HYSTEROCERAS HYATT [CRETACEOUS (ALBIAN) AMMONOID] IN TEXAS AND THE ANGOLA CONNECTION

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ABSTRACT

Three species of *Hysteroceras* from Trans-Pecos Texas—*H. varicosum* (Sowerby), *H.* sp. cf. *H. orbignyi* (Spath), and *H.* (?) n. sp.—support the correlation of the zones of *Adkinsites bravoensis* (Böse) and *Boeseites romeri* (Hass) with the middle part of the *Mortoniceras inflatum* zone of Europe and its *H. varicosum* and *H. orbignyi* subzones.

Hysteroceras varicosum and *H. orbignyi* also occur in Venezuela, Angola, Europe, and Madagascar. *Boeseites romeri* (Haas) and other elements of this Angolan fauna, however, have been reported only from Texas and Angola [although *B. maroimensis* (White) from Brazil is a close relative]; this faunal relationship indicates the first direct migration of southern African ammonites to the western North Atlantic. Given that the oceanic basin of the South Atlantic was not opened until long after the Late Albian, the ammonites of the *Boeseites romeri* fauna probably migrated through a shallow, epeiric sea during the high stand of sealevel in the early to middle part of the Late Albian, before the opening of a truly oceanic connection between the North and South Atlantic.

INTRODUCTION

The small genus of ammonites, *Hysteroceras*, which is so typical in some of the lower beds of the Upper Albian (Cretaceous System), has not been reported previously as *Hysteroceras* from North America. Böse (1923) illustrated what is probably a species of the genus on his plate 11, figures 45-51. He identified it as *Brancoceras* aff. *varicosum* (Sowerby), although his specimens appear to be more closely related to *H. orbignyi* (Spath), with the ribs markedly swinging orad on the venter where they meet and form chevrons with the ribs of the opposite flank.

The specimens of *Hysteroceras* reported herein were collected by Bill St. John in 1964 and by Jeremiah McCarthy in 1952. They represent the middle part of the Upper Albian and are from the zones of *Adkinsites bravoensis* (Böse), below, and *Boeseites romeri* (Haas), above. These zones are equivalent to the middle part of the zone of *Mortoniceras inflatum* of Europe (Kennedy et al. 1980), which has the subzones of *Hysteroceras orbignyi* (Spath), below, and *H. varicosum* (Sowerby), above (Table 1).

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TABLE 1. Comparison of European and Texan zones for the late Albian.

*TEXAS	EUROPE**		SUBSTAGE
ZONE	SUBZONE	ZONE	
DRAKEOCERAS DRAKEI	MORTONICERAS PERINFLATUM	STOLICZKAIA DISPAR	
	STOLICZKAIA BLANCHETI		
MORTONICERAS WINTONI	MORTONICERAS ALTONENSE	MORTONICERAS INFLATUM	LATE
DRAKEOCERAS LASSWITZI			
PERVINQUIERIA EQUIDISTANS	CALLIHOPLITES AURITES		
EOPACHYDISCUS BRAZDENSIS			
CRAGINITES SERRATESCENS	HYSTEROCERAS VARICOSUM		ALBIAN
BOESEITES ROMERI	HYSTEROCERAS ORBIGNYI		
ADKINSITES BRAVOENSIS			
MANUANICERAS POWELLI	DIPOLOCERAS CRISTATUM		K. Young, 1984

*MODIFIED FROM YOUNG 1967, 1979
**FROM KENNEDY, HANCOCK, AND CHRISTENSEN 1980

The specimens from the Black Gap Area (St. John 1965; Fig. 1) are from the upper 2m of the Sue Peaks Formation, which is thinner at this locality than in most areas. The specimens from Cienega Creek (McCarthy 1953; Fig. 2), Presidio County, are from the middle part of the Benevides Formation, reported as Sue Peaks Formation by Dietrich (1965).

Additional material of *Hysteroceras* is in the Texas Memorial Museum (Austin, Texas) in the small collection of pyritized micromorphs from the Sierra Mojada, western Coahuila, Mexico. This collection was sent to W. S. Adkins in the summer of 1933 by F. L. Wingfield, at that time the resident mining engineer of Cia. Minera de Peñoles, S. A.; Wingfield was then living at Esmeralda, one of the towns associated with the large mining district at Sierra Mojada. This collection of *Hysteroceras* has not been studied because the stratigraphy has not been determined and the stratigraphic section has not been measured or studied.

PALEONTOLOGY

Phylum Mollusca
Class Cephalopoda
Superfamily Acanthoceraceae Hyatt 1900
Family Brancoceridae Spath 1933
Genus *Hysteroceras* Hyatt 1900

Hysteroceras varicosum (Sowerby 1824)

H. varicosum is the type species of the genus. Spath's (1934) synonomy is adopted here. Neither Haas (1942) nor van Hoepen (1944) was aware of each other's work at the time of publication; therefore, a complete and competent synonomy awaits a restudy of the Angolan material.

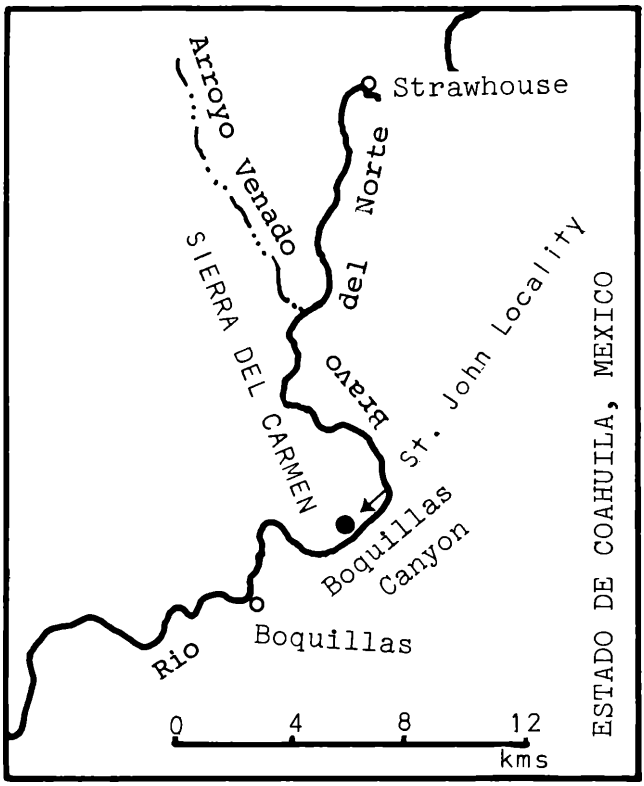

FIGURE 1. Locality collected by Bill St. John on the northwest side of Boquillas Canyon, Brewster County, Texas. The geology is mapped in Maxwell et al. (1967).

The specimen illustrated by A-D and P in Figure 3 is from about 30 m below the top of the Benevides Formation, 12 m below the lowest ocurrence of *Boesites*, and from the zone of *Adkinsites bravoensis* (Böse), Cienega Creek, Presidio County, Texas. WSA-3592 (Fig. 3, J and K) was collected by J. D. De Jong; it differs from *Hysteroceras orbignyi* Spath) in Renz (1982) in the absence of a keel on the adult and in its less dense ribbing. Specimens illustrated by Q-V in Figure 3 are from the upper 2 m of the Sue Peaks Formation, zone of *Boeseites romeri* (Haas), west end of Boquillas Canyon, Big Bend National Park, Brewster County, Texas.

Hysteroceras orbignyi (Spath 1922)

The specimen illustrated by L-O in Figure 3 is from Barbacoas, Estado de Lara, Venezuela. It was collected by J. D. De Jong. *Hysteroceras orbignyi* (Spath) has also been identified by Barker ("Cretaceous ammonites from western Venezuela" with 59 plates, unpublished and

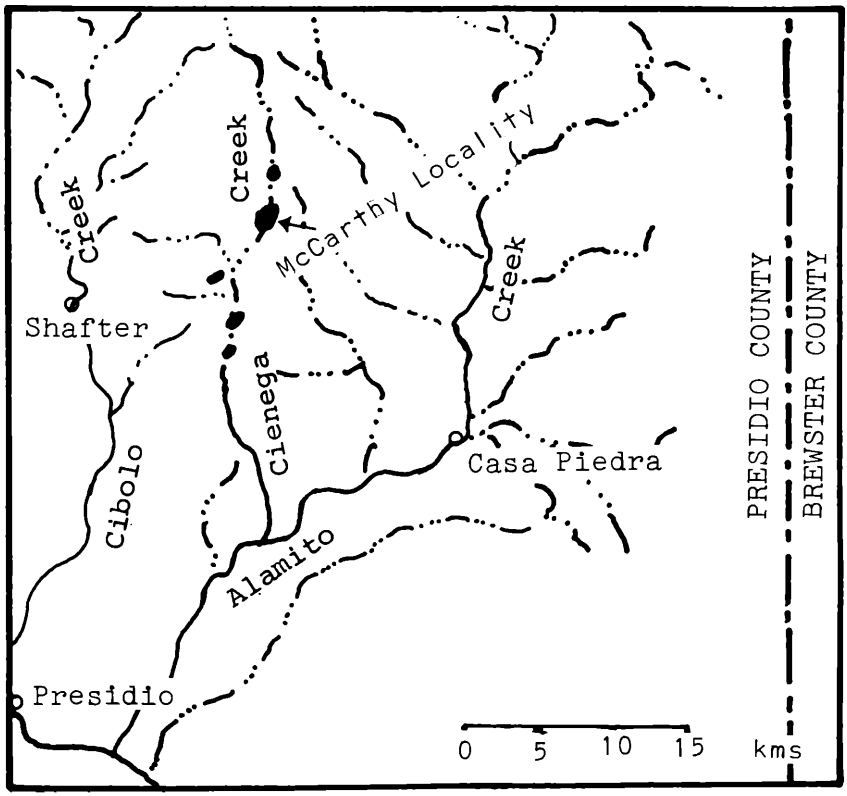

FIGURE 2. Locality collected by J. F. McCarthy along Cienega Creek, Presidio County, Texas. The areas in black are outcrops of the Benevides Formation on Cienega Creek.

undated) in collections (also by J. D. De Jong) from outcrops along the Chejende-Miton road, Chejende Area, Estado Trujillo, Venezuela. Renz (1982) discussed the stratigraphy and geography of these deposits.

The Venezuelan specimen illustrated was chosen to show the ventral chevrons formed by the meeting or sometimes joining of oradly projected ribs, so diagnostic of this species. The keel is weaker than on other, smaller specimens in the sample and is weaker than on those illustrated by Renz (1982). In the designation of species of this genus some authors have made much of the number and distribution of intercalated and primary ribs. However, this feature is extremely variable in both *H. varicosum* (Sowerby) and *H. orbignyi* (Spath) and can vary even between opposite flanks of the same specimen (Fig. 3, Q and V).

Hysteroceras sp. cf. *H. orbignyi* (Spath 1922)

The specimen illustrated by W-Z in Figure 3 is from the west end of Boquillas Canyon, Big Bend National Park, Brewster County, Texas,

A-D, J, K, P-V—*Hysteroceras varicosum* (Sowerby 1824). A-D, P:UT-1289, from about 30 m below the top of the Benevides Formation and 12 m below the lowest occurrence of *Boeseites*, Cienega Creek, Presidio Co., TX.; collected by J. F. McCarthy from bed 1 of section 4 of McCarthy (1953). J, K: WSA-3592, Adkins Collection; from Barbacoas, Venezuela, collected by J. G. De Jong. Q-V:UT-6260-B, from the upper 2 m of the Sue Peaks Formation, west end of Boquillas Canyon, Big Bend National Park, Brewster Co., TX; collected by Bill St. John in 1964. A-C, Q, U, V × 1.5; D, P, R-T × 0.75.

E-I—*Hysteroceras* (?) n. sp. UT-6261, from the upper 2 m of the Sue Peaks Formation, west end of Boquillas Canyon, Big Bend National Park, Brewster Co., TX; collected by Bill St. John in 1964. E, F × 0.75; G-I × 1.5.

L-O—*Hysteroceras orbignyi* (Spath 1922). WSA-3592, W. S. Adkins Collection; from Barbacoas, Venezuela, collected by J. G. De Jong. × 0.75.

W-Z—*Hysteroceras* sp. cf. *H. orbigyni* (Spath 1922). UT-6260-A, from the upper 2 m of the Sue Peaks Formation, west end of Boquillas Canyon, Big Bend National Park, Brewster Co., TX; collected by Bill St. John in 1964. W, X × 0.75; Y, Z × 1.5

FIGURE 3. *Hysteroceras* spp. from Texas and Venezuela.

and was collected by Bill St. John. It is from the *Boeseites romeri* (Haas) zone, upper 2 m of the Sue Peaks Formation.

This specimen (Fig. 3, W-Z) shows, at least in one view, ribs projected forward onto the venter. Otherwise, it does not seem greatly different from specimens of *H. varicosum* on the same figure. It is crushed, and the venter is not well preserved. It is questionably related to *H. orbignyi* (Spath) because of the ribs oradly projected onto the venter, but it must be remembered that many workers have confused *H. orbignyi* (Spath) and *H. varicosum* (Sowerby), even though much better preserved material than this was available for study.

Hysteroceras (?) sp.

The specimen illustrated by E-I in Figure 3 is from the upper 2 m of the Sue Peaks Formation, zone of *Boeseites romeri* (Haas), west end of Boquillas Canyon, Big Bend National Park, Brewster County, Texas. It was collected by Bill St. John.

Hysteroceras (?) sp. (Fig. 3, E-I) has a smooth ventral area, which is not typical of *Hysteroceras* or of other genera associated with the zone of *Mortoniceras inflatum*. On each flank ribs alternate, primary and secondary, ending at the slight swelling on the ventrolateral shoulder. Ribs do not extend onto a smooth, only slightly arched venter. Ribs are paired from flank to flank, and there are probably 17 to 20 ribs per whorl. With only one specimen of about one-half whorl, no attempt at assignment has been made.

DISCUSSION

The Boeseites *fauna*

The *Boeseites* fauna (Young 1968) is known only from Trans-Pecos Texas, adjacent northeastern Chihuahua, Mexico, and Angola (Haas 1942; Young 1968; Kennedy and Cooper 1975). The following species are from Hanha, Angola (Haas 1942), and Texas and Chihuahua (Young 1968).

Boeseites romeri (Haas) [= *Pervinquieria romeri* Haas 1942]
Boeseites perarmatus (Haas) [= *P. perarmata* Haas 1942]
Boeseites barbouri (Haas) [= *P. barbouri* Haas 1942]
Boeseites proteus (Haas) [= *P. proteus* Haas 1941]
Boeseites howelli (Haas) [= *P. howelli* Haas 1942]
Prohysteroceras sp. cfr. *P. hanhaense* Haas 1942
Elobiceras (?) sp.

Hysteroceras varicosum (Sowerby), *H.* sp. cf. orbignyi (Spath), and *Hysteroceras* (?) sp. occur in the *Boeseites romeri* zone, Sue Peaks For-

mation, in the Black Gap area of Brewster County. *H. varicosum* occurs a few tens of meters below the first occurrence of *Boeseites* on Cienega Creek, Hudspeth County, Trans-Pecos Texas.

There are some geographic anomalies that cannot be explained, as yet. The extensive middle Upper Albian fauna in Zululand, South Africa (van Hoepen 1931-1951), contains many forms of *Hysteroceras*, including *H. varicosum* and *H. orbignyi*, but no species of *Boeseites*. A single species of *Boeseites* [*Ammonites maroimensis* (White 1887)] has been recorded from Brazil, which by modern models was attached to Nigeria at that time (Fig. 4). However, middle Late Albian deposits in Venezuela with *Hysteroceras orbignyi* (Spath) do not contain *Boeseites* (Renz 1968, 1982) but do contain *Venezoliceras karsteni* (Stieler 1920) (Renz 1982), which is related to *Venezoliceras umsinenense* [= *Lophoceras umsinenese* van Hoepen (1931)]. *Venezoliceras umsinenense* also occurs with species of *Hysteroceras*, including *H. orbignyi* and *H. varicosum*, but species of *Boeseites* are absent from Zululand.

It is obvious that van Hoepen (1931, 1941, 1942, 1944, 1946, 1951, but especially 1941, pp. 87-90) collected from a considerable section of rocks of the early part of the Late Albian. Although Haas (1942, pp. 138-141) went to considerable effort to demonstrate that the specimens of the Vernay collection all came from the same, single "horizon," I have not been convinced. The supposed occurrence together of certain genera not found together in other parts of the world (such genera as *Elobiceras, Dipoloceras, Neokentroceras, Hysteroceras*, and *Pervinquieria)* may indicate either stratigraphic condensation or separate occurrences in different strata. Haas knew that the collections came from different toes of talus slopes (as collectors stepped off of the boat at intervals to pick up the loose fossils).

It is possible that the *Boeseites* level in the Zululand area is represented by that part of the section which van Hoepen (1946) stated was covered. This would explain the absence of such forms in van Hoepen's publications, but not their absence in Venezuela or Colombia.

The Opening of the South Atlantic

Many authors have discussed the opening of the South Atlantic to the North Atlantic (Beurlen 1961; Reyment 1969, 1980; Reyment and Tait 1972; Sclater et al. 1977; Van Andel et al. 1977; Förster 1978; and others.) This opening of the Atlantic between Nigeria and Brazil has been discussed from several different bases, which are best summarized by Reyment (1980). The general conclusion is that a truly oceanic connection (underlain by oceanic crust) between the South and North Atlantics did not develop until the Turonian, and at least not until long after the Late Albian. Some of Förster's (1978) proposed marine

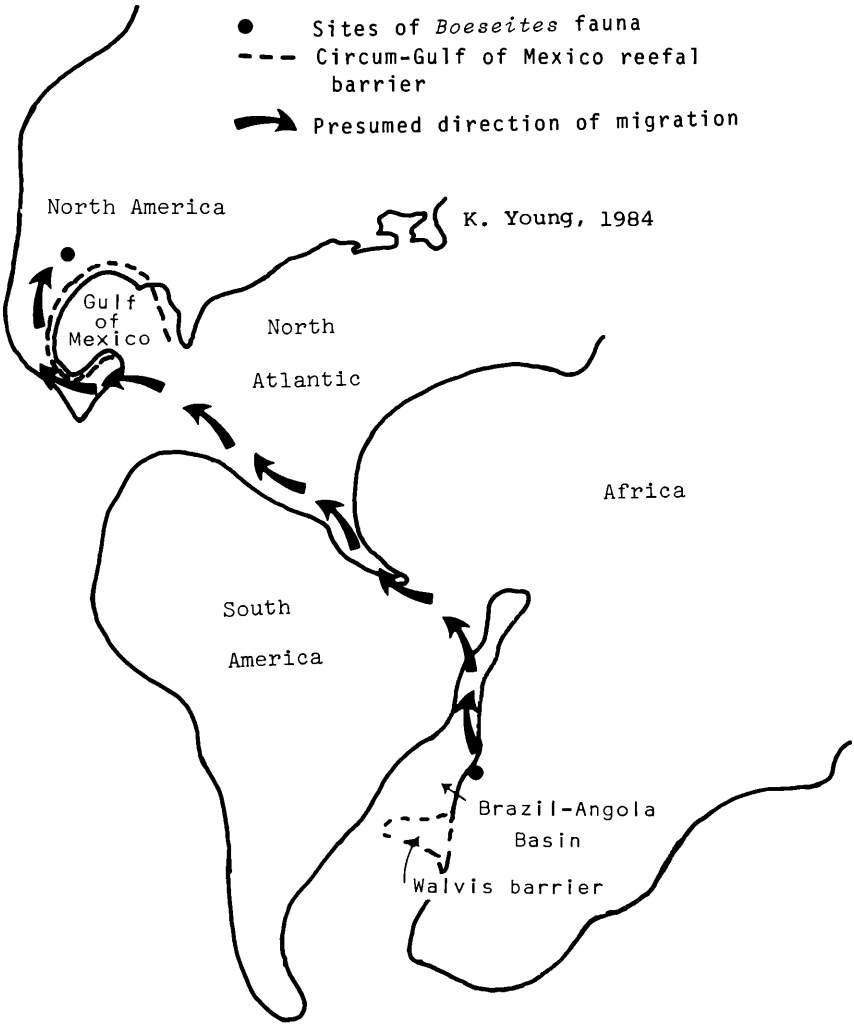

FIGURE 4. Proposed route of migration of the *Boeseites* fauna from Angola to Texas.

connections in the Albian have been explained in other ways (Reyment 1969, 1980; Kennedy and Cooper 1975; Reyment and Mörner 1977).

The Late Albian Transgression

With continential crust continuous from Nigeria to Brazil until the Turonian, processes other than continential separation are necessary to explain the distribution of the *Boeseites* fauna. Kennedy and Cooper (1975) have suggested an extensional sag. Whether this would have occurred as early as Late Albian or not is uncertain.

The transgression that began in the late Medial Albian and culminated in the Late Albian (Reyment and Mörner 1977; Förster 1978; Reyment 1980) seems adequate to explain the distribution of *Boeseites*. Perhaps the widespread distribution of *Manuaniceras manuanense* (Spath) and its relatives during the late Medial Albian indicates that Reyment et al. (1976) are correct in claiming that the late Medial Albian was the beginning of the maximum transgression of the Late Albian, but Kennedy and Cooper (1975) emphasize the differences between the manuanicerine faunas of these different areas and emphasize that they could have been distributed through the Tethys. The *Boeseites* fauna, on the other hand, is not known to occur in the Tethys. The *Boeseites* fauna seems to have migrated across the shallow Brazilian shelf during the Upper Albian zone of *Mortoniceras inflatum*, which was the culmination of the transgression that started in the late Medial Albian (Fig. 4).

CONCLUSIONS

The *Boeseites* fauna is known only from Angola in Africa and from northern Mexico and Texas in the Americas, except for one species, *Boeseites maroimensis* (White), in eastern Brazil. Such a restricted distribution means that this fauna crossed the Brazilian Shelf during a widespread, high stand of sealevel in the Late Albian.

At times of high stands of sealevel major oceans do not have to be present to accommodate short-lived migrations. The migration of the *Boeseites* fauna and the genus *Hysteroceras* into northern Mexico and Trans-Pecos Texas probably dates the beginning of the maximum stage of the Late Albian transgressive cycle, when migration occurred across the narrow Brazilian Shelf. It also indicates that faunas were not continuously replenished from South Africa during the Albian, but migrated only once. Therefore the *Boeseites romeri* zone in southwestern North America marks an important zone of short duraton that is correlatable and is not encumbered by the usual arguments of rapid or slow transgression, regression, punctuational or phyletic theories of evolution, or changes in facies.

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