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Service Paper

THE STUDY AND PHOTOGRAPHY OF NEW ENGLAND SEASHORE LIFE

WITH

NATURAL COLOR SLIDES AND LECTURE NOTES

Submitted by

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There is an increasing awareness of the vast riches that the sea holds in store for us, both in terms of food and minerals. It is no wonder, when we think that it covers approximately three fourths of the earth's surface. But more significant is that, due to its depth, it offers many, many times the habitable space that land does. It is in this enormous amount of water that the most fantastic creatures on this planet live. The sea is today the last great unexplored frontier.

Scientists classify animals according to the depth of water in which they live. Littoral species live close to the shore, pelagic species live in the open sea, and those living at great depths are abyssal.

It is beyond the means of most of us to be able to make much of a first-hand study of any but the littoral. But we should not be discouraged at being limited, for there is more to learn in that one area than one human mind can cope with in a lifetime. There are still mysteries about these animals that need solving. How do some brainless animals perform certain acts of self-preservation? How does the fish in
California, the grunion, time its egg-laying with the full or new moon (and corresponding extra-high tides) so that the eggs will have until the next series of high tides to incubate in the warm sands above the water line? We are all aware that many of the lower forms of animal life have the power to regenerate lost parts, but who can tell how a fiddler crab, after losing his enormous right claw, develops his small left one to replace the lost one and then grows another small claw on the right? This applies only to the male. The female's claws are the same size, both small.

While many questions remain to be answered, nevertheless, much is known about the habits and history of sea creatures. It is believed that all life on the earth at one time lived in the sea. While many forms advanced and left the ocean to become our first land animals, some of our present-day animals resemble very closely their ancestors. The echinoderms, such as starfishes and sea urchins, have not advanced in millions of years, although they have undergone slight changes. They are unique in that they have never been represented by a land-residing member. Numerous skeletons of some echinoderms have been found in the oldest (400 to 500 million years) of all fossil-bearing rocks.

Perhaps one reason for the starfish's long survival without improvement is that, along with certain sponges and a few
other low forms, it is not sought as food by others. Most animals, in order to survive, are fighting constantly against being eaten, while at the same time seeking out others smaller, or perhaps larger but more defenseless, for their own meal. The majority of animals feed on plankton, weakly-swimming creatures of the open water, and are carnivorous; but some, like the periwinkle, are herbivorous, feeding on algae. Even though an animal may survive to die a natural death (and some sea animals live to ripe old ages), its dead body may be consumed by a scavenger like the lobster or crab or some snails. Cannibalism is the rule rather than the exception and little mercy is shown. A crab will devour bit by bit one of its own kind.

One might think that those animals who find it profitable to form limy shells out of the less-soluble salts contained in salt water would be invulnerable to attack, but such is not the case. Of great economic importance is the damage done in oyster beds by the voracious starfish. Snails bore mechanically into barnacles and other immobile forms and cut them to pieces. Other animals bore into rock for their own protection by exuding an acid. A whole book could be written on the fascinating but sometimes gruesome ways in which animals secure a meal, or keep from being devoured.

How then do these animals prevent their extinction, with such a high rate of mortality? The answer lies in the
fantastically high rate of reproduction. However, many adults do nothing more to see that their species is perpetuated than to lay a tremendous number of eggs. These eggs then go unattended as do the ensuing larvae, and many fail to find habitable spots or are eaten. But think what would happen if they all survived! The ocean, despite its vast size, would be entirely inadequate.

Curious names get attached to many things of the sea, some of them misleading. The sea-mouse is really a marine worm. The sea-cucumber resembles a cucumber but is really an echinoderm, even though its five-parted anatomy is not as obvious as it is in the starfish. Its tube feet are arranged in five double rows. Some marine animals are even named after plants, like the anemones, which resemble the wild flower because of their petal-like, poison-laden tentacles.

We usually think of animals as having power of locomotion, but many sea creatures besides the anemone are sessile. Many others have very primitive means of moving about.

One should not overlook the plant life found along the shore at low tide. It, too, is interesting, both in its relationship to animals and by virtue of its own habits, beauty, and economic importance. Ocean plants are quite different from land forms, having not roots but a holdfast; this provides anchorage only. Most of them are algae; thus they reproduce by means of spores rather than by flowers and seeds. One of
the few exceptions is eelgrass, which is a flowering aquatic plant. This plant illustrates the economic importance of plants. Animals use plants to provide shelter and food. It is believed that a disease wiped out the eelgrass, leaving many creatures, including some fish of commercial value, without their customary haven.

Some of the true seaweeds are also important. Rockweed has been used as fertilizer, dulse as a food, and kelp as a food supplement for humans and livestock. Agar and algin are two important seaweed gums of commerce. It is the third one, however, carrageenin, that interests the writer most because this is the one that is extracted from Irish moss.

Irish moss was first used by the people of Ireland in the early 1800's for what they thought was its nutritional value. Many Irish immigrated to Scituate, Massachusetts, in the middle of that century and, finding Irish moss abundant, started the first business of its kind in this country. Business boomed during World War II when the price of green moss went to 2 cents per pound because of the limited amounts received from Europe. By now, the gum had become important as a colloidal substance in hundreds of products. It kept cocoa particles from settling in chocolate milk. Chemists and engineers found many other uses for it in foods and beverages, drugs, cosmetics, leather dressings, and shoe polishes. Industry used it as a lubricant for drawing tungsten filaments.
Necessary for harvesting moss are a dory, and a rake for pulling the moss from the rocks where it grows just below the water at low tide. It is hard work and it takes time to acquire the knack of getting a good, clean rakeful nearly every time, while keeping the dory in position despite wind and waves. It makes a pleasant and profitable summer. It was through mossing that the writer first became aware of and interested in sea life.

Just recently the opportunity arose to combine this interest in the seashore with another hobby, photography. At least one good transparency of most of the common plants and animals found along the shoreline of New England was taken, using Kodachrome, for certainly only color does justice to a project of this nature. At the start, the equipment was limited to a camera, a Kodak Retina I, equipped with double-exposure prevention, f/3.5 lens, and Compur rapid shutter. This was a good start, but it soon became obvious that considerably more equipment would be needed. A periwinkle doesn't look like much at 3½ feet! To get close to the subjects, three Kodak Portra Lenses, a 1½, a 2½, and a 3½ were purchased. There were many occasions to use the 2½ and 3½ together. This reduced the lens-to-subject distance to only seven inches with the camera focusing scale set at four feet. Working at such close range called for a tripod and also a means of ascertaining correct exposure, which was taken care of by a Weston Master II exposure meter. Since mostly Type A film (for artificial light) was going to be used, a filter for use with
this film in daylight was needed. With a few more odds and ends, a cable release, a lens hood, and a steel tape, all was ready. Now to use this equipment correctly!

The principal problems, whether inside or out, were getting the correct exposure and making sure the subject would be centered in the picture. Centering by means of the view finder is not difficult at normal distances, but in close-ups, due to the separation of the axis of the view finder and the axis of the lens, another means has to be devised. By attaching a block of wood to the underside of the camera by means of the tripod socket, a focal frame can be built out of wire (attached to the wood) that properly "frames" the picture at the correct distance for whatever lens or combination of lenses is being used. This means that a different frame must be built and tested for each lens or combination of lenses. Also, each lens is not limited to an exact lens-to-subject distance, but has some latitude. For example, the 1+ lens can be used at distances from 22 inches to 39 inches. Two lenses used together, the 3+ and 2+, can be used for distances between seven inches and eight inches. Incidentally, the depth of field decreases as the lens-to-subject distance decreases, until it is less than one inch with the combination 3+ and 2+. This means that care must be taken in placing the camera at the correct distance from subject. So many different distances were used, each dependent on the size of the subject, that, instead of constructing these frames,
the ability to "sight" by eye along the axis of the lens was relied upon, much as one would sight along the barrel of a shotgun. Of course, it was necessary to sight two ways, from above the camera and from the side. This method proved to be very successful.

The guide in all this work was a Kodak Data Book, Kodak Lenses. It states that the lens opening for a camera with a 50 mm lens must be f/8 for one Portra Lens and f/16 for combinations. With this established, there was no choice, after taking a meter reading, but to use the shutter speed opposite f/8 or f/16. Thus, the first steps were to get the proper lens or lenses on, depending on the size of the subject; get aligned at the proper distance; set the lens opening; and set the camera focusing scale. This depended on the lens or lenses being used and the lens-to-subject distance. It could be read from a diagram in the Kodak Data Book. The meter reading then gave the shutter speed. With such a wealth of information supplied by the photography industry, one can hardly go wrong.

More trouble was encountered with some of the specimens than with the technique of photography. It was surprising that the green crab remained still long enough and in the right place to be photographed. The mistake was made of taking it and some other specimens in water, using artificial light, with the result that the colors are not good, the whole scene having a greenish tinge. It was done in an effort to portray, for example, the tube feet
of the starfish. Another time this difficulty might be overcome by using daylight to get, for example, a good shot of a live sea urchin, showing its tube feet extended beyond the tips of the spines. A brittle star should be photographed before it lives up to its name and loses one or more of its arms.

Perhaps something should be said about collecting specimens. Shore types can be divided into three classes: rocky, sandy, and muddy. Each will produce life, or remains of life, peculiar to itself. Many times curious things are washed up on a beach that originate in deeper water. The egg capsule of the skate, sometimes called a "devil's purse"; the egg case of the whelk; and the egg case, or "sand collar", of the moon snail are examples.

The rocky, tidal pool is one of the most interesting and fruitful places to visit. In general, the pools nearest the water, which are left exposed for shorter lengths of time, offer much more than those higher up on shore where the water warms excessively. In crevices, around rocks and underneath seaweed are the places where many animals seek shelter. Seaweeds help prevent the drying out of animals, another instance of the close relationship between animals and plants. Of course some animals, like the crabs, have adapted themselves for living out of water part of the time by developing a protective shell or membrane which prevents their drying out. The fiddler crabs go even farther than this. They carry water with them in their gill
chambers. From this water they get the oxygen they will need
during a stay of many hours out of water.

Sometimes one doesn't succeed in finding just what he is
after. Some of the most interesting things are stumbled upon
more or less by accident. A rakeful of Irish moss might contain
such things as sea cucumbers, sea urchins, brittle stars, horse
mussels, starfishes, or some other interesting form of seaweed.

It takes patience sometimes to find some particular thing,
but after a few minutes beside a rocky pool, some form of life
will be seen. Maybe a good philosophy is just to browse about with
nothing particular in mind and take things as they come. You
won't be disappointed; there's so much of interest, so much to
learn about the seashore and its life.
APPENDICES
LECTURE NOTES

1. Typical Maine Coast. Much of Maine's 2,500 miles of coastline looks like this, with spruce trees growing right down to the bold, rocky shore.

2. Sandy, Muddy Shore. Southern New England has many miles of sandy beaches, occasionally interrupted by patches of hard mud and rocks.

3. Rocks and Pools. Among the rocks and mud are many pools abounding in plant and animal life.

4. Eyed Finger Sponge (Chalina oculata). Sponges are the lowest of the many-celled animals. They lack one characteristic of nearly all other animals, the power to move about. These skeletons are sometimes washed ashore from deeper water.

5. Marine Worms (Nereis virens). Worms are the first animals to show bilateral symmetry. These clam worms, among the most common of the segmented worms, are used widely for bait because of their large size and brilliant coloring.
6. **Common Starfishes** (Asterias Forbesii). These are the most common of the echinoderms, whose bodies usually show some five-parted marking. The starfish moves by alternate movements of hundreds of sucker-feet on its underside, as seen on the specimen on the right. The orange dot on the back of the specimen on the left is a sieve which strains incoming water.

7. **Sea Urchins and Sand Dollar** (Strongylocentrotus drobachiensis and Echinarachnius parma). Sea urchins, above, also move about by means of tube feet which can be extended beyond the spines. The skeleton, or "test", on the right has lost its spines. Again, the "test" of the sand dollar, having a five-petaled pattern on its upper side, is what is frequently found on the beach. When alive, this animal is covered by short, fine spines. It is eaten by flounders, cod, and haddock.

8. **Sea Cucumber** (Cucumaria frondosa). This echinoderm, wormlike in appearance, has five double rows of tube feet running from end to end. Ten branched tentacles at the mouth end capture food. It is said to be edible.
9. **Common Barnacles** (*Balanus balanoides*). The rock at the lower left is covered with many barnacles, a common sight between tide marks. These crustaceans (jointed-legged animals covered with a hard shell) are seen at low tide with the shell closed for protection. The shell opens when covered with water, and food is swept in by means of their feathery legs. They measure less than one half inch in diameter.

10. **Ivory Barnacle** (*Balanus eburneus*). These barnacles, much larger than the common barnacles, were found attached to this bottle, which had washed ashore during a storm.

11. **Maine Lobsterman.** The lobsterman's life looks ideal on a beautiful summer day, but it actually entails long hours of hard work in all kinds of weather. Lobstering is a very large coastal industry.

12. **Plugging a Lobster.** Here the lobsterman inserts a plug in the joint of the crusher claw to render it harmless.

13. **Lobster** (*Homarus americanus*). The plug is visible in the right claw. The other claw is a cutter. Some lobsters are left-handed. The lobster walks forward but swims backward by using its caudal (tail) fin. It is a scavenger.
14. **Hermit Crab** *(Pagurus pollicaris)*. This curious crustacean with a soft abdomen seeks shelter in empty snail shells. It casts its skin periodically and moves into a larger shell as it grows.

15. **Green Crab** *(Carcinides maenas)*. This is the most common small crab, often found high up on the beach under loose rocks or in pools. It is an exceedingly lively creature.

16. **Spider Crab** *(Hyas coarctatus)*. This crab is less frequently seen than other crabs, since it lives in deeper water. When found, it is usually missing one appendage (as this specimen is), because it is a quarrelsome species. The crab is always covered with an assortment of seaweed which it selects and "plants" on its back. The choice always harmonizes with its surroundings.

17. **Horseshoe or King Crabs** *(Limulus polyphemus)*. These animals are not true crabs but are more closely related to spiders. They are the last living members of their group and have existed unchanged for nearly two hundred million years. Empty shells such as these might be found after the adults molt.
18. Moon Snails (Polynices heros). A live moon snail protects itself by withdrawing inside its shell and closing the opening with its horny operculum. The shell on the left was probably broken by a gull's dropping it upon a rock to get at the flesh inside. The lower shell is encrusted with a colony of minute animals.

19. Boat Shells (Crepidula fornicata). These animals, like the moon snails, are one-shelled mollusks (shellfish). Here one is growing on another. Young oysters settle on empty boat shells, which are scattered over the ocean floor by the ton for this purpose.

20. Periwinkles (Littorina litorea). These animals survive for long periods of time out of water and are found in great numbers all over rocky areas. Periwinkles are a common article of food in Europe.

21. Rock Purple (Thais lapillus). This mollusk is capable of drilling holes through shells of young oysters and clams. Tyrian purple, a dye used centuries ago, was made from the bodies of snails related to this species.
22. Knobbed Whelks (Busycon caricum). The knobbed whelk is the largest mollusk (10 inches long) in New England. It bores holes in shells of other mollusks and sucks out their contents. It likes a sandy habitat.

23. Whelk Egg Case. These capsules, fastened together to form long strings, contain the young whelks. Here the baby whelks may be seen, perfectly formed and not more than one eighth of an inch in length. All of these were contained in the one opened capsule.

24. Boat Shells and Jingle Shells (Crepidula fornicata and Anomia simplex). The boat shells, on the left, show how this species got its name. The diaphragm (or shelf) resembles the deck of a boat. The jingle shells, bivalves, are irregular in shape, fragile and almost translucent.

25. Mussel Beds. Here in Maine, blue or edible mussels are exposed in great numbers at low tide.

26. Blue Mussels with Byssus Threads (Mytilus edulis). The yellow byssus threads are visible here. The mussel secretes these tough threads by a gland in order to attach itself to an object.

27. Blue Mussel (Mytilus edulis). This bivalve is considered delicious eating, especially by the French people.
28. **Oyster Shells** *(Ostrea virginica)*. These shells are the remains of the most valuable non-backboned animal, from a commercial standpoint. Oysters live beyond low tide limits. They are actually "farmed" -- planted, thinned, protected from enemies, and harvested.

29. **Scallop Shells** *(Pecten irradians)*. The scallop is another commercially important bivalved mollusk. Many lovely shells such as these are found along the beach. Only the central muscle is eaten. The scallop propels itself by opening and closing its shell rapidly so that the expelled jet of water causes it to move.

30. **Sea Clam and Razor Clam** *(Mactra solidissima and Ensis directus)*. The sea clam or hen clam is the largest bivalve on the northern Atlantic coast. It lives under the sand at the surf line. A delicious chowder can be made from it. The razor clam, named because of its similarity to the old-fashioned straight razor, lives in the sand at the low water mark, in an upright position. Because it burrows very rapidly, it is difficult to dig out. Although not used for food extensively, it is edible.
31. **Quahog Shells** (*Venus mercenaria*). This is the common "hard-shelled" clam or "little neck" of southern New England. Immature quahogs are called "cherry stone" clams. It is important as a food, especially when oysters are considered out of season. Quahog shells were used for wampum by the Indians.

32. **Soft-shelled Clam** (*Mya arenaria*). This clam, which lives between tides almost anywhere where it can bury itself, is the common commercial clam of New England. It has been dug in such great quantities that steps are being taken to insure its continued abundance. Indians depended largely upon this clam for food, as evidenced by shell heaps which can be seen today, especially along the Maine coast.

33. **Clam Digger's Equipment**. This four-tined fork and slatted hod comprise the clam digger's equipment.

34. **False Angel's Wing** (*Petricola pholadiformis*). In contrast to the preceding bivalved mollusks, this animal is not eaten. It lives in these round burrows which it bores in clay or soft mud between tide levels. Its pretty shell accounts for its common name.
35. **Rockweed at Low Tide.** A familiar sight along the rocky portions of the coast is this display of rockweed, one of the common "seaweeds". Here, at low tide, the rocks are literally covered.

36. **Nodose Rockweed** (*Ascophyllum nodosum*). One of the common rockweeds is nodose rockweed. Here one plant is attached to a rock the size of a grapefruit by means of its holdfast.

37. **Rockweed at Half Tide.** The same plants are seen at half tide floating by means of their numerous air vessels. Some plants attain lengths of five feet.

38. **Vesicled Rockweed** (*Fucus vesiculosus*). Vesicled rockweed is the other common rockweed. These plants, like practically all other seaweeds, are algae and reproduce by means of spores rather than by seeds.

39. **Irish Moss Drying in Sun** (*Chondrus crispus*). This is the most important commercial marine plant of New England. Its extracted gum is used in many foods, drugs, and cosmetics. It is a red alga, but when found along the beach is usually bleached nearly white. It is harvested by rakers at low tide and dried in the sun before shipping to processing plants.
40. **Bleached Coralline, Bleached Irish Moss and Shell of Rock Crab** (Corallina officinalis, Chondrus crispus and Cancer irroratus). In the upper right is a bit of Irish moss found in the tide wrack. The shell is that of a rock crab, the common crab of New England. In the upper left is a bleached and brittle specimen of coralline, a plant which gets its name from the fact that its stems look like jointed coral.

41. **Coralline on Periwinkle** (Corallina officinalis and Littorina littorea). This pinkish-purple coralline has attached itself to a live periwinkle.

42. **Egg Case of the Skate.** This hard, brittle, black object, often cast up on the beach, is the egg capsule of the skate, a fish belonging to the ray family. It is sometimes called a "devil's purse".

43. **Dike at Cohasset.** Plants and animals are not the only things of interest along the coast. Here is a dike, a band of igneous rock, which, when in molten form, flowed into a fissure.

44. **Maine Coast.** Once again, as it has for countless centuries, the tide rises to cover a multitude of fascinating forms of life.


