic in the structure of its reproductive organs, while the other two are as distinctly monœcious or unisexual. A marked difference is also to be noted in the relative size or caliber of the reproductive follicles in the hermaphroditic and in the unisexual species. In *O. edulis* the caliber of the generative tubules appears to be relatively much greater than in *O. virginica* and *O. angulata*, nor are the tubules so densely crowded together as in the latter species. Up to this time this difference appears to me to be so marked that I think it would be possible to distinguish sections of *O. edulis* from those of the other two species by means of this one character. In other respects the history of the development of the reproductive tissues in both species appears to be similar. In all the sexual tissue arises as a linear, interstitial differentiation between the coarse, connective-tissue cells of the animal, only that in *O. edulis* the rudimentary network does not form quite so close a meshwork as in the other two forms here considered. The tubules have a more extensive anastomosis with each other in the unisexual species than in the hermaphroditic. In all the forms fine vessels pass off from the dorsal and ventral somatic arteries, which tend to branch into vessels of a capillary fineness amongst the productive follicles. Thus the glandular portions of the reproductive organs are effectively nourished by supplies of blood passing from the great vessels given off by the heart. These are the principal characteristic features of the reproductive follicles in the hermaphroditic and unisexual forms which are noticed upon comparing the two together. The most important differences between the two forms are to be found, however, in the mode in which the generative elements are produced in each type, which we will now consider.

In *O. edulis* the reproductive glands when well developed show in many cases a lining of large nearly mature ovules or ovarian eggs, at intervals, and insinuated between them large coarsely granular bodies may be observed, in which large, irregular, nuclear bodies are often embedded. These nuclear bodies are further distinguished from those of the ovules by their oval or oblong and often irregular form, and by containing a dense mass of granules which absorb safranin in such quantity as to become opaque. This granular *chromatin*, as it would be designated by Flemming, is usually aggregated at the center of the nuclear or cellular mass, whichever it may be, and is furthermore apt to conform to a certain extent to the external outline of the body which contains it. From these bodies the rounded granular cells appear to arise, which fall into the cavity of the tubule or follicle, there to undergo further segmentation, and finally break up into spermatozoa with spherical heads and filiform tails or flagella. Even in some cases, where no spermatozoa are as yet revealed by the methyl green, these rounded spermogens or spermatoblasts are to be seen free in the center of the follicles. Usually, however, the spermatoblasts have been crowded towards the external end of the tubule where they have undergone differentiation into spermatozoa. The spermatozoa are often on this account so crowded together at the outlet of the tubules, passing even into the superficial ducts, so that when acted upon by the methyl green they are revealed as a dense, almost opaque, dark, bluish-green mass. The ovules, on the other hand, which may be quite nearly mature, remain unstained, except their spherical clear nucleus and nucleolus, which is double, as if formed of two conjoined spherules. If the safranin has been washed out of the nucleus the one spherule of the nucleolus only is apt to retain the color. The peculiar nucleus of the ovules at once distinguishes them from the elements, which later break up and become the spermatozoa. Apparently every phase of the spermatogenetic process is under way in the follicles, while more or less nearly mature ovules may be adherent to the walls of the same tubules. In some specimens I find the tubules to contain nothing but ova, with little or no trace of spermatoblasts; in others, again, both classes of products may be present in about the same condition of maturity. In still others little else but spermatozoa are to be found, but, adherent to the walls of the follicles, cells are to be found which have the nucleus so characteristic of the more mature ovules. These, I am inclined to believe, are the representatives of what will later become ova, and not the representatives of spermatoblasts. It is a singular fact that the spermatozoa have a tendency in *O. edulis* to cling together in masses of about a uniform size. Though the spermatic particles which comprise these masses are somewhat separated from each other, if compressed together they would evidently form a body about the size of the spermatoblasts from which they were derived. Later they tend to break up and form a more homogeneous, granular mass at the outlet of their parent tubule, where the latter joins the outgoing efferent duct. While it is true that some sections of *O. edulis* show little evidence of the presence of anything else but the product of one sex, it appears to me that there is sufficient evidence of the hermaphrodite character of the generative glands of the species presented by a pretty large series of sections taken from about fifty individuals from different localities along the coasts of Wales, Scotland, England, France, Holland, and Germany. Sometimes a portion only of a section will be hermaphroditic, showing that different parts of the generative glands of the same animals may be of different sexes. The result of this arrangement is that it is scarcely possible for the eggs to escape impregnation by the milt generated alongside of them, and we may, I believe, fairly assume that *Ostrea edulis* is a self-fertilizing hermaphrodite.

The condition of things in the generative tubules of *Ostrea virginica* and *angulata* is very different, as may be gathered from the following account. In the first place I have never found any evidence of hermaphroditism either in the living animal or in sections of the reproductive organs. The mode of pressing out the spawn from the gland and ducts of *O. virginica*, and the physical test used to determine the sex of the products in practical work during the last season, afford the most positive demonstrations of the unisexuality of that species. Examining sections, however, we never find either in the reproductive follicles of *O. virginica* or of *O. angulata* any evidence of the coexistence of ovules and spermatozoa. In fact, the mode of spermatogenesis in the unisexual species is very different from that of the hermaphroditic. As indicated in Brooks' figure of a part of a section of a male oyster, the spermatozoa are peculiarly arranged in the follicle or tubule. Upon applying a high power (500 to 800 diameters) I find that the heads of the spermatozoa show a very marked tendency to be arranged in rows like beads and not in oblong clusters, as in the hermaphroditic species. Moreover, the walls of the generative tubules are lined by relatively very much smaller spermatoblasts than those found free in the reproductive follicles of the hermaphrodite form. This spermatogenetic layer is often very marked in the males of the unisexual species, and even at an early stage of the functional activity of the testicular organs presents much the same structure that it does later. The rows of spermatozoa already alluded to also have a tendency to be bent towards the outlet of the tubules, giving rise to a fringe-like appearance on either side of follicle with a clearer space between the edges of the fringe-like masses of spermatozoa. In fact it is plainly to be seen that the spermatozoa are being budded off from the spermatogenetic layer, and that the appearances just described are a result of that process. It results from this that the structural peculiarities of the testicular tubules are very characteristic, so that once recognized they will never afterwards be confounded with the arrangement observed in the ovary of the female, where, as in the hermaphrodite species, the ova may be seen in different stages of development, though where the majority of the ovules have attained nearly full development, it may happen that few of the nascent ovules closely adherent to the walls of the follicles are visible.

The distinction between *Ostrea edulis* and the American and Portuguese species is therefore very marked and important. Möbius, Der Auster und die Austernwirthschaft, Berlin, 1877, page 19, says of their species: "Oysters are hermaphrodites. In the largest number of individuals, in the whole reproductive organ, I found only spermatozoa, but no eggs. In seven oysters which carried blue brood in the beard, the sexual gland contained only spermatozoa. Three oysters with younger white embryos in the beard had no spermatozoa in the sexual gland. In the most of the brood-bearing oysters the sexual gland contained neither eggs nor spermatozoa. Of 309 oysters, which were taken, on the 25th May, from four different banks east of the island of Sylt and afterward examined from May 26 to June 1, 18 per cent. were hermaphroditic, and of the remaining 82 per cent. one-half were egg-bearing, the other half sperm-bearing. In none were the sexual products completely mature. From these observations I conclude that the eggs and spermatozoa do not develop simultaneously but successively in the sexual gland; that spermatozoa may be developed very soon after the discharge of the ova, and that probably one-half of the oysters of one locality during a breeding period produce only eggs, and the other half produce only spermatozoa." To the same effect are the statements of Lacaze-Duthiers; but Davaine seems to have first noticed the peculiar aggregations of spermatozoa in oval masses in *Ostrea edulis*. Brooks thinks "Gerbe's statement, that among 435 European oysters one year old he found 35 with young, 127 with ripe eggs, and 189 with ripe semen, seems to be sufficient to show the incorrectness of Lacaze-Duthiers' conjecture that the functionally male condition precedes the functionally female condition."

This is about the state of the controversy at present in regard to the breeding habits of *Ostrea edulis*. The only authority, as far as I am aware, who distinctly takes the ground that eggs of this species are fertilized in the reproductive organs is Horst, who says: "Not only do the embryos pass through their first stages of development within the mantle cavity of the adult, and impregnation occurs internally instead of externally, but it may also be said that the eggs and spermatozoa come into contact in their passage out of the generative glands." It is barely possible, indeed probable, if my memory serves me rightly, that Davaine has put similar observations upon record. Horst also distinctly asserts that the normal development of the embryos of *Ostrea edulis* cannot take place outside of the parent. Mr. Berthelot, according to Mr. Brandely, has discovered that the fluids in the mantle cavity of *O. edulis* contain albumen in a notable proportion, upon which the young are supposed to be nourished. Mr. Brandely has found by direct experiment, that in the case of *O. angulata* it is possible to artificially impregnate the eggs. His attempts to fertilize the eggs of *O. edulis* with the milt of *O. angulata* and *vice versa* were unsuccessfully repeated at different times for the last two years. I am now also uncertain in regard to the identity of the species of which Lieutenant Winslow succeeded in artificially impregnating the eggs at the mouth of the St. Mary's River, in the Bay of Cadiz, Spain, which he says were natives, the variety having existed and flourished in the bay for as far back as could be remembered. I quote his description of the specimens he used in his experiments as follows: "In appearance they were quite similar to the American species (*Ostrea virginica*), having long shells of from one to three inches in length, rougher and thicker than is usually the case with the European oyster." This remark raises the question whether the experimenter was not really working with *O. angulata* instead of *O. edulis*. The locality where he got his specimens and where he conducted his experiments also makes it not improbable that he was in reality working the native unisexual species, *O. angulata*.

To return to the question of the breeding habits of *Ostrea edulis*, it appears to me that we cannot very well question the authority of Möbius, Lacaze-Duthiers, and Horst, in regard to the bisexual state of the reproductive organs. My investigations also give some countenance to the fact of a preponderance either of eggs or of spermatozoa in different individuals; in fact, in some cases the one or other seems to be almost exclusively the mature product. But we are not yet in a position to arrive at a conclusion in this matter because of the scantiness of the observations which have hitherto been made. The hypothesis that the spermatozoa are drawn from without into the generative ducts by the ciliary action of the gills and mantle may be dismissed with the remark that microscopic investigation, to my mind, has effectually disposed of the probability of any such a state of affairs. We may see the spermatozoa in course of development in the same follicle with the ova, which is conclusive proof that the milt has not been derived from without, from the water into which it had been discharged by neighboring individuals. In truth, we find in some cases the spermatozoa present so deep down in the utmost ramifications of the generative follicles that it is not conceivable that they should have been drawn in from without.

As to the alternate activity of the organs in producing ova and spermatozoa there is a possibility that such is the case, but as stated at the outset there is as yet no conclusive proof of the fact. Certain it is, that I have yet to see sections of *O. edulis* in which both ova and spermatozoa are not present in some condition of development at the same time. If the one be not present in a fully developed state, developing traces of it may be discovered, or even a very minute quantity of developed milt or a few developed eggs may be present in some one follicle, while in the others there are perhaps exclusively eggs or exclusively milt in a developed condition. I am aware that this view of the matter is opposed to the current doctrine that nature provides against continuous interbreeding, but when we find the eggs and milt about equally advanced in development in the same follicle, what is there to prevent self-fertilization; in fact, what else can be the mode of reproduction?

In some of the sections of *O. edulis* examined by me the ovules already measured $\frac{1}{250}$th of an inch in diameter, showing them to be about twice the size of the ripe eggs of *O. virginica* and *O. angulata*, in both of which the ova are of about the same size when mature. Estimates which I have made, based on the figures of the eggs of *O. edulis* given by M. Davaine, show them to be $\frac{1}{130}$th of an inch in diameter. Estimates based on the figures of Lacaze-Duthiers give $\frac{1}{270}$th of an inch, while Möbius and Horst give the size of the young fry at $\frac{1}{150}$th of an inch in diameter. The spherical heads of the spermatozoa of the three species here discussed measure about the same or approximately, $\frac{1}{13000}$th of an inch in diameter. The clusters of spermatozoa of *O. edulis* measure approximately $\frac{1}{750}$th of an inch in diameter. The spherical unsegmented spermatoblasts which break up into spermatozoa in *O. edulis* measure $\frac{1}{1500}$th of an inch in diameter. The nucleus of the ovarian eggs of *O. edulis* measure not quite $\frac{1}{750}$th of an inch in diameter. The nucleus of the ovarian egg of *O. angulata* measures approximately $\frac{1}{1333}$rd of an inch in diameter, which is about that of the nucleus of the egg of *O. virginica*. The large spherule of the nucleolus of the egg of *O. edulis* measures $\frac{1}{2750}$th of an inch in diameter; the small spherule, which is stained red by the safranin, measures $\frac{1}{4250}$th of an inch; the long diameter of the conjoined spherules is $\frac{1}{1750}$th of an inch. The long diameter of the nucleolus of the egg of *O. angulata* and *O. virginica* is about $\frac{1}{4000}$th of an inch. A slide in my possession containing some of the brood of *O. edulis* shows that, even after it has acquired both valves of the shell within the beard of the mother oyster, the brood varies greatly in size. I find, for example, that such fry measures from $\frac{1}{110}$th of an inch down to as small as $\frac{1}{150}$th. This brood, like that of the American oyster, has not yet acquired any umbonal prominences at the hinge end of the valves. Before this occurs in the American oyster embryo considerable growth has taken place, but when the shell already covers the body the whole embryo, contrary to what is found in the European species, measures little, if any, more in diameter, than the egg, or about $\frac{1}{500}$th of an inch. Later, when the embryo has grown considerably and when it is on the eve of attaching itself permanently, it measures from $\frac{1}{80}$th down to $\frac{1}{90}$th of an inch in diameter. The mode of fixation of the fry of both species is probably the same, but the mode of incubation—the one in the mother, the other in the open water—we see is widely different, differing as greatly in this respect as do the eggs in size and details of construction, as shown by the measurements which I have given. It must not be forgotten, however, that the material from which I prepared my sections was received from Europe, in January and March, when it is to be supposed that the reproductive organs were not yet fully developed, and that consequently the dimensions of the ovarian ova as found by me are rather to be considered as being below than above their true ones when fully developed at the height of the spawning season.

It is a very remarkable fact that one finds individual specimens of oysters in which the reproductive organs have undergone total atrophy or wasting away at the completion of the spawning season. Examining sections through the body-mass of spawn-spent oysters taken from their native waters in August last, I find that the whole of the connective tissue subjacent to the mantle, and between the latter and the liver, especially over the sides of the body-mass, has disappeared, together with all traces of the reproductive organs, including the superficial branches of the efferent ducts. At the first bend of the intestine there is still some of the connective tissue remaining; but even here and in the mantle it has changed its character entirely, and become very spongy and areolar, instead of solid, and composed of large vesicular cells, such as are met with when the animal is in a better condition of flesh. In fact, it appears as if this mesenchymal or connective tissue substance had been used up and converted into reproductive bodies—generative products—in the case of the spawn-spent and extremely emaciated individuals. In sections from individuals in various conditions from that in which the rudimentary network of generative tubules has just appeared in the connective tissue, on up to those in which the reproductive tissues are enormously developed in bulk and proportion to the mass of the remaining structures, there is a perfect gradation from their complete absence to their full development. This would appear to be very strong evidence in support of the theory that the reproductive follicles, or tubules, are developed anew each season directly from the specialization of certain strings or strands of connective tissue cells.

Many animals manifest a periodic development of the glandular portions of the reproductive organs; but I know of no form in which there is any such presumptive evidence that these organs are annually regenerated and finally altogether aborted as seems to be the case with the oyster. Together with the changes here described, the most remarkable changes in the solidity and consistence of the animal take place. The shrinkage of a spawn-spent oyster in alcohol or chomic acid solution is excessive, and will, when complete, reduce the animal to one-tenth of its bulk while alive. This shrinkage is due to abstraction of the water with which the loose, spongy tissue of the exhausted animal is distended. A so-called "fat" oyster, on the other hand, will suffer no such excessive diminution in bulk when placed in alcohol or other hardening fluid. In consequence of this variable development of the reproductive organs as well as that of the connective tissue of the body-mass, the amount of solid protoplasmic material contained in the same animal at different times under different conditions must vary between wide limits. And, inasmuch as the nutritive and reproductive functions of animals are notoriously interdependent, it follows in consequence of the enormous fertility of the oyster that a vast amount of stored material in the shape of connective tissue must be annually converted into germs and annually replaced by nutritive processes. Plentitude or dearth of food are also to be considered; but it now becomes a little easier to understand the physiological interdependence of the reproductive function and the so-called fattening process.

To a great extent what has been remarked in the preceding paragraphs of the wasting away of the reproductive organs in *Ostrea virginica*, seems to apply also to *O. edulis* and *O. angulata*. The last species has an extraordinarily thick body-mass with the stratum of reproductive follicles of remarkable thickness, averaging a much greater development than I have ever seen in any other form. When the contents of this great mass of tubules has been discharged a diminution in the bulk of the body-mass must naturally ensue, probably accompanied by a wasting away of the connective tissue and tubules such as apparently occurs in the American species. From what I have seen of the generative tubules of *O. edulis* in sections, they are evidently regenerated much as in *O. virginica*. In a few specimens I find them almost entirely gone, or present only in an extremely rudimentary state.

BRINGING WHALE OIL FROM THE PACIFIC TO NEW YORK.

By FREDERICK HABERSHAW.

[From letter to Prof. S. F. Baird.]

I am bringing the Northwest Pacific whale oil, which is now delivered by whalers at San Francisco, to the Atlantic by bulk cars instead of by Cape Horn route, as formerly. The total amount coming thus by rail is 21 cars this year, averaging 3,300 gallons each, or 69,300 gallons.

San Francisco has become the whaling depot of the Pacific, for the fitting up and discharging of whalers; it is only a question of time when all this product will be brought to the Atlantic by rail. Probably in a few years all the manufacturing will be done there instead of at New Bedford.

113 MAIDEN LANE, NEW YORK, *January* 30, 1883.