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The Paleontology and Paleoecology of the Biostrome Fauna of the Edwards Formation of Texas

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THE PALEONTOLOGY AND PALEOECOLOGY OF THE BIOSTROME FAUNA OF THE EDWARDS FORMATION OF TEXAS

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ABSTRACT

"Rudistid reefs" and the "rudistid reef facies" have long been referred to in conjunction with the Edwards formation of Texas. The general geology of the Edwards is reviewed with emphasis on the lithologic and faunal characteristic of the biostrome facies.

The reefs have been divided into those structures which have undergone preservation by calcification and those which have been replaced by siliceous material. The siliceous reefs offer an unusual type of preservation, and the occurrence of new species and extensions in geologic range of other species in these reefs is noted.

A comparison between the calcareous and siliceous faunas shows that the variations are mainly due to slight environmental differences rather than to mode of preservation.

The paleoecology suggests that these biostromes were deposited in a relatively shallow (10 to 20 fathoms, epicontinental sea. The waters were warm, clear, of normal salinity, and populated by an abundance of pelecypods, gastropods and corals. The pelecypod concentrations attracted a large number of carnivorous marine snails.

INTRODUCTION

In an earlier paper (Matthews 1951) the writer presented the results of a study of the paleontology and lithology of the rudistid biostromes of the Edwards formation of Texas. The object of this paper is to review the general geology of the Edwards and to further evaluate certain ecologic and paleontologic data accumulated during the earlier study in an attempt to reconstruct the enviroment during the time that the Edwards rocks were deposited.

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METHOD OF STUDY

During the period from June 1948 to September 1951 outcrops of the Edwards formation were studied in north-central and south-central Texas. Exposures were studied and collected in Bell, Williamson, Coryell, Hamilton, McClennan, Johnson, Hood, Mills, Kerr and Somervell counties. Sections were measured and fossils collected at localities in the above-mentioned counties. These collections were later studied in detail.

LOCALITIES

Specific localities referred to in this paper are:

M210—Road metal quarry, located on top of Edwards scarp approximately 13.6 miles west of Cleburne on Highway 67 in southwest Johnson County. Calcareous preservation. Referred to as Cleburne-Glen Rose Reef.

M258—Road metal quarry, top of Edwards escarpment, approximately 5.6 miles west of Belton on Highway 190 in Bell County. Calcareous preservation. Referred to as Belton-Killeen Reef.

M265—Crest of a low hill approximately 15 miles southwest of Kerrville in southern Kerr County. Siliceous preservation. Referred to as Kerrville Reef.

M267—Quarry on top of a low hill about 3 miles north of the town of Priddy in Mills County. Calcareous preservation. Referred to as Priddy Reef.

M268—Top of a high cliff on the North Fork of the San Gabriel River, approximately 10.1 miles southwest of Georgetown in Williamson County. Siliceous preservation. Referred to as Georgetown Reef.

M269—Crest of low hill, 7.9 miles southwest of Goldthwaite in Mills County. Siliceous preservation. Referred to as Goldthwaite Reef.

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GENERAL GEOLOGY OF THE EDWARDS FORMATION

Type Locality

Literature pertaining to the Edwards produces considerable confusion as to the type locality of the formation. This difficulty may have arisen, in part, because of past changes in nomenclature which are now scattered throughout the literature. The formation was first known as the Caprina limestone and described by Shumard (1860). The type locality, according to Hill (1901), is the summit of Comanche Peak in Hood County, where both the Comanche Peak and Edwards were first described. Hill later abandoned the name, but it was revived by Cragin (Hill and Vaughan 1897). In the same reference (ibid 227) is the following statement: "The geographic name Edwards is here substituted for the "Caprina limestone" of Shumard, the latter being abandoned because it is a paleontologic term; also for the term, "Barton Creek limestone" of Hill, abandoned by him and revived by Cragin. The term "Barton Creek" is objectionable, and was abandoned by its author because it was not a good locality name and because it is a two-word name. The name Barton has been applied to a division of the English Eocene for many years, but we doubt if, in the absence of any defined code of geologic nomenclature, such an objection may be considered valid". The above paper implies that the type locality is in the Nueces Canyons in Edwards County. Adkins and Arick (1930) also give the Edwards County locality as the type. Sellards, Adkins and Plummer (1932 p. 332) list the type locality as being ". . . on Barton Creek near Austin". However in the same publication (p. 346) is the statement: ——"The Edwards was described from the canyons in the Nueces . . .".

STRATIGRAPHIC POSITION AND CONTACTS

Lower Cretaceous of Texas

(Comanchean Series)

North Texas Formations		South-Central Texas Formations
	: Grayson	: Buda
		: Del Rio
	: Mainstreet	
	: Pawpaw	:
Washita Group	: Weno	:
	: Denton	: — — — — Georgetown
	: Fort Worth	:
	: Duck Creek	:
	: Kiamichi	Absent
Fredericksburg	: Goodland — — — — — — — — — — — — — —	: Edwards
	:	: Comanche Peak
	: Walnut	: Walnut

The Edwards thickens from its northern limit near Fort Worth to a point south of Waco. The Kiamichi is not found at the surface south of Waco and throughout its southern extent the Edwards is overlain by the Duck Creek limestone of the Washita Group. Adkins and Arick (1930) report an unconformity at the position of the Edwards-Duck Creek contact in Bell County. The contact of the Edwards and the underlying Comanche Peak is, in general, gradational.

OCCURRENCE AND THICKNESS

As mentioned above, the northern limit of the Edwards appears to be near Fort Worth where Adkins reports " . . . four feet of crystalline limestone at the top of the Fredericksburg limestone mass (called Goodland, more properly Comanche Peak) and below the Kiamichi; this Edwards contains an abundance of a caprinid, **Caprinula** cfr. **anguis".** Dr. Gayle Scott in a personal communication to Sellards, Adkins and Plummer (1932) made a similar statement concerning the northern limits of the Edwards. To the south in southwestern Johnson County the Edwards is about 35 feet thick. In the summits of Comanche Peak in Hood County are about 35 feet of Edwards with the top eroded. The formation thickens to about 50 to 75 feet on the Brazos River near Blum in Hill County. Near Crawford in McLennan County the formation is more than 60 feet thick. From Bell County south, the Edwards thickens from about 50 feet in Bell County to about 186 feet in the valley of the San Gabriel in Williamson County, and 300 feet in Travis County.

In the west central part of the state the Callahan Divide is in many places capped by the Edwards. Hill (1901) lists 83 feet at Logans Gap, Comanche County, and about 44 feet at Round Mountain in the same county. Other thicknesses in this general area are: Taylor County 20-75 feet: Nolan County 75 feet: Callahan County 110 feet of undifferentiated Edwards and Comanche Peak.

In the Llano Estacado it is thinned but present. It extends as far north as southern Garza County and as far east as Stonewall County where it is 40 feet thick. In Coke County it is from 23 feet to 55 feet thick. Some exposures in Tom Green County attain a maximum thickness of 200 feet (Henderson 1928).

The greatest development of the Edwards is in the southwestern part of the state where Hill and Vaughan (1897) report 683 feet in the canyons of the Nueces. It is 400 to 500 feet thick in northern Bexar County and 724 feet thick in southern Bexar County. In Medina County it has a thickness of about 460 feet. In southern Brewster County Sellards, Adkins and Plummer (1932) report a thickness of the formation of more than 800 feet in the rim of the Solitario and it is estimated to be 1000 feet thick south of Terlingua in southern Brewster County.

FACIES

The Fredericksburg group, considered as a whole, presents a complex assortment of facies, corresponding to various conditions of sedimentation. The principal facies exhibited are:

1. **Marginal or littoral facies:** these sediments are generally considered to be those deposited in the part of the shore zone that is covered with water at high tide and not covered with water at low tide. This is usually a relatively narrow area. The Fredericksburg littoral facies consists of sand, sandstone, and sandy shale.

2. **Neritic facies:** the neritic area comprises in general the limits of the continental shelf, and it may also apply to epicontinental seas. The width of the neritic zone varies from narrow, as around some oceanic islands, to wide as on the eastern coast of the North American continent. This facies is represented by widespread marls, marly limestones and chalky limestones of the Walnut, Comanche Peak and Kiamichi formations.

3. **Biostrome facies**[1]**:** The biostrome facies may possibly be local modifications between the littoral and neritic facies. The biostrome facies in the Edwards is dominated by bioclastic deposits of coquina, shell debris, detrital and shelly limestones, and organic limestones of several types.

The Edwards considered in this paper is of the biostromes facies (see plates I and II). The reef limestones and associated rocks are generally accompanied by the usual rudistids and a typical reef fauna. Since this paper deals primarily with sediments of this type, the biostrome facies will be discussed in some detail.

LITHOLOGY OF THE BIOSTROME FACIES

The lithology of the reef facies of the Edwards limestone is one that is usually quite easily recognized. It consists primarily of coquinas (see plate I) of the broken shells of pelecypods (usually rudistids and chamids), gastropods and some coralline material; dense, precipitated limestones of various types; chert lenses and nodules which are often found closely associated with the reefs; considerable secondary chert; and in some occurrences a complete siliceous replacement of the reef fauna associated with siliceous coquina often embedded in a matrix of chert or cherty limestone.

The thickness of the biostromes varies from ten inches to as much as twenty feet. In some places there is an alternation of reef beds and non-reef material. One exposure in Hamilton County, near Star, consists of five beds of reef material alternating with an equal number of non-reef beds.

FAUNA OF THE BIOSTROME FACIES

The fauna of this facies varies somewhat from one outcrop to the other, but is always a true reef type. Aberrant pelecypods such as **Caprina** spp., **Caprinula** spp., **Toucasia** spp., **Radiolites** spp., and **Monopleura** spp., are well represented in various localities. Other pelecypods found in greater or lesser abundance from reef to reef are **Pecten duplicostata** Roemer, **Chondrodonta munsoni** (Hill), and **Phacoides acutilineatus** (Roemer). Some representative gastropods are **Nerinea** spp., **Cerithium** spp., **Anchura** spp., and **Pileolus whitneyi** Ikins and Clabaugh. A few echinoids, including **Goniopygus,** are present. Branching corals (such as **Cladophyllia furcifera** Roemer) are locally abundant and compound corals are sporadic. Protozoans are present in some outcrops. Ammonites are rare or absent in the reef facies.

A summation of the species collected in the field is included below. Faunal relationships of the reefs as a whole are contrasted from one locality to another with comment on notable variations of abundance, number of species present, state of preservation, etc.

The specimens are treated in phylogenetic order rather than according to geographic occurrence. The relative abundance or absence of species are noted where these factors vary geographically.

1/ Early workers have referred to the biostrome facies as "rudistid reefs", "caprina beds", "rudistid tangles", etc. Criteria for the establishment of these deposits as biostromes have been outlined in a previous paper (Matthews 1951, p. 219).

PHYLUM PROTOZOA

The only locality in which protozoans were noted is Kerrville Reef. The foraminiferans **Orbitolina texana** Roemer and **Lituola edwardsensis** Ikins and Clabaugh are quite abundant. These forms, which are macroscopic, occur throughout the entire reef exposure and are found both enclosed in the reef material and in surface residue. Samples of loose material from each locality were studied but no other protozoans noted. Miliolids, characteristic of certain limestone beds of the Edwards at other localities, are seemingly absent in the Kerrville reef.

PHYLUM PORIFERA

Sponges are represented only by the perforations left on various mollusc shells. These were presumably made by **Cliona,** the boring sponge, which used these organisms for attachment rather than for food. The nature and distribution of these perforations are similar to scars found on many species of **Gryphaea,** these scars having been attributed to **Cliona.** The theory that the siliceous spicules of sponges may have aided in the formation of flint and chert may also be taken as indirect evidence of the existence of sponges. The proponents of this theory attribute the origin of certain siliceous rocks, like those found in the Edwards, to the silica of spicules.

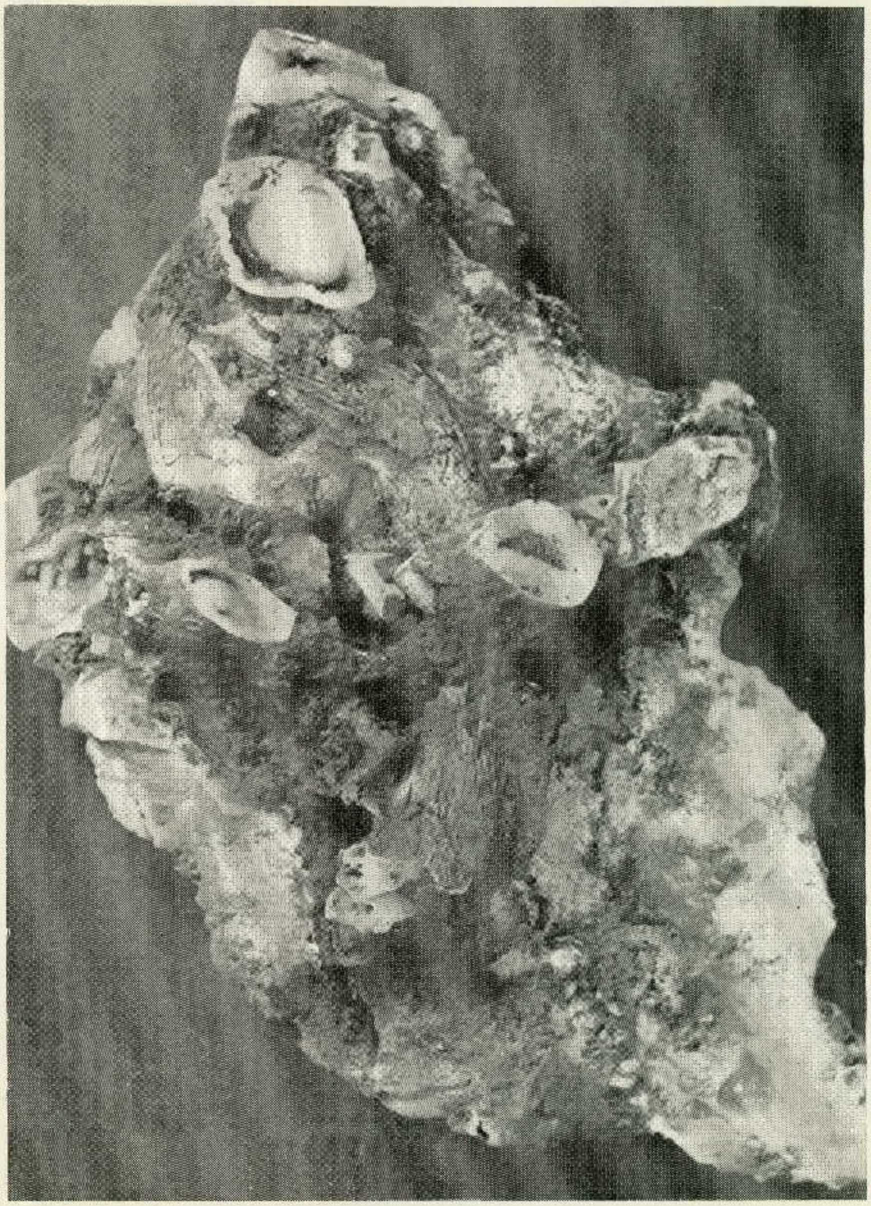

Plate Number I

Portion of siliceous rudistid reef. Note quartz crystals in internal chambers of the caprinids. Kerrville Reef, 15 miles southwest of Kerrville, Kerr County, Texas.

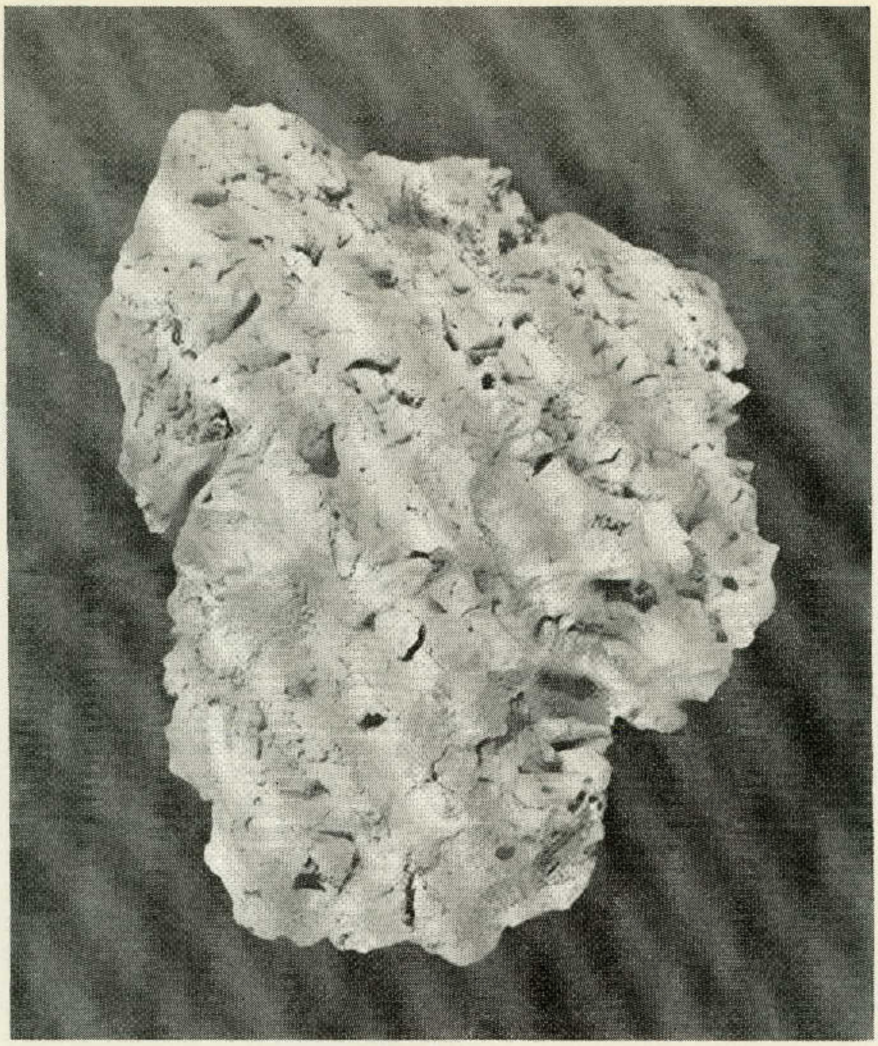

Plate Number II
Portion of calcareous rudistid reef three miles north of Priddy, Mills County, Texas.

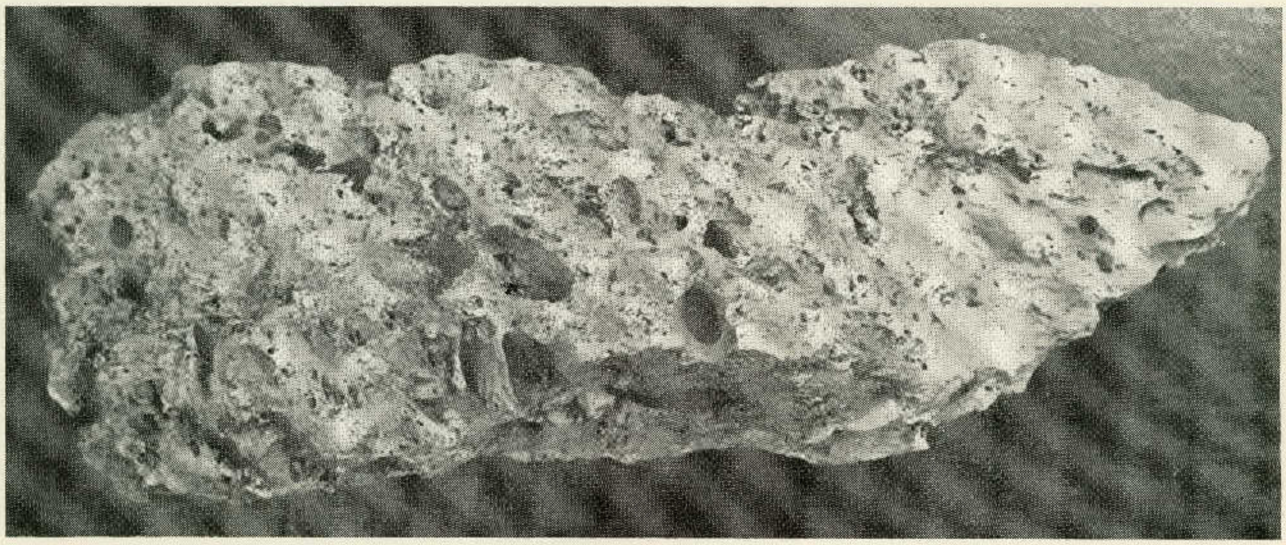

Plate Number III
The typical "honey-comb" Edwards limestone. Goldthwaite, Mills County, Texas.

PHYLUM COELENTERATA

The only coelenterates observed were corals. Several scleractinians were collected from the coquina of the siliceous reefs, but no corals were noted at any calcareous reef mentioned in this paper. All three siliceous reefs studied contain numerous coral remains. The colonial type coral was best developed in the Goldthwaite Reef, although the coquinas of this reef contain remains of both solitary and colonial types. The large colonial types served as a place of attachment for young caprinids, and worm tubes were found among the coralla. **Pleurocora** sp., is abundant at Kerrville, and one specimen of **Cladophyllia furcifera** (?) Roemer was found. The Georgetown Reef yielded relatively few coral remains, but several well preserved specimens of **Cladophyllia furcifera** Roemer were collected.

PHYLUM ANNELIDA

Tubes of annelid worms occur on the shells of numerous molluscs at all but the Belton-Killeen Reef. The remains of organisms from this reef bear the markings of boring worms, but no serpulid worm tubes were found. Several long, tortuous molds which are believed to be "worm tubes" were discovered among the rocks. **Serpula** was observed in all other reef localities usually being attached to other specimens. **Spirorbis** occurs in the Cleburne-Glen Rose Reef, Goldthwaite Reef, and Kerrville Reef. The species is most abundant in the Kerrville Reef and occurs plastered to the remains of many corals, pelecypods, and gastropods. This form is seemingly quite rare in the Texas Cretaceous.

PHYLUM ECHINODERMATA

Echinoderms are rare in all reefs included in the current study. The Kerrville Reef yielded one fragment of an echinoid test, possibly **Goniopygus** sp., and one short echinoid spine. Fragments of **Cidaris hemigranosus** Shumard were found in the Cleburne-Glen Rose Reef. This form has previously been known only from the middle Washita group in Texas.

PHYLUM MOLLUSCA

The molluscs comprise the bulk of the biostrome fauna. The remains of the aberrant pelecypods, the caprinids and rudistids, occur in amazing abundance at all localities discussed in this paper. While the term "rudistid reef" is generally used to refer to these deposits, it is actually the caprinids which make up the greater portions of the reef. The only rudistid found in abundance is **Radiolites davidsoni** Hill. The more abundant genera, **Caprina, Caprinula, Monopleura, Toucasia,** etc., are members of the Suborder Chamacea and should properly be referred to as chamids. The rudistids and caprinids are a complex group and are in great need of revision.

The genus **Caprina** is quite abundant and represents more specimens than any other genus. They are usually difficult to identify because of the great masses of remains which are embedded together. **Caprinula** is also very abundant, particularly in the calcareous reefs at Cleburne-Glen Rose and Belton-Killeen. **Toucasia** is common in the Georgetown reef, but comparatively rare at other localities studied. **Monopleura** occurs in abundance at Georgetown where it made up a large percentage of the better preserved specimens. The internal molds of many **Monopleura** were collected at the Belton-Killeen area. **Monopleura pinguiscula** White is the most abundant species, but a few specimens of **Monopleura marcida** White were collected. **Radiolites davidsoni** Hill is not reported from any siliceous reef, but occurs in all calcareous exposures. This species is usually poorly preserved but fragments are easily recognized by the unusual structure of the shell. The greatest single concentration of **Radiolites** was noted at the Cleburne-Glen Rose Reef.

Pecten duplicostata Roemer is common at Georgetown (the only occurrence in a siliceous exposure), and at the Belton-Killeen Reef. The specimen is relatively abundant at the above localities but apparently absent from the other four reefs. Some evidence of **Pecten** was observed at Cleburne-Glen Rose but possibly the specimens were not in place. The **Pecten** shells are of the large convex valve type and probably were transported into the reef by mechanical means. The valves are not extensively eroded or broken in most occurrences, and probably washed in from nearby waters. Most of these shells bear evidence of the attacks of boring worms and gastropods.

Chondrodonta munsoni Hill forms great clusters of shell deposits throughout the Cleburne-Glen Rose Reef. The only other occurrence of **Chondrodonta** noted was at the Belton-Killeen locality where it is quite common.

Phacoides acutilineata (Roemer) occurs as internal molds in the Priddy Reef and Belton-Killeen Reef. Silica replaced shells are found intact in the reef at Kerrville.

An internal mold of **Lima** was collected at the Priddy Reef; however, the species cannot be determined.

Gastropods are abundant in the siliceous reefs, particularly at Georgetown and Kerrville. The paleontological record of gastropods in the calcareous reefs is largely in the form of internal molds and is quite incomplete. No direct evidence of gastropods was found at the Cleburne-Glen Rose Reef but certain mollusc shells bore perforations similar to the type made by predaceous gastropods. **Pileolus whitneyi** Ikins and Clabaugh is abundant at both Kerrville and Georgetown, but no specimens of this type were observed at Goldthwaite, or at any of the three calcareous reefs. Closer study of the **Pileolus** assemblage from the Georgetown reef probably will reveal one or more new species of this genus. Various species of **Nerinea** occur at all reefs with the exception of the Cleburne-Glen Rose locality. **Anchura** and **Aporrhais** are also common at several of the reefs. Several species of **Cerithium** were found at both Kerrville and Georgetown. On the basis of the gastropods collected, the Georgetown and Kerrville faunas are quite similar. Several gastropods which may be new genera, species, and extensions of geologic range were collected from the Kerrville and Georgetown areas. It is quite possible that a similar fauna was present in the Goldthwaite Reef before it was so extensively eroded. The gastropods are distributed throughout the entire reef and often oriented in much the same manner in which they lived. Much will probably be learned of the Lower Cretaceous gastropod fauna by a later study of these well preserved specimens.

PHYLOGENETIC LIST OF SPECIES COLLECTED FROM THE EDWARDS REEFS

Phylum Protozoa
Class Sarcodina
Order Foraminifera
Lituola edwardsensis Ikins and Clabaugh 1940
Orbitolina texana (Roemer) 1852

Phylum Porifera
Class Demospongia
Order Monactinellida
Cliona (?)

Phylum Coelenterata
Class Anthozoa
Subclass Zoantharia
Order Scleractinia
Pleurocora sp.
Cladophyllia furcifera Roemer 1888

Phylum Mollusca
Class Gastropoda
Subclass Prosobranchia
Monodonta texana Ikins and Clabaugh 1940
Pileolus whitneyi Ikins and Clabaugh 1940
Trochus (Tectus) texanus Roemer 1888
Nerita sp.
Tylostoma sp.
Tylostoma elevatum Shumard 1854
Lunatia (?) **pedernalis** Roemer (not Hill) 1852
Lunatia (?) sp.
Turritella sp.
Nerinea spp.
Cerithium bushwhackense Ikins and Clabaugh 1940
Cerithium roemeri Ikins and Clabaugh 1940
Cerithium kerrvillense Ikins and Clabaugh 1940
Anchura sp.
Aporrhais (Quadrinervus) singleyi Stanton 1947
Fusinus (?)
Pseudonerinea sp.
Solarium pseudoplanorbis Ikins and Clabaugh 1940
Liotia (?)
Chrysostoma (?)
Columbellina (?)
Cyclostrema (?)
Circulopsis (?)

Class Pelecypoda
Subclass Prionodesmacea
Order Dysodonta
Suborder Pectinacea
Pecten duplicostata Roemer 1849
Pecten cfr. **texanus** Roemer 1852

Suborder Ostreacea
Chondrodonta munsoni (Hill) 1893

Suborder Limacea
Lima sp.

Subclass Teleodesmacea
Order Heterodonta
Suborder Lucinacea
Phacoides acutilineata (Roemer) 1888

Order Pachyodonta
Suborder Chamacea
Toucasia patagiata (White) 1884
Toucasia texana (Roemer) 1852
Monopleura marcida White 1884
Monopleura pinguiscula White 1884
Caprina crassifibra (?) Roemer 1852
Caprina sp.
Caprinula anguis Roemer 1888

Suborder Rudistacea
Radiolites davidsoni Hill 1893

Phylum Annelida
Class Chaetopoda
Order Polychaeta
Serpula sp.
Spirorbis sp.

Phylum Echinodermata
Class Echinoidea
Subclass Regularia
Order Cidaroida
Cidaris hemigranosus Shumard 1860
Goniopygus (?) sp. indet.

PALEOECOLOGY OF THE BIOSTROME FAUNAS

The biostrome facies of the Edwards consists largely of bioclastic debris, as well as debris from the reef proper, and any interpretation of the paleoecology of these deposits must take into account the fact that many of these fossils indicate transportation from other localities. It is believed that some of the pelecypods and gastropods did not live in the biostrome, but lived in the water near the shell deposits. **Pecten duplicostata** was noted in association with rudistids and chamids at several exposures. The presence of only single valves of this animal, the orientation of the valves in the sediments, plus the fact that **Pecten** is a free-swimming mollusk indicates that these isolated valves were washed into the reef after the death of the animal. These shells are neither badly eroded or broken, indicating transportation from sites which were relatively close to the reefs. The orientation and relatively greater abrasion of the shells of certain of the less common gastropods indicates that these snails were not members of the reef fauna but were brought in by bottom currents. The morphology of their shells readily adapts them to transportation by means of rolling along the bottom, and this method of dispersal probably accounts for the abrasion of the shells as well as their random orientation in the reef. The majority of the gastropods found in the reefs, however, are true reef dwelling types.

The members of the biostrome fauna which are more commonly found in place are the oysters, chamids and rudistids. **Chondrodonta munsoni** and **Radiolites** are commonly found in the same localities, and both fossils have thick, heavily-ribbed shells implying adaptation to life in shallow waters subject to wave action. In exposures dominated by the **Chondrodonta-Radiolites** association corals are absent and carnivorous gastropods are relatively rare. The absence of these forms indicates that the environment for this association was probably in water of less than normal salinity. **Chondrodonta** is more abundant in the northern exposures of the Edwards and it is assumed that the sea became somewhat shallower in that direction.

In exposures where **Chondrodonta** and **Radiolites** occur together **Radiolites** is always found higher in the section. The regularity with which this occurs is taken as evidence of an ecologic succession of **Chondrodonta** upward to **Radiolites.**

Corals are more abundant in exposures in which the dominant attached pelecypods are **Toucasia, Caprina** and **Monopleura. Cladophyllia, Pleurocora** and other corals are commonly found attached to the substratum and to the shells of other organisms. The gastropod **Nerinea** is also abundant where corals are found. **Nerinea** and **Cladophyllia** require a firm substratum upon which to live, and the shell of **Nerinea** and the delicate branches of **Cladophyllia** assume a habitat of relatively quiet water and a solid bottom.

The presence of the foraminiferans **Lituola** and **Ammomarginulina** further suggest a warm, shallow, clear, marine environment for the biostrome facies.

Juveniles of most genera are present throughout the biostromes, embryonic shells of **Toucasia** and **Monopleura** are commonly found clustered on the shells of mollusks and corals, and the shells of young gastropods are also abundant. This evidence of a normal, growing marine community further substantiates the belief that these deposits were formed in place by attached organisms rather than a random collection of shells accumulated after the death of the animals.

The large pelecypod concentrations in the reefs attracted a large number of carnivorous marine snails. Neatly bored holes made by the radulas of these animals are common on many pelecypod shells in the reefs. Browsing, herbivorous snails were also collected and are represented by such genera as **Nerita, Neritina,** and **Aporrhais.** While no algae or other plant remains were identified from the material collected they were probably a vital part of the reef biota as suggested by the presence of the above herbivores. All of the gastropods are marine forms, occurring more commonly where corals, and **Monopleura** and **Toucasia** are present. The gastropods represent the largest contribution in total number of genera and species to the total biota of the biostrome. In those reefs where silicification has taken place most gastropod shells are in an excellent state of preservation.

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