

## CONCLUSION

Bring any discoveries to the attention of the Rangers.

The fossils of Torrey Pines State Beach are here today and gone tomorrow. What is now published is out of date in a few months because the coastal bluff erodes away as does the beach itself. Winter is the time to discover fossils and record them for science and our children. Every fossil is a puzzle piece that helps in piecing together the history of the Eocene 45 to 53 millions of years past. The Torrey Pine tree above the cliff, so rare and protected, still succumbs to the bark beetle as trees of the Eocene were felled by bark beetles. The fossil record is important to continue this discovery and documentation. One never knows when you might be the person that discovers a fossil pine needle or fossil pine cone, or another bark and its bark beetle burrows. Such discoveries help define knowledge of the habitat and life from so many years past. We hope you enjoy these images and think of the questions that still remain. What is it and what story does it have to say? The fossils illustrated here were randomly discovered and are displayed on these pages in random order. Author plans to expand this booklet with more fossil discoveries. Enjoy!



**24.** Winter surf will sometime remove all the sand upon the beach. It is during this kind of winter that the mudstone and siltstone erodes enough to present extinct in situ fossil shells, occasional bone, carbonized wood and plant. You photograph, document in writing and do not remove. You also inform a Ranger of its presence.

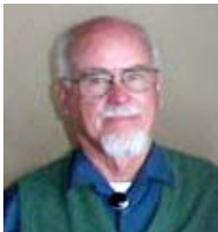


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## Select Fossil Records of Torrey Pines State Beach By Wesley M. Farmer

From 1990-1998 I photographed all new fossils I discovered on a mile-long stretch of beach, in the coastal bluff and under-foot, from the life guard tower to include the fault lines south of Flat Rock. These images were selected from 2,279 images documenting fossil and sites. These images are now on CD\_ROM. The elements cause erosion and for every two hour walk along the beach there was something relating Eocene fossils to document. This is true particularly during some winters when little or no sand is upon the beach. GPS Latitude and Longitude were recorded for the various discoveries now on the CD\_ROM as part of the 560 field notes plus a CD\_ROM Microsoft PowerPoint Presentation of select records. In time the documentation and collection of images will prove meaningful and help refine what is already published of the fossils from Torrey Pines State Beach. On the hunt for fossil data between these grids: (GPS from) N 32° 255.25' W 117° 15.565' to: N 32° 54.750' W 117° 15.465'

Wesley M. Farmer became a Torrey Pines State Reserve Docent February 1990 after my program presentation. Farmer has earned three docent of the month awards. He is the former Editor (1994) of The Torreyana Newsletter and contributor of color photographs in the early "Flowering Plants of Torrey Pines State Reserve". Other activities services and employment include:



1. Enjoy nature photography and making Microsoft PowerPoint shows.
2. San Diego State Bachelor of Science (June, 1957); Famous Artists School Commercial Art, Illustration and Design (April, 1970); Arizona State University Master of Science (June, 1970); Columbia Pacific University Doctorate of Philosophy (Zoology, November, 1984).
3. Web page: [www.angelfire.com/ca2/seashorediscoveries/index.html](http://www.angelfire.com/ca2/seashorediscoveries/index.html)
4. Couple of grand children.
5. Programs presented to San Diego Mineral And Gem Society, Docents at Torrey Pines State Reserve, San Diego Shell Club, Phoenix Shell Club, Seniors groups, couple of High School Biology and Art groups and Southern California Unified Malacologists.
6. Sculpted 6 foot long life like Coelacanth and a Whale Shark that was displayed at SIO and San Diego County Fair (see web site above for images).
7. Curator of Exhibits at the San Diego Museum of Natural History.
8. United States Military Service in Patient Care.
9. Author of 8 other books and booklets marine science non fiction.
10. One man art displays in Long Beach, San Pedro, San Diego, Tempe.
11. Past President San Diego Shell Club, twice.
12. Leader for ebb tide nature walks for folks of all ages.

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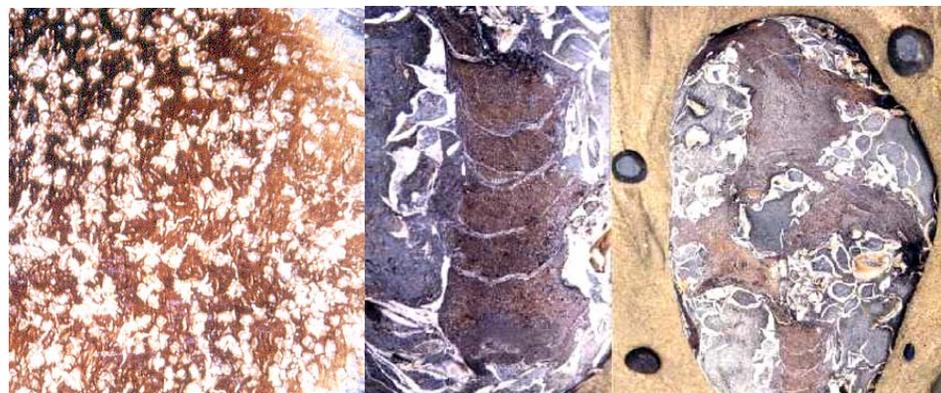
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Dedicated to Emily and Alex Hayes



**25.** Summer sand covers the beach; along the coastal bluff, a great time for a walk upon the beach. The calm surf builds the sand upon the beach. The bedrock might be 5 feet under the surface of the sand. The left image illustrates a large piece of sea cliff with wind caves and an arched edge. That section fell to the beach, the sea cliff is now smooth and ready for new wind caves to form (right). Anything to document before the rubble is all gone?

N 32° 54.903' W 117° 15.508' a place at this area of beach.



**23.** A large colony of oysters once lived upon this carbonized bamboo-like plant. (upper right) This 40 pound rock was discovered on the beach below Animal Canyon (photo as discovered). Photomicrograph of wood (upper left). There is a fresh water and salt water question here, why? The plant was in salt water long enough to provide substrate (surface by which animals/plants attach and grow) for the oysters. Compare modern-day root pattern of bamboo plant (right) to that of fossil (middle).





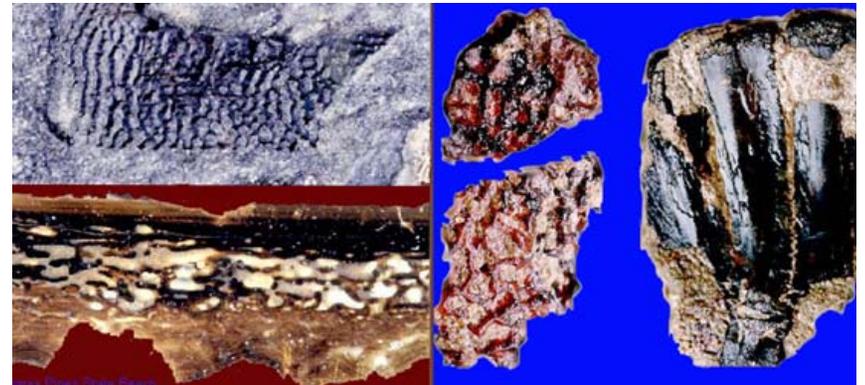
**22.** The fossil mold (above) is 8 1/4" long and 2.5" wide. This is a plant and animal combination, one needing the protection from the plant stem while the animal grows inside the burrow. The plant is providing a burrow habitat for the animal to grow to maturity. The animal and plant have now gone; this natural sandstone mold preserves that moment in time when both were alive. Imagine how the burrows grew larger as the animals lived and grew. Did the critters compete for space, choosing not to occupy the space of the one growing next to it? Interesting fossil!



**20.** The left photo contains a cross-section of extinct piddock clams, Paramartisia, a distinct genus/species that lived 50 million years ago. The right photo displays the same mineralized clam shell, as found closed and lifted from its burrow in carbonized fossil wood, embedded in mudstone. Since its discovery on the beach, the mudstone and its plant/animal combination have been eroded into grains of sand by the action of surf and waves. Present-day and unrelated piddock clams are burrowed at the foot of Flat Rock and can be seen at ebb tide.

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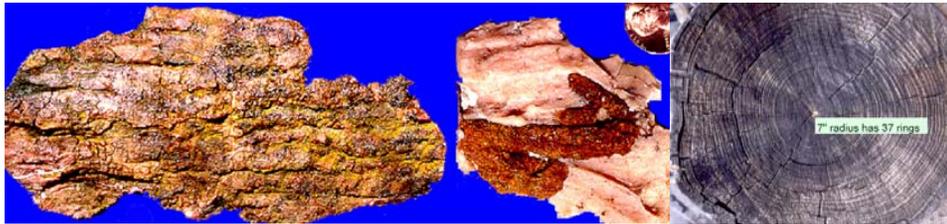


**1.** Five soft-shelled turtle bones and skin were discovered between 1990 to 1998. The crinkled skin texture (upper left) is several inches long and in mudstone. Two skin pieces (left side, right square) are fragments from the lower left of the three dorsal bones (right side, right square). The zigzag sutures between these bones can be seen as well. Soft-shelled turtles live in fresh water, correct? So how did turtle fossils get here, near the ocean, in 48 million year old Eocene mudstone, in what is now Torrey Pines State Reserve and Beach? Imagine a lagoon as it may have been a long time ago.

## INTRODUCTION

The mile-long stretch of coastal bluff and beach south of the parking lot (here known as Torrey Pines State Beach) to just beyond flat rock is in transition at all times (see aerial photo on cover). During winter storms the sea cliff becomes heavy with rain water. Weathering occurs, landslides happen and pieces of fossils become visible. To a scientist ready to discover and document, there is a story to find in every piece of fossil or sandstone mold. What is it? What was it when it was alive? What habitat did it live in? Could any petrified plant here be a relative of any still living as a Torrey Pine tree? After all the bark fossil and bark beetle lived 50 million years ago, just as they do today. Here is the evidence. Could it be a piece of a puzzle that the Torrey Pine Tree is a living fossil? This booklet has a few select images of fossil plant and animal pieces of the Eocene kind.

There are many fossil discoveries yet to be found. Why not document each fossil before they are made into grains of sand by the passing of the seasons. The data base then will grow and grow!



2. An 11 by 14 inch sandstone natural impression of bark was discovered on the Torrey Pines State Beach in June, 1997 (left photo). I made a plastic cast to make a positive image of the bark. When extended to a full circle, the bark had a suggested arc of 14 inches. Petrified bark beetle frass (or droppings) is pictured from the opposite side of the sandstone mold (middle photo). The tree rings of today's Torrey Pine tree felled by bark beetles are counted to compare and estimate the age of the discovered fossil. A 7 inch radius count suggests 37 rings or 37 years of growth (right photo). The bark beetles diet of old appears the same as the diet of bark beetles today. Could it be that this record suggests that a Torrey Pine tree is a living fossil?



21. A concretion is a round mass of mineral matter found in sandstone. Concretions come in various shapes and colors though generally rounded in form and materialize around a central object. They generally grow outward, layer by layer. As the bluff erodes away, other concretions buried in the sandstone will begin to emerge. And after months of wind and rain, concretions will disappear as grains of sand and the sea cliff in time will present other concretions by way of the erosion process. Challenge: Compare and contrast concretions with geodes (small, hollow rock or shells with crystals lining its inside wall).



19. There is pictured a hollow oyster shell with crystals (left) and an inch-long clamshell with orange crystals (right). These calcite crystals form from water percolating into the hollow shell. Impurities in the water color the crystals. When the mudstone in which they are embedded, break open, crystal-filled shells are often observed. In the process, the shell will break open as well. A camera could capture the color and nature of the crystals (but then so could a rendering in watercolor, ink or pencil).



16. Here is a picture of a mineralized shipworm. The distal pallet portion is preserved in clear calcite (crystalline form of calcium carbonate). The pallet plugs the opening of the burrow. However, when the burrow is not plugged by the pallet, two siphons protrude from the sides of the wood. One siphon is for inhalant filtering; the other is for exhalant of matter no longer of use. Living, mature shipworms, a kind of clam which burrows inside wood, grow to 10 inches in length!



5. Ostrea idriaenensis, a fossil oyster, is well represented at Torrey Pines State Beach. There were also critters living inside the oyster shell; for example, the acorn mussels (left) and burrowing sponges (black dots on far right). The acorn mussels and the burrowing sponges lived in sea shells then, just as they do today. Oyster beds seen in overhanging sea cliff ledges (right) end up on the beach as a landside.



14. These pits or burrows were made by the shipworm Teredo. Four summer tree rings are visible, the pits embedded in the softer spring wood (upper right). The remaining branched fossil plant in sea cliff has yet to fall to the beach (right).



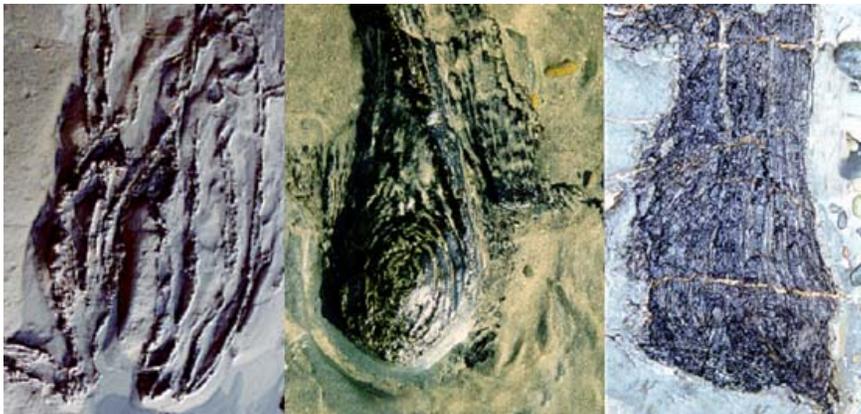
7. Discovered upon the beach was a carbon-covered piece of petrified wood. Sectioning the piece showed it to be hollow, lined with calcite crystals. The lines in the petrified wood are streaks of iron pyrite or fool's gold. One that studies fossil plants (paleobotanist) could identify the family of plant. Then perhaps, the kind of habitat in which it lived, could also be identified.



**6.** The three images above indicate three leaf impressions that were discovered along the sea cliff. Each photo suggests a central or principal vein of a leaf called a midrib. In the left and middle photos, the midrib impressions are vertical and darkly lined. In the right photo, the midrib is vertical and light colored, suggesting a silt lining, called a matrix. Challenge your visual discrimination skills to see the broad sawtoothed edges and narrow base of the leaf impressions on the left, and the wide, smoother edges of the other two leaf impressions. Could a paleobotanist identify these types of leaves?



**15.** The middle image suggests two in situ monocot plants with ends broken off. (palm or tree fern) They are lying with their fronts facing down, as if they fell down. One appears pinched out under the siltstone. The other is rounded and covered by dark carbon. At the end of one of the fibers is the impression of a "face" (left). Alive, the white areas would have transported water to the leaves. This is the function of the vascular system. Inset (right) shows the "wood" as it would appear when alive; now, it is petrified with carbon flakes.



**8.** In situ are: a fallen tree (left), carbonized knothole (center) and another carbonized plant (right). The fossils on the left and middle are located south of Flat Rock. Winter storms erode away any chance of further discovery and data collecting.

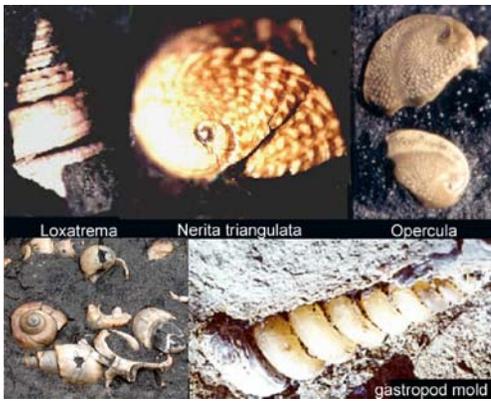


Here is another "what is it" kind of fossil.



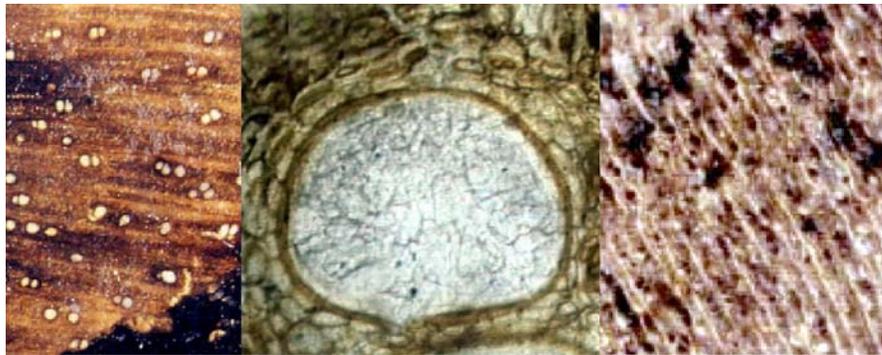
**13.** One school of thought is that this compressed in situ carbon is wood. (There are no cell structures; it has a vitreous texture). When heated, it smells of sulfur. Another school of thought is that it is solidified tar, when heated it smells like gasoline. Another kind of carbon is in the form of crude oil that floats upon the surface of the sea and lands on the beach or rock (lower right) then slowly flows. These kinds of carbon can be seen some winters when no sand is upon the beach.





12. All of these shells are extinct, as Loxotrema turritum (upper left) and Solena novacularis the razor clam (lower right). These rocks wash up on the beach from offshore during winter storms. Sometimes the shell has color markings and some shells not. When the calcium is dissolved away, a mudstone cast/mold is seen (left side, right square). The interior shell of the cork screw snail (gastropod mold, Turritella sp.) is filled with calcite. Sometimes there is a collection of various kinds of extinct sea shells contained within the dark silt-stone from offshore. The habitat of the razor clam (lower right) is bays and estuaries. The opercula (top center) are from the Nerita.

9. Siltstone, resistant to erosion, has formed around a piece of plant, now carbonized (left). An oyster, living upon and under the plant (center) has a colony of bryozoans or moss animals living upon the oyster (right). Oystrea or oysters live today in the calm waters of bays and estuaries. This Dove shell has a colony of bryozoa or moss animals partially covering the shell for comparison.



18. It seems amazing that some of the cobbles on the beach are actually rounded, petrified pieces of wood. Inside these fossilized cobbles, there are petrified wood cell structures. These structures can be observed by making thin sections with a diamond saw and by viewing the sections under a dissecting microscope. It is amazing that the sun helped to make these same cells grow a very long time ago. Amazing to discover, study and identify these petrified wood and plant cells and surmise its habitat of 45-53 million years ago.



3. One cobble (upper left) of many cobbles on a winter beach (below) is a petrified plant. By sectioning the cobble, we see growth rings and cell structures suggestive of a plant (right). A paleobotanist would study the fossil plant structures to determine its possible family and genus.



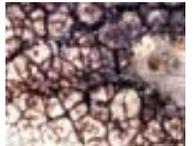
**10.** Bays and estuaries are favorite haunts of ghost shrimp and mud shrimp. Their burrows criss-cross within the mudflats. The shrimp has a habit of pressing balls of food into the walls of its burrow. The shrimp does that today just as the shrimp did 53 million years ago. Falling from the sea cliff or washing ashore in mudstone, the above fossil burrows are examples seen in the sandstone and mudstone of Torrey Pines State Beach.



**4.** A mineralized humerus bone (upper arm, shoulder to elbow) was discovered in situ January 1995 in mudstone. It is said to be the bone of a saltwater crocodile. In a few more years, it will be eroded away by the action of the surf. Could there be more related bones in the mudstone around this particular one? A GPR could answer that question. It is located at N 32° 5.119' W 117° 15.554'



**11.** This large rock fossil (center) might have come from the stomach of a tapir (but then, tapirs were small). Today tapirs live in water and feed on overhanging foliage and branches. Is it possible that this mammal died and became buried in silt, the stomach contents gradually mineralized (right), and then 53 million years later washed ashore in a winter storm? Inside are some clues as to what appears as petrified wood (left and right). It was discovered on the beach near Animal Canyon. My spin on this fossil is controversial.



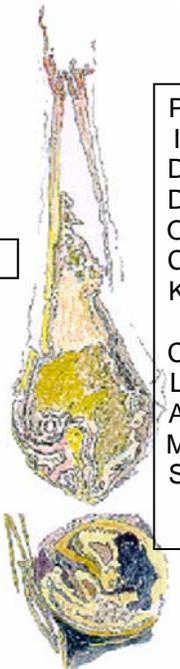
Burrows in branch



Humerus bone Saltwater crocodile

See page 4

**17.** Sharpen your observation skills. Notice the details inside a real and/or mineralized branch, leaf, clam, oyster, burrow or bone. Take pencil, pen, colored pencil or watercolor and patiently mark down the important details. Can you draw the details within a leaf or grub burrow using contour and shadow? Now compare the drawn pictures with photographs of same.



See page 20.