

## THE WEST COAST OF FLORIDA.

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Our observations on the west coast of the peninsula were confined to the tract included between Cedar Keys and the mouth of the Caloosahatchie (Punta Rassa), or over an area measured by somewhat less than three degrees of latitude. Along this entire reach the coast is very low, rarely rising more than from five to ten feet above water-level in the immediate neighborhood of the ocean border. The most elevated point would seem to be the dune at Clearwater, which, according to an official railroad survey, rises to a height of thirty-two feet; a portion of this "bluff" is made up of the remains of an ancient Indian shell mound, the wreck of which is clearly indicated in the large conchs, *Fulgur per-versum*, *Melongena corona*, etc., which lie scattered about. Immediately back of the town of Tampa, about a quarter of a mile up the Hillsboro River, and a little to the inland of the left bank, the solid rock rises to a height of some fifteen or twenty feet, but southward, again, even these minor elevations disappear, and the coast for the greater distance presents the appearance of a tide-level reach.

Contrary to what is generally supposed, solid rock enters very largely into the formation of the peninsular border, and its outcrops can be observed as well without as within the river channels. Thus, it is exposed on the Homosassa River a short distance (a mile or more) above its mouth, at various points on the Cheeshowiska, on John's Island at the mouth of that river, along the Pithlachascootie, on Clearwater beach, at Ballast Point on Hillsboro Bay, at the locality above Tampa already indicated, and at numerous other points. The rock is almost everywhere a more or less compact limestone, heavily charged with fossil remains, and at a few localities, as at Ballast Point and along the bed of the Hillsboro River, largely impregnated with silica, forming a tough siliceous matrix which readily yields to the hammer. Where the solid rock is not visible the eye rests upon a beach of homogeneous white or yellowish sand, which in some places is almost wholly deficient in shell-fragments, while in others it is literally packed with them. The most extensive shell-bank observed forms the ocean front between Little Sarasota Inlet and Casey's Pass, where, in a thickness of 4-5 feet, the greater number of the molluscan species now inhabiting this part of the coast can be found. A true coquina rock was found at the entrance to Little Sarasota Inlet,

and again on Philippi's Creek (tributary of Big Sarasota Bay)—at the latter locality overlying a fossiliferous arenaceous limestone—the first time, I believe, that it had been noticed on the west coast of the State.

Everywhere along the border the oceanic floor shelves very gradually, so that at even considerable distances out to sea only a few feet of water can be obtained. Whether or not a distinct channel depression exists beyond the mouths of all the various streams discharging on the coast, our means did not permit us to determine with any amount of positiveness, but it would seem that such is the case in at least some instances. Admitting this configuration of the bottom, it could readily be accounted for on the hypothesis of a steady or continued subsidence of the land, to which numerous facts, not necessary to be indicated in this place, seem to point. It is barely possible that the acidulated waters of the outflowing streams could have produced any measurable amount of subaqueous erosion. The mouths of the northern streams more especially—Hompsassa, Cheeshowiska, etc.—are very largely obstructed by oyster-reefs, which, in some places, appear above water-level during low water, and render difficult a passage of the channel to all but the smallest craft. These reefs are rapidly developing, and must ultimately completely bar the passages.

The vegetation along the west coast may be said to be fairly luxuriant. A semi-tropical character prevails in the northern tracts, especially well-marked along the upper Cheeshowiska, where the forest unfolds itself in its noblest and most magnificent proportions. The bay, water-oak, live-oak, cypress, and palmetto stand out as the most prominent features of this confused vegetable maze, whose penetrability is rendered possible only through the small bayous or narrow water-courses which partially enter the inner recesses of the wilderness. Southward, as at Dunedin, etc., where the thickness of the sand deposit very materially increases, the virgin forest largely disappears, and is replaced by a much weaker growth of yellow-pine and saw-palmetto, the latter forming an undergrowth rarely rising above three or four feet. This stretch of pine land extends for a very considerable distance down the shore, relieved here and there by recurrences of the more vigorous tropical jungle, a feature observed along some of the larger water-courses. Much of the thicket has been removed from the banks of the Hillsboro, but on the Big Manatee, a short distance above Braidentown, the palm forest assumes its pristine character. Along the protected bays and lagoons, formed by the outlying sand keys—Sarasota Bay, Gasparilla—the outer border more especially (or the keys) is fringed by a dense growth of mangrove, which continues with but slight interruption to the southern end of Charlotte Harbor. Its greatest development is seen here, where the "bushes" attain the dimensions of small forest trees. At the time of

our visit the foliage wore an autumnal aspect, the sere and purple leaves, the result of the recent cold wave, severely recalling the end of a northern season.

OFF ST. MARTIN'S REEF AND THE HOMOSASSA RIVER.—Somewhat to the north of the mouth of the Homosassa River the coast is bordered by a long line of broken reef, under whose lee we anchored the first night after leaving Cedar Keys (February 14). Here, in water of 6-7 feet depth, we obtained, by means of the scoop-net and hook, numerous sponges and several corals, the former of which thrives here in abundance. A large specimen of the logger-head sponge was found to measure nearly 17 inches in greatest diameter and eight inches in height. A number of these were immediately put in alcohol, and others placed on deck to dry, but the highly offensive odor resulting from decomposition necessitated their early restoration to the oceanic medium. The corals belonged to the genus *Orbicella* (*O. [Siderina] galaxia*), and were dead, but traces of the animal substance, still highly colored, showed that their existence had but recently ended. I believe this is the most northern point in the Gulf at which coral life has thus far been determined.

On the following morning we pushed our skiff up the Homosassa. My own observations were restricted to the lower two miles, but special information as to the upper course was brought to me by Mr. Willcox, who on many previous occasions ascended the stream to its source, for a further distance of about six miles. The fountain is described as a transparent pool of considerable depth, lodged in a basin of compact limestone, probably of the same character and age as that which appears not very far from the mouth of the river. At Wheeler's (left bank), somewhat more than a mile from the Gulf, this limestone was exposed at the time of our visit some one and a-half to two feet above the water, which has honeycombed it in all directions. Great numbers of *Mytilus hamatus* are here attached to the rock. A number of caverns and sinks appear some little distance from the bank, evidently excavated by the water of the stream gaining access into the numerous fissures that traverse, and are being cut into, the fundament. Large lumps of rock, collected from a well-digging, show an unmistakable fossiliferous character, but the fossils are mainly in the form of casts or impressions, and barely permit even of the determination of genera (mollusks). The immediate border rock is much more compact, and in a rapid inspection might be taken to be non-fossiliferous, but a magnifying lens readily reveals its true nature. The innumerable casts and impressions of the miliolite genera *Biloculina*, *Triloculina*, *Quinqueloculina*, *Sphæroidina*, and other kindred forms, clearly betray its foraminiferal structure, and point to its deep-sea origin or formation. I propose to designate this

limestone the "Miliolite Limestone," representing one of four distinct types of foraminiferal rock found in the State, the others being the Orbitoide, Nummulitic, and Orbitolite limestones. It certainly forms part either of the Oligocene formation or of the Upper Eocene, much more likely the former, and may possibly be in part synchronous with a portion of the West European miliolite rock.

The banks of the Homosassa are beautifully wooded, presenting in the profusion of the palmetto and yucca growths a partially tropical aspect. I was much surprised at the general absence of indications of animal life, the forest being as silent as the inner recesses of our more sombre northern wilds. An occasional flock of herons or white ibises would, perhaps, for a moment cloud the firmament, a mullet spring from the water, or the cardinal grosbeak peal its clear whistle, but otherwise an impressive silence pervaded the entire solitude. This was in marked contrast to some of our later experiences, and was probably accidental. A few days before our arrival, I was informed by Mr. Wheeler, a large spotted cat, of a light color, and somewhat smaller in size than the panther or Florida lion, had been killed in this neighborhood. To my numerous inquiries as to its identity with a species of lynx or catamount, or one of the better-known tiger-cats, I was only able to elicit a negative reply. Its distinctness from all of these forms was independently confirmed by our cook, an experienced huntsman of the upper Homosassa, whom we obtained later in the course of the day. Is it possible that the ocelot is an inhabitant of these wilds, and that it should have escaped the notice of traveling naturalists?

OFF THE CHEESHOWISKA RIVER.—On the 16th and 17th the "Rambler" remained at anchor off the mouth of the Cheeshowiska River, giving us an opportunity to explore several miles of this exquisitely beautiful stream. The vast oyster reef at its mouth rendered the passage of the channel intricate, and in a manner dangerous, and on our return journey one of the boats had to be partially relieved of its load and hauled over the shells. On John's Island, which guards the mouth of the river within the reef, we found innumerable aboriginal implements, some very rude, others more perfect, fashioned from a siliceous rock which appears to be identical with the rock exposed on a small island about three miles S. E. of the mouth of the Homosassa. The great number of partially finished implements and chips, and the masses of the nearly crude rock lying about, leave little doubt in my mind that the island, as first suggested by Mr. Willcox, was the true factory where these implements were manufactured.

At low water a somewhat spongy limestone, containing numerous molluscan impressions and a few Orbitoides, appears on the ocean front;

in nearly all instances where large masses of this limestone are examined they are seen to be bordered by, or enclosed in, a limestone of a somewhat different character and color, which, in addition to numerous fragments of marine-type fossils, contains the remains, beautifully preserved in many cases, of freshwater organisms, such as *Vivipara* (*V. Waltonii*) and *Ampullaria* (*A. depressa*), and of species which still inhabit the existing waters. The working over or re-formation of the original limestone is thus established beyond a doubt. The same limestone is exposed about a mile further up the river, where a clump of palmettos marks a turn in the stream.

For some distance above and below this point the region may be described as a grass or meadow land, subject to periodical overflows from the numerous tidal channels that intersect it in all directions, and which in a measure disguise the principal stream. Terra firma appears only at intervals, but is then clearly marked by the inevitable growth of palmetto which clothes it. The tall sedges were alive with the busy and ever garrulous grackle or "jackdaw" (*Quiscalus major*), whose familiar notes were poured forth in one almost continuous strain. We observed numerous egrets and snow-herons, and an occasional blue-heron. Where perching room was afforded we were almost sure to meet with one or more individuals of the snake-bird (*Plotus anhinga*), with expanded drying wings, or the dreamy cormorant quietly watching its opportunity. Two raccoons appeared on a mud flat within easy gun-shot of our boat—remarkably enough, if we except a limited number of deer, rabbits and squirrels from the upper Caloosahatchie—the only terrestrial mammals encountered by our party during the entire trip of six weeks.

At about four miles above its mouth the stream emerges from the virgin forest, which extends in an almost unbroken belt to the limits of vision. To one who has never before contemplated the beauties of a southern vegetation it is impossible to convey an idea of the magnificence of this semi-tropical jungle—the endless variety of contrasts that are presented in the vegetable outlines, the luxuriance that is ever manifest, and above all the brilliant greens that peer refreshingly through the outer dense masses of foliage! The eye never tires of following the delicate tracery of the innumerable climbing plants that hang festooned from the arms of some noble forester, or shroud the palmetto in a garden of its own, or of gazing upon the rugged trunks of the live-oak and water-oak that rise above these, and rear their crowns, heavily draped in Spanish moss, against a firmament of deepest blue. Everything was bright and fresh, and it seemed as though a region had been found where neither the chilling blasts of winter nor the parched tongue of summer had as yet been able to penetrate. I observed a marked deficiency of plants in bloom; indeed, as far as my own observations went, all the visible

flowers were confined to a limited number of water or marsh-plants—lily, flag, etc.

At Loenecker's, a short piece beyond the outer border of the woods, is the locality whence Mr. Willcox obtained the nummulites described by me some four years ago as *Nummulites Willcoxi*, the first representatives of the genus that had up to that time been found on the North American continent. The exact spot is a ploughed field, cleared from the bush, about five minutes from the right bank of the river, and elevated, according to a rough estimate made by us, about 4–6 feet above the surface of the water. The rocks containing the fossils occur loose in the soil, and, doubtless, have in great part been thrown up by the plough. No trace of a solid outcrop was anywhere visible. While, therefore, the presumptive evidence is that these rocks have been moved, and are, consequently, no longer in their normal positions, yet it is highly probable that the parent rock is not far distant. Indeed, I am assured by Mr. Willcox that he has observed the "Nummulitic" *in situ* at a locality distant some fifteen miles in a N. E. direction. We found the rock at Loenecker's literally charged with the tests of nummulites and orbitoides, so much so, in fact, as to present the appearance of being built up almost entirely of the hard parts of this lowest group of animal organisms. Many of the larger fragments or boulders, as on John's Island, were encased in a newer matrix of considerably darker color, in which the remains of the recent shells already referred to, and some others—*Mytilus*?—were found embedded in a beautiful state of preservation. To what extent this newer freshwater formation extends, or if it constitutes but a mere strip formed as a fringe to the older (marine) deposits, our means did not permit us to determine. But manifestly, there must have been considerable changes in the topography of the region since the river limestones, of comparatively recent date, were added to, and united with, the marine limestones of the Nummulitic (Oligocene) period.

In company with one of our boatmen I ascended the river for a further distance of about a mile and a-half, in the hope of discovering an outcrop. This we found in a mass of rock jutting out from the bottom of the channel, but barely reaching the surface of the water, and in a number of rounded ledges whose outlines we could distinguish through the limpid waters. With the assistance of a mattock we succeeded in detaching several fragments, but the toughness of the rock, and the difficulty of striking below the water, prevented us from obtaining as many specimens as we should have desired. Much to my surprise the rock contained not a fragment of either of the two forms of Foraminifera which were so abundant at Loenecker's, and so eminently serve to characterize the formation in which they occur. Indeed, the only

fossil impressions were those of two species of bivalves, which, from their imperfect state of preservation, can only doubtfully be referred to *Modiola* and *Cytherea*.

The lateness of the hour prevented any further exploration in this direction, and compelled us to retrace our steps in the direction of the schooner. Evening had now fairly set in, and the exuberance of animal life that everywhere greeted us on our ascent vanished as if forever. A stray flock of herons or ibises might still be seen wending its path in the direction of some secluded heronry, an occasional hawk gracefully circling in its aerial height, but the hushed silence of eventide hung like a pall over the landscape. The numerous turkey-buzzards which earlier in the day hovered like so many spectres over the objects of their special adoration, flitting their shadows, as ethereal clouds, across the emerald wall of the forest, now clung noiselessly to the withered branches of some former pride of the wilderness. Thirty or forty, or even more, of these birds could frequently be counted on a single tree, perched like so many black statues in silent contemplation of the visions of departed day.

Only the waters still gave evidence of unabated animal vitality. The myriads of fish—mullet, skip-jack, etc.—that disported in the tangle of grass which everywhere covered the floor of the river, formed a most interesting picture, and one decidedly refreshing in its novelty. We observed two individuals of the alligator-gar.

ANCLOTE KEYS.—In our anxiety to make the best of our sailing time we grounded on a grass shoal just beyond Anclote, and anchored for the night (18th). Low water early in the morning permitted of a considerable amount of wading, and we had thus a very favorable opportunity presented for studying the zoological features of our anchorage. We found a spinose star-fish (*Echinaster* sp.?) fairly abundant, and secured a number of specimens, but this was the only species of the group observed here. There were no urchins—at least, we failed to detect any if present. We hooked up a number of the bright yellow sponges of the genus *Rhaphyrus* (*R. Griffithsi*), and with our landing-net scooped in a fair supply of one or more species of simple ascidians (*Ascidia ovalis*?). Much of the grass was found coated with the compound masses of a species of *Botryllus*. Among the other forms of animal life taken here were the scallop (*Pecten nucleus*), sea-spider (*Libinia canaliculata*), cow-fish (*Ostracion quadricorné*), zebra-fish (*Chilomycterus geometricus*), and a pipe-fish (*Syngnathus*), besides a considerable number of diminutive molluscan forms (*Columbella*, *Nassa*, *Cerithium*, etc.). The tulip-shell (*Fasciolaria tulipa*) was fairly abundant.

We floated off on high-water, and steered southward to Dunedin.

Here we were informed of the recent finding of mastodon remains at a locality some three miles distant, but, unfortunately, the limited time at our command did not permit us to visit the spot. I followed the coast line for about a mile south of the town, through a dreary sand tract of yellow pine and saw-palmetto, in the hopes of finding an outcrop of rock, but without success. At Clearwater the most elevated point of land on the west coast, the dune, to which reference has already been made in the introduction, makes its appearance, rising to the very modest height of 32 feet. Immediately north of the landing a tough siliceo-calcareous rock juts out from the ocean beach, but the scanty and unsatisfactory condition of its contained organic remains precluded the positive determination of its position in the geological scale, although in all probability a belonging of the Oligocene series.

We grounded again just off the passage of Sand Key, and remained becalmed and anchored for a full day and a half in a somewhat unprofitable position. The sand-beach on the ocean side of the key was literally packed with the shells of *Venus cancellata*, but I failed to observe a single live animal of that species, although undoubtedly an inhabitant of the adjoining waters. Among the living Mollusca, *Strombus pugilis*, *Fasciolaria tulipa*, and *Fulgur perversum* were sufficiently abundant; the last, however, was most numerously represented on the inner side of the key, on the mud-flats, where its egg-capsules or spawn-ribbons, many of them evidently only recently deposited, lay scattered about. Although our attention was centred in that direction, we observed but few individuals in the virtual act of depositing this ribbon, but, doubtless, many others performing the operation escaped our notice. In these instances the animal was in greater part buried in the sand or mud, the spawn-ribbon being anchored by the smaller end to a shell or pebble. On lifting the animal from its cover, the ribbon was almost immediately ejected.

The crown-conch (*Melongena corona*), judging from its abundance, evidently found here a most congenial home among the mud-flats. In shoal water the bottom was covered for acres with two species of sea-anemone (*Cerianthus*), whose habits could be very easily studied through the transparent water. Owing to the depth, a foot or more, to which the animals were immersed in the sand, and the tenacity with which they held on to their anchorages, it was almost impossible to obtain perfect specimens. I observed that the body portion, or external tunic of the animal, was much more sensitive to impacts than the tentacular; thus, if touched on the body, the animal almost instantly withdrew, whereas if the tentacular portion only was touched, there was frequently a decided hesitancy on the part of the animal to withdraw. This was not always the case, however. When once retracted the animal remained in this condition for a considerable period. I noticed, too, that a cloud of

sand or mud precipitated over the animal produced no sensible effect upon its movements. Pelagic forms of life, such as jelly-fishes, were decidedly scanty, and it must be admitted that their absence was a source of no little disappointment. Unfortunately, we were not sufficiently equipped for prosecuting zoological researches by night, otherwise as far as the pelagic fauna is concerned, our efforts at collecting might have been attended with better success. Toward evening we obtained a number of *Idyas* of the form of *Idya roscola*, only colorless, which were retained alive in a basin of sea-water for very nearly two days.

While in our enforced captivity off Sand Key we were much interested in watching the habits of the hundreds of pelicans, cormorants, and gulls that frequented a small sand island or shoal in the middle of the harbor. The pelicans and cormorants seemed to mingle indiscriminately into a single household, but the gulls evidently preferred an independent position of their own, ranging themselves in linear series, lumps of silvery white, like so many sentinels to a flock.

TAMPA AND HILLSBORO BAYS.—We left our anchorage early on the 21st, and the same evening made Point Pinellas, at the entrance to Old Tampa Bay. The passage of Boca Ceiga (John's Pass) was effected without much difficulty, although its direction had to be made from the mast-head. Recourse to the mast-head has frequently to be had in the navigation of Florida waters, owing to the numerous shoals that bar the passages, and the difficulty of their determination from a low level. Even the most experienced pilot will consider himself fortunate if he escapes one or two trials of stranding during a day's journey, and there are probably very few who can claim immunity from the results of what the non-initiated might consider bad sailing.

We dragged in shallow water just after passing the Boca Ceiga, but the dredge brought up little of consequence; the haul consisted almost exclusively of myriads of *Venus cancellata* and *Nassa trivittata*. At our anchorage inside of Point Pinellas we secured a specimen of a beautiful rose *Aurelia*, measuring some seven inches across the disk, the first of our jelly-fish captures; a species of brittle star, *Ophiolepis elegans*, was very abundant, and several individuals could almost invariably be obtained from every bunch of grass that was scooped up by the net. We tried the experiment of night collecting, and obtained a number of forms that would otherwise probably have been lost. The young of an undetermined species of fish, and numerous small crustaceans were especially attracted by the glare of our lamp, and through it we also obtained a specimen of the balloon-fish (*Tetrodon turgidus*), and a half-beak (*Hemirhamphus unifasciatus*), which, in its eager survey of the artificial "moon," skipped over it and landed in our boat.

The shore at this point was strewn with dead fish, more especially with the remains of the cavalle and cow-fish, an index of the disastrous effects of the cold wave that had recently swept over the greater part of the State. It was almost inconceivable that a sudden lowering of the temperature could have had such a marked effect upon the vitality of animals inhabiting the sea, but the proof of such effect was everywhere apparent, and could not be argued round by any amount of logical theorizing. The worst effects were, however, to be noted further down the coast.

At about noon of the next day we made Ballast Point, four-and-a-half miles southwest of Tampa, a spot made famous to geologists and mineralogists through its numerous silicified shell remains, retained in the most exquisite state of preservation, and the coral-chalcedonies that occur in the form of organic geodes. In the yellow limestone that makes the basal outcrop at this locality I immediately recognized the foraminifer which Conrad some forty years previously had described as *Assilina* (*Nummulites*) *Floridana*, and from which the age of this portion of the peninsula had been considered established. Conrad had evidently entirely misinterpreted the nature of his fossil, inasmuch as his drawing represents an imperfect individual, or one in which through an irregular removal of the shell layers, exposing a gradational elevation of the disk, the involution of the whorls is made to assume the form of a spiral, instead of that of a series of concentric rings. The rock here was crowded with the disks of this foraminifer—many of them in the condition figured by Conrad, others perfect—which, as I had already suspected, is no nummulite at all, but a member of the very different genus *Orbitolites*. This is the first record of this somewhat rare genus being found on the North American continent. Among the other fossil impressions I detected those of *Venus penita* and *V. Floridana*, also described by Conrad, and of a number of generic types the specific characters of which were too much obscured to permit of clear definition.

Numerous angular boulders of a tough siliceo-calcareous blue rock, also densely charged with fossils, rest on the yellow limestone above mentioned, but the relative sequence of the two formations could not be determined at this point. Several of the fossil species occurring in this rock appeared also to be contained in the limestone, but the former was distinguished from the latter by the total absence of the foraminifer *Orbitolites* and by the presence of vast numbers of casts and impressions of a species of *Cerithium*. This genus, one of the most abundantly represented and distinctive genera of the Eocene, Oligocene and Miocene formations of Western and Central Europe—indeed, of nearly all regions where the early and middle Tertiary deposits are developed to any extent—had hitherto been known only by stray individuals in this

country, and its absence constituted one of the negative faunal features by which the American Tertiary formations were distinguished from the European. The discovery of a true *Cerithium* rock, therefore, becomes an interesting feature in connection with the geology of this region.

The country about here presents the appearance of an inhospitable sand tract, thinly dotted with pine groves, and covered with a low growth of saw-palmetto (*Sabal serrulata*), the reputed home of the rattlesnake and moccasin. We found a species of prickly-pear (*Opuntia*) in bloom. A short piece above Ballast Point proper, at Newman's Landing, is the outcrop which furnishes the silicified shells and chalcedonized corals to which reference has already been made. Unfortunately, the position of the outcrop is such as not to permit of an absolute correlation with the deposits exposed at the Point, but I feel satisfied that it cannot represent an age very different from that of the yellow limestone, with which it holds several molluscan species in common. Its position is in the Lower Miocene series. The greater number of the species are here imbedded in a marly matrix, from which they can be readily removed by means of a pick or mattock. With few exceptions all the forms are extinct; a limited number of them are found in the nearly equivalent deposits of the island of Santo Domingo. The corals are principally *astræas* and *madrepores*, but of a number of distinct species; as far as could be determined they form a border fringe, the remains possibly of an ancient reef. What led to their hollowing out in the form of geodes, and the manner of the substitution of chalcedony for the carbonate of lime, are problems still awaiting solution; doubtless, heated waters, largely impregnated with silica, were directly involved in the operation, but just why the outer layers of the coral masses should have been preserved, while the inner parts so readily yielded to solution, is not exactly apparent.

The day after our arrival in Tampa, I, in company with our cook, made an examination of the lower Hillsboro, sailing up the river in our skiff for a distance of about five miles. The shores were almost everywhere very low, rarely rising more than five or six, or a dozen, feet above the water, except immediately above the town, where, a short distance from the left bank, there is a somewhat abrupt rise of possibly twenty feet or more. A fairly luxuriant growth of woodland covers both banks for the greater distance, but we found few traces of that primeval forest which at one time, doubtless, graced this region as it still does the region of the Cheeshowiska. Nor did the forest present here the same tropical appearance which it unfolds in the region further to the north; the bay and water-oak still continue as some of its dominating features, but there is a very noticeable deficiency of palmettos, and, in their stead, a marked increase of the coniferous element—yellow pine and swamp cypress.

Not much more than a quarter of a mile above Tampa, and just below the ship-yard, a tough siliceo-calcareous rock, identical with that found at Ballast Point, appears on the left bank immediately on water-level; the same rock is visible on the right bank at a further distance of about a half mile, and reappears again at intervals of three, four and five miles. There can be no doubt that it forms the bed of the stream for this distance. It can be readily identified by its numerous *Cerithium* remains, the same as we found impressed in the rock at Ballast Point. At Magbey's Spring, a short piece above the ship-yard, we found water issuing from a yellow and white limestone, containing numerous fossils; large sink-holes expose the fossiliferous limestone, crowded with shell remains and the *Orbitolites Floridana*, for an extent of some ten feet. Owing to the very limited nature of the exposure I was unable to determine its true dip, but as the locality is distant not more than a few hundred feet from the river, and rises above it some fifteen or twenty feet, there can be no doubt that the rock in question overlies that which appears immediately on the river front, and which, as has already been said, almost positively forms its bed for a distance of several miles. In this section, therefore, we have established the relation existing between the two rocks exposed at Ballast Point. The locality at Magbey's Spring is the only one on the Hillsboro River where we observed the Orbitolite limestone.

During the day's journey my attention was called to an individual of the Florida "mud-puppy," but I was unable to approach the animal sufficiently near to determine whether it was a *Necturus* or not. Turtles were surprisingly abundant, and their splash, when dropping from an overhanging bough, could be heard at frequent intervals around the turns of the stream. Nine individuals, of possibly more than one species, were seen on a single raft, sunning themselves in pleasant ignorance of impending danger. I much regretted not being able to visit the falls of the Hillsboro, about three miles beyond the furthest point reached in our exploration, where the ledge of rock over which the water is precipitated is said to be largely coralliferous, and of the same character as that observed at Ballast Point.

MANATEE RIVER.—We left Tampa toward evening, pushing off with falling tide, and headed for the Manatee River. The dredge was thrown over in the mouth of that stream, and struck on an *Anomia* bank. The dead shells of *Venus cancellata* were brought up in great quantity, together with a number of crabs, a species of *Lima*, and several individuals of the common sea-urchin of this part of the coast, *Toxopneustes variegatus*; depth of water about 12 feet.

It was our intention to explore some of the islands in Terraceia

Bay, where fossil remains were reported to be abundant, but at Braidentown we were informed that a fossiliferous exposure was presented a few miles (5-6) above the town at a locality known as Rocky Bluff, and we accordingly determined to visit that spot. The "bluff" we found to be a ledge of rock, rising about two or three feet above water-level at the time of our visit, and consisting of at least two well-defined layers—a basal white "marl" and yellowish sandstone, and an overlying siliceous conglomerate. The latter is almost entirely deficient in organic remains, whereas the marl is densely charged with them. Among the recognizable forms occurring here I determined a number of well-known and distinctive Miocene species of mollusks, such as *Pecten Jeffersonius*, *P. Madisonius*, *Perna maxillata*, *Venus alveata*, *Arca incongrua*, etc., which left no doubt as to the age of the deposits in which they were imbedded. The existence of a Miocene formation in this portion of the peninsula was entirely unlooked for, and its discovery, therefore, the more significant and interesting. A further exploration of this bed was made on the succeeding day, but without adding much that was new to our stock of information obtained the day previous. The white bed thinned out and disappeared after a short distance, but the yellow sand-rock, largely honeycombed, and containing much fewer fossils, many of them identical with the forms of the marl, continued up the river to the furthest point reached by us. I observed and collected many fragments of manatee bones, ribs principally, but am not prepared to say that any of these were of a fossil character, although their position might have led one to suppose that they had been washed from the bank. Mr. Willcox, however, assures me that he observed several pieces concerning the fossil nature of which there could be no doubt.

In the hope of discovering a more extended outcrop in the interior, and of securing a position whence a general survey of the region could be obtained, I attempted to penetrate the dense growth of palmetto that here descends to the river's bank, but owing to the obstruction presented by the large fan-leaves, and the difficulty of determining landmarks in a tract where the component vegetable elements so greatly resembled one another, was compelled to desist after wandering about three-quarters of a mile. The forest is here evidently largely of second growth, but few of the trees, mainly palmettos, attaining to more than mediocre proportions. Mr. Brock secured two alligators before leaving the river, the larger of which measured about nine feet in length. About a mile above the point where we made our geological examination the river-bank was packed with the remains of dead fish, which were lying heaped up in windrows of tens of thousands of individuals. No such wholesale destruction of the shore-fishes appears to have been known to any of the inhabitants.

SARASOTA BAY.—We were informed that at Hunter's Point, near the northern end of the Bay, we would find a coral rock or formation skirting the shore; I was naturally anxious to determine the accuracy of the statement, inasmuch as no reef formation had been reported from the region so far to the north. The rock in question turned out to be a vast mass of growing *Vermetus* (*V. varians*), which from a short distance actually presented the appearance of a clump of rocks. A limestone of an analogous structure crops out in the meadow a few hundred feet from the shore. The same growth of *Vermetus* reappears at Whittaker's, a few miles further down the bay, where the matted tubes of the gasteropod form organic "boulders" or reefs stretching over acres of territory, one of the most striking features of this part of the coast. A yellow sand-rock, some three or four feet in thickness, appears at this point on the shore margin; its general aspect bears the impress of a recent formation, but I found in it the casts of one or more species of coral of a facies new to me, which, in the absence of other definable organic remains, led me to suspend judgment as to the age of the deposit. The same coral I afterwards identified in a more compact, and much more fossiliferous, limestone occurring on White Beach, Little Sarasota Bay.

On Perico Island, where we landed for the purpose of skinning our alligators, we found vast numbers of the common fiddler-crab of the coast (*Gelasimus pugilator*), which, in apparent concerted action, were hurrying from the sea-border into the interior, passing far beyond the line of their burrows. So numerous were the migrating hordes, that in many places they literally obscured the beach, and the noise of their progression was like that produced by a wind moving a heavy accumulation of autumn leaves. The border of the island was covered with a heavy fringe of mangrove, on whose aerial roots, considerably above water-level, we found the parasitic oyster (*Ostrea parasitica*) clinging in great abundance. The interior of the island supports a stunted growth of saw-palmetto, and the usually accompanying yellow-pine. We found a moccasin coiled on the leaf-stalk of a palmetto, about two feet above the ground—the first ophidian met with on our trip; the animal, although plainly cognizant of our approach, made no attempt to attack, and but a very feeble one to escape, and was consequently secured without much difficulty.

At a locality known as Mrs. Hanson's, opposite to which we anchored for the night, I was conducted to a spot where it had been reported a human skeleton lay embedded in the rock. My misgivings as to such a find were naturally very great, but I could not resist the temptation of satisfying myself personally in the matter, even at the risk of appearing over-credulous to my fellow-companions. The rock I found to be a partially indurated ferruginous sandstone, removed but a short distance from

the sea, and but barely elevated above it; the condition of its exposure was, doubtless, the result of recent sea-wash. I was much surprised to find actually embedded in this rock, and more or less firmly united with it, the skeletal remains of a mammalian, which I had little difficulty in determining to be the genus *Homo*. Most of the parts, including the entire head, had at various times been removed by the curiosity-seekers of the neighborhood, but enough remained to indicate the position occupied by the body in the matrix. The depression which received the head was still very plainly marked, but unfortunately the outline had been too much disturbed to permit of any satisfactory impression being taken from it. I was able to disengage from a confused mass of stone and skeleton two of the vertebræ, which Dr. Leidy has kindly determined for me to be in all probability the last dorsal and first lumbar. The distinctive cancellated structure of bone is still plainly visible, but the bone itself has been completely replaced by limonite.

How great an antiquity these human remains of iron indicate, I am not prepared to say. That they are very ancient there can be no question, considering the nature of their fossilization, and the position which they occupy; but to which exact horizon in the geological scale they are to be referred, still remains an open question. I in vain searched the region for geological landmarks by which the special bed containing the remains could be correlated, but in vain. I could find no trace of any other fossil in the deposit, nor, owing to the low position of the bed, and the absence of overlying deposits of any magnitude, could its homotaxis with reference to the fossiliferous deposits occurring elsewhere on the bay be ascertained. The probability naturally lies with the Post-Pliocene age of the deposit, but for aught we know to the contrary, the age represented might in fact be Tertiary. At all events, as has already been stated, the remains are very ancient, and not impossibly they represent a period as far (if not further) removed from the present one as is indicated by any other human remains that have thus far been discovered.

About three-quarters of a mile below Mrs. Hanson's a compact terrestrial sand-rock, containing numerous individuals of several common forms of recent snail (*Polygyra volvoxis*, etc.), and evidently representing a modern formation, is exposed at water-level, extending for some little distance up the channels that have been left by the retreating waters. The presence of this hard rock of terrestrial origin on the immediate ocean front, and in the very path of existing waters, coupled with the circumstance of the complete absence of associated marine forms of life, renders it more than probable that this portion of the coast has quite recently been undergoing subsidence. It is true that the encroaches of the sea might be attributed to a simple washing away of the coast line, but this hardly appears probable in view of the resisting nature of the

rock, and the fact that it rests horizontally and shelves for some distance, at least, under the sea.

From this point Captain Strobhar and I made a diversion in favor of Philippi's Creek, a tributary of the bay. We found plenty of water in the stream itself, but the approaches to it, owing to the widening out of the channel, were very shallow, and for a considerable distance our skiff had to be dragged over the bottom. The difficulties of the passage were further increased by the numerous islands, largely overgrown with mangrove, which interpose themselves in the mouth of the creek, rendering the channel very intricate. Almost at the mouth of the stream, and at several points above the mouth, we found a true compact coquina rock, some three to four feet in thickness, the first time, I believe, that such a rock had been noted to occur on the west coast of the peninsula. The shell fragments composing it were largely triturated, and in most instances not even the genera of mollusks represented by them could be identified. Underneath this rock, where present, there crops out a yellow arenaceous limestone, which is exposed at various points along the stream, rising about two feet above water-level. It contains coral impressions and numerous shells, many of the latter apparently identical with forms found in the yellow rock of the Manatee River (*Pecten Jeffersonius*, etc.), and representing either a Miocene or early Pliocene formation, more likely the former. I found at one spot, evidently washed out from the bank, a large fragment of the jaw of a cetacean. Philippi's Creek is reported to harbor numerous alligators, but on our trip both up and down the stream we saw but a single individual, and that a young animal. The weather was not very warm, and possibly the reptiles may have kept beneath the surface.

A water-way through the mangroves conducts from Big Sarasota Bay to Little Sarasota Bay, and may be used with much advantage by small craft. Owing to the chances of stranding we were compelled to take the outside route, and thus to pass the bars at both inlets. A considerable surf was rolling at the time we entered Little Sarasota Inlet just before sun-down, but we succeeded in making the point, and anchored under the lee of the bar of sand that separates the inlet from the sea, in one of the most picturesque spots that we had thus far seen in our journey.

The rock guarding the entrance to the channel on the north side is a coquina, very similar to that found on Philippi's Creek. It is rapidly undergoing destruction through the wash of the sea, and will, doubtless, in a very short time be completely removed. In color it differs essentially from the typical coquina of the east coast, which is very light, or nearly white, whereas this one is by contrast rather dark.

On White Beach, on the inner side of the bay, we again found large

quantities of dead fish strewn over the shore. The same burden rested on the long line of oyster reef which extends not very far from this point into the bay, where thousands upon thousands of carcasses were heaped up in continuous banks, upon which the gorged turkey-buzzards were lazily attempting to recover from their revels. The air was actually foul with the odor of decomposition. A reef rock, of Miocene or early Pliocene age, I was unable to determine which, with numerous impressions or casts of corals, some of them identical with the forms found at Whittaker's, juts out on White Beach, where it has been largely honey-combed through the wash of the water, and in places is rendered soft and friable; in other spots, again, it is tough and very resisting. Among the numerous molluscan remains there were few that were retained in anything like a perfect state of preservation, and scarcely one that permitted of specific determination. Indeed, I only indicate with doubt the occurrence of *Pecten Jeffersonius*, *P. Madisonius*, and *Venus alveata*. In a somewhat different rock, but without doubt belonging to the same series, we found abundant casts of a large oyster, not unlikely *Ostrea Virginica*, associated with similar remains of the clam (*Venus Mortoni*?), cockle (*Cardium magnum*?) and a *Perna*. A small stream empties into the bay near this point, exposing heavy beds of rock on either bank to a thickness of some eight to ten, or twelve feet. I found a few casts of gasteropods in these deposits, and a few fragments of scallops, apparently *Pecten Madisonius*, but the fossils were not numerous, and barely determinable. The difficulty of wading in the stream, too, prevented me from penetrating very far. A short distance from this point we were conducted to a locality where the carapace of a large fossil turtle, measuring nearly three feet across, was embedded in the roadway, of which it formed a part. The time-honored passage of vehicles over it had completely crushed the carapace, breaking in the top, but the outline was still clearly defined in its entire circumference. I secured two large fragments, from which I had hoped to determine the specimen on my return, but, unfortunately, they were left behind at one of our packing stations.

Mr. Brock, who, in company with the cook, had during the absence of the remainder of the party explored a portion of North Creek, another tributary of the bay, reported the existence of a highly fossiliferous stratum exposed on the banks of that stream at an elevation of some ten to twelve feet. This stratum, which is underlaid by a white friable limestone, was traced for a distance of about three-quarters of a mile, but it is said to extend very much further. It is much to be regretted that want of time did not permit us to make a more extended exploration of this very interesting locality, and to definitely determine the different ages of the deposits occurring here. The shell bed is either Pliocene or Post-Pliocene, but the very limited number of fossils that were brought to me

for determination, among which I recognized the giant *Fasciolaria gigantea*, pear-conch (*Fulgur perversus*), and clam (*Venus mercenaria?*), did not permit me to settle the question. I strongly incline to the Pliocene age of the deposit, inasmuch as we subsequently found the same fossils occupying a nearly similar position along the upper Caloosahatchie, and in a stratum whose Pliocene age was placed beyond question. Still, from this correspondence alone, I should not like to pronounce too positively on the matter of correlation.

From Little Sarasota Inlet to Casey's Pass the ocean front is made up of a vast shell bank, three to five feet or more in thickness—a non-indurated coquina, if so it might be termed—which at the time of our visit was being rapidly destroyed through the action of the surf. The beach was strewn with dead shells, among which I in vain searched for a living specimen. We dragged in twenty feet of water, but the dredge struck on an unproductive shell-bottom, and brought principally fragments to the surface. The dredge was again thrown over just beyond Casey's Pass, bringing up fragments of arenaceous and serpuloid rock, besides numerous dead shells, principally of the genera *Arca*, *Cardita*, and *Venus*, the greater number of which were stained pink through some peculiar process of ferric oxydation. We also obtained several branches of an *Oculina*, still retaining much of the colored animal substance or cœnosarc, which would go far toward confirming the assertion of our captain that a submerged coral reef exists opposite this point at a distance of a few miles from the coast. None of the coral-polyps were visible in the mass. We dragged again off Stump's Pass, in water of 10–15 feet, and obtained among other things a beautiful assortment of the large sand star-fish, *Luidia clathrata*.

LITTLE AND BIG GASPARILLA INLETS.—We made Little Gasparilla Inlet on the afternoon of Feb. 24th, anchoring for the night. This is considered to be one of the best collecting grounds on the coast, and our explorations on the following morning fully confirmed this impression, at least so far as our own personal experiences would permit us to form a judgment. The numerous shoals and grass flats, protected and exposed bayous or inlets, afford an almost endless variety of retreats to the different animal forms that abound here, and serve in great measure to circumscribe the individual habitats. Thus, one spot would be largely relegated to a species of *Cerithium* (*C. muscarum*), another to a second species of the same genus (*C. ferrugineum*), and a third to an association of both these forms. In one of the inlets I found large quantities of the green shells of *Fasciolaria tulipa* inhabited by the *Clibanarius vittatus*, the combined colony, as if with a common impulse, moving in one given direction. The correspondence existing between the color-tints of the hermit and that of its

protecting shell was very remarkable, but whether this correspondence was in the present instance merely accidental or as the result of selection, I am not prepared to say. That a unity of color between the shell and the crab would in a measure tend to conceal the latter from general observation and thus secure for it a partial protection from its enemies, is undeniably true; but it may be questioned whether the peculiar tints of the animal were not, in this special instance, a development depending upon the general surroundings—the grassy bottom, etc.—rather than a relation holding with the shell, the choice and subsequent habitation of which may have been purely fortuitous circumstances.

The *Vermetus* "reef" was here again largely developed, forming a prominent fringe along the shore margin. I picked up two stranded jelly-fishes, of the genus *Cyanea*, which had evidently only quite recently been washed on the beach; the disk of the larger individual measured 22 inches in diameter. Both specimens were kept on deck of our schooner for four days, with the object of drying and ultimate preservation; but at the end of that time, owing to an unfortunate accident, which resulted in their partial destruction, and the steadily growing odor of decomposition, I reluctantly heaved them overboard. The elimination of water had been very rapid during the period of desiccation, and in a short time, doubtless, but for the accident, both disks, beautifully exhibiting all the lines of structure, would have been ready for final preservation.

The bottom of the inlet was in places covered with a species of sea-anemone, one of the forms occurring off Sand Key, in Clearwater Bay, and also with the common sea-urchin (*Toxopneustes variegatus*). The latter had in nearly all cases covered itself with a dome of gravel and broken shell—in imitation of the general character of the bottom—which was supported on the extremities of the ambulacral feet, and served to conceal the animal from view. Mr. Willcox had on a previous occasion called attention to this remarkable habit on the part of the urchin, but he seems not to have fully recognized the importance of the deception played by it as a factor in its own defense. So complete was this deception that I must have wandered probably over a full acre of urchin-ground before I was made aware of the presence of these animals; indeed, were it not for accidentally stumbling over one of the hillocks, thereby exposing the animal beneath, I might to the present time have been left in ignorance of their existence there. To positively test the nature of this covering of broken shell I partially filled my collecting bucket with shell fragments, and placed in it a number of the urchins stripped of their covering. With wonderful rapidity the frightened creatures bored their way into the mass of debris, and appeared almost immediately with a large accumulation of shell fragments centred on their ambulacral tips. There could be no doubt, whatever, as to at

least one of the uses of this, to some persons purely "ornamental," armor. The shell fragments I found supported indiscriminately by both their convex and concave surfaces.

Mr. Willcox and the cook were very fortunate in securing with the dip-net some half-dozen specimens of a large spotted *Aplysia* or sea-hare, which appears to be new to science. The largest individual measured about eight inches in length, and full five inches in width. The color of the mantle was sea-green, tinged with purple, with large irregular blotches of lighter color, and numerous white, or at least very light, spots of about the dimensions of the cross-section of a slate-pencil. The nearest ally of this animal appears to be the *Aplysia depilans* (*leporina*) of the Mediterranean, from which, however, the species differs in many essential particulars. I would propose for the new form the name of *Aplysia Willcoxi*. When placed in a bucket of water, especially when irritated, the animal emitted a magnificent purple-crimson fluid, which almost instantly clouded everything in the vessel. Two other species of *Aplysia*-forms belonging to the genus *Notarchus* were found at the same locality, one of which appears to be identical with the West Indian *N. Pleii*; the other closely resembles the eastern *N. Savignana*, and may be identical with that species. A dozen or more of the individuals were collected, and placed in our alcohol vessels, the strength of the alcohol in which they were immersed being gradually raised from below 50 per cent. to about 80 per cent. The animals were evidently caught on their feeding-grounds, a grass shoal rising to within about three feet of the water-surface. On our return to this spot, toward the close of our journey, a large individual of the *Aplysia Willcoxi* was observed slowly floating out to sea, propulsion on the surface of the water being effected or assisted through a measured movement of the folds of the mantle.

We found a small sand-fly very abundant at this locality, which annoyed us considerably when on land, the first time that any annoyance was experienced from insect pests. So deficient, indeed, did the entire region thus far traversed appear in insect life that one might almost have concluded that the members of this group were either entirely wanting or but accidentally represented. Travelers who, at this season of the year, expect to meet with a gorgeous entomological display, rivaling what has so frequently been described as a heritage of the tropics, will naturally be disappointed, as will also the botanist, who, in anticipation of the facts of nature, expects to revel in a bed of flowers. It is a mistake to suppose that there are here no true seasons of animal and vegetable life. Hibernation, or retardation of growth as dependent upon seasonal conditions, is probably nearly as well marked in Florida as it is in most of the region situated to the far north, and I have no doubt that the

apparent absence of insect life is in reality only a reflection of this period of quiescence.

We dragged off Big Gasparilla and again off Boca Grande, but both times over unproductive grass-bottom.

CHARLOTTE HARBOR.—In the grass bottom off Uzeppa Island, where our schooner anchored for the night, we found numerous single tunicates and a few large clusters of a brilliantly colored branching red-sponge; otherwise there was a marked deficiency in the variety, no less than in the numerical development, of animal life at this place. We dragged opposite the northern extremity of Sanibel Island alternately over a shell and grass-bottom, but the dredge added little of consequence to our collections. An extensive shell-beach faces the ocean front on Sanibel Island opposite to Blind Pass, but at the time of our visit it was strewn almost entirely with dead and water-worn shells; living specimens of the shuttlecock shell (*Pinna muricata*), were, however, very abundant.

We ran aground on a grass shoal just before reaching Punta Rassa, but soon righted, and put into harbor not long after sundown. For hours during this day's journey our vessel was followed by a number of drum-fish, which appear to have hung close to the keel, and whose diabolical serenade was continued from early in the afternoon almost through the night. The different individuals, judged by their "booms," must have retained their relative positions almost without change.