THE CRYSTAL RIVER FORMATION (EOCENE) AT MARTIN, MARION COUNTY, FLORIDA

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ABSTRACT

Although several paleontologists have mistakenly said that Martin Station is located in Hernando County, Dall clearly stated that it was a railway station at Martin, Marion County, Florida, which is about ten miles north of Ocala. The importance of this place is that it is the type locality for *Turritella martinensis* Dall, which MacNeil and others have used as a zone fossil for lower Oligocene strata in Mississippi, Alabama, and Florida.

The authors suggest that the strata at Martin are Eocene in age. There appears to be no Oligocene beds in the immediate vicinity of Martin. We believe that the Eocene-Oligocene boundary in Florida should be placed between Puri's *Asterocyclina-Spirulaea vernoni* zone and his *Lepidocyclina chaperi* zone.

INTRODUCTION AND DESCRIPTION OF THE LOCALITY

Some of the earliest fossil collecting done by the United States Geological Survey in Florida was in the vicinity of Gainesville and Ocala, in Alachua and Marion Counties respectively. These fossils were later described by Dall (1890-1903) in *Contributions to the Tertiary fauna of Florida.* One of the important localities whence Eocene invertebrate fossils were collected was a place referred to by Dall as "Martin Station." Under the heading, *The Ocala Limestone, or Nummulitic Rock of Heilprin,* Dall (1903, p. 1556) clearly stated where this place was located: "The fauna of the limestone appears to be the same as that of a much silicified country rock quarried at Martin, a railway station about ten miles north of Ocala in Marion County." The location of Martin Station is shown in Figure 1. Despite this statement, Schuchert *et al.* (1905), refer to the Martin Station locality as being in Hernando County, Florida, for *Turritella indenta* var. *martinensis* Dall (p. 677) and for *Cerithium ocalanum* Dall (p. 140). Apparently this error arose from the fact that labels with the specimens from Martin Station in the National Museum of Natural History read Hernando County rather than Marion County. Druid Wilson (personal communication) said that it seems improbable that any of the material listed by Dall came from Hernando County. Both Bowles (1939, p. 283) and MacNeil (1944, p. 1317, and 1946, p. 48) accepted the type locality of *Turritella indenta* var. *martinensis* as being in Hernando County because they were misled by the erroneous locality data on the labels. Other paleontologists, *e.g.* Palmer and Brann (1966, p. 933 and p. 880), have also cited the Martin Station locality as being in Hernando County for *Turritella indenta* var. *martinensis* and *Cerithium ocalanum* respectively, but these authors may have taken this error from the literature. There are undoubtedly other paleontologists who have perpetuated this error in print, but we have not attempted to ferret out additional references.

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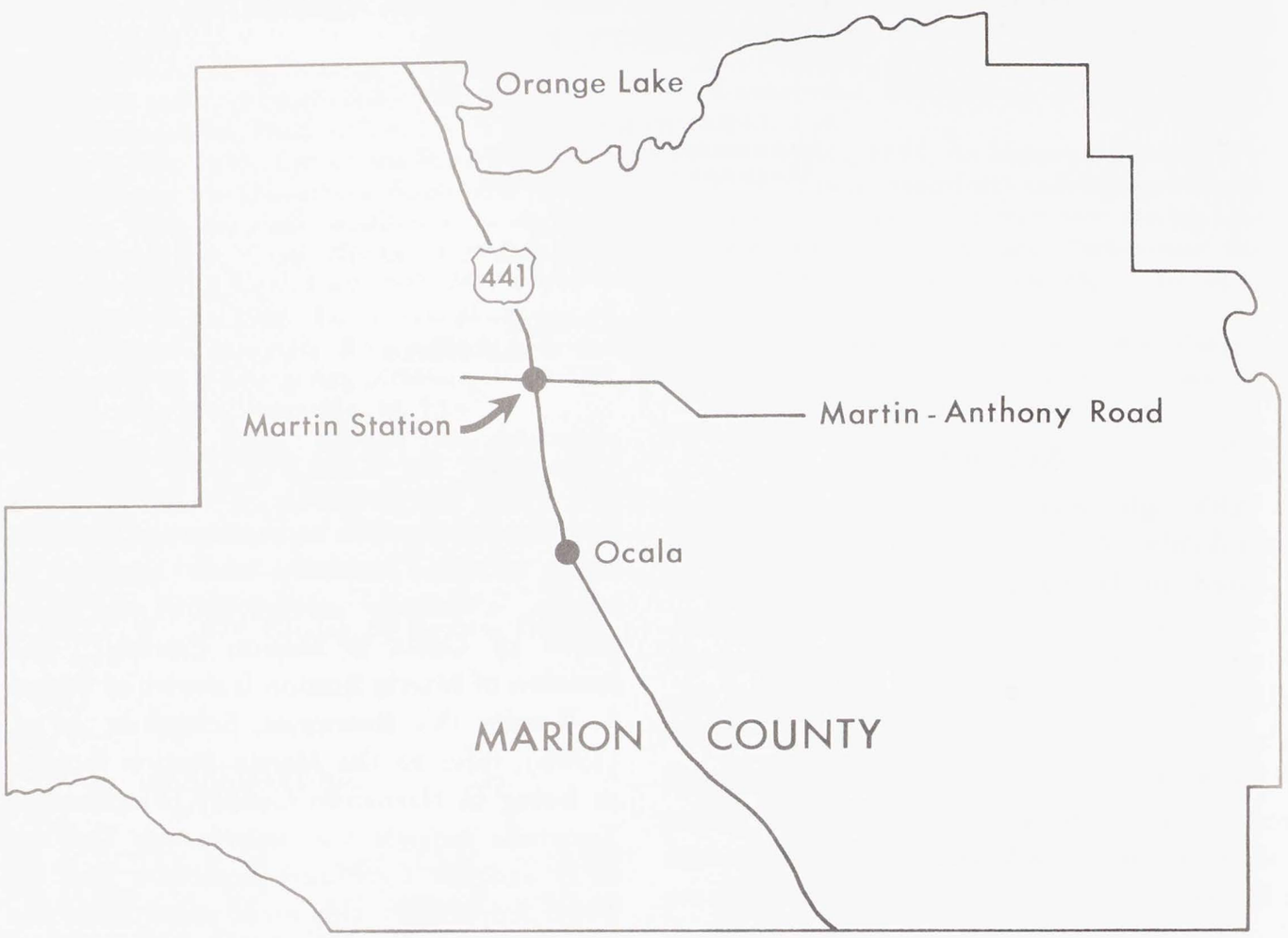

Figure 1. Map of Marion County, Florida, showing the location of Martin Station.

Dall's *Turritella indenta* var. *martinensis* is now called *Turritella martinensis* in the more recent paleontologic and stratigraphic literature except that of Allison and Adegoke (1969, p. 1263), who believe that the species *martinensis* should more properly be allocated to the genus *Torcula* Gray, 1847. However, for the purpose of this paper, we will refer to this species as *Turritella martinensis* because stratigraphers have used it as a zone fossil and have consistently so called it. *Cerithium ocalanum* Dall is classified as *Rhinoclavis (Ochetoclava) ocalana* by Palmer and Brann (1966, p. 880).

The fossils described by Dall from Martin Station are in a brown to greyish-brown chert, and most of them are well preserved and easily identifiable. The chert was quarried, crushed, and used principally for railroad ballast. There are still some chert boulders in an elongate depression east of the railroad tracks near where the railroad station at Martin was formerly located. One of the commonest fossils found in these boulders is a small species of turritellid, which agrees in morphological characteristics with Dall's brief description of *Turritella martinensis* (1892, p. 308-309); a specimen is shown in Figure 2. In some of the boulders *Amusium ocalanum* Dall is abundant (Figure 3). A small species of *Glycymeris* and a small solitary coral were also seen.

The elevation at Martin is about 80 feet, but hills nearby are more than 160 feet above sea level. Above the Crystal River Formation of the Ocala Group is, in places, a richly fossiliferous marine limestone that ranges in thickness from about two to 15 feet. This bed also contains several species of terrestrial gastropods. Cooke (1945, p. 114, 129-130) referred these patches or outliers of limestone to the Tampa Limestone, which is the St. Marks Formation of Puri and Vernon (1964, p. 117). However, Puri (1957, p. 72) questionably called this lime-

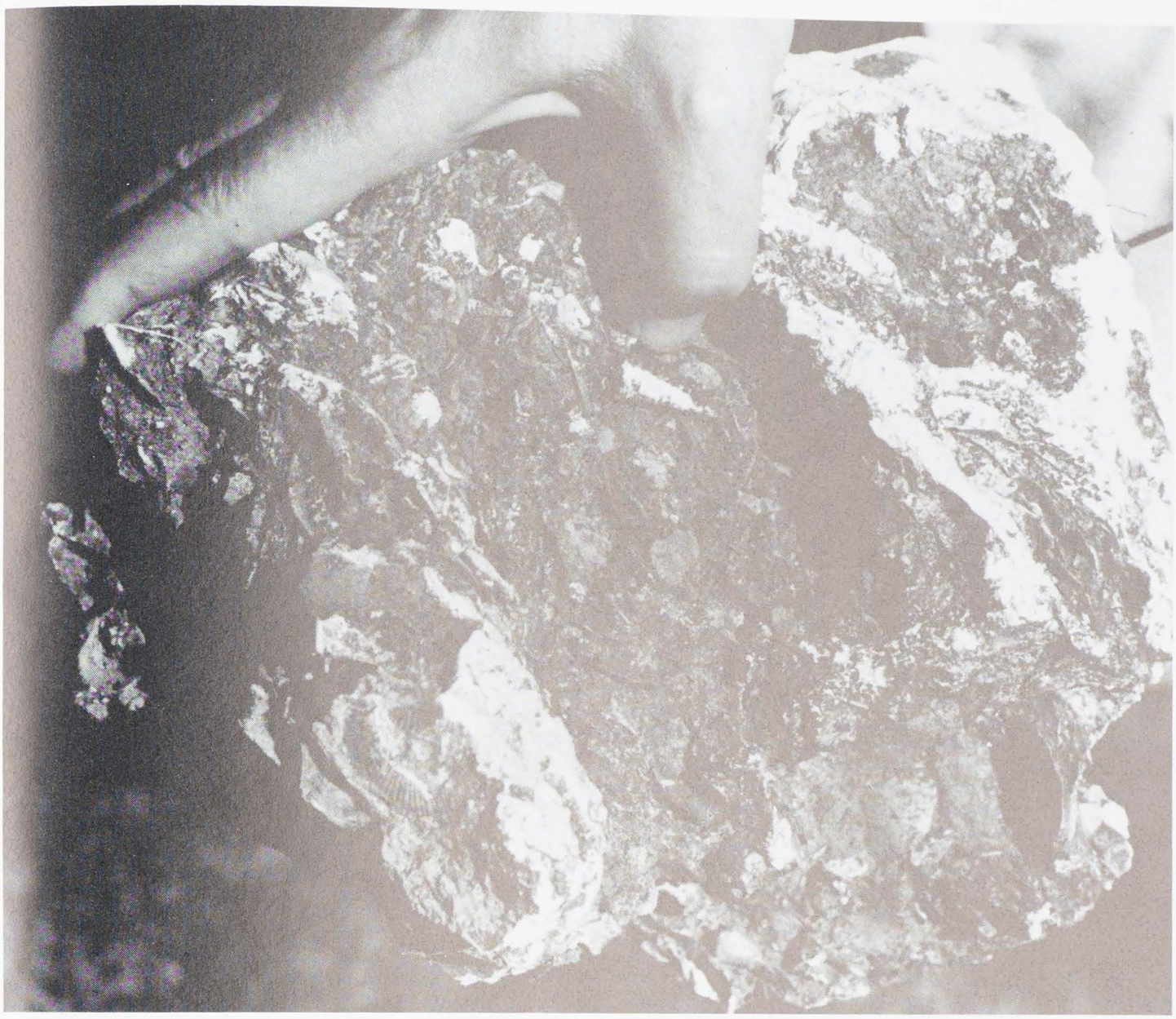

Figure 2. A chert boulder from Martin Station containing a specimen of *Turritella martinensis.*

stone the Hawthorne Formation, and Wilson *in* Espenshade and Spencer (1963, p. 18-19, 25, and Table 10) also placed it in the Hawthorne. In any event, all of the paleontologists who have studied the fauna of this limestone have considered it to be early Miocene in age.

On some of the higher hills in this region, as much as 40 feet of unquestionable Hawthorne Formation crops out. Brooks *et al.* (1967, p. 25-27) described a section from 2.6 miles east of Martin where the Martin-Anthony road crosses U.S. Highway 301.

The chert in the Crystal River Formation has replaced the original limestone that was dissolved by ground water. The source of the silica must have been mainly the clay minerals in the Hawthorne Formation. The Hawthorne Formation is found on the hills in this area as outliers, but this formation has been eroded away at places like Martin, where the elevation is only 80 feet above sea level. The chert is not an indicator of the age of the beds because chert has replaced limestone in several of the upper zones of the Crystal River Formation in Marion and Alachua Counties.

THE AGE OF THE BEDS AT MARTIN STATION

In the list of species from Martin Station, Dall (1903, p. 1557-1558) claimed that 14 of them are also found in the Ocala Limestone, eight also from the Vicksburg, and six also from the Silex Beds (Tampa Limestone). Druid Wilson (personal communication) told the senior author that some of the fossils collected at Martin Station indicate

Figure 3. A chert boulder from Martin Station showing part of a specimen of *Amusium ocalanum.*

Vicksburgian affinities. It is worth noting, in this regard, a statement made by Cheetham (1963, p. 10) concerning his bryozoan zones in the Jacksonian. "The upper zone of the Jacksonian, the *Floridina antiqua* zone, includes not only the greatest diversity of cheilostome bryozoans (85 species) but also the largest percentage of species peculiar to a zone of the Jacksonian (39 per cent). The zone is characterized by commingling of species restricted to the Jacksonian and species of Oligocene aspect. The bulk of the assemblage, 58 species, has Jacksonian affiliation; only six species whose first appearance occur in this zone continue into overlying deposits. The *Floridina antiqua* zone occupies approximately the same stratigraphic interval as the *Nummulites vanderstoki-Hemicythere* and *Asterocyclina-Spirolaea [sic] veroni* zones of Puri and the *Textularia hockleyensis* zone of Stuckey." For a comparison of Cheetham's (1963) and Puri's (1957) zonations of the Ocala Group, see Figure 4.

The abundance of *Amusium ocalanum* in the fauna from Martin Station is an excellent indicator that the highest zone in the Ocala Group from which these fossils probably come is Puri's *Nummulites vanderstoki-Hemicythere* zone because *Amusium ocalanum* is either exceedingly rare or absent above this zone in peninsular Florida (McCullough, 1969, p. 10). Furthermore, none of the characteristic zone fossils of the next overlying zone, the *Asterocyclina-Spirulaea vernoni* zone, were found in the Martin Station fauna. Some of the diagnostic fossils for this latter zone are *Spirulaea*

OCALA GROUP FAUNAL ZONES

				PURI	CHEETHAM
UPPER EOCENE	JACKSON STAGE	OCALA GROUP	CRYSTAL RIVER	Lepidocyclina chaperi	Spondylus dumosus
				Asterocyclina - Spirulaea vernoni	Floridina antiqua
				Nummulites vanderstoki - Hemicythere	
				Lepidocyclina - Pseudophragmina	Tubucellaria nodifera
				Spiroloculina newberryensis	
			WILLISTON	Operculinoides moodybranchensis	Periarchus lyelli
				Operculinoides jac onensis	
			INGLIS	Periarchus lyelli floridanus - Plectofrondicularia? inglisian	

Figure 4. A comparison of Puri's and Cheetham's zonation of the Ocala Group. The writers consider Puri's *Lepidocyclina chaperi* zone and Cheetham's *Spondylus dumosus* zone to be Oligocene.

vernoni Richards, *Chlamys (Lyropecten) incertae* Tucker-Rowland, *Chione* sp., and *Wythella eldridgei* (Twitchell). *Asterocyclina* is rare in peninsular Florida and is not a useful marker for this zone.

Excluding Puri's highest zone of the Ocala Group, the *Lepidocyclina chaperi* zone, which appears to be absent in at least the northern half of the Ocala Uplift, the two most distinct megafossil changes within the Ocala Group are between the *Periarchus lyelli floridanus-Plectofrondicularia? inglisiana* zone and the *Operculinoides jacksonensis* zone, which separate the Inglis and Williston Formations; and between the *Nummulites vanderstoki-Hemicythere* zone and the *Asterocyclina-Spirulaea vernoni* zone. The *Asterocyclina-Spirulaea vernoni* zone has such a distinctive assemblage of megafossils that its presence would be difficult to overlook and we did not see this zone in any outcrops nearest to Martin.

Puri (1957, pl. 3) indicated in an isometric projection of the Ocala Group that the highest zone found in the vicinity of Martin is the *Lepidocyclina-Pseudophragmina* zone, which is immediately below the *Nummulites vanderstoki-Hemicythere* zone, as shown in Figure 4.

We examined the limestone at two quarries; one 0.8 of a mile south of Martin, the other 2.0 miles north of Martin. At these places the highest zone seen was either the lower part of the *Nummulites vanderstoki-Hemicythere* zone or the upper part of the *Lepidocyclina-Pseudophragmina* zone. There appears to be no strata of Oligocene age in the immediate vicinity of Martin. We have come to the conclusion that there is probably a structural high in the Ocala Uplift in the area of Martin Station, which extends eastward to Anthony, Sparr, and Citra.

A problem has arisen because MacNeil has used *Turritella martinensis* (1944, p. 1317, footnote, and 1946, p. 48-49, 55) as a zone fossil for lower Oligocene strata in Mississippi, Alabama, and Florida. In 1944, MacNeil claimed that this species is abundant in the upper part of the Forest Hill Sand of Mississippi. In 1946 (p. 55) he correlated his *Turritella martinensis* zone with the Marianna Limestone of Florida and Mississippi and the

Mint Spring Marl Member in Mississippi. These stratigraphic units were placed in the lower Vicksburg Group in his restricted use of the Vicksburg (1944) and were not considered to be the lowest Oligocene by him because he placed the Forest Hill Sand and the Red Bluff Clay of Mississippi at the base of the Oligocene, considering these lithologic units to be equivalent to the *Lepidocyclina fragilis* zone=*Lepidocyclina chaperi* zone of Florida.

MacNeil (1946, p. 48) stated that *Turritella martinensis* occurs abundantly in a large quarry about five miles southeast of Crystal River in Citrus County (very likely the type locality of the Crystal River Formation) and at water level on the Suwannee River at Ellaville, which is the type locality of the Suwannee Limestone. At the latter locality MacNeil noted that the bed at water level had been variously referred to the Byram and the Ocala Formations. Hunter (1972, p. 21, *in* Banks, Reves, and Hunter) stated that the lower beds at Ellaville are Bumpnose Limestone, which she placed in the Red Bluff Stage. Randazzo (1972, p. 333) stated that the lower part of the section at Ellaville is suspected as being Eocene Crystal River Formation. Downstream from Ellaville about ten miles, in a large quarry west of Dowling Park in Lafayette County, Hoganson (1972, p. 32) found as much as ten feet of the *Asterocyclina-Spirulaea vernoni* zone overlain by the Suwannee Limestone. It is most likely that the bed at water level at Ellaville is the *Asterocyclina-Spirulaea vernoni* zone of the Crystal River Formation, but this has not as yet been proved. MacNeil said that this bed has a Mint Spring molluscan fauna. MacNeil (1946, p. 49) redefined the Suwannee Limestone so as to include the *Turritella martinensis* zone as a lower member of this formation in northern and peninsular Florida.

Hunter (1972, p. 21, *in* Banks, Reves, and Hunter) considered *Turritella martinensis* a marker for the Bumpnose Limestone, which she and many other stratigraphers believe to be the oldest Oligocene rocks in Florida. Allison and Adegoke (1969, p. 1263) have quoted a statement from Druid Wilson that, "apparently a thin bed of silicified Oligocene limestone occurs rather widely above the 'Ocala' Eocene. At some places north of Ocala, silicified Oligocene and Eocene fossils are mixed together and lie upon the eroded top of the Eocene. *Turritella martinensis* apparently came from the Oligocene." Mainly on the basis of these assertions and some fossil identifications by Wilson from Martin Station or nearby, Allison and Adegoke came to the conclusion that *Torcula martinensis martinensis=(Turritella martinensis)* is an Oligocene species and possibly restricted to early Oligocene. However, Adegoke in this same publication, described *Torcula martinensis henkeri* from the Department of Bolivar, Colombia, in strata he considered middle to late Eocene in age.

Although *Turritella martinensis* may be a useful index fossil for lower Oligocene strata in Mississippi, Alabama, and Florida, it has led to the belief that some beds in Florida are Oligocene in age when they are actually late Eocene in age. At Martin Station, the type locality of *Turritella martinensis,* this species ranges downward into at least the *Nummulites vanderstoki-Hemicythere* zone and possibly into the *Lepidocyclina-Pseudophragmina* zone, both of which are considered to be Eocene in age. In silicified boulders in Alachua County, *Turritella martinensis* has been found with *Spirulaea vernoni,* a zone fossil for the *Asterocyclina-Spirulaea vernoni* zone (Williams, 1974, p. 65).

THE EOCENE-OLIGOCENE BOUNDARY IN FLORIDA

There is not complete agreement as to where in the stratigraphic section in Florida the Eocene-Oligocene boundary should be placed. Moore (1955, p. 19) placed his Bumpnose Limestone at the top of the Eocene. This is the equivalent of Puri's *Lepidocyclina chaperi* zone, and Puri (1957, p. 5, 34) and Puri and Vernon (1964, p. 43, 58) followed Moore in this regard. MacNeil (1944, fig. 1, p. 1315; 1946, p. 55; 1966, p. 3252) and Cheetham (1963, p. 7) placed the Bumpnose Limestone at the base of the Oligocene, as did Huddlestun and Toulmin (1965, p. 159), Toulmin (1969, p. 475), and Hunter (1972, p. 14, *in* Banks, Reves, and Hunter). Cheetham (1963, p. 10) stated his reason for placing the *Lepidocyclina chaperi*

zone at the base of the Oligocene: "Cheilostome bryozoans in the uppermost part of the Ocala Group, in the 'Shubuta' Clay, and in the Red Bluff Marl are more closely akin to those of the Vicksburgian (Oligocene) than to those of the Jacksonian. Therefore, these deposits have been referred to an Oligocene biostratigraphic unit, the *Spondylus dumosus* zone (Cheetham, 1957). Only 51 per cent of the 39 species of cheilostomes in this zone are known to occur in underlying deposits, whereas 87 per cent have been recorded in overlying beds (App. 2). The contact between the *Floridina antiqua* and *Spondylus dumosus* zones is apparently the major faunal discontinuity in Eocene-Oligocene deposits in the eastern Gulf Coast region. The *Spondylus dumosus* zone occupies the same interval as the *Lepidocyclina chaperi* zone defined by Puri. However, Puri has not recognized this zone in the Florida peninsula."

Beginning with the *Nummulites vanderstoki-Hemicythere* zone, some of the prominent Tethyan elements become rare or disappear, as for example *Exputens ocalensis* (MacNeil) and *Gisortia harrisi* Palmer. At the top of this zone, *Amusium ocalanum* disappears from peninsular Florida. *Turritella martinensis* either appears in this zone or possibly in an even lower zone, the *Lepidocyclina-Pseudophragmina* zone. In the *Asterocyclina-Spirulaea vernoni* zone, the Oligocene elements of the fauna become much more prominent and numerous. *Chlamys (Lyropecten) incertae* Tucker-Rowland appears, and this large-ribbed pectinid species resembles *Chlamys (Aequipecten?) flintensis* Mansfield (1937, pl. 14, figs. 1, 3), but it is considerably smaller than this latter species. *Chlamys (Lyropecten) incertae* resembles some other Oligocene species of pectinids but not any other pectinid species found in older Ocala strata. A probably unnamed species of *Chione,* which Palmer (1927) and Davies (1971) do not record in beds as old as Eocene, becomes abundant in the *Asterocyclina-Spirulaea vernoni* zone, and also a species of *Glycymeris* with split ribs that closely resembles *Glycymeris lamyi tampae* Mansfield (1937, pl. 10, figs. 4, 6-7). The presence of the echinoid genus *Phyllacanthus,* which Davies (1971) does not report from beds older than Oligocene, is another indicator that the *Asterocyclina-Spirulaea vernoni* zone may be Oligocene rather than Eocene. Furthermore, Puri (1957, p. 119), reporting the foraminiferid *Bitulogenerina vicksburgensis* Howe as commonly occurring in the *Asterocyclina-Spirulaea vernoni* zone, stated that previous occurrences of this species have been from the Oligocene, and that this species is considered to be a good marker for the Vicksburg.

Should the Eocene-Oligocene boundary be drawn below the *Asterocyclina-Spirulaea vernoni* zone in Florida? The presence of a species of *Chione,* the split-ribbed species of *Glycymeris, Phyllacanthus,* and some other groups that resemble Oligocene or even early Miocene relatives, might favor this action. However, when various groups of animals are traced carefully back in time, we frequently find that their first occurrence is in strata older than previously supposed.

On the other hand, the presence of the following genera and subgenera: *Asterocyclina, Hantkenina, Cribrogloborotalia, Pseudophragmina (Proporocyclina),* among the foraminiferids; the annelid worm *Spirulaea;* the echinoid genera *Wythella, Weisbordella, Eurhodia, Phymosoma;* that are either restricted to, or have not as yet been found in strata younger than the Eocene, point to an Eocene age for the *Asterocyclina-Spirulaea vernoni* zone. The generic and subgeneric ranges were taken from Davies (1971) Durham (1966) and Loeblich and Tappan (1964).

We believe that the evidence from the local fossil record indicates that the Eocene-Oligocene boundary in Florida should be drawn between the *Asterocyclina-Spirulaea vernoni* zone and the *Lepidocyclina chaperi* zone. This would place the Eocene-Oligocene boundary at the top of the Crystal River Formation, with the Bumpnose Limestone at the base of the Oligocene section.

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