



The Cretaceous ammonites of Venezuela

Otto Renz, Basel

With 91 Text figures and 40 Plates

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Dr. Otto Renz was born in Kaufbeuren, Bavaria, and received his university education in Basel, obtaining his doctorate in geology in 1935. The subject of his doctoral thesis was "Stratigraphische und mikropalaeontologische Untersuchung der Scaglia (Obere Kreide - Tertiär) im zentralen Apennin". Following a year as assistant at the University of Basel, Geological Institute he joined the Royal Dutch/Shell Group of Companies and was assigned to Colombia where he worked mainly in the Llanos, the eastern Andes and the Magdalena Valley. Between 1941 and 1945 he was in what is now Indonesia and in 1946 was transferred to Venezuela where he remained until retirement in 1959. During this period he was assigned to special projects in Greece (1954) and Spain (1957). Immediately following retirement Dr. Renz taught final year and post-graduate students at the Central University of Venezuela and in 1960 was retained by Shell to conduct geological research in Puerto Rico and Jamaica. Since January 1962 Dr. Renz has devoted himself to scientific research, mainly in the field of palaeontology, at the Museum of Natural History in Basel.

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A. Introduction

During the Cretaceous Period a marine basin extended from Trinidad and northern Venezuela across the Cordillera Oriental of Colombia and into the southwestern part of Peru, a distance of some 3500 km. Its northern and northwestern extension into the present-day Caribbean cannot be determined with any precision and must therefore remain open to speculation. The basin limits to the southeast, on the other hand, can be clearly delineated, as it was marked by the edge of the Guayana Shield. Over much of Venezuela, north of the Guayana Shield, an uninterrupted sequence of sediments accumulated throughout the Cretaceous. Initially vast quantities of terrigenous material, erosion products from the uplifted Guayana Shield, were swept into the basin. The depressions, such as the Uribante and Machiques Troughs, were first filled with conglomerates and later by thick sequences of quartz sands with plant remains which were widespread along the southeastern slope of the basin. These sands are for a great part derived from the Roraima Formation which constitute the pre-Mesozoic cover of the Guayana Shield. The sands are of interest in that they contain intercalations of black shales in which ammonites of Aptian age have been found in the Serranía del Interior situated in the States of Monagas and Sucre. The ammonites are found as limonitized moulds, their overall appearance closely resembling age equivalent assemblages in Europe. In the Andes, lithologically similar non calcareous black shales, probably also of Aptian age, are devoid of ammonites.

Basinwards, the clastic sediments were successively replaced by carbonates predominantly of organogenic origin. Extensive platforms of biostromal limestone were built in a shallow epicontinental sea within the photic zone which apparently were partially subjected to wave action. The associated fauna comprises, in the main, thick-shelled pelecypods, echinoids and locally corals, as in the Serranía del Interior. Foraminifera are restricted to benthic types. Ammonites are rarely present, having been found only in the Andes, within Aptian sediments in the State of Táchira and within the upper Albian sequences in Trujillo and Lara States.

In addition to these shallow water carbonates, lithologically and faunally distinct carbonates were deposited in closed basins which developed at different times in widely separated areas on the platforms. Sedimentation in these restricted basins proceeded in an environment below the wave base and beyond the photic zone, in waters which were poorly oxygenated. The associated bottom fauna in these reducing conditions was, therefore, impoverished and restricted to inoceramids and small bivalves and gastropods. The sediments, on the

other hand, locally abound with fossils of pelagic origin, commonly preserved in characteristic ellipsoidal limestone concretions of varying size. In addition to fish and saurian remains, rich assemblages of planktonic foraminifera and of ammonites are found. The euxinic sediments which accumulated in these isolated basins are of great importance in that they constitute a very rich source rock which generated most of the oil found in western Venezuela (Hedberg, 1931).

The comparatively stable conditions which had prevailed throughout most of the Cretaceous Period were interrupted in early Tertiary times. The Caribbean orogeny affected the northern part of the basin causing a strong metamorphism of the sediments and thus destroying their fossil content. Large masses of Cretaceous and older rocks became detached from the rising orogen and were moved southwards, by downslope gliding, into the developing flysch basins of Barquisimeto and Guárico. Within these allochthonous slabs, the original lithologies and fossil assemblages have been preserved. At the same time detached slabs of predominantly Cretaceous sediments slid, under the influence of gravity, down the flexured eastern edge of the basin into the Barquisimeto Trough. These can now be observed between the towns of Carora and El Tocuyo in the State of Lara.

The folding and faulting resulting from the late Tertiary orogenic phase affected the rigid sediments of the Andes in a manner quite distinct from the more plastic, chaotic, originally semifluid masses of glided flysch in the Tertiary basin, deprived locally of its original bedding and burdened by abundant heterogeneous rigid rock fragments.

From the foregoing, it can be seen that conditions favourable for the development and preservation of ammonite assemblages persisted from early Aptian to late Coniacian time in Venezuela. The ammonites included in this monograph represent only a small proportion of the total number of species which flourished during that time. This compilation must, therefore, be considered as a first step in the study of Venezuelan ammonites.

In selecting species to be included in this monograph, careful attention has been given to the determination of the precise stratigraphical interval from which they were collected. This not only has an important bearing on the taxonomy but also facilitates comparisons with assemblages from elsewhere in the world. Whenever possible, an attempt has been made to establish the relationship between the Venezuelan assemblages and those described from Europe, North Africa, The Middle East, Madagascar and West Africa, notably Nigeria,

Source of the material

The specimens used in this study and compilation have been brought together from a variety of sources. An important source was the material collected over a number of years by geologists employed by the former *Compañía Shell de Venezuela, Ltd.* whose documentation in terms of the locality and stratigraphic position of each sample was exemplary.

In 1949 a large collection of specimens from the La Luna Formation of the States of Trujillo and Lara was made by J.D. De Jong. These were provisionally described and identified by Professor M. Breistroffer of Grenoble in the same year.

During the following year, well preserved ammonites were collected from the La Puya Formation. This material, which is lodged in the Basel Museum of Natural History, was studied originally in the years 1968–1972 by O. Renz and more recently revised for the purpose of this monograph.

Materials from the *Serranía del Interior* in eastern Venezuela comes from two sources. A few specimens from the Valle Grande Formation (Aptian) collected in 1954 by E. Rod and W. Maync were used. Most, however, come from a collection made in 1972 by H.A. Guillaume.

In order to supplement the existing material, selective collecting of ammonites, mainly from Turonian and Coniacian outcrops in the Andes was undertaken in the years 1979 and 1980 by O. Renz assisted by F.A. Galea Alvarez and C. Villalobos.

Abbreviations and depositories of material

The following abbreviations are used to indicate the source of the material:

BM – British Museum (Natural History), London

MBJ – Museum of Natural History, Basel

MPI – Ministerio de Energía y Minas, Caracas

Gu – H.A. Guillaume, *Compañía Shell de Venezuela*

JG – J.D. de Jong, *Compañía Shell de Venezuela*

Re – O. Renz, *Compañía Shell de Venezuela* and *Maraven S.A.*, Caracas

VK – G.H. Voorwijk, *Compañía Shell de Venezuela*

J – Museum of Natural History, Basel. Casts of specimens deposited with *Maraven*, Caracas

All specimens collected by geologists from the former *Compañía Shell de Venezuela, Ltd.* are deposited with *Maraven, S.A.*, Caracas.

Material collected by Prof. Reinhard is deposited in the "Musée d'Histoire Naturelle Geneva".

Material collected by E. Rod is deposited in the Museum of Natural History, Basel.

Measurements are abbreviated as follows:

Dm – diameter; Wh = whorl height; Ww – whorl width; U – umbilicus. All measurements are given in millimeters. Dimensions such as percentage of diameter follow in parentheses.

Preparation and illustration of the ammonites

The time-consuming task of extracting the specimens from the matrix and the detailed preparation was undertaken by the author. In order to highlight the morphological details, particularly of those forms possessing little ornamentation, the specimens were given a light coating of ammonium chloride.

In only a few cases could the ammonites have been illustrated in their living positions as the peristome is seldom preserved. In the interest of consistency and to facilitate comparisons, all specimens have, instead, been illustrated in the accepted conventional position.

Acknowledgments

The initiative to produce a monograph of the Cretaceous ammonites of Venezuela came from the staff of the Exploration Department of *Maraven, S.A.* in Caracas. The request that I should undertake the task was conveyed to me in June 1978 by *Maraven's* Exploration Manager, Dr. H. Krause.

The two visits to Venezuela, in 1979 und 1980, gave me the opportunity to study reports and to carry out the necessary additional investigations in the field. Costs incurred during these visits were met by *Maraven*.

A monograph such as this could not have been produced without the cooperation of others. In the first place I would like to thank Dr. H. Krause, for his hospitality, encouragement and advice during my visits to Venezuela. The field work was done in the company of geologists employed by *Maraven*, notably Dr. P. Bartok, Dr. A. Mozetic and Dr. V. Pumpin. Their local experience was of benefit and many of their suggestions have been incorporated in this monograph. I am grateful to Mr. C. Villalobos and Miss F.A. Galea Alvarez of *Maraven's* Paleontological Laboratory for their assistance both in the collecting of additional ammonite specimens and in furnishing me with stratigraphic data.

I acknowledge also the friendly cooperation of Dr. J. Fierro and Dr. F. Rondón, both geologists with the "Ministerio de Energía y Minas". It was they who

introduced me to the modern ideas on the structural geology of Western Venezuela.

I express my gratitude and admiration for the peasants living in the regions investigated, whose kindness and hospitality facilitated my work in the field.

All the laboratory work including specimen preparation and photography was carried out at the Museum of Natural History, Basel. Thanks should be extended to the Museum authorities and in particular to Dr. P. Jung, Director of the Museum's Geological Department whose constructive criticism and advice has been greatly valued.

Special thanks are due to Mr. R. Panchaud, the very experienced curator of the Museum, for his numerous helpful suggestions and practical assistance.

The exceptionally high quality of the photographs included in this monograph demonstrate the ability and skill of Mr. W. Suter of the Museum's photographic laboratory. I am greatly indebted to him for his many hours of patient work.

Much of the burden of tracing literature references and securing copies from many parts of the world has been assumed by Mr. Ch. Scherler, the librarian of the Natural History Museum. I am grateful for his unselfish efforts on my behalf.

I wish to record my thanks to Dr. E. Lanterno of the "Musée d'Histoire Naturelle", Geneva, for lending me the ammonites collected from the Aptian of Eastern Venezuela by Prof. M. Reinhard.

The important responsibility assumed by Dr. P.H. Rowlands of coordinating the various phases involved in the production of this monograph deserves a special mention. He also played a significant role in reviewing and editing the manuscript.

I would lastly like to acknowledge the part played by Dr. P. Soder in editing the text and by Dr. C. Petzall in translating the monograph to produce the Spanish edition.

B. Historical review of ammonite studies in Venezuela

The famous explorer and scientist A. von Humboldt can be credited with being the first to record views on Venezuelan geology. During his journeys through Venezuela, Colombia and Peru in the years 1799 to 1804, von Humboldt observed the rocks which make up the Andes and sought to explain the genesis of that impressive mountain range. He was particularly fascinated by phenomena related to volcanism, though he did not neglect the study of the distribution and succession of sediments and of their fossil content. His observations on the geography and geology of the entire area were elaborated in Paris between 1808 and 1827 and published in 30 volumes under the title: "Voyage aux régions équinoxiales du Nouveau Continent fait en 1799-1804". This was subsequently translated into Spanish by L. Alvarado (1941-1942).

In Venezuela, von Humboldt explored the Andes of Mérida and Trujillo (Pico Niquitáo), the Serranía del Interior of eastern Venezuela (Cueva de los Guácharos) and the Orinoco valley as far south as the Casiquiare region. A collection of fossils assembled by von Humboldt was brought to Europe and investigated by Leopold von Buch (1839). Five ammonite species and some bivalves from Peru and Colombia were described and figured, but none from Venezuela. Half a century elapsed before the first Venezuelan ammonites were collected and described.

In 1849, Herman Karsten studied the geography and geology of parts of Colombia and Venezuela and compiled his observations in a map that was published in 1850. From the Serranía del Interior Karsten (1850, p.348) mentions fossils from the Cerro de Los Pilonés (State of Sucre), namely ammonite fragments, belemnites and inoceramids which he collected in dark shales containing elliptical concretions. These deposits may be considered to be part of what subsequently became known as the Querecual Formation. When crossing the north-eastwards plunging chain of the Andes in the State of Lara, between the town of El Tocuyo and the plain of Carora, Karsten reached the broad synclinal depression of Barbacoas. It was here, in the vicinity of Barbacoas village, that he discovered for the first time complete specimens of Venezuelan ammonites. They were found in a dark blueish limestone which is widely exposed in that depression and which, according to his observations, is similar to the limestones in the Serranía del Interior.

In April 1849, the fossils collected by Karsten were shipped from Puerto Cabello to Berlin, where Leopold von Buch recognized the following species (1850, p.341): *Ammonites inflatus* Sowerby = *Mortonicerias inflatum* (J. Sowerby)

Ammonites varicosus Sowerby = *Hysterocheras varicosum* (J. Sowerby)

Ammonites Hugardianus d'Orbigny = *Neoharpoceras hugardianum* (d'Orbigny)

Ammonites Mayorianus d'Orbigny = *Puzosia mayoriana* (d'Orbigny)

Ammonites Roissyanus d'Orbigny = *Oxytropidoceras* (O.) *roissyanum* (d'Orbigny)

Ammonites Tucuyensis von Buch = *Anapuzosia tucuyensis* (von Buch)

Ammonites Tucuyensis von Buch actually is the first ammonite to be described from Venezuela (von Buch, 1850, p.342, figured on plate 10). The holotype here figured (Text fig. 1) is deposited at the Humboldt University in East Berlin. L. von Buch recognized the remarkable similarity between this ammonite assemblage from the Venezuelan Andes and those known at that time from Europe. He wrote:

"Mit nicht wenig Überraschung wird man durch diese Reste von Seethieren ganz wieder nach Europa versetzt, und mehr als es jemals von den Produkten irgend einer andern Gegend von Amerika geschehen ist. Man glaubt eine Sammlung der Versteinerungen aus den hohen Alpen von Savoyen vor sich zu sehen, die Produkte der bekannten Montagne de Fiz oder aus dem Val d'Hilliers in Wallis, oder gar von der Perte du Rhône bei Genf."

When A. Wegener formulated his continental drift hypothesis in 1929 he had no knowledge of these far-sighted supporting remarks.

At present we may assume that most of the ammonites were obtained by Karsten from a limestone layer that forms the top of the late Albian La Puya Formation, which overlies the Albian Peñas Altas Formation.

In 1886, 36 years after his journey, Karsten published his observations from Ecuador, Colombia and Venezuela and figured additional ammonites from his Venezuelan collection. They are:

Ammonites Leonhardianus Karsten (Trujillo), pl. 2, fig. 5 = *Paralenticeras leonhardianum* (Karsten)

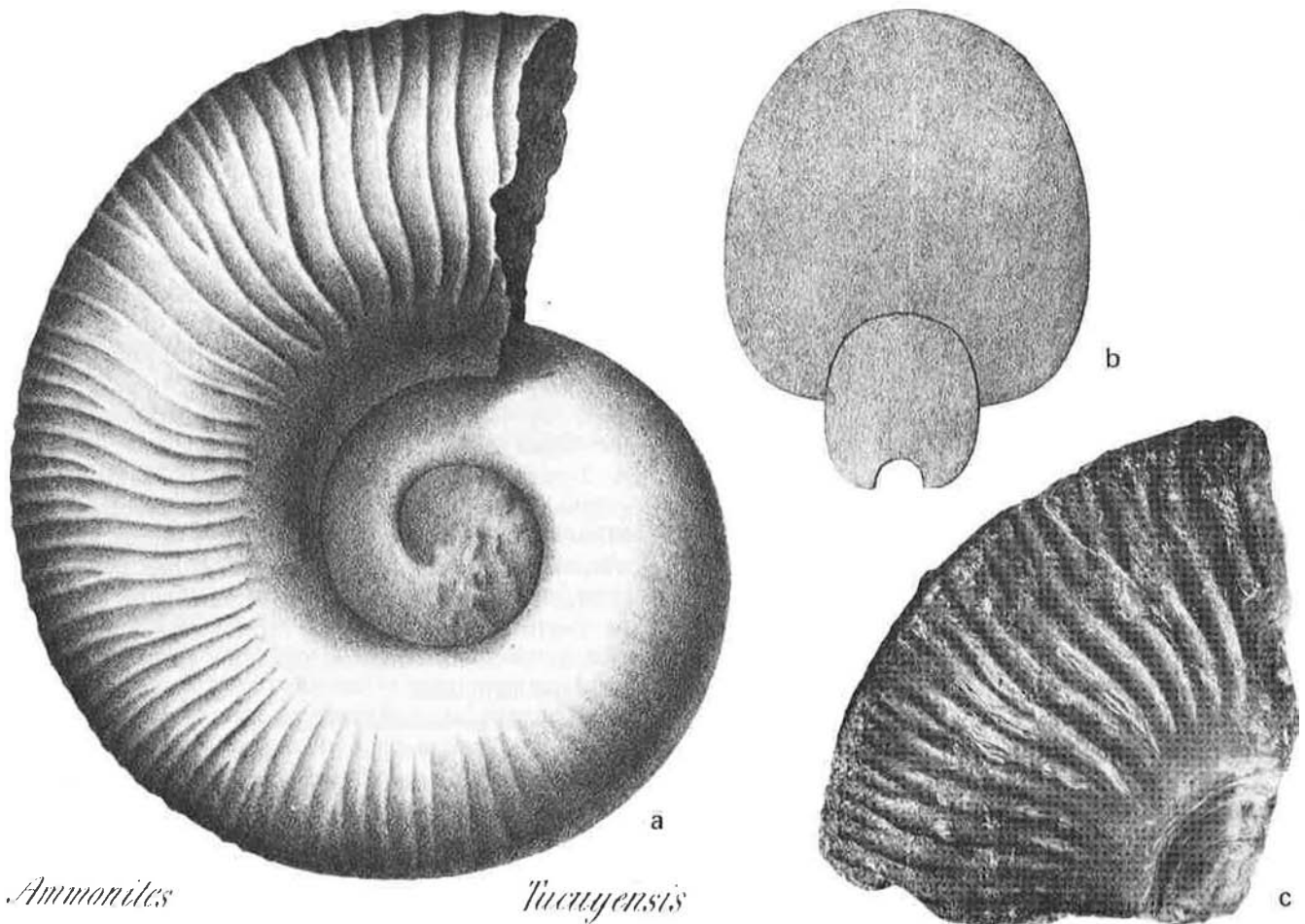
Ammonites Toroanus Karsten (Barbacoas), pl. 4, fig. 2 = *Vascoceras* sp.

Ammonites Ospinae Karsten (Barbacoas), pl. 4, fig. 3 = *Acanthoceras ospinae* Karsten (Bürgl, 1957, p. 137)

Ammonites Mosquerae Karsten (Barbacoas), pl. 4, fig. 4 = *Benueites mosquerae* (Karsten)

Ammonites Barbacoensis Karsten (Barbacoas), pl. 4, fig. 5 = ? *Harleites barbacoensis* (Karsten)

Karsten, in his discussion of the fossil occurrence, comments that "Les sphéroïdes renferment au centre une coquille". From this it may be deduced that the ammonites originate from the middle and upper part of the La Luna Formation, more specifically from the Chejendé



Text fig. 1
Puzosia (Anapuzosia) tucuyensis (von Buch), 1850
 a-b. Reproduction of holotype.
 c. Holotype in collection Karsten, Humboldt University, East Berlin.

and Timbetes Members which overlie the Aguada Member in the States of Trujillo and Lara. In these members, fossils are typically found within limestone concretions.

The geographer W. Sievers visited the Venezuelan Andes in 1884-85 and compiled his observations in a geological map and in 11 cross-sections published in 1888. His section 11 follows the trail which at that time connected El Tocuyo with the Hacienda Montevideo in the Carora plain. It already reflects some of the main regional tectonic features of the area. In an appendix to Sievers' publication, G. Steinmann (1888, p.36-38) gave the following determinations from Sievers' collection from the "Schichten von Barbacoas":

Schloenbachia inflata Sowerby = *Mortoniceras inflatum* (J. Sowerby)

Schloenbachia varians Sowerby = *Schloenbachia varians* (J. Sowerby)

Schloenbachia cf. *Belknapi* Marcou = ? *Oxytropidoceras (Venezoliceras)* cf. *robustum* Renz

Steinmann (p.37) assigned a late Albian age to this assemblage and compared the limestone at Barbacoas with lithologically similar, dark, *Exogyra*-bearing lime-

stones which outcrop in Táchira (probably the upper Turonian Guayacán Member which is part of the ill defined "Capacho Formation" of Sievers). Additional material collected by Sievers in the State of Táchira, near the town of Rubio was described by K. Gerhardt (1897a). It includes ammonites indicating a late Coniacian to Santonian age (*Texanites texanus*) which have not been found in other parts of Venezuela. This fauna is composed of:

Mortoniceras texanum Roemer = *Texanites texanus* (Roemer)

Mortoniceras canaense Gerhardt = *Peroniceras canaense* (Gerhardt)

Gauthiericeras Lenti Gerhardt = *Gauthiericeras lenti* (Gerhardt)

Amaltheus Sieversi Gerhardt = *Paralenticeras sieversi* (Gerhardt)

Lenticeras Andii Gabb = *Lenticeras andii* Gabb

Gerhardt (1897b) tried to compare ammonite assemblages from Venezuela with those of Colombia and Peru. In a table (p.68) the ammonite bearing limestones of Barbacoas are interpreted as "upper Gault" and as time equivalent with the formations containing *Schloenbachia acuto-carinata* Shumard, 1853 = *Oxytropidoceras (Venezoliceras) acutocarinatum* (Shumard) in Colombia and Peru. The interval containing *Lenticeras andii* (Gabb) in Peru was correlated with the respective interval in Venezuela, at present regarded as a limestone corre-

sponding to the lower part of the La Luna Formation (upper Turonian to basal Coniacian), intercalated between the Guayacán Member below and the Táchira chert Member above.

In a revision of the genus *Mortoniceras* of the Gault, C. Stieler (1920, p.392) restudied Karsten's collection from the Barbacoas region. He recognized:

Inflatoceras inflatum Sowerby = *Mortoniceras inflatum* (J. Sowerby)

Inflatoceras Bouchardianum d'Orbigny = *Dipoloceras bouchardianum* (d'Orbigny)

and established the following two new species:

Oxytropidoceras venezolanum Stieler (p.394) and

Oxytropidoceras karsteni Stieler (p.395)

It is almost certain that Karsten obtained all these species from the present La Puya Formation. *Dipoloceras bouchardianum* probably represents one of the broad, strongly tuberculated species of *Oxytropidoceras* (*Venezoliceras*).

The region of Barbacoas was visited by C. Wiedenmayer in 1937. He correlated the fossiliferous limestones of the present La Puya Formation with the El Cantil Formation (Albian-Cenomanian) of Liddle (1928) which is exposed in the Serranía del Interior and distinguished the following species:

Mortoniceras inflatum (J. Sowerby)

Mojsisoviczia dürfeldi (Stieler)

Venezoliceras venezolanum (Stieler)

Lyelliceras ospinae (Karsten)

The first three species mentioned originate from the La Puya Limestone. *Lyelliceras ospinae* possibly was collected from the Aguada Member of the La Luna Formation (Cenomanian), and, according to Bürgl (1957, p.137, pl.12, fig.5) would be an *Acanthoceras*.

The first ammonites from the Serranía del Interior (State of Monagas) were collected by M. Reinhard in 1922 (p.13) from a conspicuous shale sequence intercalated between the Taguarumo Formation (von der Osten, 1955, p.139) and the El Cantil Formation, which has been referred to as García Formation by H. Guillaume (1972, p.1628). The fossil locality is situated near Pico García (type locality of the García Formation), 6 km north of Aragua de Maturín. L. Collet (1922, p.16) who investigated Reinhard's collection, recognized:

Uhligella Zürcheri Jacob = *Beudanticeras zuercheri* (Jacob)

Saynella bicurvata Michelin = *Aconeceras* sp.

Acanthoplites crassicostratus d'Orbigny = *Colombiceras* sp.

Neocomites (Hoplites) furcatus Sowerby = *Dufrenoyia* sp.

Parahoplites Deshayesi Leymerie = *Burckhardtites* sp.

Parahoplites sp. (four species)

Douvilleiceras Martini d'Orbigny = *Chelonicerases* sp.

Lytoceras aff. *anysoptycum* Uhlig = ?*Tetragonites* sp.

From this assemblage Collet could confirm the presence of Aptian sediments in the Serranía del Interior. He also discussed the similarity of the Alpine-Mediterranean ammonite faunas of Aptian age with that of Venezuela (see also von Buch, 1850).

The ammonites collected by Karsten in the Perijá foothills were again studied by W.O. Diedrich (1924) who for the first time mentioned *Barroisiceras haberfellneri* (Hauer), from the upper part of the La Luna Formation (Coniacian).

In his comprehensive compilation of the geology of Venezuela R.A. Liddle (1928) mentioned some additional ammonite localities from Táchira (p.168) and from the Perijá foothills (Quebrada La Luna, p.174).

In 1937, L. Kehrer collected *Sphenodiscus lenticularis* Hyatt from the Mito Juan Member at the top of the type section of the Colón Formation in the Río Lobaterita (at Peña Negra, about 1 km northwest of the town of Colón; fig.1, 3, p.48), thus confirming the Maastrichtian age of the upper Colón. The determination was made by A. Tobler in Basel. Kehrer extensively studied stratigraphic sections of the Cretaceous in Táchira (fig.1), Mérida (fig.4), Trujillo (fig.5) and Lara (fig.6), however, without finding ammonites and thus failed to obtain a satisfactory basis for correlating his lithological units.

M. Gerth (1941, p.341-352), in his compilation of the geology of South America, restudied Karsten's ammonites and mentioned:

Prionocyclus barbacoensis (Karsten)

Mortoniceras (Pervinquieria) inflatum (Sowerby)

Mortoniceras varians (Sowerby) = ?

Oxytropidoceras cf. *belknapi* (Marcou)

Mojsisoviczia dürfeldi Steinmann = *Mojsisoviczia dürfeldi* Steinmann

Venezoliceras venezolanum (Stieler)

Lyelliceras ospinae Karsten

A few additional ammonites, according to Gerth, would indicate levels older than Albian, namely:

Psilotissotia leonhardiana (Karsten) = *Paralentoceras leonhardianum* (Karsten)

Pseudohaploceras toroanum (Karsten) = *Vascoceras* sp.

Ammonites gen. nov. *mosquerae* Karsten = *Benueites mosquerae* (Karsten)

A pre-Albian age of these species seems unlikely. It is more probable that these species originate from Turonian sediments (upper part of Chejendé Member of the La Luna Formation).

A comprehensive paper by F.H. Sutton (1946) gives the first description of Aptian ammonites of the Apón Formation in the Perijá mountain front. A.A. Olson (unpublished report) determined:

Deshayesites columbianus Riedel (pl.3, fig.1)

Deshayesites cf. *stutzeri* Riedel (pl.3, fig.7)

Parahoplites cf. *inconstans* Riedel (pl.3, fig.4)

From the La Luna Formation, Sutton (p.1650) listed a number of species which, according to him, indicate an early Turonian age (*Eucalycoceras*, ?*Prionotropis*, *Hoplites*, *Barroisiceras*, *Neoptychites*), late Turonian (*Coilopoceras*, ?*Discohoplites*, ?*Protacanthoceras*), and Coniacian (*Peroniceras*, *Barroisiceras*).

The discovery of middle Albian ammonites in the uppermost part of the Chimana Formation by Hedberg and Pyre (1944a, p.9, 1944b) was of regional importance. They were found just below the disconformable contact

with the overlying Querecual Formation (Hedberg, 1937a, b). R.M. Imlay identified *Oxytropidoceras* cf. *carbonarium* (Gabb) = *O. acutocarinatum* (Shumard) indicating a late middle Albian age.

After the Second World War, when oil was discovered in the Cretaceous of the Maracaibo Basin, a more detailed investigation of the Cretaceous exposed along the Perijá foothills and in the Andes became necessary. Accurate information regarding the exact stratigraphic position of ammonite and other fossil occurrences was still lacking at that time. For sound age determinations of lithologic units, ammonites proved to be of decisive importance. Foraminifera are generally poorly preserved and can only be studied in thin sections in the hard, often recrystallized, limestones. Therefore they play a subordinate role in age determination.

A revision of the Cretaceous sections along the Perijá foothills and in the Serranía del Interior of eastern Venezuela, by Rod and Maync (1954), greatly improved the understanding of the stratigraphy and their findings served as a basis for later investigations. From the Serranía del Interior Maync studied foraminifera and ammonites which were collected in great number from the Borracha Formation by Rod (Rod and Maync, 1954, p.232). From there the genera *Chelonicer* and *Colombicer* were determined by L. F. Spath (p.265). From the lower part of the Valle Grande Formation (Rod and Maync, 1954, p.239) characteristic species belonging to *Hypacanthoplites*, *Megalytoceras*, *Dufrenoyia*, *Aconoceras*, *Chelonicer* and other genera indicate a late Aptian age (*martinioides* Zone). Some Albian genera, such as *Beudanticeras* and *Puzosia*, determined by B. W. Imlay, originate from the Chimana Formation.

Cretaceous rocks of the Venezuelan Andes and the Perijá foothills were further studied by O. Renz, between 1955 and 1958. He discovered a considerable number of new ammonite localities, which provided a sounder basis for

the correlation of lithological units (O. Renz, 1956, 1958, 1959a, 1977). He found for the first time Aptian ammonites belonging to the genus *Roloboceras*, in the upper part of the Tibú Member, in the States of Táchira (Seboruco section, Text fig.3, section 16) and Mérida (Egido). In 1968-72 he investigated the late Albian ammonite fauna of the La Puya Formation from Barbacoas in the State of Lara (Renz, 1968, 1970, 1971, 1972). Here the genera *Mortoniceras*, *Hystero*, *Oxytropidoceras* (*Venezolicer*), *Anapuzosia*, *Desmoceras* and *Parengonoceras* predominate, whereas *Goodhallites* and *Neophlycticeras* are only sporadically observed.

Our knowledge of Venezuelan ammonites was greatly enhanced by H. Guillaume's (1972) investigation of the lower Cretaceous stratigraphy in the Serranía del Interior in 1958-60. The ammonites which he collected were determined by C.W. Wright of the British Museum (London) and the foraminifera (from about 500 samples) by H. Bolli and J.P. Beckmann of the Federal Institute of Technology (Zürich). This resulted in a reliable chronostratigraphic correlation of ammonite and foraminiferal faunas.

The late Aptian *Chelonicer martinioides* Zone and the overlying *Ch. subnodosocostatum* Zone correspond to the *Bioglobigerinella barri* and *Praeglobotruncana infracretacea* Zones. Within the Albian, the *Douvilleicer* *mammillatum* (early Albian) and the *Hoplites dentatus* Zones (middle Albian) can be distinguished. They belong to the *Praeglobotruncana rohri* and *Neobulimina subcretacea* Zones, respectively (Guillaume et al., 1972, p.1640). Part of the ammonites collected by Guillaume are described and figured in this monograph.

A detailed compilation of the geology of Venezuela and its oil-bearing basins was published by González de Juana et al. in 1980. This publication became available when the present study was terminated and could not be considered.

C. Aptian Stage

1. Stratigraphic review

a) Western Venezuela: Perijá Range and Andes (Text fig. 2-4)

During the Early Cretaceous the *Maracaibo Platform* was a stable featureless peneplain over most of which old metamorphic rocks were exposed. It was bound towards the west and southeast by rapidly subsiding trough regions which were gradually filled by thick, predominantly coarse-grained terrestrial to fluvio-deltaic deposits, referred to as *Río Negro Formation* (Hedberg, 1931). The clastic material was partly derived from the Maracaibo Platform and partly from the Guayana Shield. Locally, supply from the Santander Massif (in Colombia) is also possible. On the Maracaibo Platform, the Río Negro Formation is reduced to a basal conglomerate which is mainly composed of well-rounded quartz pebbles and represents the early transgressive phase of the Cretaceous. Age-indicative fossils are not known so far from the Río Negro Formation.

The subsiding area west of the Maracaibo Platform, in the Perijá Range, is known as the *Machiques Trough* (Sutton, 1946). The infill of this trough is exposed in the Perijá mountain range of Venezuela, in the area between the rivers Santa Rosita to the north and Cusare to the south.

The *Uribante Trough* (Renz, 1956) in the Andes forms the northeastern termination of the Colombian Cretaceous basin in the Cordillera Oriental. The northwestern part of this basin continues into the Perijá Range (Machiques Trough) and the Guajira Peninsula.

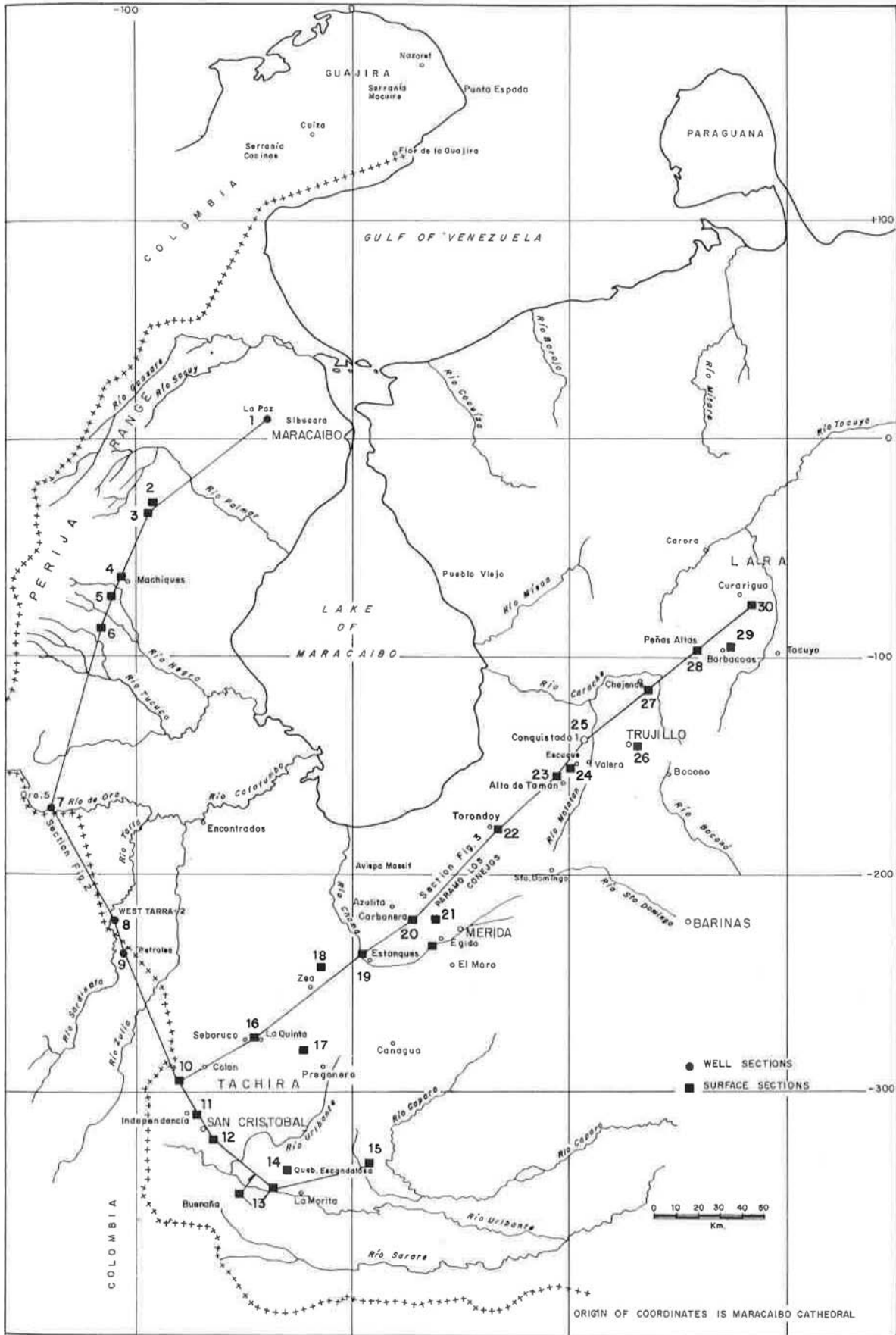
It may be assumed that the trough areas underwent a progressive regional subsidence, beginning during the Late Jurassic to Early Cretaceous in Colombia, and during the Early Cretaceous in the Venezuelan Andes and the Perijá Range. During the Aptian the Maracaibo Platform began also to subside gradually. After the initial transgression by the sea and the deposition of the clastics, a sheet of lithologically and faunistically uniform shallow-water carbonates accumulated in a well-aerated environment, at a level probably just below wave action. These carbonates were originally named the Tibú and were designated as a member of the Uribante Formation by Notestein et al. (1944). Sutton, 1946, p. 1642, incorporated the present Tibú Limestone in his Apón Formation. Renz (1956) suggested that the Tibú should instead be considered as a member of the Apón Formation (Sutton, 1946, p. 1642) and in 1959 he favoured the elevation of the Tibú in the Perijá Range and the Andes to a formation status.

Within the trough areas the *Tibú Formation* reaches thicknesses of several hundred meters. On the Maracaibo Platform as well as on the *Mérida Swell* (a pre-Cretaceous basement uplift coinciding with the highest present-day elevations of the Andes in the State of Mérida) the Tibú is thin, ranging up to 50 m. In the impressive section where the Cretaceous can be seen transgressing over metamorphic basement on the *Páramo de los Conejos* (4000 m above sea level) north of Mérida, the Tibú, containing *Choffatella*, has a thickness of less than 10 m. It is conformably overlain by the Guáimaras Shale of late Aptian to early Albian age (Renz, 1959a, fig. 6, section 3).

The Tibú in western Venezuela is characterized by light to dark grey, well layered, micritic limestones rich in skeletal particles and interbedded with grey marly limestone and marls. Southeastwards in the direction of the Guayana Shield the character changes in that clastic material constitutes a progressively greater part of the interval. The fauna consists predominantly of benthic organisms typical for a well-aerated shallow marine environment; thick shelled pelecypods and echinids are abundant, whereas corals and photosynthesizing algae are absent. *Choffatella decipiens* Schlumberger (Maync, 1949) is the most common foraminifer. *Orbitolina* has not been observed. A comprehensive search has failed to yield ammonites indicative for the Barremian. The oldest forms are sporadic occurrences of the ammonite genus *Roloboceras* (known throughout the lower Aptian in England) which are restricted to the upper part of the formation in the States of Táchira and Mérida (Renz, 1959a). The exact position of the Barremian-Aptian boundary thus remains undetermined.

The Tibú extends eastwards as far as the Loma León mountain range, situated 10 km southwest of Barquisimeto, which is interpreted by Renz (1960) to be an autochthonous fault-block along the Boconó fault system.

In the Machiques Trough area a closed subsiding anoxic basin developed during the later Aptian, creating favourable conditions for the generation of oil source rocks. Here, bituminous, dark/blue-grey, homogeneous, dense, micritic platy limestones, which contain abundant concretions were deposited. This conspicuous lithological unit has been designated as *Machiques Member* by Renz (1959a). Lithologically, the interval can hardly be distinguished from the La Luna Formation (Turonian-Coniacian), higher in the section. In addition to an abundance of fish remains, the concretions contain a well-preserved assemblage of Aptian ammonites, the majority belonging to the genus *Deshayesites*. The fossils were first figured by Sutton (1946).



Text fig. 2
 Location of Cretaceous well and surface sections in western Venezuela mentioned in Text fig. 3 and 4.

shale interval might be connected with subaquatic erosion and respective accumulation.

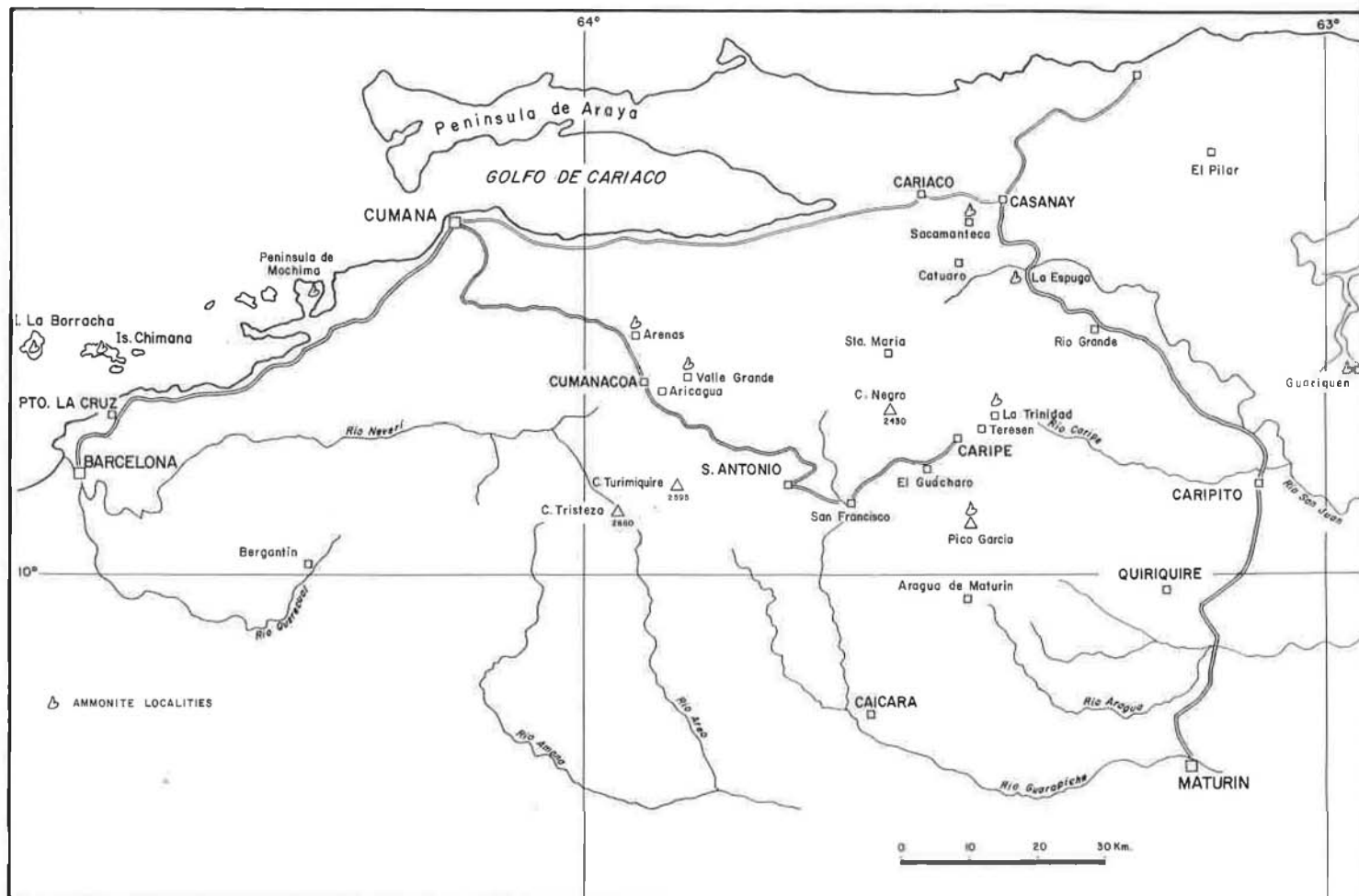
Because of the poorly preserved microfauna and the scarcity of ammonites in the overlying Albian, the limit between Aptian and Albian remains undetermined in the sections along the Perijá as well as in the Andes. According to its stratigraphic position the age of the Guáimaras Shale may be late Aptian to early Albian.

In the Cretaceous section exposed in the Cordillera de la Costa, Aptian ammonites have only been found at Quebrada Onoto, a tributary of the Río Cura, in the State of Aragua. They belong to the genus *Chelonicer*s and indicate a late Aptian age. They occur in an unmetamorphosed limestone sequence which probably is time-equivalent to the Agua Blanca Formation further west (Renz and Short, 1960, p. 289).

It should be noted that since the Piché, Machiques and Guáimaras were defined as members by Renz in 1959a, the author has reconsidered their stratigraphic status and would now prefer to elevate them to Formations. For this reason they are indicated as Formations in the text figures, and in the text hereafter.

AGE	FORAMINIFERA	AMMONOIDEA	STRATIGRAPHY
CENOMANIAN	ROTALIPORA APPENNINICA		N QUERECUAL FORMATION
	ROTALIPORA TICINENSIS		
LATE ALBIAN	NEOBULIMINA PRIMITIVA		NO SEDIMENTATION LOCAL EROSION
	PRAEGLBOTRUNCANA PLANISPIRA		
MIDDLE ALBIAN	NEOBULIMINA SUBCRETACEA	HOPLITES DENTATUS	CHIMANA FORMATION
EARLY ALBIAN		DOUVILLEICERAS MAMMILLATUM	EL CANTIL FORMATION
	PRAEGLBOTRUNCANA ROHRRI		
LATE APTIAN	PRAEGLBOTRUNCANA INFRACRETACEA	CHELONICERAS SUBNOODOSOCOSTATUM	GARCIA FORMATION
	BIGLOBIGERINELLA BARRI	CHELONICERAS MARTINI	
	BIGLOBIGERINELLA cf. BARRI		
EARLY APTIAN TO BARREMIAN	CHOFFATELLA DECIPIENS		BARRANQUIN FORMATION

Text fig. 5
Stratigraphic nomenclature of the Cretaceous in the Serranía del Interior, based on H. A. Guillaume, H. M. Bolli and J. P. Beckmann (1972).



Text fig. 6
Location map of Aptian and early Albian ammonite localities in the Serranía del Interior.

b) Eastern Venezuela: Serranía del Interior (Text fig. 5-6)

In the Serranía del Interior (States of Sucre and Monagas) ammonite-bearing rocks of Aptian age are more favourably developed than in the west of Venezuela.

The oldest Cretaceous sediments belong to what was once referred to as the *Barranquín Formation* (Liddle, 1928), which consists of orthoquartzite interbedded with black-silty shales and thick beds of predominantly biostromal limestones. The age of the succession has been indicated as Barremian to early Aptian (Guillaume, 1972, p.1624). Towards the north, the upper part of the Barranquín laterally grades into the *Taguarumo Formation* (von der Osten, 1955, p.139; Guillaume, 1972, p.1625). The exposed part of this formation reaches a thickness of 250 m according to Guillaume. It consists of thickly bedded rudist-biostromes, calcarenites, oolites and algal limestones. *Choffatella decipiens* is abundant and the presence of *Orbitolina* has been recorded. No determinable ammonites have been found.

The Barranquín to the south, and the Taguarumo Formation developed farther north, are overlain by an ammonite-bearing shale interval referred to as the *García Formation* by Guillaume (1972). The thickness of this shale interval increases northwards to as much as 150 m. Its rich fauna of ammonites, described in this monograph, indicates that it falls within the *Chelonicerases martinioides* Zone of late Aptian age.

The microfauna from the García Formation corresponds to the *Bioglobigerinella barri* and the *Praeglobotruncana infracretacea* Zones according to Bolli and Beckmann (in Guillaume, 1972).

Towards the north, the García Formation laterally grades into the lower part of the Valle Grande Formation (Rod and Maync, 1954) which is characterized by the abundance of glauconite present in shales, quartz sands and carbonates. At the type locality, the Valle Grande overlies the Barranquín Formation and farther north the Taguarumo Formation. Here, the ammonite fauna consists of the genera *Valdedorsella*, *Beudanticeras*, *Aconeceras*, *Diadochoceras*, *Gargasiceras*, *Colombiceras*, *Acanthohoplites*, *Dufrenoyia* and *Mathoceras*.

The García Formation is followed by the *El Cantil Formation* (Liddle, 1928; Rosales, 1959) which consists of thick bodies of biostromal limestones (*Guácharo Member*) interbedded with shale layers and sandstones which increase in thickness towards the Guayana Shield and from which ammonites are not known. To the north, the El Cantil grades laterally into the *Valle Grande Formation* (Guillaume, 1972, fig. 1). The age of the heterochronous El Cantil Formation ranges from Aptian in the south to early Albian further north.

2. Systematic description of Aptian ammonites

a) Aptian in the Perijá river sections (State of Zulia) (Text fig. 4)

In the river sections along the Perijá foothills ammonite assemblages of Aptian age were only found in the Machiques Formation which is developed in a La Luna type lithology. They predominantly occur in limestone concretions. These emit a strong oil smell and show positive reactions with chloroform. On breaking the fossils, live oil commonly appears in cavities between calcite crystals. Preservation is good and specimens with tests are generally available. The thick sections of the Tibú Formation (Renz, 1959a and 1977) in the Machiques Trough area, which are believed to be in part of Barremian age, have not yielded any ammonites.

Family Deshayesitidae Stoyanow, 1949

Subfamily Deshayesitinae Casey, 1963

Genus *Deshayesites* Kazansky, 1914

Type species: Ammonites deshayesi Leymerie in d'Orbigny, 1841.

Occurrence: Europe, Caucasus, Georgian SSR (Rouchadzé, 1933), California, Mexico, Colombia, Venezuela, Greenland (Spath, 1946), Queensland.

Casey (1964, p.289) introduced the genus *Neodeshayesites* for forms described by Riedel (1938) from Colombia (type species: *D. stutzeri*, pl.7, fig.5-7). Casey considered those forms 'as a special group, more closely allied to *Dufrenoyia* than to *Deshayesites*'. In Colombia as well as in Venezuela '*Neodeshayesites*' occurs in formations of La Luna lithology, deposited in a very special environment, fundamentally different from environments which prevailed in Europe during Aptian time. We can thus expect that the slight differences in morphology which separate '*Neodeshayesites*' from *Deshayesites* reflect environmental conditions and should not influence taxonomy above species level.

An Aptian age for *Deshayesites* is not supported by additional ammonite genera from the Perijá area. It is only based on the occurrence of *Dufrenoyia* in Quebrada La Gé, within the Cogollo Formation, thus higher in the section than the *Deshayesites* of Quebrada Santa Rosita (Text fig.4).

In the Serranía del Interior identical *Deshayesites* were collected by Guillaume (1972, p.1650) from the lower part of the Valle Grande Formation (lower part of the interval corresponding to the *Chelonicerases martinioides* Zone, Guillaume et al., 1972, p.1648-1650). Wright in

Guillaume (p. 1650) considers those forms as ancestors of *Dufrenoyia* (compare Kemper, 1964). We follow Wright in Guillaume (1972, p. 1650).

Collignon et al. (1979) described similar slightly square-ventered *Deshayesites* from the Aptian in the Santander region in northern Spain.

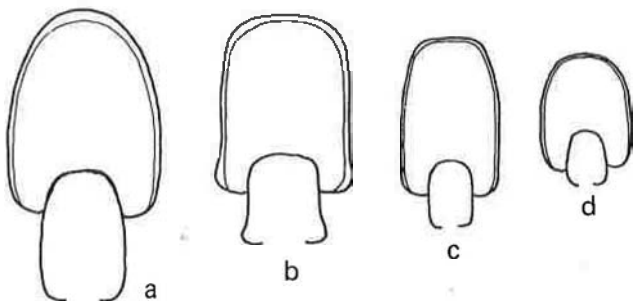
Deshayesites columbianus Riedel
Pl. 1, Fig. 1a-b, 2; Text fig. 7a

- 1938 *Deshayesites columbianus* Riedel, p.40, pl.7, fig.16-20; pl.12, fig.12; pl.14, fig.21.
1946 *Deshayesites columbianus* Riedel, Sutton, pl.3, fig.1-2.
1957 *Colombiceras karsteni* (Marcou), Bürgl, pl.9, fig.1a-c.
1979 *Neodeshayesites columbianus* (Riedel), Etayo-Serna, p.62, pl.9, fig.8; pl.10, fig.7.

Lectotype: *Deshayesites columbianus* Riedel, p.40, pl.7, fig.16, 17, selected by Etayo-Serna, 1979, p.62.

Location: Perijá foothills, Quebrada Santa Rosita (fig.2, section 23 in Renz, 1977), early to late Aptian, Machiques Formation.

Description: MBJ28581 internal whorls. Body chamber last half volution. Peristome simple, initiated by a contraction of the whorl followed by a low collar identical with preceding ribs. Whorl section on body chamber oval. On inner volutions venter almost squared (Pl. 1, Fig.2) thickest below midflank, from there gently converging towards broadly rounded venter (Text fig.7a). Umbilicus 37% of diameter, feebly expanding towards mouth border. Umbilical wall low, fairly steep; umbilical margin narrowly rounded. Costation begins with about 15 mm diameter (Re2699a, Pl.1, Fig.2). Primaries originate low on umbilical wall and cross flank in a prorsiradiate, slightly sigmoidal, curve. Secondaries regularly alternating with primaries, ending near mid-flank. Both cross venter with maximum elevation. Bifurcation or incipient bifurcation occurs occasionally also on body chamber. On last volution 54 ribs occur of which 27 are primaries. Suture line not preserved. Lobe formula: E L U₂ U₃/U₁ I (Schindewolf, 1966, p.684).



Text fig. 7

Whorl sections of *Deshayesites*:

- a. *D. columbianus* Riedel, MBJ28581, Pl. 1, Fig. 1, 1×.
b. *D. ?nodosus* Riedel, Re2699b, Pl. 1, Fig. 3, 1×.
c. *D. rotundus* Riedel, Re2699c, Pl. 1, Fig. 6, 1×.
d. *D. stutzeri* Riedel, Re2699e, Pl. 1, Fig. 5, 1×.

Measurements: Dm 80 mm, Wh 27 (0.35), Ww 20 (0.25), U 30 (0.37)

Specimen Re2699a shows a juvenile stage with late beginning of costation.

Distribution: Colombia, Venezuela.

Remarks: *D. columbianus* appears to be very similar to, if not identical with *C. karsteni* (Marcou), figured by Karsten (1886, pl.5, fig.1a-b), Bürgl (1957, pl.9, fig.1a-c) and Etayo-Serna (1979, p.64, pl.9, fig.2; pl.10, fig.6).

Deshayesites? nodosus Riedel
Pl. 1, Fig. 3a-b; Text fig. 7b

- 1938 *Deshayesites nodosus* Riedel, p.38, pl.7, fig.10-11.

Location: Perijá foothills, Quebrada Santa Rosita, Machiques Formation, early to late Aptian.

Description: Re2699b. Last half whorl belongs to body chamber. Peristome just indicated. Whorl section high subrectangular on costal section, intercostally oval. Venter faintly squared. Sides flattened, parallel, widest on strong umbilical tubercles. Umbilical wall low and steep, narrowly rounding into flank at intercostal section. Umbilicus 35% of diameter. Costation slightly inclined forward. Ribs begin near umbilical seam and branch or incipiently branch from umbilical tubercles which are variable in strength, and placed on umbilical margin. Short intermediate ribs, flattening out near mid-flank, are subordinate. All ribs rise slightly on ventrolateral shoulder, then cross straight over venter. External suture typical for genus.

Remarks: The holotype of *Deshayesites nodosus* from Colombia represents a juvenile stage displaying features characteristic for *Dufrenoyia*. The relation of the present specimen with *D. nodosus* Riedel remains doubtful, this also because the stratigraphic position of *D. nodosus* from Colombia in relation to the Venezuelan specimen is not known.

Measurements: Dm 65 mm, Wh 25 (0.37), Ww 19 (0.30), U 23 (0.35).

Distribution: Colombia, Venezuela.

Deshayesites stutzeri Riedel
Pl. 1, Fig. 4a-b, 5a-b; Text fig. 7d

- 1938 *Deshayesites stutzeri* Riedel, p.37, pl.7, fig.5-9; pl.12, fig.14.
1946 *Deshayesites stutzeri* Riedel, Sutton, pl.3, fig.7.
1964 *Neodeshayesites stutzeri* (Riedel), Casey, p.289.

Lectotype: *Deshayesites stutzeri* Riedel, pl.7, fig.5, 6, selected by Casey, 1964, p.289.

Location: Perijá foothills, Quebrada Santa Rosita, Machiques Formation, early to late Aptian.

Description: Re2699d, adult specimen; Re2699e, juvenile stage without costae on internal whorls. Specific features

differentiating this species from *D. columbianus* are the high whorl section (Text fig. 7d) and the resulting more narrow umbilicus which attains 26% diameter, against 37% in *D. columbianus*. Ribs rise slightly on ventrolateral shoulder, resulting in a slightly squared venter on costal section. Suture imperfectly preserved.

Measurements:	Dm	Wh	Ww	U
Re2669e	35 mm	15 (0.43)	12 (0.34)	9.2 (0.26)
Re2669d	47 mm	20 (0.42)	14 (0.33)	12.5 (0.26)

Distribution: Columbia, Venezuela.

Deshayesites rotundus Riedel
Pl. 1, Fig. 6a-b; Text fig. 7c

1938 *Deshayesites rotundus* Riedel, p. 37, pl. 7, fig. 14-15.

Location: Perijá foothills, Quebrada Santa Rosita, Machiques Formation, early to late Aptian.

Description: Re2699c. Internal mould. Whorl section compressed, highly whorled. Flanks parallel, slightly convex, thickest near mid-flank (Text fig. 7c). Venter subtruncated. Umbilicus with 25% of diameter relatively narrow. Costation fine and densely spaced (29 ribs on half volution). Ribs arise on steep umbilical wall, just above umbilical seam. On umbilical margin ribs elevate into bullate tubercles from which most bifurcate indistinctly, crossing flank in a flexuous curve. Shorter intermediate ribs are intercalated. Faint ribs rise on ventrolateral shoulder, what results in a slight squared venter, not perceptible on holotype from Colombia. All ribs attenuate below mid-flank towards umbilical margin. Suture not visible.

Measurements: Dm 48 mm, Wh 22 (0.46), Ww 13 (0.27), U 12.2 (0.25)

Distribution: Colombia, Venezuela: ..

Genus *Dufrenoyia* Burckhardt, in Kilian, 1915

Type species: *Ammonites furcatus* J. de C. Sowerby, 1831.

Occurrence: Europe, Mexico, Texas, Colombia, Venezuela, Japan (Obate et al., 1975), Madagascar (Collignon, 1962).

Dufrenoyia aff. *furcata* (J. de C. Sowerby)
Pl. 1, Fig. 7a-b

- 1836 *Ammonites furcatus* J. de C. Sowerby, p. 339, pl. 14, fig. 17.
1925 *Dufrenoyia furcata* Sowerby sp., Burckhardt, p. 17, pl. 10, fig. 12-13.
1964 *Dufrenoyia furcata* J. de C. Sowerby, Casey, p. 378, pl. 62, fig. 2-3; pl. 63, fig. 1; pl. 65, fig. 1a-b; Text fig. 134a, 135, 136, cum synon.

Holotype: Hythe Beds, Kent (Fitton, 1847, p. 295). Refigured by Casey, 1964, pl. 62, fig. 2.

Location: Perijá foothills, Quebrada La Gé, from intercalation of dark nodular limestone, 10 cm in thickness and of La Luna facies in the Cogollo Formation, late Aptian.

Description: Re2574. Matrix consists of calcite crystals. Whorl section subtrapezoidal. Sides on costal section bulging below mid-flank, then flattening and converging towards squared venter, bound by narrowly rounded edges. Umbilicus 35% of diameter with low, steep slope, grading into flank. Primary ribs feebly sigmoidal, about radial, broadly rounded and separated by wide interspaces. They begin above umbilical seam. Secondary ribs merge with primaries around mid-flank. Some are free-ending within interspaces. Ribs rise in obtuse tubercles at ventral edges, and then cross straight over venter. Suture destroyed by recrystallisation. For ontogeny of suture line see Michailova, 1957, fig. 2. Lobe formula as on *Deshayesites* (Schindewolf, 1966, p. 688; Wiedmann, 1966, p. 43).

Measurements: Dm 36.5 mm, Wh 13 (0.35), Ww 13 (0.35), U 13 (0.35)

Distribution: England (lower Aptian). According to Casey (1964, p. 380): 'no authentic examples of *D. furcata* have been figured since the time of Sowerby'.

Remarks: The present specimen differs from the holotype by its slightly less sigmoidally curved ribs and by a somewhat denser costation.

The species is absent from the collection of Collet (1922, p. 17); it has been mentioned by Gerth (1935, p. 345) and Liddle (1946, p. 142), but the respective originals are not available.

Dufrenoyia justinae Hill
Pl. 1, Fig. 8a-b

- 1893 *Acanthoceras Justinae* Hill, p. 38, pl. 7, fig. 1-3.
1925 *Dufrenoyia texana* Burckhardt, p. 20, pl. 9, fig. 2-15.
1938 *Dufrenoyia texana* Burckhardt, Riedel, p. 48, pl. 8, fig. 15-19; pl. 14, fig. 25.
1904 *Hoplites furcatus* Sowerby, Lasswitz, p. 4, text fig. 1.
1939 *Dufrenoyia justinae* (Hill), Scott, p. 1022, pl. 60, fig. 7-8; pl. 62, fig. 9.
1949 *Dufrenoyia justinae* (Hill), Humphrey, p. 122, pl. 6, fig. 1-7; pl. 7, fig. 1-9.
1956 *Dufrenoyia texana* Burckhardt, Bürgl, p. 6, pl. 1-3.
1976 cf. *Dufrenoyia justinae* var. *sanctorum* Bürgl, Cantu Chapa, p. 10, pl. 1, fig. 5.

Location: Perijá foothills, Quebrada La Gé, from intercalation of dark nodular limestone, 10 cm in thickness and of a La Luna facies in the Cogollo Formation, late Aptian.

Description: Re2416. Differs from *D. dufrenoyi* (d'Orbigny) by the possession of ribs crossing straight over squared venter without bifurcations, especially on body chamber (compare Humphrey, 1949, p. 122-123). Humphrey united *D. texana* with *D. justinae* from the Río Nazas in Mexico. Bürgl (1956, 1957) maintained the species *D. texana* and distinguished the two varieties

sanctorum (large umbilicus and fewer ribs) and *media* (intermediate between *justinae* and *texana*).

Measurements: Dm 42.5 mm, Wh 16 (0.37), Ww 13 (0.31), U 12 (0.28)

Distribution: Mexico, Texas, Colombia, Venezuela.

b) Aptian in the Andes (States of Táchira and Mérida) (Text fig. 3)

In the Venezuelan Andes cephalopods of Aptian age are very rare and, are apparently restricted to the upper part of the Tibú Formation. Ammonites and some nautili (*Heminautilus etheringtoni* Durham, det. W.S. Adkins; compare Etayo-Serna, 1979, pl. 4, fig. 8; pl. 5, fig. 9) were first observed by Renz in 1949 within the Cretaceous section exposed 2 km east of Seboruco (section 35 on fig. 3, Renz, 1977), situated along the road La Fria-La Quinta (State of Táchira). At that time these ammonites were determined as *Chelonicer*s.

The ammonites lived in a shallow, neritic, well oxygenated environment, just below wave action. They are accompanied by numerous bivalves (mainly *Exogyra*), echinoderms and benthic foraminifera. Corals and algae are absent. The formation consists of hard, micritic, splintery limestones alternating with layers of skeletal limestone of great variety and intercalated with partly nodular marls.

The first collection of fossils was taken to Austin for determination by Dr. Adkins. During a visit to Venezuela in 1979, the author, accompanied by A. Mozetic, obtained additional ammonites which all belong to the genus *Roloboceras* Casey, 1954. In England this genus is restricted to the lower Aptian. In the Seboruco section the age assignment cannot be substantiated by additional ammonites. If an early Aptian age should also prove correct in Venezuela, which is probable, the upper part of the Tibú Formation would be dated as early Aptian. The overlying Guáimaras Shale would thus comprise the late Aptian and probably also part the early Albian. Additional ammonite discoveries might help to clarify the situation.

Family Douvilleiceratidae Parona and Bonarelli, 1897

Subfamily Roloboceratinae Casey, 1961

Genus *Roloboceras* Casey, 1954

Type species: *Ammonites Hambrovi* Forbes, 1845.

Occurrence: Southern England, France, Spain.

Roloboceras saxbyi Casey
Pl. 3, Fig. 1a-b, 2a-b

1961a *Roloboceras saxbyi* Casey, p. 507, 509.

1961b *Roloboceras saxbyi* Casey, p. 188, pl. 30, fig. 1, 2; text fig. 57c-d.

Holotype: *Roloboceras saxbyi* Casey, pl. 30, fig. 1a-b; text fig. 57d, suture.

Location: Estado Táchira, Cretaceous Seboruco section between the villages of Seboruco and La Quinta. Tibú Formation, 10 m below limit of Guáimaras shale Formation, late early Aptian.

Description: Re6801 (Pl. 3, Fig. 11). Internal mould. Whorl section at that size semi-circular, depressed. Costation uniform, rather dense for species. Ribs rounded, as wide as interspaces, crossing straight over venter without modifications. Some unite at umbilical border at poorly defined bulges. On a fragment (Re6906, not figured) representing a juvenile stage, distinct umbilical tubercles are developed. Suture not preserved. According to Schindewolf (1966, p. 674, fig. 412) a second umbilical lobe is not present. The primary suture is quadrilobate (Casey, 1961b, p. 188, text fig. 57). Later in ontogeny a small lobe develops on saddle L/U which might be interpreted as U₃.

Measurements: Dm 140 mm, Wh 83 (0.59), Ww 53 (0.37), U 43 (0.30).

Re6905 (Pl. 3, Fig. 2), a septate fragment with distinctly coarser and wider ribs, approaches the holotype.

Distribution: England, Venezuela.

Roloboceras hambrovi (Forbes) Pl. 2, Fig. 25a-b

1845 *Ammonites Hambrovii* Forbes, p. 354, pl. 13, fig. 4, lectotype.

1921 *Chelonicer*s *hambrovi* (Forbes), Spath, p. 317, pl. 8, fig. 3.

1961b *Roloboceras hambrovi* (Forbes), Casey, p. 179, pl. 29, fig. 5-6; pl. 30, fig. 7-8; pl. 31, fig. 3; pl. 32, fig. 5, with synonymy.

Lectotype selected by Casey, 1961, p. 179.

Location: Section of Seboruco, Tibú Formation, 10 m below Guáimaras Formation, late early Aptian.

Description: Re6906. Septate fragment with four coarse umbilical bulges preserved. Whorl section depressed, semi-circular with vertical umbilical wall. Strong ribs branch from umbilical bulges, variable in strength. Intermediate ribs do not connect with umbilical bulges and fade out in interspaces. Over venter all ribs preserved are equal in strength.

Distribution: England, Venezuela.

c) Aptian in the Serranía del Interior (States of Sucre and Monagas)

All ammonites available were collected from shales of the García Formation and the basal part of the Valle Grande Formation from widely spread localities, by M. Reinhard (1922), E. Rod and W. Maync (1954), and

H.A. Guillaume (1972). They are mostly small-sized moulds consisting of limonite and occasionally of goethite (FeOOH). Tests are generally not preserved. Detailed stratigraphic correlations between ammonite localities may not be correct. Most of the fossils were washed out from shale beds, and their original position in the sections had to be reconstructed. Their age is considered to be late Aptian (Gargasien) probably corresponding to the *martinooides* Zone.

Family Ancyloceratidae Meek, 1876

Subfamily Ancyloceratinae Meek, 1876

Genus *Ancyloceras* d'Orbigny, 1842

Type species: Ancyloceras matheronianum d'Orbigny, 1842.

Occurrence: Europe, USA, Japan, Colombia, Venezuela.

Ancyloceras mantelli Casey Pl. 2, Fig. 24a-b; Text fig. 8a-b

1960 *Ancyloceras mantelli* Casey, p. 21, pl. 1, fig. 3, holotype, pl. 2, fig. 1; pl. 3, fig. 1-2.

Location: Valle Grande Formation type section, 4.5 km east of Cumanacoa, late Aptian. Coll. E. Rod.

Description: MBJ28760. Single, well preserved fragment of inner spiral. Whorl section (Text fig. 8b) as wide as high, suboctagonal in costal section. Widest at smallest dorsal nodes of six-fold-tuberculated ribs which alternate with thinner untuberculated intermediaries. On mould, nodes blunt and rounded, diminishing in size from ventral to dorsal. Over dorsum all ribs subdued in strength. Suture line (Text fig. 8a) complex, with bifid saddles and trifid lateral and dorsal lobes, as typical for the genus.

Family Macroscaphitidae Hyatt, 1900

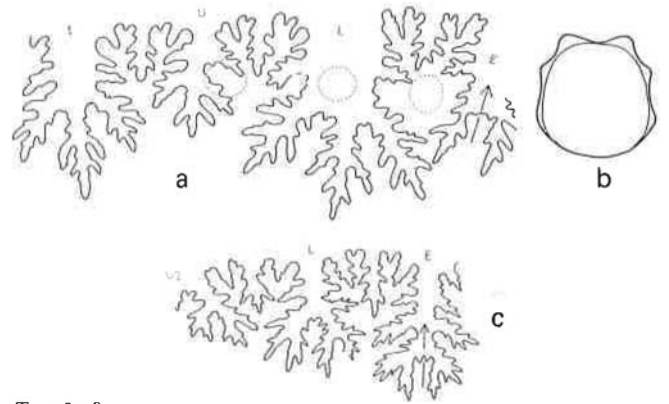
Genus *Macroscaphites* Meek, 1876

Type species: Scaphites yvani Puzos, 1831 (d'Orbigny, 1840, pl. 128, p. 515).

Occurrence: Europe, North Africa, Venezuela.

Macroscaphites cf. *striatisulcatus* d'Orbigny Pl. 2, Fig. 22a-b

1941 *Macroscaphites striatisulcatus* d'Orbigny, p. 153, pl. 39, fig. 4-7.



Text fig. 8

Ancyloceras mantelli Casey, MBJ28760, Pl. 2, Fig. 24

a. Suture line 5×.

b. Whorl section 2×.

c. ?*Jauberticeras* sp., MBJ28762, Pl. 2, Fig. 23, suture line 5×.

1954 *Macroscaphites striatisulcatus* (d'Orbigny). Rod and Maync, p. 270.

A partly deformed, juvenile, untuberculated specimen (Gull179) from the García Formation at Pico García may be compared with d'Orbigny's species *Macroscaphites striatisulcatus*.

Family Gaudryceratidae Spath, 1927

Subfamily Gabbioceratinae Breistroffer, 1953

Genus *Jauberticeras* Jacob, 1907

Type species: Ammonites Jaubertianus d'Orbigny, 1950b.

Occurrence: Spain, France, Caucasus, Madagascar, California.

Jauberticeras sp. juv.

Pl. 2, Fig. 23a-b; Text fig. 8c

Location: Valle Grande, type section of Valle Grande Formation, 4.5 km east of Cumanacoa, Aptian. Coll. E. Rod.

Description: MBJ28762. Single, limonitized, juvenile specimen. Whorl section depressed, with bluntly rounded lateral angle on mid-flank. Venter convex rounded. Umbilicus 53% of diameter, wide for genus. Moderately steep slope from lateral angle towards umbilical seam. Ornament consists of dense, prorsiradiate striae-like ribs on test. On last volution four distinct constrictions. Suture (Text fig. 8c) typical for genus. Asymmetric second umbilical lobe widens to a suspensive lobe $U_2 = S$ (compare Wiedmann, 1962b, p. 68, fig. 23b). The specimen appears to be very closely related to *Jauberticeras subbeticum tyrrhenicum* from Sardinia (Wiedmann, 1968; p. 44, pl. 2, fig. 10), but shows a narrower whorl section.

Family Oppeliidae Bonarelli, 1894

Subfamily Aconeceratinae Spath, 1923

The family comprises the genera *Aconeceras* Hyatt, 1903 and *Sanmartinoceras* Bonarelli, 1921. The latter differs from *Aconeceras* by a distinct falcoid costation. In the present collection, from the Serranía del Interior, only *Aconeceras* is represented.

Genus *Aconeceras* Hyatt, 1903

Type species: Ammonites nesus d'Orbigny, 1841, pl. 55, fig. 7-9.

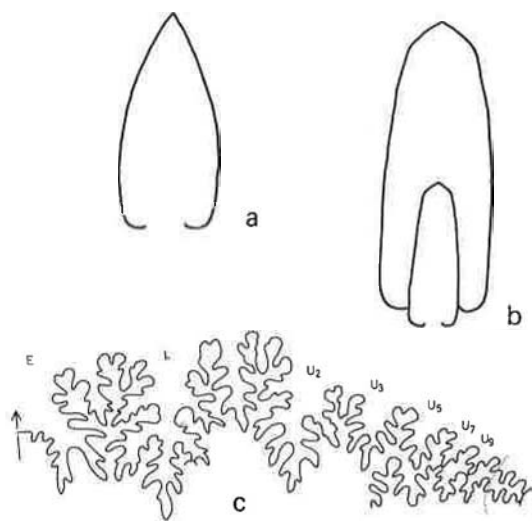
Occurrence: Europe, Madagascar (Breistroffer, 1936a), South Africa (Spath, 1921), Australia (Whitehouse, 1926, 1927).

Aconeceras nesus (d'Orbigny)

Pl. 1, Fig. 15a-b, 19a-b; Text fig. 9a

- 1841 *Ammonites Nisus* d'Orbigny, p. 184, pl. 55, fig. 7-9
 1893 *Oppelia Nisus* d'Orbigny, Sarasin, p. 152, pl. 4-6, fig. 9a-c, Text fig. 1-2.
 1910 *Aconeceras nesus* d'Orbigny, Kilian, p. 338 (Lethaea).
 1925 *Aconeceras nesus* d'Orbigny, Corroy, p. 271.
 1955 *Aconeceras nesus* d'Orbigny, Eristavi, p. 88.
 1961b *Aconeceras* cf. *nesus* (d'Orbigny), Casey, p. 128, text fig. 40f.
 1962 *Aconeceras nesus* d'Orbigny, Collignon, p. 31, pl. 229, fig. 972.
 1966 *Aconeceras nesus* (d'Orbigny), Schindewolf, p. 398.
 1979 *Aconeceras nesus* (d'Orbigny), Martinez, p. 346, pl. 1, fig. 6a-c.

Location: Hacienda La Trinidad, 8 km northeast of Caripe. Basal shale zone of Valle Grande Formation, *martinioides* Zone.



Text fig. 9

Suture line and whorl sections of *Aconeceras*:

- a. *A. nesus* (d'Orbigny), Gu1044, Pl. 1, Fig. 15, 6×.
 b. *A. haugi* (Sarasin), Gu1568, Pl. 1, Fig. 14, 3×.
 c. *A. haugi* (Sarasin), coll. Reinhard, 1922, Pl. 1, Fig. 19, 5×.

Description: Gu1044 (Pl. 1, Fig. 15a-b). Conch oxycone, high-whorled. Sides of whorl feebly convex, converging towards keel without ventrolateral shoulder (Text fig. 9a). Umbilicus 20% of diameter. Low, steep umbilical wall with narrowly rounded edge. No sculpture. Suture not preserved.

A larger, identical specimen (Pl. 1, Fig. 19a-b) from the type locality of the García Shale at Pico García has been collected by M. Reinhard (1922, deposited in the Musée d'Histoire Naturelle, Genève).

Measurements:	Dm	Wh	Ww	U
Gu1044, Pl. 1, Fig. 15	9.2 mm	5 (0.50)	2.5 (0.26)	2 (0.20)
Museum Geneva, Pl. 11, Fig. 19	15 mm	8 (0.53)	5 (0.33)	2 (0.13)

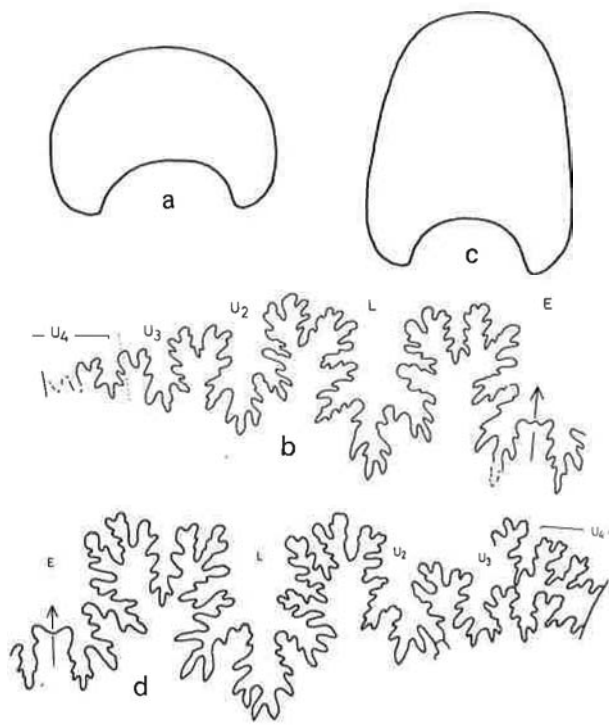
Distribution: Europe, East Africa, Madagascar, Venezuela.

Aconeceras haugi (Sarasin)

Pl. 1, Fig. 14a-b; Text fig. 9b-c

- 1893 *Oppelia Haugi* Sarasin, p. 156, pl. 4-6, fig. 11a-c.
 1950 *Aconeceras* (*Sanmartinoceras*) *haugi* (Sarasin)?, Wright and Wright, p. 123.
 1961b *Aconeceras* cf. *haugi* (Sarasin), Casey, p. 128, text fig. 40g-h.
 1972 *Aconeceras* (*Sanmartinoceras*) *haugi* (Sarasin), Wright in Guillaume et al., p. 1650.

Location: Houses Sacamanteca, along Camino Real Cariaco-Catuaro. Basal shale zone of Valle Grande Formation, *martinioides* Zone.



Text fig. 10

- a, b. *Valdedorsella getulina* (Coquand), Gu1602, Pl. 2, Fig. 19, a. whorl section 3×; b. suture line 6×.
 c, d. *Beudanticeras* ("*Zuercherella*") *zuercheri* (Jacob), Gu1618, Pl. 1, Fig. 20; c. whorl section 3×; d. suture line 5×.

Description: Gu1568. Involute, high-whorled. Whorl section subfastigate (Text fig. 9b). Ventrolateral shoulder rounded, but distinct. Sides parallel, flattened. Umbilicus 13% of diameter. Umbilical wall steep, pronounced angular edge. Costation feeble; ribs falcooid, broadly flattened, rising slightly near mid-flank. External suture (Text fig. 9c) coincides with drawing by Sarasin (1893, p. 154, fig. 3). According to ontogenetic studies by Schindewolf (1966, p. 398, fig. 242) suture typical for Haploceratidae (Middle Jurassic to Early Cretaceous). Umbilical lobus does not split. The sequence of umbilical lobes on the external line, U₃, U₅, U₇, U₉ (Text fig. 9c) and on the internal line U₄, U₆, U₈ is not observable on the present material (Schindewolf, 1967, p. 399).

Measurements: Dm 22.5 mm, Wh 12 (0.53), Ww 5 (0.22), U₃ (0.13)

Distribution: France (lower Aptian), Venezuela.

Remarks: *Sanmartinoceras bonarelli* in Bonarelli and Nagera (1921, p. 27) from Patagonia as well as *Sanmartinoceras groenlandicum* Rosenkrantz (see Casey, 1961b, p. 131, text fig. 42) are distinguished by more pronounced costae, a high serrated keel, and a spiral depression.

Family Desmoceratidae Zittel, 1895

Subfamily Puzosiinae Spath, 1922

Genus *Valdedorsella* Breistroffer, 1947

Type species: *Desmoceras akuschaense* Anthula, 1899.

Occurrence: Southern Europe, Caucasus, North Africa, Madagascar, Colombia, Venezuela.

Valdedorsella getulina (Coquand)
Pl. 2, Fig. 19a-c; Text fig. 10a-b

- 1880 *Ammonites Getulinus* Coquand, p. 18.
1907 *Puzosia Getulina* Coquand, Pervinquier, p. 151, pl. 6, fig. 16.
1912 *Puzosia Getulina* Coquand, Joleaud, p. 120, pl. 1.
1920a *Puzosia Getulina* Coquand, Fallot, p. 45, pl. 2, fig. 7-10.
1962 *Valdedorsella Getulina* Coquand, Collignon, p. 33, pl. 229, fig. 977.
1966 *Valdedorsella getulina* (Coquand), Schindewolf, p. 615 (suture).
1968 *Valdedorsella getulina* (Coquand), Wiedmann and Dieni, p. 108.
1975b *Valdedorsella getulina* (Coquand), Bevia, p. 683, pl. 2, fig. 1-4.

Location: La Espuga along road Carúpano-Caripito, basal shale interval of Valle Grande Formation, late Aptian, *martinioides* Zone.

Description: Gu1602. Whorl section rounded, slightly wider than high, thickest just below mid-flank (Text fig. 10a). Umbilicus narrow, one quarter of diameter. Umbilical wall high, rounding into flank. On outer volution seven straight, deep, slightly prorsiradiate constrictions, curving forward over broad venter. Ribs of low relief between constrictions cross venter. External suture

line preserved (Text fig. 10b). Ontogenetic development of suture as for *Beudanticeras* (Schindewolf, 1966, p. 615). Sequence of lobes: E, L, U₂, U₃, U₄ (=S) U₁ I.

Measurements: Dm 17 mm., Wh 7 (0.41), Ww 10 (0.59), U 4.5 (0.26)

Distribution: Upper Aptian in Mediterranean area, Madagascar, Venezuela.

Subfamily Beudanticeratinae Breistroffer, 1953

Genus *Beudanticeras* Hitzel, 1902

Type species: *Ammonites beudanti* Brongniart, 1822.

Occurrence: World-wide.

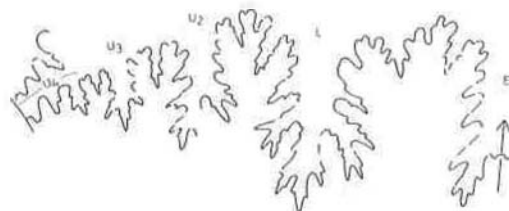
Beudanticeras ("Zürcherella") *zürcheri* (Jacob)
Pl. 1, Fig. 20a-b; Text fig. 10c-d

- 1906 *Desmoceras Zürcheri* Jacob, Jacob and Tobler, p. 9, pl. 2, fig. 2a-b.
1920a *Uhligella Zürcheri* Jacob, Fallot, p. 261, pl. 3, fig. 7.
non 1933 *Uhligella Zürcheri* Jacob and Tobler, Rouchadze, p. 183, pl. 2, fig. 4, 5.
1954a *Zürcherella zürcheri* Jacob, Casey, p. 112.
1958 *Zürcherella zürcheri* Jacob, Luppov and Drushchic, p. 109, pl. 50, fig. 8a-c.
1964 *Zürcherella zürcheri* Jacob, Kemper, p. 39, pl. 4, fig. 1; pl. 15, fig. 1; pl. 17, fig. 1-3.
1966 *Zürcherella zürcheri* (Jacob), Schindewolf, p. 623 (suture).
1968 *Beudanticeras* ("Zürcherella") *zürcheri* (Jacob), Wiedmann and Dieni, p. 130, pl. 12, fig. 1.
1975b *Zürcherella zürcheri* Jacob, Bevia, p. 686, pl. 4, fig. 3-4.

Lectotype: *Desmoceras Zürcheri* Jacob, 1906, pl. 2, fig. 1, selected by Casey, 1954a, p. 112.

Location: La Espuga, along the road from Carúpano to Caripito, basal shale of Valle Grande Formation, *martinioides* Zone.

Description: Gu1618. Body chamber not preserved. Conch planulate, involute, high-whorled. Venter narrowly rounded; sides feebly convex, thickest above umbilical margin (Text fig. 10c). Umbilical width about one quarter diameter. Umbilical wall low, rounding into flank without edge. On outer volution eight shallow constrictions fade around mid-flank and then cross venter in a forward directed bow. Faint intermediate ribbing can be



Text fig. 11
Beudanticeras ("Uhligella") cf. *mulleriedi* Humphrey, MBJ28766, Pl. 2, Fig. 21, suture line 5×.

recognized. Suture as on *Valdedorsella getulina* Coquand (Text fig. 10d).

Measurements: Dm 25 mm, Wh 12 (0.48), Ww 8.5 (0.34), U 6 (0.24).

Distribution: Upper Aptian in Europe, Venezuela.

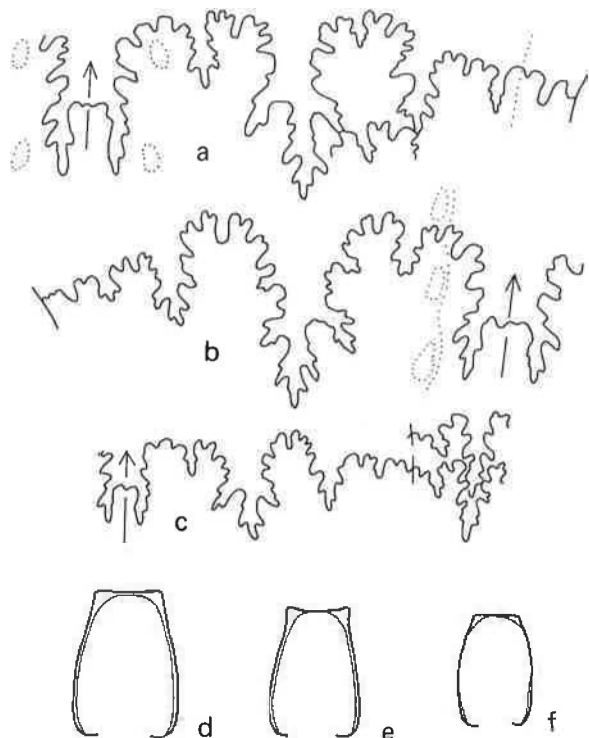
Remarks: This specimen is identical in all aspects with figure 2a-b on plate 2 of Jacob and Tobler (1906) from Chaudron (Basses-Alps), France.

Beudanticeras ("Uhligella") cf. *mullerriedi* (Humphrey)
Pl. 2, Fig. 21a-b; Text fig. 11

1949 *Uhligella mullerriedi* Humphrey, p. 153, pl. 18, fig. 10, 13.

Location: Type section of Valle Grande Formation, 4.5 km east of Cumanacoa, Aptian. Coll. E. Rod.

Description: MBJ28766. Limonitized phragmocone. Conch discoidal. Whorl section subelliptical, thickest above umbilical edge. Sides feebly convex, converging towards narrowly rounded venter. Umbilicus 20% of diameter with low, steeply rounded wall. Ornament restricted to eight collared constrictions projected over venter. The ribs in front of the constrictions are bullae-like swollen, flattening towards mid-flank; the ribs



Text fig. 12

Suture lines and whorl sections of *Dufrenoyia*:

a, e. *D. dufrenoyi* (d'Orbigny), Gu1585, Pl. 1, Fig. 9, suture 4x, whorl section 1x.

b, f. *D. aff. ?codazziana* (Karsten), Gu1037, Pl. 1, Fig. 12, suture 4x, whorl section 1x.

c, d. *D. dufrenoyi* (d'Orbigny), Gu1584, Pl. 1, Fig. 10, suture 4x, whorl section 2x.

behind the constrictions begin near mid-flank and attain their maximum strength over venter. End of ribs indistinctly connected, knee-like, near mid-flank. Some weak intermediate ribs indistinctly blurred. Suture (Text fig. 11) as on *Beudanticeras*.

Measurements: MBJ28766. Dm 22.5 mm, Wh 10 (0.44), Ww 8.5 (0.38), U 4.5 (0.20).

Remarks: *Uhligella riedeli* Humphrey (1949, p. 153, pl. 18, fig. 1-2) differs from present species by its strong sigmoidal costae in front of constrictions.

Genus *Melchiorites* Spath, 1923

Type species: *Ammonites melchioris* Tietze, 1872.

Occurrence: Mediterranean area, Madagascar.

Melchiorites melchioris (Tietze)
Pl. 2, Fig. 20a-b

1872 *Ammonites Melchioris* Tietze, p. 135, pl. 9, fig. 9-10.

1883 *Haploceras Melchioris* Tietze, Uhlig, p. 232, pl. 17, fig. 5, 12.

1898 *Puzosia Melchioris* Tietze, Simionescu, p. 73, pl. 4, fig. 2.

1907 *Puzosia Melchioris* Tietze, Karakasch, p. 75, pl. 7, fig. 4, 8; pl. 8, fig. 6; pl. 24, fig. 23.

1907 *Puzosia (Latidorsella?) Melchioris* Tietze, Pervinquier, p. 147, pl. 6, fig. 15.

1920b *Puzosia Melchioris* (Tietze), Fallot, p. 254, pl. 3, fig. 5.

1962 *Melchiorites Melchioris* Tietze, Collignon, p. 36, pl. 230, fig. 980.

1968 *Melchiorites melchioris* Tietze, Wiedmann and Dieni, p. 109, pl. 10, fig. 4.

Location: Type section Valle Grande Formation, late Aptian. Coll. E. Rod.

Description: MBJ28759. Single, small pyritized specimen. Whorl section compressed, subquadrate, with rounded venter, grading into parallel, flattened sides. Inner whorl without sculpture. Straight, prorsiradiate constrictions, curving forward over venter, beginning at 20 mm diameter. No intermediate ribs. Suture not visible.

Measurements: Dm 23 mm, Wh 9 (0.40), Ww 8 (0.35), U 5.5 (0.24).

Family Deshayesitidae Stoyanow, 1949

Subfamily Deshayesitinae Casey, 1964

Genus *Dufrenoyia* Burckhardt, in Kilian and Reboul, 1915

Dufrenoyia dufrenoyi (d'Orbigny)

Pl. 1, Fig. 9a-b, 10a-b, 11a-b, 16; Text fig. 12a, c, d, e

Type species: *Ammonites furcatus* J. de C. Sowerby,

1841 *Ammonites Dufrenoyi* d'Orbigny, p. 200, pl. 33, fig. 3-6.

1849 *Ammonites Dufrenoyi* d'Orbigny, Quenstedt, p. 158, pl. 5, fig. 10a-b.

- 1897 *Hoplites Dufrenoyi* d'Orbigny, Sarasin, p. 769, fig. 6 (suture).
 1949 *Dufrenoyia dufrenoyi* (d'Orbigny), Humphrey, p. 123, pl. 8, fig. 1-6.
 1964 *Dufrenoyia dufrenoyi* (d'Orbigny), Kemper, p. 42.
 1966 *Dufrenoyia dufrenoyi* (d'Orbigny), Schindewolf, p. 688 (suture).

Location: Arenas, 5 km north-northeast of Cumanacoa. Basal shale of Valle Grande Formation, late Aptian.

Description: Gu1585, Gu1586, MBJ28764. Conch compressed. Whorl section high-rectangular. Venter flattened, slightly concave between prominent clavi. Sides subparallel, flattened (Text fig. 12d, e). Umbilicus about 28% of diameter. Primary ribs sigmoidally curved, flattening and broadening towards ventrolateral shoulder, and ending into clavi, spirally elongated. Secondary ribs terminate near mid-flank. The internal suture is exposed on a single specimen (Gu1584, Pl. 1, Fig. 10a-b, Text fig. 12c; compare Wiedmann, 1966, p. 46). Lateral lobes are asymmetric on all specimens examined (Text fig. 12a).

Remarks: The range of variations is shown by the figured specimens. Schindewolf (1966, p. 683) studied the ontogenetic development of the suture of the Deshayesitidae. The second umbilical lobus (U_2) does not, as usual, originate between the lateral and umbilical lobe but at a later ontogenic stage, on the crest of the internal saddle. Thus U_2 does not change its original position (Schindewolf, fig. 420, p. 684). Lobe formula: $E L U_2 U_3 / U_1 I$.

Distribution: Europe, Texas, Mexico, Colombia, Nigeria.

Dufrenoyia aff. ?*codazziana* (Karsten)

Pl. 1, Fig. 12a-b; Text fig. 12b, f

- 1886 *Ammonites codazzianus* Karsten, p. 61, pl. 3, fig. 4a-b, 5a-b.
 1972 *Dufrenoyia* cf. *codazziana* (Karsten), Wright in Guillaume et al., p. 1651.
 1979 *Dufrenoyia codazziana* (Karsten), Etayo-Serna, p. 58; pl. 1, fig. 7, 8; pl. 3, fig. 4a-b.

Lectotype: *Ammonites codazzianus* Karsten, 1886, pl. 5, fig. 5, selected by Etayo-Serna, 1979, p. 59.

Location: Hacienda Trinidad, 8 km northeast of Caripe. Basal shale of Valle Grande Formation, late Aptian.

Description: Gu1037. Whorl section compressed, high-rectangular; widest near mid-flank. Sides parallel, feebly convex flattened. Venter squarish, flat; no concavity between low ventrolateral clavi (Text fig. 12f). Umbilical wall gently rounding into flank. Ribs slightly abraded, dense and low. Primary ribs cross flank in prorsiradiate sigmoidal curves. One or two ribs beginning near mid-flank. All ribs end at low, elongate ventrolateral clavi. Suture typical for genus (Text fig. 12b).

Distribution: Colombia, Venezuela.

Remark: The present specimen may represent a new subspecies of *Dufrenoyia codazziana*. Its preservation, however, is not sufficient to figure as a holotype.

Genus *Burckhardtites* Humphrey, 1949

Type species: *Neocomites nazasensis* Burckhardt

Occurrence: Mexico, Venezuela.

Burckhardtites nazasensis (Burckhardt)

Pl. 1, Fig. 17a-b, 18

- 1925 *Neocomites nazasensis* Burckhardt, p. 14, pl. 3, fig. 4-7.
 1949 *Burckhardtites nazasensis* (Burckhardt), Humphrey, p. 130, pl. 10, fig. 1-5.
 1976 *Burckhardtites nazasensis* Burckhardt, Cantu Chapa, p. 10, pl. 1, fig. 1.

Holotype: *Neocomites nazasensis* Burckhardt, p. 14, pl. 3, fig. 6-7 (see Casey, 1964, p. 289).

Location: Lower part of the type section of the Valle Grande Formation, 4.5 km east of Cumanacoa, late Aptian. Coll. E. Rod.

Description: MBJ 28767. Limonitized fragment, closely comparable with holotype. Conch compressed. Sides flattened, converging feebly towards truncated venter. Greatest thickness on umbilical margin. Low umbilical wall declining steeply towards moderately wide umbilicus (on holotype 18% of diameter). Costation close. Fine ribs begin on umbilical seam, elevate bullae-like on umbilical margin and cross flank in a biconcave curve. Intercalated shorter ribs flatten out below mid-flank. All ribs are distinctly elevated on ventrolateral edge and attenuated over venter. Suture not preserved. The small fragment shown on Pl. 1, Fig. 18 was collected by M. Reinhard from the García Shale at Pico García.

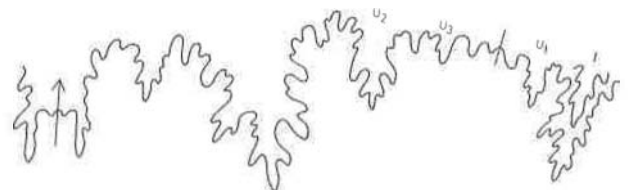
?*Burckhardtites* sp. indet.

Pl. 1, Fig. 13a-b; Text fig. 13

- 1949 *Burckhardtites* sp., Humphrey, p. 133, pl. 10, fig. 6, 8.

Location: Pico García, type section of García Formation, Aptian. Coll. M. Reinhard, 1922.

Description: One of numerous small fragments which may be compared with *Burckhardtites*. It differs from previously described specimens by exhibiting a stronger and more regular costation. Long and short ribs alternate. The venter is not tabulate but rather rounded and resembles that of *Prodeshayesites* Casey (1964, p. 353), a



Text fig. 13
Burckhardtites sp. (?*Prodeshayesites* sp.), coll. Reinhard, 1922, Pl. 1, Fig. 13, suture line 5 \times .

genus not accepted by Kemper (1964, p.41). Suture line (text fig.13) as on *Dufrenoyia* (compare Wiedmann, 1966, fig. 34, p.43).

Subfamily Mathoceratinae Casey, 1963

Genus *Mathoceras* Casey, 1963

Type species: *Hoplites* (*Kilianella*?) *Matho* Pervinquière, 1907.

Occurrence: Tunisia.

Mathoceras venezolanum Renz
Pl. 2, Fig. 1a-b, Text fig. 14a

1978 *Mathoceras venezolanum* Renz, p.681, fig. 3a-b, l, 4a.

Location: Type section of Valle Grande Formation, Serranía del Interior. Late Aptian, *martinioides* Zone.

Description: Gu1237, BM.C68185. About one-fourth of the outer whorl belongs to the body chamber. Whorl smooth on initial stage to about 4.5 mm diameter, whorl section oval. Later turning to subquadrate, thickest on ventrolateral tubercles. Flanks parallel, slightly convex between ribs. Venter subtabulate, broadly concave between opposing external clavi. Umbilicus 30% of diameter. Umbilical wall falls steep on ventrolateral clavi on preceding volution, and rounds gently into flank. Costation distant, about 19 ribs on outer whorl, of which eight, at about equidistant intervals, are stronger primaries provided with prominent ventrolateral tubercles. Towards body chamber primaries are slightly raised into umbilical bullae. Intermediate secondaries, beginning on umbilical margin are weak, variable in strength, and some are faintly elevated on ventrolateral shoulder. All ribs are straight between umbilicus and ventrolateral shoulder, on outer third of flank turning distinctly forward towards the venter, broadening and flattening, and ending in prominent ventral clavi, obliquely projected forward. Few of the secondary ribs are only slightly elevated on venter. Suture (Text fig. 14a) as on *Dufrenoyia* (Schindewolf, 1966, p.688).

Measurements: Gu1237, BM.C68185 (end phragmocone). Dm 17.5, Ww 7 (0.40), Wh 7.4 (0.42), U 5 (0.30).

Mathoceras sucre Renz
Pl. 2, Fig. 3a-b

1978 *Mathoceras sucre* Renz, p.682, fig. 3e-f, 4c.

Location: Type section of Valle Grande Formation, Serranía del Interior. Late Aptian, *martinioides* Zone.

Description: Gu1238, BM.C68186. Begin of body chamber uncertain. Juvenile volutions, up to 7 mm diameter, smooth, oval, venter rounded. Later whorl section gradu-

ally turning to rectangular, simultaneously with strengthening of ventral clavi. Flanks parallel, slightly convex. Venter flat, tabulate, concave between external clavi. Siphon partly broken out. Umbilicus shallow, about one third of diameter. Umbilical wall low, falling on mid-flank of preceding volution; umbilical margin rounded. Costation weak, variable, beginning at a diameter of about 7 mm. Ribs very low, sigmoidally curved, parting from umbilical margin where faint indications of umbilical bullae are recognizable on body chamber only (better visible on opposite side). Eight roughly equidistant ventrolateral bullae of different strength are developed. From there ribs turn slightly adorally, ending in 20 prominent ventral clavi obliquely turning forward and differing in height according to strength of ribs. Faint looping of ribs between ventrolateral bullae and ventral clavi occurs occasionally.

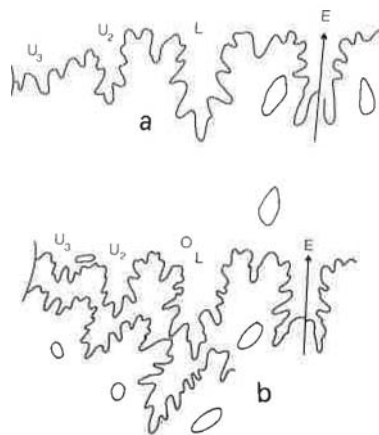
Measurements: Gu1238, BM.C68186: Dm 15.5, Ww 5.4 (0.34), Wh 7 (0.46), U 5 (0.32).

Mathoceras caribense Renz
Pl. 2, Fig. 4a-b; Text fig. 14b

1978 *Mathoceras caribense* Renz, p.682, fig. 3g-h, m, 4d.

Location: Base of Valle Grande Formation, near houses named Sacamanteca, south-southeast of Cariaco, Serranía del Interior. Late Aptian, *martinioides* Zone.

Description: Gu1570, BM.C68188. Diameter of phragmocone 10 mm. Inner volutions up to about 5 mm diameter, without sculpture, whorl section oval, venter broadly rounded. As growth proceeds whorl section more compressed, turning gradually to subrectangular. Sides feebly convex between ribs, thickest below mid-flank. Venter about tabulate, flatly concave between peripheral clavi. Umbilicus one third of diameter. Umbilical wall rounding into flank and falling on preceding volution slightly above mid-flank. Costation begins at 8 mm



Text fig. 14

Suture lines of *Mathoceras*:

a. *M. venezolanum* Renz, Gu1237, BMC68185, holotype, Pl. 2, Fig. 1, 4x.

b. *M. caribense* Renz, Gu1570, BMC68188, holotype, Pl. 2, Fig. 4, 8x.

diameter. Eight distant, prorsiradiate primary ribs are present which swell on body chamber into low umbilical bullae, and gradually losing strength toward the outer third of flank. Here they are raised in low, bullae-like tubercles from which they curve forward, ending in prominent ventral clavi. Faint looping of ribs occurs between ventrolateral tubercles and peripheral clavi. Suture (Text fig. 14b) as on *Mathoceras venezolanum*.

Measurements: Gu1570, BM.C68188: Dm 12.3, Ww 4 (0.33), Wh 5 (0.40), U 4 (0.33).

Mathoceras laeve Renz
Pl. 2, Fig. 2a-b

1978 *Mathoceras laeve* Renz, p. 684, fig. 3c-d, 4c.

Location: Base of Valle Grande Formation, near houses referred to as Sacamanteca, SSE of Cariaco, Serranía del Interior, late Aptian, *martinioides* Zone.

Description: Gu1569, BM.C68187. Conch partly covered by thin, iron-stained layer, possibly representing test, diagenetically altered. Beginning of body chamber uncertain (assumed position indicated by line). Whorl section on early stage oval, widest near mid-flank; on outer whorl section rectangular, flat-sided, widest below mid-flank. Venter tabulate; concave between opposing clavi. Umbilicus about 30% of diameter, shallow and low, slightly widening towards end. Umbilical wall steep, grading into rounded margin. Sculpture begins near 8 mm diameter with faint ventral elevations. Costation, smooth, unstable, nearly effaced around mid-flank. Ribs distinctly falconid, without ventrolateral elevations. Ribs part from low, elongated umbilical bullae at irregular intervals, and change in size. From some umbilical bullae, branching or incipient branching is faintly indicated. Those ribs seem to unite again at rather low, elongated ventral clavi, continuing on venter with pronounced forward obliquity.

Measurement: Gu1569, BM.C68187: Dm 16.1, Ww 5.3 (0.33), Wh 7 (0.43), U 4.9 (0.30).

Remarks: Kvantaliani (1980) assumes *Mathoceras* to be related to the Leymeriellidae Breistroffer (1951). A new subfamily, the Venezuellinae, is introduced. It comprises the genera *Venezuella* Kvantaliani and *Renziella* Kvantaliani. The genus *Venezuella* includes the species *Venezuella venezolana* (Renz), *V. sucre* (Renz) and *V. caribensis* (Renz). The genus *Renziella* has only one species *Renziella laevis* (Renz). In a letter to the author Kvantaliani stated that: "The final decision on this problem will depend, apparently, on the study of the ontogeny of the suture-line of *Mathoceras* Casey, 1964 and on your (Renz) new species." The author supports this sentiment and proposes to carry the study further, when additional material of *Mathoceras* becomes available.

Family Douvilleiceratidae Parona and Bonarelli, 1897

Subfamily Cheloniceratinae Spath, 1923

Genus *Chelonicer* Hyatt, 1903

Type species: *Ammonites cornuelianus* d'Orbigny, 1840.

Occurrence: Almost world-wide.

Chelonicer aff. *debile* Casey
Pl. 2, Fig. 17a-b; Text fig. 15a

1962 *Chelonicer* (*Epicheloniceras*) *debile* Casey, p. 244, pl. 37, fig. 3-7; text fig. 85, holotype.

Location: Type section Valle Grande Formation, 4.5 km east of Cumanacoa, late Aptian. Coll. E. Rod.

Description: MBJ28768. Single limonitized, juvenile specimen reaching 17 mm diameter. Whorl section coronate (Text fig. 15a). Stronger primary ribs provided with faint umbilical bullae, strong ventrolateral bullate tubercles and weak tubercles on broad venter. Primary ribs separated by three to four untuberculated weaker ribs.

Remarks: According to Kemper (1964, p. 49) *Chelonicer* (*Epicheloniceras*) *debile* Casey coincides with *Chelonicer* *tschernyschewi* Sinzow (lectotype: Sinzow, 1906, pl. 3, fig. 2).

Chelonicer aff. *buxtorfi* Jacob
Pl. 2, Fig. 18a-b; Text fig. 15b

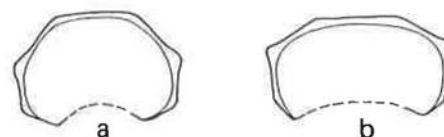
1906 *Douvilleicer* *Buxtorfi* Jacob and Tobler, Robler, p. 15, pl. 1, fig. 9-11.

1962 *Chelonicer* (*Epicheloniceras*) *buxtorfi* (Jacob, in Jacob and Tobler), Casey, p. 253, pl. 39, fig. 8a-b, with synonymy.

1964 *Chelonicer* *buxtorfi* (Jacob and Tobler), Kemper, p. 53, pl. 11, fig. 1a-b.

Lectotype: 1906 *Douvilleicer* *Buxtorfi* Jacob and Tobler, pl. 1, fig. 9a-b, selected by Casey, 1961b, p. 253.

Location: Type section of Valle Grande Formation, 4.5 km east of Cumanacoa, late Aptian. Coll. E. Rod.



Text fig. 15
Whorl sections of *Chelonicer*:
a. *Ch.* aff. *debile* Casey, MBJ28768, Pl. 2, Fig. 17, 3×.
b. *Ch.* aff. *buxtorfi* Jacob, MBJ28809, Pl. 2, Fig. 18, 2×.

Description: MBJ28809. Single, juvenile specimen. Diameter 21 mm. Whorl section coronate (Text fig. 15b). Costation uniform. 15 ribs on half whorl. Umbilical bullae subdued, ventrolateral bullae pronounced and elevations on broad venter scarcely indicated.

Occurrence: Europe, Transcaspia, Russian Platform (Luppov, 1956), Colombia, Venezuela.

Remark: So far the two mentioned specimens of *Chelonicer* are the only ones known from the García Formation.

Family Parahoplitidae Spath, 1922

Genus *Diadochoceras* Hyatt, 1900

Type species: *Ammonites nodosocostatus* d'Orbigny, 1841.

Occurrence: Europe, Caucasus, Japan, Tanzania, Madagascar, Mexico, Venezuela.

Diadochoceras aff. *nodosocostatum* (d'Orbigny)

Pl. 2, fig. 7a-b, 8a-b, 9a-b; Text fig. 16a

1975 *Diadochoceras* aff. *nodosocostatum* (d'Orbigny), Obata, p. 7, pl. 2, fig. 4a-b (from France, Clansayes, Drôme).

Location: Río Morocoto, 6 km west of Guariquén, late Aptian. Lithostratigraphic unit not indicated.

Description: Gu1630 (Pl. 2, Fig. 8, Text fig. 16a); BM.C 68190 = Gu1627 (Pl. 2, Fig. 7); BM.C 68191 = Gu1634 (Pl. 2, Fig. 9).

Body chambers not preserved. Coiling moderately evolute. Intercostal section circular (Text fig. 16a). Umbilicus about 40% of diameter. Umbilical wall scarcely differentiated from flank. On outer volution, sixteen low, flat primary ribs occur. They are bullae-like and are elevated above umbilicus. They then weaken near mid-flank before becoming elevated again, into large, blunt, flattened, rounded, ventrolateral nodes which are followed on venter by identical nodes which nearly touch the siphonal line. Secondary ribs, interposed between distant primaries, are feebly indicated over venter and fade out towards mid-flank. Suture not preserved.

Measurements:	Dm	Wh	Ww	U
Gu1630	26 mm	8.2 (0.32)	10.2 (0.40)	10 (0.40)
Gu1627	25 mm	8 (0.32)	9 (0.36)	10 (0.40)

Remarks: Septa replaced by fibrous gypsum, pseudomorphic to aragonite, owing to decomposition of marcasite. Preservation of specimen is inadequate to figure as holotype for a possibly new species.

Michailova (1963, p. 72, fig. 8) shows that the ontogeny of the suture on *Diadochoceras* agrees precisely with that of *Acanthohoplites* and *Hypacanthoplites*. For this reason

Diadochoceras has been grouped with the Parahoplitidae (Schindewolf, 1966, p. 692).

Genus *Gargasicer* Casey, 1954

Type species: *Ammonites gargasensis* d'Orbigny, 1841.

Occurrence: France, Spain (Martinez, 1979), Colombia, Mexico, Venezuela, Madagascar.

Gargasicer cf. *recticostatum* (Kilian) Roch

Pl. 2, Fig. 11a-b, 12a-b, 13a-b, Text fig. 16c

1913 *Acanthoplites gargasensis* var. *recticostata* Kilian, p. 346 (Lethaea).

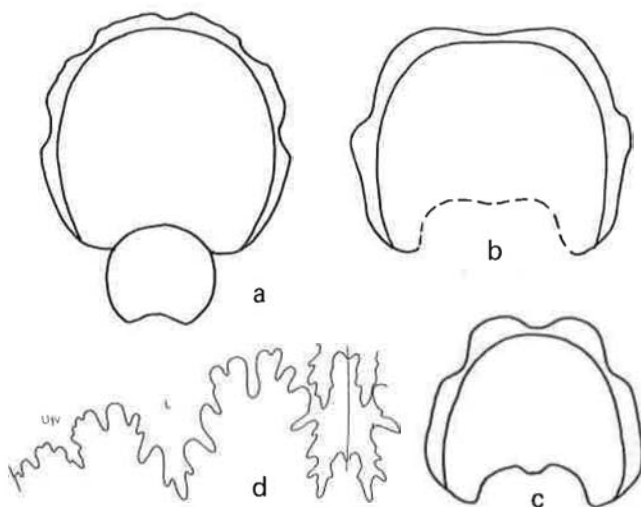
1926 *Acanthoplites gargasensis* var. *recticostata* Kilian, Roch, p. 288, pl. 18, 6a; 7, 7a.

1954a *Gargasicer* *recticostatum* (Kilian) Roch, Casey, p. 114.

Lectotype: *Acanthoplites gargasensis* var. *recticostata* Kilian; selected by Roch, 1926, p. 288, pl. 18, fig. 6, 6a.

Location: Valle Grande Formation, type section, 4.5 km east of Cumanacoa, basal shale body, late Aptian (Gargasien).

Description: Gu1404 (Pl. 2, Fig. 12). Whorl section (Text fig. 16c) subrectangular on costal section, oval on interspaces. Venter sulcate. Umbilicus 27% of diameter; 36% on MBJ28765-2 (Pl. 2, Fig. 11). Umbilical wall steep on ribs and gently rounded on intercostal section. Rectiradial primary ribs rising above umbilical seam. Dorsal half of ribs beam-like elevated, rising in a distinct tubercle about mid-flank. Here some ribs bifurcate.



Text fig. 16

a. Whorl section of *Diadochoceras* aff. *nodosocostatum* (d'Orbigny), Gu1630, Pl. 2, Fig. 8, 3x.

b. Whorl section of *Gargasicer* *acutecostatum* (Riedel), Gu1021, Pl. 2, Fig. 10, 6x.

c. Whorl section of *Gargasicer* cf. *recticostatum* Roch, Gu1404, Pl. 2, Fig. 12, 6x.

d. Suture of *Gargasicer* *aptiense* Roch, MBJ28765-1, Pl. 2, Fig. 6, 5x.

Weaker secondaries without tubercles, intercalated in variable number between primaries. From mid-flank onward all ribs gradually widen and become flat-topped and steep-sided as on *Colombiceras*. All ribs cross straight over venter, where they faintly attenuate on median line.

Measurements:	Dm	Wh	Ww	U
Gu1404	13 mm	6 (0.46)	5 (0.38)	3.5 (0.27)
MBJ28765-2	25 mm	9.5 (0.38)	78 (0.32)	9 (0.36)
MBJ28763	22 mm	8 (0.36)	8 (0.30)	7 (0.32)

Distribution: France, Venezuela.

Remark: The flat-topped ribs suggest a close connection between the described form and *Colombiceras*, from which it differs only by the concavity of the venter.

Gargasiceras acutecostum (Riedel)

Pl. 2, Fig. 10a-b; Text fig. 16b

- 1934 *Acanthoplites acutecosta* Riedel, pl. 8, fig. 1-6.
 1954 *Gargasiceras acutecostum* (Riedel), Casey, p. 114.

Lectotype: *Acanthoplites acutecosta* Riedel, 1934, pl. 8, fig. 1-4, here selected.

Location: Type section Valle Grande Formation (about 6 km east of Cumanacoa). Basal shale, late Aptian (Gargasien).

Description: Gu1021. Body chamber mechanically compressed. Whorl section (Text fig. 16b) subrounded, slightly wider than high. Venter flattened, broadly sulcate. Umbilicus 41% of diameter. Umbilical wall rounding into flank. 40 ribs on outer whorl, of which nine are stronger, separated by two to four weaker ribs. Branching or incipient branching occurs near mid-flank from bulge-like elevations. Ribs broadly flatten towards venter (comparable to *Colombiceras*). Suture indistinctly preserved.

Measurement: Dm 15 mm, Wh 5 (0.33), Ww 6 (0.40), U 6.2 (0.41).

Distribution: Colombia, Venezuela.

Gargasiceras aptiense (Roch)

Pl. 2, Fig. 6a-b; Text fig. 16d

- 1926 *Acanthoplites gargasensis* var. *aptiense* Roch, p. 292, pl. 18, fig. 5; text fig. 4 (suture).
 1954 *Gargasiceras aptiense* Roch, Casey, p. 114.

Location: Valle Grande Formation, 4.5 km east of Cumanacoa, late Aptian. Coll. E. Rod.

Description: MBJ28765-1. Small, rather densely ribbed specimen. Stronger ribs not prominent. Whorl section (Text fig. 16d) subrectangular, slightly wider than high, shoulder rounded. Venter broadly concave on costal section. All ribs flatten over venter, but less distinct than on *Gargasiceras acutecostum*. External suture well pre-

served (Text fig. 16d). It is of relevance to quote Wiedmann (1966, p. 37, fig. 29) who states that "The umbilical lobe splits into a ventral and a dorsal branch as on *Cheloniceras*".

Measurements: Dm 19 mm, Wh 7 (0.37), Ww 8.5 (0.44), U 7 (0.37).

Genus *Colombiceras* Spath, 1923

Type species: *Ammonites crassicostratus* d'Orbigny, 1841.

Occurrence: France, England, Sardinia, USSR (Mikhailova, 1958), Madagascar (Collignon, 1962), Mexico, Colombia, Venezuela.

The record of the genus *Colombiceras* is poor in Venezuela. The few fragments available do not permit reliable determinations.

Colombiceras aff. *causicum* Luppov

Pl. 2, Fig. 16a-b; Text fig. 17a-b

- 1949 *Colombiceras causicum* Luppov, p. 230, pl. 67, fig. 1.
 1958 *Colombiceras causicum* Luppov and Drushchic, p. 103, pl. 47, fig. 5a-b.

Location: Hacienda La Trinidad, 8 km northeast of Caripe. Basal shale of Valle Grande Formation, late Aptian (Gargasien).

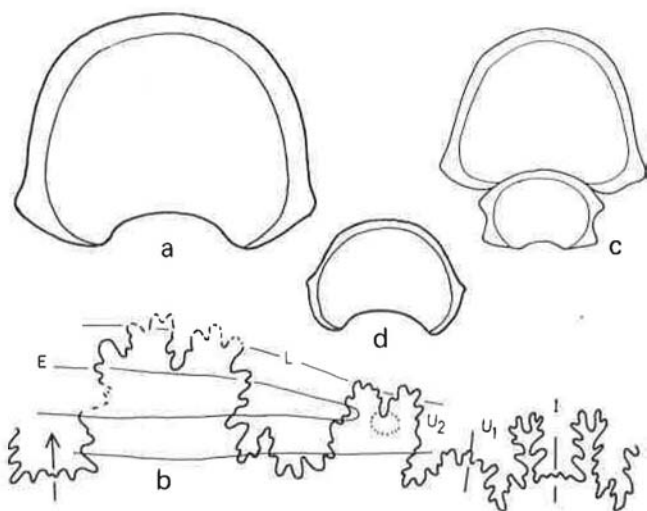
Description: Gu1033. Whorl section depressed, wider than high, broadest at umbilical tubercles (Text fig. 17a). Sides convex, rounding towards umbilicus without forming distinct edge. Costation arises at umbilical seam. Ribs rectiradiate, angulate, wedge-shaped, broadening towards venter, where they become flat-topped with vertical sides. Interspaces about half as wide as ribs, flat at bottom. Bifurcation occurs from conical umbilical tubercles. Suture (Text fig. 17b) is distinguished by shortened, somewhat distorted external and lateral lobes, a feature which results from the vertical rib sides. The ontogenetic development of the suture of *Colombiceras* has been studied by Mikhailova (1960) on well preserved material from the upper Aptian of the south of the USSR. This is referred to in Casey, 1965, p. 419, fig. 153f. The suture line after Mikhailova, 1960, shows a lobe formula $E L U_2 / U_1 I$.

Remarks: The present species differs from *Colombiceras causicum tyrrhenicum* Wiedmann (1968, p. 93, pl. 9, fig. 13; text fig. 66), which shows an equally broad whorl section, by a distinctly more dorsal position of the tubercles above the umbilicus.

Colombiceras cf. *causicum tyrrhenicum* Wiedmann and Dieni

Pl. 2, Fig. 15a-b; text fig. 17d

- 1968 *Colombiceras causicum tyrrhenicum* Wiedmann and Dieni, p. 93, Pl. 9, fig. 13; text fig. 66.



Text fig. 17

a, b. *Colombiceras* aff. *causicum* Luppov, Gu1033, Pl. 2, Fig. 16, a. whorl section 3×, b. suture line 4×.
 c. *Colombiceras* sp., MBJ28757, whorl section, Pl. 2, Fig. 14, 3×.
 d. *Colombiceras* cf. *causicum tyrrhenicum* Wiedmann and Dieni, Gu1391, whorl section, Pl. 2, Fig. 15, 3×.

Location: Valle Grande, 4.5 km east of Cumanacoa. Middle part of Valle Grande Formation. Late Aptian (Gargasien).

Description: Gu1391. This juvenile fragment may indicate the presence in Venezuela of this subspecies described from Sardinia. The features are: Whorl section slightly wider than high (Text fig. 17d). Ribs begin on umbilical seam, broaden continuously towards the widely arched venter and become flat-topped. A conical tubercle is present on the primaries, from which ribs bifurcate just below mid-flank.

Remarks: The fragment described here differs from *Colombiceras tobleri* (Jacob) 1906 (lectotype, p. 11, pl. 2, fig. 4) by the absence of a conspicuous ventrolateral thickening of ribs. A specimen comparable with *Colombiceras tobleri* has been figured by Riedel (1938, pl. 8, fig. 23, 24) from Colombia.

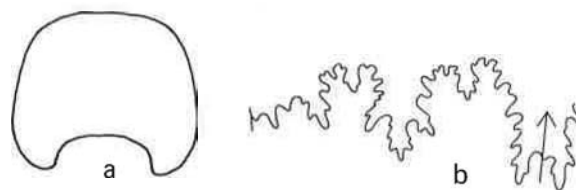
Distribution: Sardinia, Venezuela.

Colombiceras sp. indet.
 Pl. 2, Fig. 14a-b; Text fig. 17c

Location: Valle Grande, 4.5 km east of Cumanacoa. Valle Grande Formation, late Aptian, Coll. E. Rod.

Description: MBJ28757. Outer whorl fragment belongs to body chamber where whorl section (Text fig. 17c) is slightly depressed and widest on high umbilical bullae, from where flanks converge towards rounded venter. Ribs begin on umbilical seam; some increase considera-

bly in breadth and become flat-topped and steep-sided towards venter. Others cross venter with no significant breadth increase. Sharp, high lateral tubercles are developed on phragmocone (inner whorl fragment) above mid-flank, creating a more depressed whorl section. They vanish towards the body chamber. Last tubercle is indicated on first rib of outer volution. Suture not preserved. The specimen is not suitable as a holotype.



Text fig. 18

Acanthohoplites nolani Seunes, Gu1624, Pl. 2, Fig. 5, a. whorl section 3×, b. suture line 4×.

Genus *Acanthohoplites* Sinzow, 1907.

Type species: *Hoplites nolani* Seunes, 1887.

Occurrence: Widely distributed in western Europe, Caucasus, Algeria, Madagascar (Collignon, 1937, 1962), Venezuela.

Acanthohoplites nolani (Seunes)
 Pl. 2, Fig. 5a-b; Text fig. 18a-b

- 1887 *Hoplites Nolani* Seunes, p. 564, pl. 13, fig. 4.
- 1905 *Parahoplites Nolani* Seunes, Jacob, p. 408, fig. 3 (suture).
- 1953 *Acanthoplites nolani* Seunes, Glazunova, p. 32, pl. 4, fig. 1-3.
- 1955 *Hypacanthoplites nolani* Seunes, Eristavi, p. 104, pl. 4, fig. 8.
- 1960 *Acanthoplites nolani* Seunes, Kudrjavcev, p. 326, pl. 13, fig. 1-4.
- 1961a *Nolaniceras nolani* (Seunes), Casey, p. 598.
- 1968 *Acanthohoplites nolani* (Seunes), Wiedmann and Dieni, p. 88, pl. 9, fig. 10, 17.

Location: Río Morocoto, 6 km west of Guariquén, late Aptian.

Description: Gu1624. Small-sized specimen. At 20 mm diameter whorl section (Text fig. 18a) subquadrate (Ww/Wh = 0.89). Venter feebly flattened, rounding into moderately convex flanks, thickest near mid-flank. Umbilicus 31% of diameter. No umbilical edge. On outer whorl 49 ribs cross straight over flank, bending slightly adorally over venter. Branching of ribs near mid-flank. On inner whorl distinct lateral tubercles recognizable to about 10 mm diameter. Suture partly preserved (Text fig. 18b).

Measurements: Dm 19 mm, Wh 9 (0.47), Ww 8 (0.42), U 6.8 (0.31).

Distribution: Europe, Venezuela.

D. Albian Stage

1. Stratigraphic review

a) Western Venezuela: Perijá Range and Andes (Text fig. 4)

As mentioned earlier, due to the scarcity of age-indicative fossils, primarily ammonites, no accurate chronostratigraphic limit can be established between the Aptian and the Albian in field sections. The pelagic and benthic foraminifera, which can only be studied in thin-sections, are generally poorly preserved.

On the Maracaibo Platform, as well as along the Perijá foothills north of the Machiques Trough, as far as Toas Island, the Albian is represented by neritic limestones known as the *Cogollo Formation* (Garner, 1921). It is massively bedded, greyish, partly bioclastic (with subordinate oolite) and partly micritic. On the platform, the shallow water environment offered no favourable living conditions for ammonites, and foraminifera are restricted to benthic forms. Southward, towards the Machiques Trough, part of the *Cogollo* laterally grades into the *Lisure Formation* (Rod and Maync, 1954, p.209). This sequence consists of an alternation of glauconitic quartz sands, sandy glauconitic marls and massively bedded, partly glauconitic limestones.

In Quebrada La Gé a single fragment of an ammonite (Pl.4, Fig.1) belonging to the genus *Mortonicer*, was found in the upper part of the *Lisure Formation* (Renz, 1977, section 21). It indicates a late Albian age.

The *Lisure Formation* is overlain by a massively bedded, light-coloured limestone body containing *Exogyra* biostromes. This interval has been named the *Maraca Formation* by Rod and Maync (1954, p.210). It is conformably followed by the *La Luna Formation* which contains early Turonian ammonites. Thus, a Cenomanian age may be assumed for the *Maraca Formation*.

In the Machiques Trough area the *Lisure Formation* is separated from the underlying Machiques Formation (Aptian) by a massive, light grey limestone body. This contains abundant *Trigonia* sp. and has been distinguished as the *Piché Member* by Renz (1959a). Its age is considered still to be early Albian.

The *Lisure Formation* can be interpreted as a transitional formation between the *Cogollo* limestones to the north and the *Aguardiente Formation* (Notestein et al., 1944) to the south, in the State of Táchira. At the type locality, the Fila de *Aguardiente*, north of Cúcuta (Colombia), the *Aguardiente Formation* mostly consists of fine to medium grained, partly glauconitic sandstones. The quartz material in the *Lisure* and *Aguardiente*

Formations is probably derived from the Roraima Formation of the Guayana Shield. Further south, towards the Serranía del Cocuy (5493 m, in Colombia), the formation rapidly increases in thickness. The part exposed in Venezuela can be interpreted as the eastern margin of an extensive deltaic sand body which extends over large parts of the Cordillera Oriental of Colombia.

The glauconitic *Aguardiente* sands disappear towards the pre-Cretaceous Mérida Swell, being gradually replaced by progressively thickening layers of orthoquartzite without glauconite. These alternate with massively bedded micritic to bioclastic and biostromal limestones. These facies persist as far as the plunge of the Andean chains under the Barquisimeto flysch, which now is considered to be partly allochthonous (Stephan, 1977). The term *Peñas Altas Formation* was introduced by Renz (1959a) for this facies as developed in the States of Trujillo and Lara.

The *Peñas Altas Formation* is followed by a conspicuous dark, blue grey interval of platform carbonates which contains a rich late Albian ammonite assemblage. The term *La Puya Formation* was originally proposed for this interval by Renz (1959a). The detailed stratigraphy and fauna are discussed under chapter D. 2c.

Allochthonous ammonites of middle Albian age have been observed in the Barquisimeto flysch basin. *Oxytropidoceras* (*Manuanicer*) sp. was found in the Parapara region (Renz et al., 1955, p.2066) and in the surroundings of El Tocuyo (found by von der Osten). They derive from a sequence similar in lithology to that of the *La Luna*.

This indicates that middle Albian sediments of *La Luna* facies must have existed in the source area of the allochthonous material in the Barquisimeto flysch.

Along the southern foothills of the Cordillera de la Costa no ammonites indicating an Albian age have been found to date.

b) Albian in the Serranía del Interior

During the early and middle Albian favourable conditions for the development of ammonite populations were only present in the Serranía del Interior. The massively bedded limestones of the El Cantil Formation, assumed to be Aptian in age, are overlain by the *Chimana Formation* (Hedberg and Pyre, 1944). The interval, characterized by the abundance of glauconite, consists of dark shales, which are rather irregularly interbedded with massive limestones and glauconitic sands. It reaches a maximal thickness of 800 meters (Guillaume, 1972, p.1631).

Ammonite assemblages associated with rich benthic and planktonic foraminifera occur in shale intercalations. They belong to two ammonite zones, the *Douvilleiceras mammillatum* Zone below and the *Hoplites dentatus* Zone above. The lower part of the Chimana Formation furnished the genera *Phylloceras* (*Hypophylloceras*), *Pictetia*, *Beudanticeras*, *Douvilleiceras* and *Parengonoceras*. Its foraminiferal fauna corresponds to the *Praeglobotruncana rohri* Zone. In the upper part the genera *Phylloceras*, *Puzosia*, *Tetragonites*, *Beudanticeras*, *Desmoceras*, *Mojsisovicsia*, *Eubrancoceras*, *Oxytropidoceras*, *Prolyelliceras*, *Lyelliceras* and *Tegoceras* were found, together with *Neobulimina subcretacea* (Cushman), of middle Albian age.

The Chimana Formation is unconformably overlain by the *Querecual Formation* (Hedberg, 1937a, b) of which the lower part corresponds to the *Rotalipora ticinensis/appenninica* Zone, but in which no ammonites have as yet been found.

2. Systematic descriptions of Albian ammonites

a) Albian in the Perijá river sections

As previously noted ammonites have only been sporadically found in Albian sediments exposed along the river sections in the Perijá foothills and then only from the Machiques and Lisure Formations. From the uppermost part of the Machiques Formation *Parengonoceras*, the sculpture of which consists of growth lines only, and a *Prolyelliceras* were obtained. In the basal part of the Lisure Formation (lower Albian) *Knemiceras* aff. *flexiloculosum* Basse is the only ammonite found to date.

A single fragment of a *Mortoniceras* from the upper part of the Lisure Formation indicates a late Albian age which implies a Cenomanian age for the overlying Maraca Formation. This specimen is of importance in our stratigraphical considerations and has, therefore, been figured (Pl. 4, Fig. 1).

Family Engonoceratidae Hyatt, 1900

Genus *Parengonoceras* Spath, 1924

Type species: Ammonites ebrayi de Loriol, 1882.

Occurrence: Europe, North Africa, Middle East, Venezuela, Colombia, Peru.

Parengonoceras cf. *hachourii* (Dubourdieu)

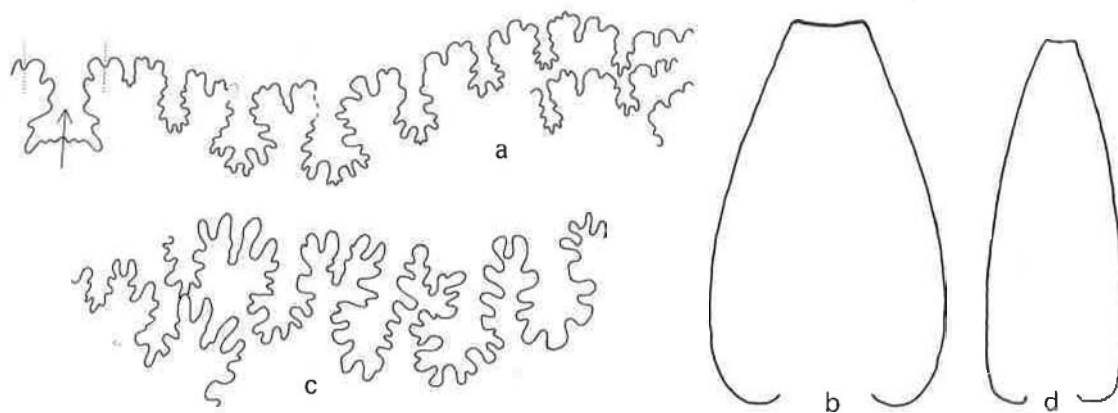
Pl. 3, Fig. 4; Text fig. 19c-d

1953 *Knemiceras hachourii* Dubourdieu, p. 23, pl. 2, fig. 10-18; pl. 3, fig. 1-5.

1979 *Knemiceras hachouri* Dubourdieu, Masse and Thieuloy, p. 69.

Lectotype here designated: Pl. 2, fig. 10-12.

Description: The fragment (Re2439) from the upper part of the Machiques Formation in the Quebrada Maraca shows falcooid growth striae, but otherwise no sculpture. It can therefore be compared with *K. hachourii* from the lower Albian in the Monts du Mellègue in Algeria. Suture (Text fig. 19c) partly preserved. Strongly frilled saddles, as indicated on worn surfaces of original material from Algeria (Text fig. 8, p. 25), rather suggest an affinity with *Parengonoceras*.



Text fig. 19

Suture lines and whorl sections of *Knemiceras* and *Parengonoceras* of the lower Albian along the Perijá foothills.

a-b. *Knemiceras* aff. *flexiloculosum* Basse, Re2420, Pl. 3, Fig. 3, 1×.

c-d. *Parengonoceras* cf. *hachourii* (Dubourdieu), Re2439, Pl. 3, Fig. 4, suture line 2×, whorl section 1×.

Genus *Knemiceras* Böhm, 1898

Type species: *Ammonites Syriacus* von Buch, 1848.

Knemiceras aff. *flexiloculosum* Basse
Pl. 3, Fig. 3a–b, Text fig. 19a–b

1940 *Knemiceras flexiloculosum* Basse, p. 430, pl. 2, fig. 3a–b.

Location: Perijá foothills, Caño Isure, light grey, dense, micritic limestone layer near the base of the Lisure Formation, early Albian.

Description: Re2420. Specimen originally about 200 mm diameter. Removed body chamber, strongly weathered. Whorl section high-trapezoidal, thickest above umbilicus, from where feebly convex flanks converge towards squared flattened and slightly concave venter which is narrower than on holotype (Text fig. 19b). Sculpture on outer whorl reduced to seven flattened, low, broad folds, strongest below mid-flank. Basse mentions six to seven conical umbilical tubercles on internal whorl which disappear when growth proceeds. Along lateral edges of venter, spirally elongated, rather closely spaced, small clavi are present alternating on both edges. Suture characterized by bifid saddles and frilled lobes as on holotype (Text fig. 19a).

Measurements: Dm 148 mm, Wh 79 (0.53), Ww 44 (0.30), U 14 (0.10)
Holotype: Dm 130 mm, Wh 63 (0.48), Ww 43 (0.33), U 18 (0.14)

Distribution: Syria, Venezuela.

? *Parengonoceras* sp.
Pl. 4, Fig. 2a–b

This fragment (Re2522) from the top of the Machiques Formation in Quebrada Macoita shows no suture. It cannot reliably be attributed either to *Parengonoceras* or to *Knemiceras*. The sculpture is reduced to small tubercles above the umbilical edge. It may represent the tuberculated juvenile stage of *Knemiceras* aff. *flexiloculosum* Basse.

Family Lyelliceratidae Spath, 1921

Genus *Prolyelliceras* Spath, 1920

A single specimen has been obtained from the upper part of the Machiques Formation, indicating that within the Machiques Trough the unit reaches into the lower Albian.

Prolyelliceras flandrini (Dubourdieu)
Pl. 4, Fig. 3a–b, Text fig. 20



Text fig. 20
Whorl section of *Prolyelliceras flandrini* (Dubourdieu), Re2400, Pl. 4, Fig. 3, 1x.

1953 *Lyelliceras flandrini* Dubourdieu, p. 27, pl. 3, fig. 6–22, Holotype pl. 3, fig. 6.

Location: Perijá foothills, Quebrada Santa Rosita, Machiques Formation, early Albian.

Description: Re2400. Internal mould. Moderate in size. Last half of outer volution belongs to body chamber. Whorl section (Text fig. 20) subrectangular, venter fastigate on ribs, rounded on interspaces. Flanks convex, rounding into gently sloped umbilical wall without margin. Umbilicus evolute, 38% of diameter. Costation prominent. Ribs beginning just above umbilical seam, straight to faintly curved over flank, broadening and flattening conspicuously before rising into prominent ventrolateral, spirally elongated clavi. Ribs continuous over venter, not attenuating, elevate into prominent siphonal clavi. Early growth stage, up to about 11 mm diameter without sculpture. Suture well preserved but partly damaged by erosion.

Measurements: Dm 41 mm, Wh 15 (0.36), Ww ?14.5 (0.35), U 15.5 (0.38)

Distribution: Algeria, Venezuela.

Family Brancoceratidae Spath, 1933

Subfamily Mortoniceratinae Spath, 1925

Genus *Mortoniceras* Meek, 1876

Mortoniceras aff. *pricei* Spath, 1922
Pl. 4, Fig. 1a–b

Location: Re2556. Perijá foothills, Quebrada La Gé, near the top of the Lisure Formation, below the transgressive La Sierra Formation (middle to lower upper Eocene). The imperfectly preserved fragment might best be compared with *Mortoniceras pricei* as figured by Spath, 1930 (Ammonoidea of the Gault, p. 394, text fig. 132, from the Perte-du-Rhône near Geneva).

b) Albian in the Serranía del Interior (Text fig. 6)

The fossils here described were collected by H. Guillaume and first determined by C.W. Wright in 1960 (Guillaume, 1972, p. 1647).

All were collected from glauconitic shales and limestones of the middle and upper part of the Chimana Formation, on the islands north of Puerto La Cruz. The majority of the ammonites are limonitized.

Family Phylloceratidae Zittel, 1884

Genus *Phylloceras* Suess, 1865

Subgenus *Hypophylloceras* Salfeld, 1924

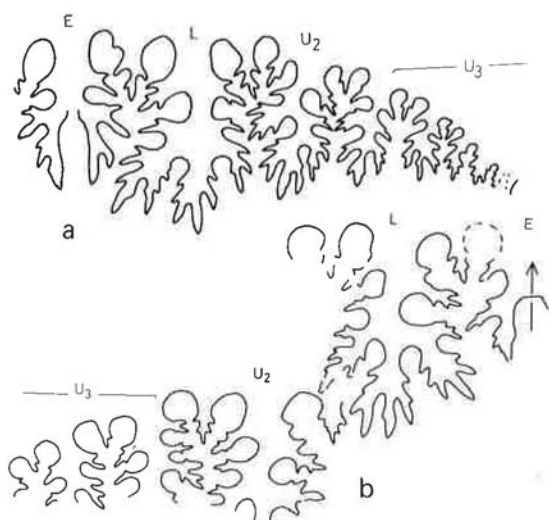
Type species: *Phylloceras onoense* Stanton, 1895.

Occurrence: World-wide. In Venezuela *Phylloceras* occurs only sporadically. So far this genus has only once been observed in a La Luna type lithology (Pl.22, Fig.21) in Venezuela. This is in contrast with the abundance of their occurrence in Europe and South Africa (Kennedy and Klinger, 1977).

Phylloceras (Hypophylloceras) moreti (Mahmoud)
Pl.4, Fig. 6a-b; Text fig.21a

- 1923 *Phylloceras subalpinum* d'Orbigny, Spath, p. 15, pl. 1, fig. 1-2.
1955 *Salfeldiella (Goretophylloceras) Moreti* Mahmoud, p.81, pl.5, fig. 2-4.
1963 *Phylloceras (Hypophylloceras) moreti* (Mahmoud), Wiedmann, p.200, pl. 19, fig.2, text fig. 46.

Lectotype: *Salfeldiella (G.) Moreti* Mahmoud, 1956, pl. 5, fig.3, selected by Wiedmann, 1963, p.200.



Text fig.21

Suture lines of *Phylloceras*:

- a. *Phylloceras (Hypophylloceras) moreti* Mahmoud, Gu547, Pl. 4, Fig. 6, 4×.
b. *Phylloceras (Hypophylloceras) tethys majoricensis* Wiedmann, Gu598, Pl.4, Fig. 7, 6×.

Location: West side of La Borracha Island, 900 m east of La Cueva inlet, Chimana Formation, middle Albian, *Hoplites dentatus* Zone.

Description: Gu547. Internal mould. Whorl section elliptical, thickest near mid-flank. Sides convex, evenly grading into arched venter and into closed, funnel-like umbilicus. No constrictions. Riblets over venter not exposed. Suture (Text fig.21a) as shown by Mahmoud (1956) and Wiedmann (1962d, 1963). Saddle E/L diphylloid, L/U₂ triphylloid.

Measurements: DM 30 mm, Wh 17 (0.57), Ww 13 (0.43), Ww/Wh 0.76

Distribution: Egypt (Sinai), Mallorca, Sardinia, England, Venezuela.

Phylloceras (Hypophylloceras) tethys majoricensis Wiedmann
Pl.4, Fig. 7a-b; Text fig.21b

- 1963 *Phylloceras (H.) tethys majoricensis* Wiedmann, p.178, pl.15, fig. 1; pl. 18, fig.3; text fig.37 (suture).
1975a *Phylloceras (H.) tethys majoricensis* Wiedmann, Bevia, p.400, fig.5, 6.

Holotype: *Phylloceras (H.) majoricensis* Wiedmann, 1963, pl. 15, fig. 1, Aptian of Santa Ponsa, Mallorca.

Location: North end of La Borracha Island, top of Chimana Formation. Shale zone above greensand, just below the transgressive Querecual Formation, middle Albian, *dentatus* Zone.

Description: Gu598. Test preserved, partly removed to free suture. Whorl section subtrigonal, widest between umbilicus and mid-flank. Sides feebly convex, converging to a more narrowly arched venter. Umbilicus narrow, funnel-like. No constrictions. Sculpture on test reduced to dense growth lines. Suture (Text fig.21b) characterized by simple diphylloid saddles. Lateral lobe less asymmetric than on *Phylloceras (Hypophylloceras) moreti*.

Measurements:	Dm	Wh	Ww	U
Holotype	28 mm	17 (0.60)	10 (0.36)	1 (0.04)
Gu598, Pl.4, Fig.7	24 mm	13.5 (0.56)	10 (0.42)	2 (0.08)

Distribution: Spain (Barremian-Aptian), Sardinia, Venezuela.

Family Tetragonitidae Hyatt, 1900

Subfamily Tetragonitinae, Hyatt, 1900

Genus *Tetragonites* Kossmat, 1847

Type species: *Ammonites timotheanus* Pictet, 1848.

Occurrence: World-wide.

Tetragonites rectangularis Wiedmann, 1962
Pl. 4, Fig. 4a-b, 5a-b; Text fig. 22a-c

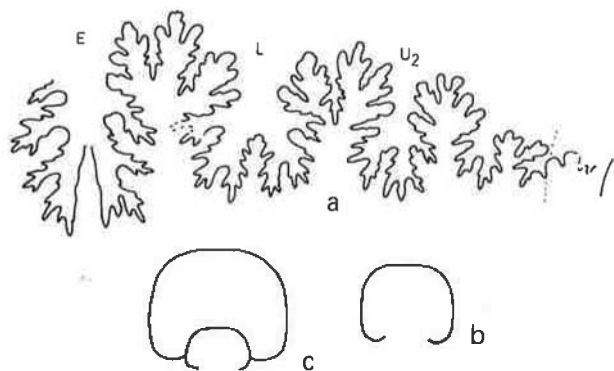
- 1902 *Lytoceras Timotheanum* Mayor, Anderson, p.63, pl.7, fig.145-48.
1908 *Lytoceras (Tetragonites) Timotheanum* Pictet, Jacob, p.19, pl.1, fig.10, 11.
1940 *Tetragonites* aff. *Timotheanus* Mayor, Fabre, p.214, pl.5, fig.2, 3.
1957 *Tetragonites timotheanus* Mayor, Almela and Revilla, p.21, pl.4, fig.4.
1962a *Tetragonites rectangularis* Wiedmann, p.178, pl.14, fig.3, holotype.
1962b *Tetragonites rectangularis* Wiedmann, p.78, pl.6, fig.1, 2, 7, 8; Text fig.28.
1963 *Tetragonites rectangularis* Wiedmann, Collignon, p.21, pl.249, fig.1069, 1070.
1968 *Tetragonites rectangularis* Wiedmann, Wiedmann and Dieni, p.47, pl.4, fig.8.
1979 *Tetragonites timotheanus* (Pictet), Scholz, p.56, pl.11, fig.7 (morphotype *rectangularis*).

Location: Mochima Peninsula, Punta La Cruz, northeast of Puerto La Cruz, upper Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu796. Internal mould. Whorl section square, subtrapezoidal (Text fig.22c). Flanks feebly convex, slightly converging towards flattened, broadly arched venter. Umbilicus deep, 23% of diameter. Umbilical wall vertical, undercut, narrowly merging into flank. Six constrictions strongly projected forward, cross straight over sides, slightly angled on shoulder and adaptically recurving on venter. On specimen Gu548 (Pl.4, Fig.4, Text fig.22b) external suture preserved (Text fig.22a). Schindewolf (1968, p.766) discovered presence of a lobe U₃, developed already on primary suture; it is thus six-lobate.

Measurements:	Dm	Wh	Ww	U
Gu796, pl.4, fig.5	30 mm	14 (0.46)	18 (0.60)	6.8 (0.23)
Gu548, pl.4, fig.4	25 mm	11 (0.44)	14.8 (0.60)	5.5 (0.22)

Distribution: France, Spain (Mallorca), Sardinia, Venezuela, Japan (Matsumoto, 1943).



Text fig. 22

Tetragonites rectangularis Wiedmann:
a. Suture, Gu548, Pl. 4, Fig. 4, 4×.
b. Whorl section, Gu548, Pl. 4, Fig. 4, 1×.
c. Whorl section, Gu796, Pl. 4, Fig. 5, 1×.

Remarks: *Tetragonites kitchini* Krenkel (1910a, p.226, pl.22, fig.8) from East Africa has a markedly smaller whorl width (about 0.41) and a wider umbilicus (about 0.31).

Family Desmoceratidae Zittel, 1895

Subfamily Puzosiinae Spath, 1922

Genus *Puzosia* Bayle, 1878

Type species: *Puzosia planulata* Bayle, 1878.

Occurrence: World-wide.

Puzosia quenstedti (Parona and Bonarelli), 1897
Pl. 4, Fig. 8a-b

- 1847-48 *Ammonites planulatus* J. Sowerby, Quenstedt, p.221, pl.17, fig.13b, d only.
1897 *Desmoceras Quenstedti* Parona and Bonarelli, p.81, pl.11, fig.3.
1908 *Desmoceras (Puzosia) Mayorianum* d'Orbigny, Jacob, pl.6, fig.1 only.
1931 *Puzosia quenstedti* (Parona and Bonarelli), Seitz, p.401, pl.6, fig.3-4.
1942b *Puzosia quenstedti angolana* Haas, p.149, pl.37, fig.2-9; pl.41, fig.1-6.
1950 *Puzosia Quenstedti* Parona and Bonarelli, Collignon, p.44, pl.9, fig.1.
1968 *Puzosia quenstedti* Parona and Bonarelli, Wiedmann and Dieni, p.114, pl.10, fig.11; pl.12, fig.3; Text fig.72-73.

Holotype: *Desmoceras quenstedti* Parona and Bonarelli, 1897, refigured Wiedmann and Dieni, 1968, pl.12, fig.3.

Location: North end of La Borracha Island, Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu377. Whorl section oval, distinctly higher than wide. Maximal width just below mid-flank. Venter broadly rounded, grading into gently convex flank. Umbilicus 30% of diameter. Umbilical wall steep, edge rounded, indistinct. On outer whorl seven, low, collared constrictions, separated by about sixteen fine ribs over venter, fading out below mid-flank. Constrictions turning slightly forward, towards venter which they cross in a flat adorally directed bow. Suture partly preserved.

Measurements:	Dm	Wh	Ww	U
Gu377, pl.4, fig.8	84 mm	33 (0.40)	30 (0.36)	24 (0.30)

Distribution: France, Sardinia, Madagascar, Angola, Venezuela.

Puzosia media Seitz
Pl. 4, Fig. 9a-b, 11a-b

- 1897 *Desmoceras* cf. *Emerici*, Raspail, Parona and Bonarelli, p.80, pl.11, fig.1.
1910 *Puzosia mayoriana* d'Orbigny, Fallot, p.27, pl.1, fig.4.

- 1931 *Puzosia quenstedti* var. *media* Seitz, p. 402, pl. 16, fig. 5.
 1949 *Puzosia Quenstedti* var. *Breistrofferi*, Collignon, p. 64, pl. 12, fig. 1.
 1963 *Puzosia Quenstedti* var. *media* Collignon, p. 61, pl. 263, fig. 1148, 1149.
 1968 *Puzosia media* Seitz, Wiedmann and Dieni, p. 115.

Location: North end of La Borracha Island, shale interval at top of Chimana Formation, between greensand and transgressing Querecual Formation, middle Albian (*dentatus* Zone).

Description: Fragment of adult specimen Gu582, Pl. 4, Fig. 11; juvenile specimen Gu585 (Pl. 4, Fig. 9). Whorl section about as wide as high. It differs from *P. quenstedti* by its subcircular whorl section and by slightly deeper and wider constrictions, slightly curved forward over venter.

Measurements: Gu585, Dm 25 mm, Wh 9 (0.36), Ww 10.5 (0.42), U 8 (0.32)

Distribution: France, Austria, Mallorca, Sardinia, Madagascar, Venezuela.

Puzosia lata Seitz
 Pl. 4, Fig. 10a-b

- 1847-48 *Ammonites planulatus* J. Sowerby, Quenstedt, pl. 221, pl. 17, fig. 13a-c only.
 1931 *Puzosia lata* Seitz, p. 403, pl. 17, fig. 2.
 1963 *Puzosia provincialis* var. *crassa* Collignon, p. 64, pl. 264, fig. 1155.
 1968 *Puzosia lata* Seitz, Wiedmann and Dieni, p. 121, pl. 10, fig. 10; pl. 11, fig. 9.

Holotype: Reproduced: Seitz, 1931, pl. 17, fig. 2.

Location: North end of La Borracha Island. Top of Chimana Formation, below transgressing Querecual Formation, middle Albian (*dentatus* Zone).

Description: Gu590. A number of juvenile specimens differ from *P. provincialis* by whorl sections being wider than high, ranging between 0.48 to 0.52. Whorl section subcircular, maximal thickness around mid-flank. Five deep constrictions, bent sigmoidally on outer half of flank, cross venter in a slightly angular sinus. The specimens available to the author may be compared with the transitional form *provincialis-lata* figured by Wiedmann and Dieni (1968, pl. 10, fig. 10a-c, p. 120).

<i>Measurements:</i>	Dm	Wh	Ww	U
Holotype	33.2 mm	0.39	0.43	0.34
Gu590	23 m	9.3 (0.40)	11 (0.48)	6.5 (0.28)

Distribution: France, Sardinia, Madagascar, Venezuela.

Subfamily Beudanticeratinae Breistroffer, 1953

Genus *Beudanticeras* Hitzel, 1902

Type species: *Ammonites Beudanti* Brongniart, 1822.

Occurrence: Europe, Africa, Queensland, Japan, Texas, Patagonia, Greenland (Spath, 1946).

Beudanticeras ('Uhligella') walleranti (Jacob)
 Pl. 4, Fig. 12a-b, 13a-b; Text fig. 23a

- 1908 *Desmoceras (Uhligella) Walleranti* Jacob, p. 31, pl. 3, fig. 1-4.
 1913 *Uhligella walleranti* Jacob, Petrovic, p. 70, fig. 13.
 1936 *Beudanticeras (Uhligella) walleranti* Jacob, Breistroffer in Besairie, p. 154, pl. 23, fig. 1.
 1947 *Beudanticeras walleranti* (Jacob), Breistroffer, p. 63.
 1961b *Beudanticeras walleranti* (Jacob), Casey, p. 161.
 1968 *Beudanticeras ('Uhligella') walleranti* (Jacob), Wiedmann and Dieni, p. 129.

Lectotype: *Desmoceras (Uhligella) walleranti* Jacob, 1908, pl. 3, fig. 1, selected by Wiedmann and Dieni, 1968, p. 129.

Location: Mochima Peninsula, near Punta La Cruz, northeast of Puerto La Cruz, upper Chimana Formation, middle Albian, *dentatus* Zone.

Description: Gu827, Gu838. Whorl section compressed, high-rectangular with parallel flattened sides. Maximal width on lower third of flank. Venter narrowly arched. Umbilicus about 20% of diameter; umbilical wall almost vertical, edge distinctly marked. Ribs on test of low relief and flattened, falciform; on internal mould still less pronounced. Constrictions indistinct. Interpretation of suture (Text fig. 23a) based on Schindewolf (1966, p. 621). U₁ begins to split into a dorsal and a ventral branch on eighth or ninth line, developing faster than later sutural lobes.

<i>Measurements:</i>	Dm	Wh	Ww	U
Gu827, pl. 4, fig. 12	78 mm	39 (0.50)	23 (0.30)	16 (0.20)
Gu838, pl. 4, fig. 13	39 mm	18 (0.46)	12 (0.31)	7 (0.18)

Distribution: Southern Europe, North Africa, Madagascar, Venezuela.

Remark: The species is one of the most common ammonites in the Albian of the Serranía del Interior.

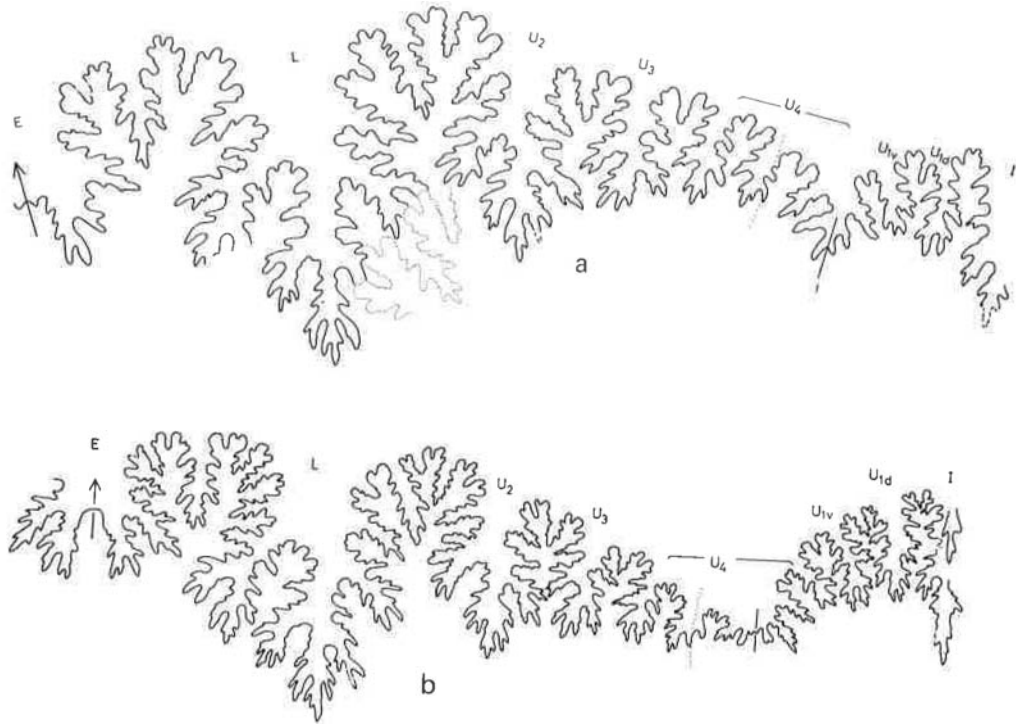
Beudanticeras ('Uhligella') rebouli (Jacob)
 Pl. 4, Fig. 14a-b, 15; Text fig. 23b

- 1908 *Desmoceras (Uhligella) Rebouli* Jacob, p. 32, pl. 4, fig. 1-5.
 1910 *Uhligella Rebouli* Jacob, Fallot, p. 21, pl. 2, fig. 1, 2.
 1930 *Desmoceras Rebouli* Jacob, Passendorfer, p. 207, pl. 3, fig. 56, 60.
 1947 *Uhligella Rebouli* Jacob, Breistroffer, p. 47.
 1957 *Uhligella rebouli* Jacob, Almela and Revilla, p. 24, pl. 5, fig. 4.
 1968 *Beudanticeras ('Uhligella') rebouli* (Jacob), Wiedmann and Dieni, p. 129, pl. 10, fig. 6.

Lectotype: *Desmoceras (Uhligella) Rebouli* Jacob, 1908, pl. 4, fig. 2, selected by Wiedmann and Dieni, 1968, p. 129.

Location: Mochima Peninsula, near Punta La Cruz, northeast of Puerto La Cruz. Upper Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu825 (Pl. 4, Fig. 14). Whorl section subrectangular, thickest above umbilical margin. Flanks flat, slightly convex, rounding into wide arched venter. Um-



Text fig. 23

Suture lines of *Beudanticeras*:

a. *Beudanticeras* ("Uhligella") *walleranti* (Jacob), Gu838, Pl. 4, Fig. 13, 5×.

b. *Beudanticeras* ("Uhligella") *rebouli* (Jacob), Gu855, Pl. 4, Fig. 15, 2.5×.

bilical wall steep, narrowly rounding into flank. Costation of low relief, as on lectotype. Ribs falciform, slightly strengthening towards ventral third of flank, strongly curved forward over venter, not attenuating towards siphonal line. After reconstruction seven flat, broad constrictions are apparent per whorl. A fragment of a larger specimen (Gu855, Pl. 4, Fig. 15) with less pronounced costation furnished a complete external and internal suture (Text fig. 23b). U_1 is split, as characteristic for Desmoceratidae. Suture identical in all aspects with that of *B. walleranti* (Text fig. 23a).

Distribution: Europe, Venezuela.

Subfamily Desmoceratinae Zittel, 1895

Genus *Desmoceras* Zittel, 1884

Subgenus *Desmoceras* Zittel, 1884

Occurrence: World-wide.

The extreme variability of *Desmoceras latidorsatum* (Michelin) has been recognized since d'Orbigny, 1841; Pictet, 1848; Kossmat, 1897 and Jacob, 1908. The subspecies *complanatum* and *inflatum* can clearly be distinguished in the middle Albian of the Serranía del Interior. In contrast, the numerous specimens of *D. latidorsatum* from the upper Albian, available from the Barbacoas

region in the Andes, are remarkably constant in whorl width and height, and may best be placed within *D. latidorsatum latidorsatum* (Renz, 1972, p. 717). It appears that *D. latidorsatum* became stabilized during the late Albian (*Hysterocheras orbigny* Zone), at least in Venezuela.

Desmoceras (*Desmoceras*) *latidorsatum complanatum* Jacob, 1908

Pl. 5, Fig. 1a-b, 2a-b; Text fig. 24a

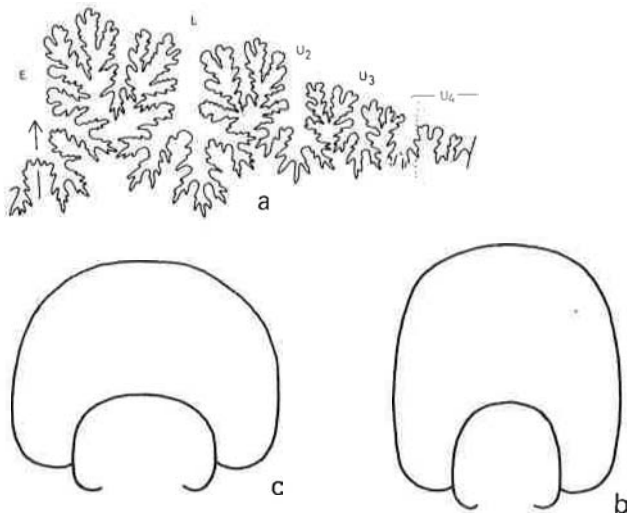
- 1908 *Desmoceras* (*Latidorsella*) *latidorsatum* var. *complanata* Jacob, p. 38, pl. 4, fig. 10a-b; pl. 5, fig. 2a-c.
 1963 *Desmoceras latidorsatum* var. *media* Jacob, Collignon, p. 84, pl. 273, fig. 1180.
 1968 *Desmoceras* (*D.*) *latidorsatum* 'var. *complanata*' Jacob, Wiedemann and Dieni, p. 132, pl. 12, fig. 7a-b.

Lectotype: Here designated: Jacob, 1908, pl. 4, fig. 10a-b.

Location: Gu799. Mochima Peninsula, Punta La Cruz, northeast of Puerto La Cruz. Upper Chimana Formation, middle Albian (*dentatus* Zone). MBJ28808, road Caripe-Casanay near houses named Arenales, middle Albian.

Description: Gu799, MBJ28808. Whorl section broad-oval, distinctly higher than wide, thickest slightly below mid-flank. Umbilicus 17-22% of diameter. Umbilical wall steep, rounding evenly into flank. No constrictions. Suture (Text fig. 24a) typical for genus (compare Schindewolf, 1966, p. 419, fig. 370).

Measurements:	Dm	Wh	Ww	U
MBJ28808, Pl. 5, Fig. 1	30 mm	14.5 (0.48)	14 (0.46)	5 (0.17)
Gu799, Pl. 5, Fig. 2	34 mm	16.5 (0.48)	15 (0.44)	7 (0.20)
Collignon, 1963, fig. 1180	55 mm	26 (0.47)	22 (0.40)	12 (0.22)



Text fig. 24

- a. *Desmoceras (D.) latidorsatum complanatum* Jacob, MBJ28808, Pl. 5, Fig. 1, suture line 3×.
 b. *Desmoceras (D.) latidorsatum latidorsatum* (Michelin), whorl section, Gu573, Pl. 5, Fig. 5, 2×.
 c. *Desmoceras (D.) latidorsatum inflatum* Breistroffer, whorl section, Gu540, Pl. 5, Fig. 8, 2×.

Desmoceras (Desmoceras) latidorsatum latidorsatum
 (Michelin)

Pl. 5, Fig. 3a–b, 4a–b, 5a–b, 7a–b; Text fig. 24b

- 1908 *Desmoceras (Latidorsella) latidorsatum* var. *media* Jacob, p. 37, pl. 4, fig. 12.
 1963 *Desmoceras latidorsatum* var. *inflata* Jacob, Collignon, p. 84, pl. 273, fig. 1177.
 1968 *Desmoceras (D.) latidorsatum* 'var. *media*' Jacob, Wiedmann and Dieni, p. 132, pl. 12, fig. 8.
 1972 *Desmoceras latidorsatum* Michelin, Renz, p. 717, pl. 8, fig. 5; pl. 9, fig. 2; pl. 10, fig. 1, 2.

Location: Gu804, Gu573, Gu798, Gu800. North end of La Borracha Island. Shale zone above greensand on top of Chimana Formation, below transgressive Querecual Formation, middle Albian.

Description: Gu804, Gu798, Gu573. Whorl section sub-circular (Text fig. 24b). Sides distinctly flattened, weakly convex. Umbilicus 18–24% of diameter. Constrictions distinct over venter, fading out towards umbilicus. Gu800 (Pl. 5, Fig. 7) may represent an intermediate form between the subspecies *latidorsatum* and *inflatum* (see p. 42).

Measurements:	Dm	Wh	Ww	U
Gu798, Pl. 5, Fig. 4	28 mm	12.3 (0.44)	15 (0.53)	6.8 (0.24)
Gu573, Pl. 5, Fig. 5	30 mm	15 (0.50)	16 (0.52)	5.5 (0.18)
Gu800, Pl. 5, Fig. 7	25 mm	12 (0.48)	15 (0.60)	4.8 (0.19)
Gu804, Pl. 5, Fig. 3	29 mm	13.8 (0.47)	14 (0.48)	5 (0.17)

Desmoceras (Desmoceras) latidorsatum inflatum Breis-

troffer
 Pl. 5, Fig. 6a–b, 8a–b, 9a–b; Text fig. 24c

- 1933 *Latidorsella latidorsata* var. *inflata* Breistroffer, p. 7.
 1961 *Desmoceras (Latidorsella) latidorsatum* var. *inflata* Breistroffer, Collignon, p. 59, pl. 24, fig. 1.
 1968 *Desmoceras (D.) latidorsatum* var. 'inflata' Breistroffer, Wiedmann and Dieni, p. 133, pl. 12, fig. 6, 9–13.

Location: Gu572, 540, 607. North end of La Borracha Island. Top of Chimana Formation, middle Albian. Gu800. Mochima Peninsula, Punta La Cruz. Upper Chimana Formation, middle Albian (*dentatus* Zone).

With six specimens available this seems to be one of the most common ammonites of the Albian in the Serranía del Interior.

Description: Gu540, Gu572, Gu607. Whorl section (Text fig. 24c) considerably wider than high, thickest between umbilicus and mid-side, or even just above rounded umbilical margin (specimen Gu607; Pl. 5, Fig. 9). From there, sides curve toward broadly arched venter. Seven to eight constrictions are apparent.

Measurements:	Dm	Wh	Ww	U
Gu572, Pl. 5, Fig. 6	37 mm	15 (0.40)	23 (0.62)	8.5 (0.22)
Gu540, Pl. 5, Fig. 8	38 mm	25 (0.43)	36.5 (0.63)	13 (0.22)
Gu607, Pl. 5, Fig. 9	16.5 mm	6.5 (0.40)	12 (0.72)	3 (0.18)

Remarks: *Desmoceras obesum* (Reynes) in Spath (1925b, holotype p. 101, pl. 4, fig. 2a–c) differs from the present species, mainly by its still wider whorl section.

The three subspecies of *D. latidorsatum* of the Serranía del Interior are connected by transitional forms.

Family Silesitidae Hyatt, 1900

Genus *Parasilesites* Imlay, 1959

Type species: *Parasilesites bullatus* Imlay, 1959 (Alaska).

Occurrence: France, Spain, Russia, Algeria, East Africa, Alaska.

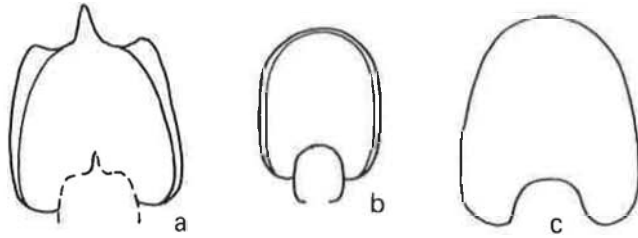
Parasilesites kilianiformis (Fallot)

Pl. 5, Fig. 10a–b; Text fig. 25c

- 1910 *Puzosia Nolani* var. *Kilianiformis* Fallot, p. 26, pl. 1, fig. 5a–b.
 1920a *Puzosia Nolani* var. *Kilianiformis* Fallot, p. 46, pl. 3, fig. 3.
 1947 *Silesitoides Kilianiformis* (Fallot), Breistroffer, p. 62.
 1957 *Silesitoides nolani* var. *kilianiformis* Fallot, Almela and Revilla, p. 28, pl. 7, fig. 3.
 1966 *Parasilesites kilianiformis* (Fallot), Schindewolf, p. 625 (suture).
 1968 *Parasilesites kilianiformis* (Fallot), Wiedmann and Dieni, p. 124, pl. 10, fig. 7.
 1979 *Parasilesites kilianiformis* (Fallot), Renz, p. 364, pl. 2, fig. 1 (Atlantic).

Location: North end of La Borracha Island. Top Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu637. Internal mould. Specimen consists of limonite and goethite. Badly broken, probably by compression during the Andean orogeny and cement-



Text fig. 25
Whorl sections of:

- a. *Mojsisovicsia evansi* (Spath), Gu416, Pl. 5, Fig. 17, 1×.
b. *Eubrancoceras aegoceratoides* (Steinmann), Gu109b, Pl. 5, Fig. 11, 2×.
c. *Parasilesites kilianiformis* (Fallot), Gu637, Pl. 5, Fig. 10, 3×.

ed by calcite thereafter. Whorl section compressed, oval (Text fig. 25c). Umbilicus 45% of diameter, umbilical wall low and steep, widely rounding into flank. Four to five broad constrictions occur, intercalated by about twenty weak, densely spaced ribs, commencing around mid-flank, and projecting forward chevron-like over venter. Suture not preserved. According to Schindewolf (1966, p. 439) U_2 splits in two branches as on Desmoceratidae.

Measurements: Dm 30 mm, Wh 10.5 (0.35), Ww 7.5 (0.25), U 13.5 (0.45)

Distribution: Mallorca, Sardinia, Venezuela, Northern Atlantic (Leg 47 B, Site 398 D, Deep Sea Drilling Project).

Family Lyelliceratidae Spath, 1921

Genus *Prolyelliceras* Spath, 1930

Type species: *Prolyelliceras peruvianum* Spath, 1930

Occurrence: Tunisia, Colombia, Peru, Venezuela, Japan (Obata et al., 1975).

Prolyelliceras peruvianum Spath Pl. 5, Fig. 12; Text fig. 26c

- 1881 *Acanthoceras Lyelli* Leymerie, Steinmann, p. 135, pl. 7, fig. 3, 3a.
1906 *Acanthoceras prorsocurvatum* Gerhardt, Douvillé, R., p. 144, pl. 2, fig. 1, 1a.
1930 *Prolyelliceras peruvianum* Spath, p. 65.
1938 *Prolyelliceras ? lobatum* Riedel, p. 57, pl. 9, fig. 9-11.
1955a *Prolyelliceras prorsocurvatum* (Gerhardt), Bürgl, p. 15, pl. 4, fig. 4a-c.
1956 *Prolyelliceras peruvianum* Spath, Benavides-Cáceres, p. 462, pl. 50, fig. 1-4.

Location: North end of La Borracha Island. Top of Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu616. Internal mould. Whorl section broadly oval (Text fig. 26e). Venter flattened, sides convex, gradually declining towards umbilical seam, without

forming distinct edge. Ribs single, straight, faintly leaning forward, elevated in ventrolateral clavi on shoulder. Ribs curve slightly forward over venter, ending in low, blunt siphonal clavi. Suture poorly preserved.

Distribution: Colombia, Peru, Venezuela.

Prolyelliceras gevreyi (Jacob) Pl. 5, Fig. 13a-b

- 1860 *Ammonites Lyelli* Pictet and Campiche, pl. 24, fig. 7a-b.
1907 *Acanthoceras Gevreyi* Jacob, p. 37.
1947 *Lyelliceras Gevreyi* Jacob, Breistroffer, p. 42 (lower Albian).

Location: North end of La Borracha Island. Top of Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu623. Whorl section compressed, high-rectangular, thickest on dorsal ventrolateral tubercles. Flanks parallel, flat. On siphonal clavi, venter low-fastigate. Ribs roughly radial, faintly sigmoidally curved and flattening over venter. Two rows of ventrolateral clavi and prominent elongated siphonal clavi occur. Umbilicus 35% of diameter; umbilical slope evenly rounding into flank. Suture not preserved.

Measurements: Dm 27 mm, Wh 12 (0.44), Ww 8 (0.30), U 9.5 (0.35)

Distribution: Switzerland, France, Venezuela.

Genus *Lyelliceras* Spath, 1921

Type species: *Ammonites Lyelli* Leymerie in d'Orbigny, 1841.

Occurrence: World-wide, except Australia.

Lyelliceras lyelli (d'Orbigny) Pl. 5, Fig. 14a-b

- 1841 *Ammonites Lyelli* Leymerie, d'Orbigny, p. 255, pl. 74, fig. 4 only.
1860 *Ammonites Lyelli* Leymerie, Pictet and Campiche, p. 196, pl. 24, fig. 1 only.
1878 *Acanthoceras Lyelli* (Leymerie), Bayle, pl. 74, fig. 4-6.
1897 *Acanthoceras Lyelli* (Deshayes in Leymerie), Parona and Bonarelli, p. 96, pl. 13, fig. 7-12.
1930 *Lyelliceras lyelli* d'Orbigny, Spath, p. 61, pl. 9, fig. 7.
1931 *Lyelliceras lyelli* d'Orbigny, Spath, p. 316, pl. 32, fig. 9a-b, 12a-b, 13a-b.
1956 *Lyelliceras lyelli* (Leymerie), d'Orbigny, Benavides-Cáceres, p. 463, pl. 51, fig. 1-3.
1963 *Lyelliceras lyelli* (Leymerie), Collignon, p. 180, pl. 315, fig. 1333.
1966 *Lyelliceras lyelli* (d'Orbigny), Schindewolf, p. 710 (suture).
1971 *Lyelliceras lyelli* (d'Orbigny), Owen, pl. 2, fig. 2a-b.
1979 *Lyelliceras lyelli* (d'Orbigny), Renz, p. 364, pl. 2, fig. 5 (Atlantic).

Lectotype: *Ammonites Lyelli* Leymerie, d'Orbigny, 1841, pl. 74, fig. 103d in Spath, 1931, p. 319.

Location: La Cueva, west coast of La Borracha Island, upper Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu238. Internal mould. Whorl section broad-oval between ribs, polygonal on four rows of tubercles placed on straight, radial ribs. Umbilical tubercles bullate, lateral ones rounded, ventrolateral and siphonal tubercles clavate. Suture not preserved. Arrangement of lobes according to Schindewolf (1966, p. 710, fig. 435: E, L, U₂, U₃, U₅/U₄, U₁, I).

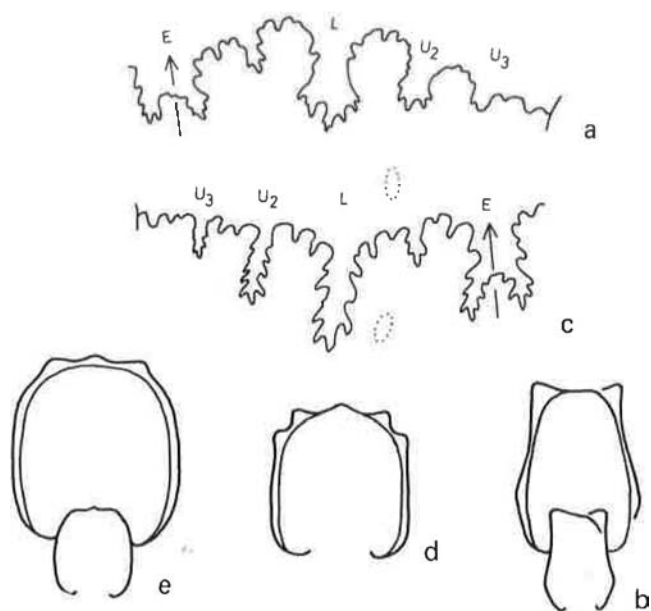
Distribution: Europe, Southern India, Japan, Madagascar, North America, Peru, Colombia, Venezuela, Northern Atlantic (Leg 47 B, Site 398 D, Deep Sea Drilling Project).

Lyelliceras pseudolyelli (Parona and Bonarelli)

Pl. 5, Fig. 15a-b; Text fig. 26c-d

- 1897 *Acanthoceras pseudo-Lyelli* Parona and Bonarelli, p. 99, pl. 14, fig. 1a-c, 2a-b.
 1913 *Acanthoceras Lyelli* Parona and Bonarelli, Sommermeier, p. 407.
 1930 *Lyelliceras pseudolyelli* (Parona and Bonarelli), Spath, p. 62.
 1931 *Lyelliceras pseudolyelli* (Parona and Bonarelli), Spath, p. 319, pl. 32, fig. 14a-b, 15a-b.
 1938 *Lyelliceras pseudolyelli* Parona and Bonarelli, Riedel, p. 54, pl. 9, fig. 5-6; pl. 13, fig. 16.
 1956 *Lyelliceras pseudolyelli* Parona and Bonarelli, Benavides-Cáceres, p. 463, pl. 52, fig. 3.
 1963 *Lyelliceras pseudo-Lyelli* Parona and Bonarelli, Collignon, p. 179, pl. 315, fig. 1334.
 1966 *Lyelliceras pseudolyelli* (Parona and Bonarelli), Schindewolf, p. 711, fig. 436 (suture).

Lectotype: *Acanthoceras pseudo-Lyelli* Parona and Bonarelli, 1897, selected by Parona and Bonarelli, 1897 from d'Orbigny, 1841, pl. 74, fig. 4.



Text fig. 26
 a-b. *Tegoceras gladiator* (Bayle), Gu791, Pl. 5, Fig. 16, suture line 4×; whorl section 2×.
 c-d. *Lyelliceras pseudolyelli* (Parona and Bonarelli), Gu423, Pl. 5, Fig. 15, suture line 4×; whorl section 2×.
 e. *Prolyelliceras peruvianum* Spath, Gu616, Pl. 5, Fig. 12, whorl section 2×.

Location: Las Playuelas, inlet on eastern side of Chimana Grande Island. Upper Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu423. Deformed specimen. Whorl section rather compressed (Text fig. 26d). Tuberculation less pronounced than on *L. lyelli*. Ribs flattening between lateral tubercles and ventrolateral clavi, then fading out over venter. Median line on venter irregularly crenulated. External suture (Text fig. 26c) as on *L. lyelli*. Ontogenetic development of suture conforms with *L. lyelli* (Schindewolf, 1966, p. 711, fig. 436).

Distribution: France, England, Peru, Colombia, Venezuela.

Genus *Tegoceras* Hyatt, 1900

Type species: *Ammonites mosensis* d'Orbigny, 1841.

Occurrence: Europe, Pakistan, Venezuela.

Tegoceras gladiator (Bayle)

Pl. 5, fig. 16a-b; Text fig. 26a-b

- 1878 *Hoplites gladiator* Bayle, pl. 45, fig. 1, 2.
 1911 *Raulinicerias gladiator* Bayle, H. Douvillé, p. 299, fig. 13, suture.
 1947 *Raulinicerias gladiator* Bayle, Breistroffer, p. 42.
 1953 *Raulinicerias gladiator* Bayle, Breistroffer, p. 70, 74.
 1957 *Tegoceras gladiator* (Bayle), Casey, p. 32.
 1966 *Tegoceras gladiator* (Bayle), Schindewolf, p. 713.
 1970 *Tegoceras gladiator* (Bayle), Destombes, p. 2064.

Location: Mochima Peninsula, Punta La Cruz. Upper Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu791. Internal mould. A well preserved fragment of this small-sized ammonite is available. Conch compressed, square shouldered. Whorl section high-rectangular (Text fig. 26b). Flanks parallel, gently declining towards umbilical seam without umbilical edge. Thickest below mid-side on umbilical bullae. Blunt ribs begin just above umbilical seam, rising into radially elongated bullae. They then flatten on outer side of flank, and end in ventrolateral clavi, alternating on both sides of shoulder. Suture pattern observed by the author (Text fig. 26a) coincides with that figured by Casey (1957, fig. 1n, p. 32). Compare also Schindewolf, 1966, p. 713.

Distribution: France, England, Venezuela.

Family Brancoceratidae Spath, 1933

Subfamily Brancoceratinae Spath, 1933

Genus *Eubrancoceras*, Breistroffer, 1952

Type species: *Brancoceras aegoceratoides* Steinmann, 1881.

Occurrence: England, France, India, Japan, Madagascar, Peru, Colombia, Venezuela.

Eubrancoceras aegoceratoides (Steinmann)

Pl. 5, Fig. 11a-b; Text fig. 25b

- 1881 *Brancoceras aegoceratoides* Steinmann, p. 133, pl. 7, fig. 2, 2a, 2b.
1912 *Brancoceras varicosum* Sowerby, Schlagintweit, p. 85.
1947 *Brancoceras aegoceratoides* Steinmann, Knechtel et al., p. 103, pl. 21, fig. 4a-c.
1951 *Eubrancoceras aegoceratoides* (Steinmann), Breistroffer, p. 266.
1956 *Brancoceras aegoceratoides* Steinmann, Benavides-Cáceres, p. 461, pl. 49, fig. 2-4.
1963 *Brancoceras aegoceratoides* Steinmann, Collignon, p. 123, pl. 289, fig. 1257-8.
1975 *Eubrancoceras* aff. *aegoceratoides* (Steinmann), Obata et al., pl. 8, fig. 1; pl. 9, fig. 1-7.

Location: La Cieneguita, inlet on south coast of Chimana Grande. Upper part of Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu109b. A rather damaged fragment. Conch small-sized, widely umbilicated. Whorl section (Text fig. 25b) broadly oval, with indistinct ventrolateral shoulder and umbilical edge. Single, round-topped ribs strengthen towards shoulder and then cross straight over venter. Specimen closely resembles the fragment figured by Benavides-Cáceres (1956) from Peru. Ontogeny of suture distinguished by non-splitting of U_1 and by alternating development of single independent umbilical lobes (lobe formula E L U_2 U_3 U_5 U_6/U_4 U_1 I) (Schindewolf, 1966, p. 706).

Measurements: Dm 46 mm, Wh 17.5 (0.38), Ww 15 (0.32), U 9.5 (0.21)

Distribution: Europe, Madagascar, Peru, Colombia, Venezuela, Japan.

Subfamily Mojsisovicsiinae Hyatt, 1903

Genus *Mojsisovicsia* Steinmann, 1881

Type species: *Ammonites ventanillensis* Gabb, 1869.

Occurrence: Europe, Greenland (Spath, 1946), Pakistan, South Africa (Zululand), Texas, Peru, Colombia, Venezuela.

Mojsisovicsia evansi (Spath)

Pl. 5, Fig. 17a-b; Text fig. 25a

- 1931 *Diploceras evansi* Spath, p. 353, pl. 32, fig. 18a-b, text fig. 115a.
1947 *Diploceras* (*Diploceroides*) *Evansi* Spath, Breistroffer, p. 90.

Location: Las Playuelas, inlet on eastern coast of Chimana Grande Island. Upper Chimana Formation, middle Albian (*dentatus* Zone).

Description: Gu416. Predominantly consisting of limonite and dark, fibrous, red goethite. Body chamber

deformed by compaction. Whorl sections (Text fig. 25a) square; intercostal section oval, thickest between mid-flank and umbilicus. Venter flattened, dominated by prominent, sharp keel. Umbilicus 32% of diameter; umbilical wall steep on ribs, rounding into feebly convex flank on interspaces. Ribs single, highly elevated, sharp-crested, asymmetric in section, with steep adoral face and gentle adaptal slope. Towards venter ribs rise into ventrolateral clavi, projected over venter, causing a deep ventral concavity towards keel. In early growth stage, up to about 18 mm diameter, whorls without sculpture. Suture partly preserved. Ontogenetic development identical with *Brancoceras*: E, L, U_2 , U_3 , U_5/U_4 , U_1 I (Schindewolf, 1966, p. 707).

Measurements near end of body chamber:

Dm 65 mm, Wh 24 (0.37), ? Ww 24 (0.37), U 21 (0.32).

Distribution: England, Venezuela.

Remark: *Mojsisovicsia ventanillensis* (Gabb) described from the middle Albian of Peru (Lissón, 1908, p. 15, pl. 16) appears to be a closely related form.

Family Engonoceratidae Hyatt, 1900

Genus *Parengonoceras* Spath, 1924

Type species: *Ammonites ebrayi* de Loriol, 1882.

Occurrence: England, France, Spain, Peru, Colombia, Venezuela.

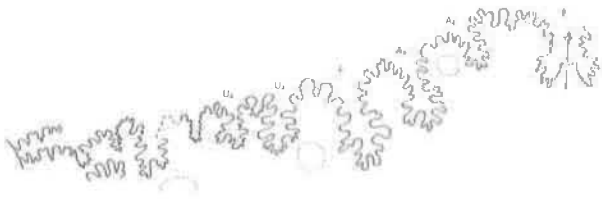
Parengonoceras aff. *pernodosum* (Sommermeier)

Pl. 6, Fig. 1, 2; Text fig. 27

- 1910 *Placentoceras pernodosum* Sommermeier, p. 331, pl. 7, fig. 1.
1956 *Parengonoceras pernodosum* (Sommermeier), Benavides-Cáceres, p. 444, pl. 44, fig. 3-4; pl. 45, fig. 1-5.

Location: West end of Chimana Grande Island. Base of upper member of Chimana Formation, about 80 m above Borracha-Guácharo limestone, late early Albian (*Douvilleiceras mammillatum* Zone).

Description: Gu29, Gu33. Internal moulds. Deformed quarter whorls. Whorl section compressed, high-rectangular, thickest on umbilical tubercles. Venter square-shouldered, broadly flattened. Four rows of tubercles placed on blunt primary folds, connecting umbilical tubercle with mid-flank tubercles, from where folds branch, rising into inner, ventrolaterally rounded, conical tubercles. From there, folds become slightly rursiradiate, ending in spirally elongated clavi, placed on sharp ventrolateral shoulder. Secondary folds begin on tubercles placed below mid-flank where they branch, ending in ventrolateral clavi, as primaries. Suture somewhat more strongly indented than on *Parengonoceras* from the



Text fig. 27
Suture line of *Parengonoceras* aff. *pernodosum* (Sommermeier), Gu29,
Pl. 6, Fig. 1, 1.5×.

upper Albian in the Andes, but otherwise identical (Text fig. 27).

Distribution: Peru, Venezuela.

Remark: The holotype of *Knemiceras tetranodosum* Lissón (1925, p. 25, pl. 2, fig. 3) from Peru, which consists only of a fragment, seems to be very similar, if not identical to the present species.

c) Albian in the Andes (States of Trujillo and Lara) (Text fig. 33)

The rich assemblage of late Albian ammonites of the La Puya Formation used in the sense prescribed by Renz (1959a), found in the surroundings of the village of Barbacoas in the State of Lara, merits some detailed discussion on the structure and stratigraphy of this part of the Andes. Reference is made to the geological map published by Renz (1959b) which covers part of the Andean structures which plunge below the Paleocene-Eocene Barquisimeto Trough.

The area between the Carora plain and the Río Tocuyo valley is dominated by two major structures, the San Pedro and the La Peña anticlines. The latter is bounded to the northwest by the prominent right lateral Hato Arriba fault. Both anticlines are disturbed by local faulting, which only becomes apparent after detailed mapping. At Hacienda Montevideo the Río Negro Formation onlaps continental sediments of the La Quinta Formation. It is conformably overlain by sediments which are a typical product of the shallow water Tibú environment. In spite of a comprehensive and methodical search no ammonites were found in the Tibú at this locality. Towards the Guayana Shield the amount of clastic components in the Tibú Formation rapidly increases. In the sandy facies of the Tibú exposed in the core of the La Peña anticline (stop 10 of the excursion guide map by Renz, 1959b), *Choffatella* is still present in calcareous intercalations. The Tibú is separated from the overlying Peñas Altas Formation (lower to middle Albian) by a rather thick, black, silty, micaceous interval representing the Guáimaras Formation. This occasionally contains some small pelecypods and plant remains, but no ammonites.

The Peñas Altas Formation consists of two lithologically similar sandstone members separated by an alternation of sands, black shales and thickly bedded skeletal limestones intercalated with biostromes of caprinids and an

interval with *Orbitolina*. There are also subordinate layers of oolites which indicate intervals of highly agitated environments. The sandstone of the Peñas Altas Formation are partly cross bedded, orthoquartzites, composed of angular to semi-rounded, river-transported, partly frosted quartz grains. Grains of blue quartz derived from the Guayana Shield, which are well known in Paleocene sands, are absent. It would appear that the rocks from which the blue quartz was derived had not been exposed for erosion at that time.

There is a sharp, morphologically well expressed contact at the top of the Peñas Altas, which separates it from the overlying La Puya Formation (Text fig. 33). The La Puya begins with 2 to 10 cm of hardground consisting of iron oxide which indicates a period of non-deposition. This is followed by a conspicuous, 2 to 4 m thick interval of black shale with no trace of fossils. This is in turn overlain by a sequence of thick bedded, very fossiliferous shallow-water limestones, containing intercalations of locally nodular marly layers. These contain abundant pelecypods, mainly oysters (*Exogyra*), rudists and locally caprinids, small *Terebratula* and some echinoids. Corals are restricted to small solitary species; algae were not observed. A rich ammonite fauna is present, confined to a single layer in the upper part of the limestone. The ammonites are accompanied by an impoverished assemblage of small gastropods and lamellibranchs which persist into the lower part of the Aguada Member of the La Luna Formation. It may be considered as a transitional hemipelagic facies between shallow, well aerated and anoxic environments.

An ammonite association which is comparable to that of the Vraconian (latest Albian) of Europe (England to Sardinia) is found in the lower part of the Aguada Member, 20 to 30 m above its base. Some of the ammonite genera are the same as those found in the Chejendé syncline (State of Trujillo) and at Barbacoas. Typical genera occur, such as *Anisoceras*, *Lechites* and *Mortoniceras* with four rows of tubercles.

The preservation of the ammonites was initially adversely affected by sediment compaction, during which many shells were crushed. They suffered further deformation during the Andean orogeny, by tectonic compression and jointing, mainly along the narrow axes of the synclines and anticlines. The body chambers are filled with sediment, whereas the phragmocones remained void and were only later filled with sparry calcite crystals. Sporadically thermally altered oil occurs in the phragmocones, a phenomenon which is common in the ammonites of the La Luna Formation.

The La Luna and Colón Formations are exposed in the synclinal depression between the San Pedro and La Peña anticlines. The Colón is divided into a lower and an upper shale interval by the Cujizal sandstone Member, which represents an important terrigenous contribution from the Guayana Shield. Locally younger limestones of Paleocene age are preserved.

The core and southeastern flank of the La Peñas structure, comprising a relatively undisturbed sequence of the

La Luna, the Colón and the Paleocene Humocaro Formations which are well exposed in the Quebrada La Porra. The Humocaro is subdivided into a lower part with *Venericardia* and an upper part containing layers with *Lithothamnium* and the foraminifera *Ranikothalia*. In the direction of the Barquisimeto Trough, the Humocaro grades into a thick *Lithothamnium-Ranikothalia* reef which marks the edge of the platform (Text fig. 46).

Family Desmoceratidae Zittel, 1895

Subfamily Desmoceratinae Zittel, 1895

Genus *Desmoceras* Zittel, 1884

Subgenus *Desmoceras* Zittel, 1884

Desmoceras (D.) latidorsatum latidorsatum (Michelin) Pl. 6, Fig. 3a-b, Text fig. 28

- 1838 *Ammonites latidorsatus* Michelin, p. 101, pl. 12, fig. 9, 9a, p. 101.
 1841 *Ammonites latidorsatus* Michelin, d'Orbigny, p. 270, pl. 80, fig. 1-4.
 1848 *Ammonites latidorsatus* Michelin, Pictet, p. 300, pl. 3, fig. 4, 5.
 1865 *Ammonites latidorsatus* Michelin, Stoliczka, p. 148, pl. 74, fig. 1-4.
 1897 *Desmoceras latidorsatum* Michelin, Kossmat, p. 172, pl. 25, fig. 2-5.
 1897 *Desmoceras latidorsatum* Michelin, Parona and Bonarelli, p. 79, pl. 10, fig. 8.
 1903 *Puzosia latidorsata* Michelin, Choffat, p. 21, pl. 6, fig. 1.
 1906 *Desmoceras latidorsatum* Michelin, Boule, Lemoine and Thevenin, p. 16, pl. 2, fig. 4.
 1916 *Puzosia (Latidorsella) latidorsata* Michelin, H. Douvillé, p. 105, pl. 12, fig. 4-6.
 1923 *Desmoceras latidorsatum* Michelin, Spath, p. 40, pl. 2, fig. 2.
 1930 *Latidorsella latidorsata* Michelin, Passendorfer, p. 640, pl. 3, fig. 48.
 1954 *Desmoceras latidorsatum* (Michelin), Matsumoto, p. 248, pl. 6, fig. 5.
 1957 *Desmoceras latidorsatum* Michelin, Almela and Revilla, p. 26, pl. 6, fig. 4.
 1961 *Desmoceras (Latidorsella) latidorsatum* Michelin, Collignon, p. 59, pl. 24, fig. 1.
 1963 *Desmoceras latidorsatum* Michelin, Collignon, p. 84, pl. 273, fig. 1176.
 1968 *D. (Desmoceras) latidorsatum* (Michelin), Wiedmann and Dieni, p. 131.
 1972 *D. (Desmoceras) latidorsatum latidorsatum* (Michelin), Renz, p. 717, pl. 8, fig. 5a-d; pl. 9, fig. 2a-b; pl. 10, fig. 1a-b, 2a-b.

Holotype: *Ammonites latidorsatum* Michelin, 1838. Cooper and Kennedy (1979, fig. 36) refigured the original of d'Orbigny (1841, pl. 80, fig. 5) from the middle Albian of France.

Remarks: All the varieties of *D. latidorsatum* distinguished to date can be found in the lower and middle Albian of the Serranía del Interior. In contrast, all specimens from the upper Albian of the Andes are large and notably uniform in size. The measurements of a great number of individuals vary within very narrow

limits which approximate those of the type specimen. The species is typically represented by the relatively small sample MBJ21066 which has its test mostly preserved.

The large size of *D. latidorsatum* in the Andes may be due to a more favourable environment than the black shale facies of middle Albian age which prevailed in the Serranía del Interior.

Suture (Text fig. 28) typical for genus (compare Schindewolf, 1966, fig. 370, p. 605; Wiedmann and Dieni, 1968, p. 134, fig. 81).

Desmoceras (Desmoceras) latidorsatum is one of the most common ammonites of the assemblage, and represents about 10% of the total number of specimens obtained.

Distribution: Almost world-wide.

Genus *Bhimaites* Matsumoto, 1954

Type species: *Ammonites bhima* Stoliczka, 1865, pl. 69, fig. 1, 1a.

Occurrence: Southern India, Madagascar, Sardinia (Wiedmann and Dieni, 1968), Venezuela.

Bhimaites aontzyensis Collignon Pl. 6, fig. 4a-b, 6; Text fig. 29a-b

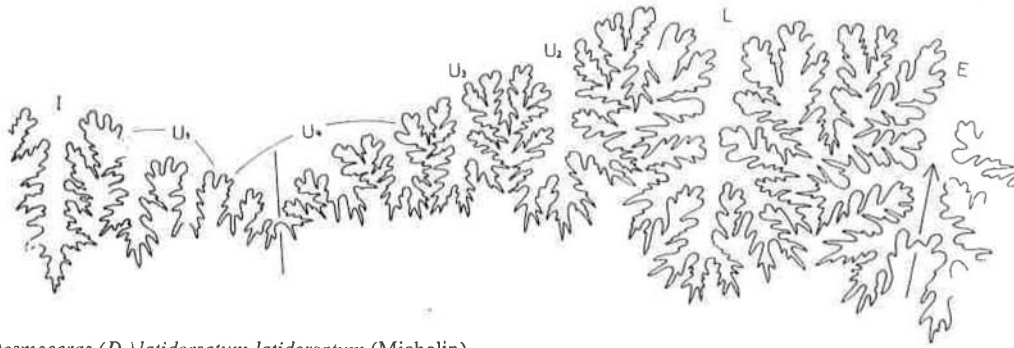
- 1961 *Bhimaites aontzyensis* Collignon, p. 37, pl. 6, fig. 2, 2a.
 1972 *Bhimaites aontzyensis* Collignon, Renz, p. 714, pl. 7, fig. 3a-b; pl. 8, fig. 1a-b, 3a-b, 4; pl. 9, fig. 1a-b; text fig. 7a, 8 (suture).

Location: Upper layer of La Puya Formation, in Quebrada Cerro Gordo section, 4 km NNE of Barbacoas. Late Albian, *H. orbigny* Zone.

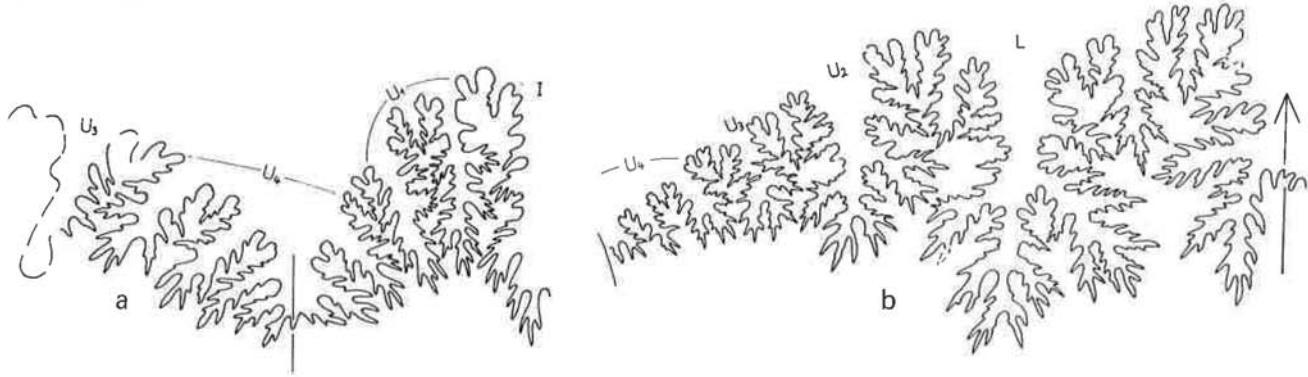
Description: MBJ28516, Pl. 6, Fig. 4a-b. Inner whorls with fragments of test. Conch compressed. Whorl section sub-oval, distinctly higher than wide, thickest just below mid-flank. Sides gently convex, flattened. Venter broadly arched, grading into flank without definable shoulder. Umbilicus 20% of diameter. Umbilical wall steep, with sharp, narrowly rounded edge. Sculpture reduced to sigmoidally curved, faint constrictions, beginning at a late stage of growth (about 40 mm diameter). They cross venter in a wide, forwardly projected, chevron-like arch.

Distribution: Southern India, South Africa (Zululand), Madagascar, Sardinia, Venezuela.

MBJ21053, Pl. 6, Fig. 6. La Aguada. Outer whorl, with beginning of body chamber. Faint ribbing between constrictions begins at 70 mm diameter on internal mould and considerably earlier on test (at about 40 mm diameter). Bifurcation of ribs on outer half of flank can be recognised. Towards body chamber ribs gradually change into distinct folds, the strength of which increases adorally. This feature, which is not restricted on the present species, was also observed on body chambers of



Text fig. 28
Suture line of *Desmoceras (D.) latidorsatum latidorsatum* (Michelin),
MBJ21069, refigured Renz (1972, p. 718), La Aguada, La Puya
Limestone, 2 \times .



Text fig. 29
Bhimaites aontzyensis Collignon:
a. MBJ21053, Pl. 6, Fig. 6, internal suture, 2 \times .
b. MBJ20745, refigured Renz (1972, p. 716) external suture, La Aguada,
La Puya Limestone, 2 \times .

other specimens. Suture (Text fig. 29a-b) typical for *Desmoceras*.

Measurements: MBJ28516, Dm 65 mm, Wh 31 (0.48), Ww 23 (0.35), U 13 (0.20)

Distribution: Madagascar, Venezuela.

Bhimaites stoliczkai (Kossmat)
Pl. 6, Fig. 5a-b

- 1865 *Ammonites Beudanti* Brongniart, Stoliczka, p. 142, pl. 71, fig. 3, 3a only.
- 1897 *Puzosia stoliczkai* Kossmat, p. 119, pl. 24, fig. 6.
- 1936 *Puzosia stoliczkai* Kossmat, Venzo, p. 69, pl. 11, fig. 1.
- 1954 *Bhimaites stoliczkai* Kossmat, Matsumoto, p. 113.
- 1961 *Bhimaites stoliczkai* Kossmat, Collignon, p. 36, pl. 6, fig. 1.
- 1965a *Bhimaites stoliczkai* Kossmat, Collignon, p. 56, pl. 332, fig. 1496.
- 1968 *Bhimaites stoliczkai* (Kossmat), Wiedmann and Dieni, p. 123, pl. 17, fig. 13.
- 1972 *Bhimaites stoliczkai* (Kossmat), Renz, p. 716, pl. 7, fig. 1a-b, 2a-c; pl. 8, fig. 2a-b.

Lectotype: *Ammonites Beudanti* Brongniart, in Stoliczka, 1865, pl. 71, fig. 3; separated by Matsumoto, 1954.

Location: Barbacoas syncline between the houses of La Leona and Los Corales, upper part of La Puya Formation, late Albian, *H. orbignyi* Zone.

Description: MBJ20747. Test only partly preserved. Flanks converging towards sub-fastigate, narrowly arched venter. Whorl section thickest within inner third of flank. Umbilicus 23% of diameter. Umbilical wall steep rounding into flank. Sculpture on test reduced to faint sigmoidal periodic ribs, difficult to distinguish from growth lines on flank. They rise over venter to form low ribs slightly adorally projected. Suture not preserved.

Measurements: MBJ20747, Dm 52 mm, Wh 25 (0.50), Ww 18 (0.34), U 12 (0.23).

Subfamily Puzosiinae Spath, 1922

Genus *Puzosia* Bayle, 1878

Subgenus *Anapuzosia* Matsumoto, 1954

Type species of subgenus: *Puzosia buenaventura* Anderson, 1938.

Occurrence: California, Venezuela.

Puzosia (Anapuzosia) tucuyensis (von Buch)
Pl. 7, Fig. 1a-b, 2a-b; Text fig. 30a-b

- 1850 *Ammonites tucuyensis* von Buch, p. 342, pl. 10 (refigured Text fig. 1).
- 1972 *Puzosia (Anapuzosia) tucuyensis* (von Buch), Renz, p. 704, pl. 1, fig. 1-3; pl. 3, fig. 2; text fig. 1.

Holotype: *Ammonites tucuyensis* von Buch, pl. 10, collected by Karsten (1849) and deposited in the Institute of

Paleontology, Humboldt University, East Berlin (Text fig. 1).

Location: Upper limestone layer of La Puya Formation, north of Barbacoas (State of Lara), near the houses of La Aguada, late Albian, *H. orbignyi* Zone.

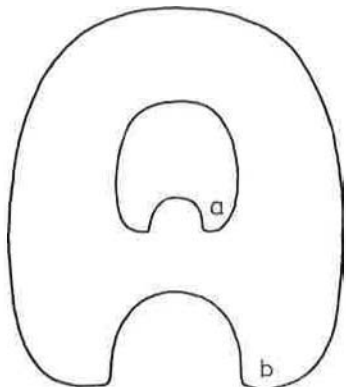
Description: MBJ20749. Large-sized ammonite. Body chamber destroyed. Test mostly preserved. Whorl section subcircular (Text fig. 30b), slightly higher than wide, thickest near mid-flank (B/H=0.86). Venter broadly arched, shoulder indistinct. Umbilicus about 30% of diameter; umbilical wall steep, rounding into flank without umbilical edge. Costation faintly prorsiradiate, stronger on test than on internal mould. Ribs slightly sigmoidally curved, crossing straight over venter. Bifurcation, occasionally trifurcation as well as incipient branching, occurs above mid-side, at different levels. On test of outer volution seven strong periodical ribs, corresponding to low constrictions on internal mould. They rise over venter, steepening adorally. On last volution of phragmocone 115 ribs cross venter and 60 reach umbilical margin. Suture not preserved (compare Renz, 1972, text fig. 3, p. 708). Juvenile stage (MBJ21044, Pl. 7, Fig. 2a-b; Text fig. 30a) mostly covered by test on which constrictions are subdued. Ribbing begins late, at about 35 mm diameter.

Measurements: MBJ20749, Dm 155 mm, Wh 63 (0.41), Ww 754 (0.35), U 47 (0.30).

Distribution: Venezuela.

Puzosia (Anapuzosia) saintoursi Collignon
Pl. 7, Fig. 3a-b, 4a-b

- 1963 *Puzosia saint-oursi* Collignon, p. 68, pl. 263, fig. 1150, pl. 266, fig. 1157, p. 61, 68.
1972 *Puzosia (Anapuzosia) saintoursi* Collignon, Renz, p. 711, pl. 4, fig. 2a-b; pl. 5, fig. 1a-b, 2a-b; pl. 6, fig. 1a-d, 2a-b; suture fig. 6.



Text fig. 30

Puzosia (Anapuzosia) tucuyensis (von Buch), whorl sections:
a. MBJ21044, Pl. 7, Fig. 2, 1×.
b. MBJ20749, Pl. 7, Fig. 1, 1×.

Holotype: *Puzosia saint-oursi* Collignon, pl. 266, fig. 1157.

Location: Upper layer of La Puya Formation. MBJ20753 near the houses of La Aguada. MBJ21052 near the houses named Vano. Late Albian, *H. orbignyi* Zone.

Description: MBJ20753. Test preserved, body chamber destroyed. Whorl section almost circular (B/H=0.96), thickest slightly below mid-flank. Umbilicus 31% of diameter (holotype 37%). Six outstanding periodical ribs on outer volution. Intermediate ribs increase in density adapically. On outer volution 64 slightly sigmoidal ribs begin above rounded umbilical margin. Most of them bifurcate or start to bifurcate on outer third of flank, in such a way that 126 ribs cross broadly arched venter in a faintly forward directed bow. Periodical ribs first appear at about 5 mm diameter, ribs developing from growth lines at about 25 mm diameter (Pl. 7, Fig. 4). Juvenile stage (MBJ21052) shows incipient constrictions at an early stage. Costation appears much later, at about 30 mm diameter.

Measurements: (MBJ20753) Dm 126 mm, Wh 52 (0.41), Ww 54 (0.43), U 39 (0.31).

Distribution: Madagascar, Venezuela.

Family Engonoceratidae Hyatt, 1900

Roughly 20% of the ammonite fauna obtained from the La Puya Formation belong to the family Engonoceratidae. Preservation of phragmocones is generally favourable. Body chambers, however, are generally crushed by compaction. Phragmocones were not filled with surrounding sediment after deposition, in most specimens. The cavities were densely filled by coarse grained sparry calcite cement later. Part of the organic material has been thermally altered, probably into impsomite, which can be observed between the calcite crystals in the cavities of some specimens.

Genus *Parengonoceras* Spath, 1924

Type species: *Ammonites ebrayi* de Loriol, 1882.

Occurrence: England, France (Destombes, 1965), Spain, Venezuela, Colombia, Peru, North Africa (Destombes, 1969).

Parengonoceras discoides Renz Pl. 8, Fig. 2a-b; Pl. 9, Fig. 2a-c

- 1970 *Parengonoceras discoides* Renz, p. 1032, pl. 1, fig. 1a-b, holotype; 2a-c; pl. 2, fig. 1, 2a-b; pl. 4, fig. 2a-b.

Location: Barbacoas syncline, near the houses of La Aguada, 4 km northwest of the village of Barbacoas. La Puya Formation, late Albian, *H. orbigny* Zone.

Description: MBJ20689 (Pl. 8, Fig. 2), MBJ20664 (Pl. 9, Fig. 2) juvenile stage. Large-sized ammonites reaching diameters of up to 500 mm. Shell slender-discoidal, involute. Venter flattened, square-shouldered, rounding when growth proceeds. Whorl section high-subtrapezoidal, thickest between mid-flank and umbilical margin. Flanks moderately convex, converging towards venter. Sculpture at early growth stage, to about 40 mm diameter (MBJ20664), consists of small tubercles on umbilical margin, from where flat folds commence, broadening club-shaped when approaching venter. Indistinct bifurcations at different levels may occur near mid-flank. Folds end in spirally elongated, sharp-crested clavi, alternating along lateral edges of venter. Flanks become progressively smoother as growth proceeds. Feebly falcate growth lines, which strongly curve forward on outer fourth of flank, cross straight over venter. Suture shows somewhat less frilled saddles than on *Parengonoceras pernodosum* from the middle Albian part of the Chimana Formation in the Serranía del Interior. First lateral saddle with two adventitious lobes. Lobe formula: $E A_2 A_1 L U_2 U_3/U_1 I$ (Renz, 1970, p. 1031).

Measurements:	Dm	Wh	Ww	U
MBJ20689, Pl. 8, Fig. 2	121 mm	71 (0.58)	33 (0.27)	6.5 (0.05)
MBJ20664, Pl. 9, Fig. 2	74 mm	42.5 (0.57)	21 (0.28)	5.5 (0.07)

Parengonoceras elegans Renz
Pl. 8, Fig. 3; Pl. 9, Fig. 1a-c

1970 *Parengonoceras elegans* Renz, p. 1036, pl. 3, fig. 1a-c, 2a-b holotype; pl. 4, fig. 1, 3a-b; Text fig. 4a-g.

Location: Barbacoas syncline, near the houses of Vano (MBJ20688) and Cerro Gordo section (MBJ20675), La Puya Formation, late Albian.

Description: MBJ20675 (Pl. 9, Fig. 1). Large-sized ammonites. Test preserved. Shell broadly discoidal. Whorl section subtrapezoidal. Venter square-shouldered, distinctly concave. Flanks moderately convex. Early stage (up to about 60 mm diameter) with umbilical tubercles, from which club-shaped flat folds branch near mid-flank, as on *Parengonoceras discoides*. After an interval without sculpture, a group of about three pronounced tubercles appears (at 123 mm diameter). They are placed within the

lower third of flank, on low bulges which fade towards venter.

On a large specimen from Vano (MBJ20688, Pl. 8, Fig. 3) venter becomes rounded at 160 mm diameter. Ventrolateral clavi displace sideways. Their longitudinal axis form angles of about 45° with edges bounding venter. Suture with slightly less frilled saddles than on *Parengonoceras discoides*.

Measurements:	Dm	Wh	Ww	U
MBJ20675, Pl. 9, Fig. 1	164	89 (0.54)	50 (0.30)	15 (0.09)
MBJ20688, Pl. 8, Fig. 3	198	112 (0.56)	64 (0.32)	17 (0.09)

Parengonoceras duplicatum Renz
Pl. 8, Fig. 1a-b; Pl. 9, Fig. 3a-b, 4a-b

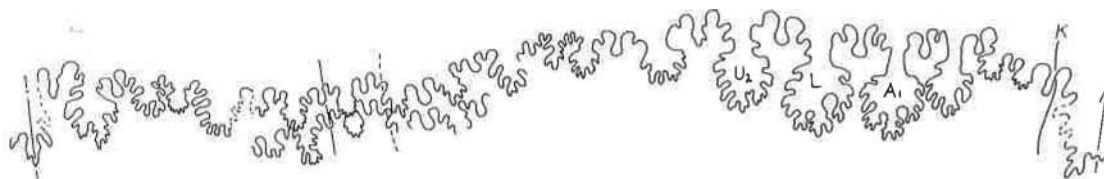
1970 *Parengonoceras duplicatum* Renz, p. 1038, pl. 5, fig. 1-4; pl. 6, fig. 1-2; pl. 7, fig. 3, holotype; pl. 8, fig. 2; text fig. 5a-g, 6.

Location: Barbacoas syncline, near the houses of La Aguada (MBJ20706) and Vano (MBJ20692 and 20693). La Puya Formation, late Albian.

Description: MBJ20693, Pl. 8, Fig. 1, MBJ20692, Pl. 9, Fig. 3, juvenile stage. Large-sized species. Test partly preserved. Shell broadly discoidal. Whorl section trapezoidal, widest on the tubercles slightly above umbilical margin. Venter square-shouldered, broadly concave. Umbilicus about 10% of diameter. On early stage, up to about 40 mm diameter, broad, low folds are distinctly stronger and bifurcations slightly more distinct than on *Parengonoceras elegans*. After an interval without sculpture, to about 90 mm diameter (one volution), tuberculation above umbilical margin reappears (MBJ20706, Pl. 9, Fig. 4). Tubercles are here placed on broad, fold-like, bulges, which branch indistinctly and end in long bullae, along lateral edges of squared venter. After one volution, at 130 mm diameter, tuberculation fades and flanks become smooth. Saddles on suture seem to be less frilled than on *Parengonoceras elegans*.

Measurements:	Dm	Wh	Ww	U
MBJ20692, Pl. 9, Fig. 3	54	28 (0.52)	15 (0.30)	6 (0.11)
MBJ20693, Pl. 8, Fig. 1	116	58 (0.50)	37 (0.32)	13 (0.11)

Remarks: Most abundant species of *Parengonoceras*. The holotype was found in a horizontal position, on the surface of the upper limestone layer of the La Puya Formation, at the precise contact against the La Luna Formation.



Text fig. 31
Suture line of *Parengonoceras barbaçoense* Renz, holotype MBJ20685, Pl. 10, Fig. 1, 1x.

Parengonoceras barbacoense Renz
Pl. 10, Fig. 1a-c, 2a-b; Text fig. 31

- 1970 *Parengonoceras barbacoense* Renz, p. 1041, pl. 6, fig. 3a-b; pl. 7, fig. 1-2; Text fig. 7a-c.
?1970 *Knemiceras andinum* Renz, p. 1047, pl. 10, fig. 1a-b; fig. 3.
?1970 *Parengonoceras* sp. Renz, p. 1045, pl. 8, fig. 1a-b.

Holotype: *Parengonoceras barbacoense* Renz, 1970, pl. 6, fig. 3; pl. 7, fig. 1 (outer volution of holotype).

Location: Barbacoas syncline, near the houses of La Aguada (MBJ20685, holotype; MBJ20687 = *Parengonoceras* sp., Renz, 1970). La Puya Formation, late Albian.

Description of holotype, MBJ20685 (Pl. 10, Fig. 1a-c): Test largely preserved. Whorl section broad-trapezoidal. On inner juvenile, tuberculated stage whorl section widest on umbilical tubercles, later widest below mid-flank. Venter broadly flattened, slightly concave, square-shouldered. Flanks converging towards venter, concavely impressed before reaching ventrolateral edge. The outer volution of the holotype (Pl. 10, Fig. 1c) has been removed to free the tuberculated early stage (Pl. 10, Fig. 1a-b). This lasts to about 65 mm diameter. It is characterized by outstanding conical tubercles above umbilical margin, placed on broad folds branching around mid-flank and ending in elongate clavi along ventral edge. On suture line (Text fig. 31) frilling of saddles is more reduced than on *Parengonoceras duplicatum*, approaching bifid saddles which characterize *Hypengonoceras whorlthi* Kossmat, 1895 (compare also Arias and Wiedmann, 1977, fig. 4, p. 10).

<i>Measurements:</i>	Dm	Wh	Ww	U
MBJ20685, Pl. 10, Fig. 1	155 mm	82 (0.53)	55 (0.35)	14 (0.09)
MBJ20687, Pl. 10, Fig. 2	111 mm	60 (0.54)	47 (0.42)	11 (0.10)

Remarks: This species differs from *Parengonoceras discooides* by a coarser and longer lasting ornamentation of the early stage and by a greater width of whorl sections.

Knemiceras andinum Renz (1970, p. 1047, pl. 10, fig. 1a-b), with its suture not preserved, cannot be grouped with any certainty, either with the genus *Parengonoceras* or with *Knemiceras*. It may, however, be related to *Parengonoceras barbacoense* Renz.

Genus *Knemiceras* Böhm, 1898

Type species: *Ammonites syriacus* von Böhm, 1898.

Occurrence: France, Spain, Portugal, North Africa, Middle East, South America.

This genus, which is widespread in South America, is known since many years (Gabb, 1877; Paulcke, 1903; Douvillé, R., 1906; Sommermeier, 1910; Lissón, 1908, 1925; Knechtel et al., 1947; Benavides-Cáceres, 1956). Breistroffer (1952, p. 2633) assumed that Peru might be one of the regions in which *Knemiceras* originated.

Knemiceras compressum Hyatt
Pl. 10, Fig. 3a-b, 4a-b; Pl. 11, Fig. 1a-b

- 1903 *Knemiceras compressum* Hyatt, p. 149, pl. 16, fig. 9, 10, holotype, 15-18.
1937 *Knemiceras compressum* Hyatt, Basse, p. 172, pl. 11, fig. 7, Text fig. 73 (suture).
1940 *Knemiceras compressum* Hyatt, Basse, p. 429, fig. 3a.
1952 *Knemiceras compressum* Hyatt, Mahmoud, p. 83.
1955 *Knemiceras compressum* Hyatt, Mahmoud, p. 58, pl. 4, fig. 2.
1956 *Knemiceras compressum* Hyatt, Benavides-Cáceres, p. 451.
1970 *Knemiceras* aff. *compressum* Hyatt, Renz, p. 1046, pl. 9, fig. 1a-b, 2a-b, 3a-b, 4; Text fig. 9a-d.

Location: Barbacoas depression, all specimens from the La Aguada section, La Puya Formation, late Albian.

Description: MBJ20672, 20732, 20673, juvenile stages. Test preserved in most cases. Shell moderately inflated. Whorl section high-trapezoidal, widest on lateral tubercles just above umbilical margin. Umbilicus 10 to 15% of diameter. Umbilical wall steep, margin distinct. Venter square-shouldered. Eight prominent, rounded, blunt lateral tubercles are located on few, broad folds. Some seem to branch from lateral tubercles, others to begin around mid-flank. All folds end in elongate clavi which alternate on ventrolateral edges. Suture poorly preserved. Saddles bifid, fairly rounded.

<i>Measurements:</i>	Dm	Wh	Ww	U
MBJ20672, Pl. 11, Fig. 1	84 mm	42 (0.50)	31 (0.37)	13 (0.15)
MBJ20673, Pl. 10, Fig. 4	48 mm	24 (0.50)	18 (0.37)	7 (0.14)
MBJ20732, Pl. 10, Fig. 3	79 mm	42 (0.53)	25 (0.31)	8 (0.10)

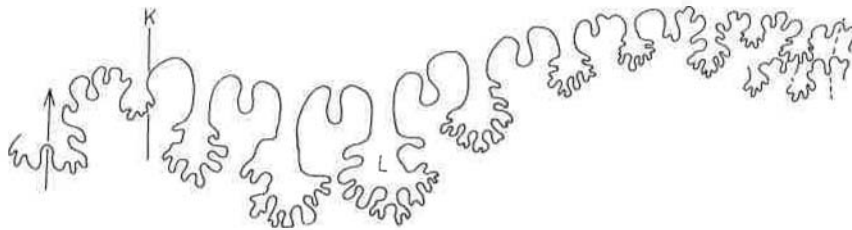
Knemiceras laraense Renz
Pl. 11, Fig. 2; Text fig. 32

- 1970 *Knemiceras laraense* Renz, p. 1049, pl. 11, fig. 2; pl. 12, fig. 1 holotype; Text fig. 11a-c.

Location: Barbacoas depression, houses of La Aguada. La Puya Formation, late Albian.

Description: MBJ20667, holotype. Partly covered by test. Whorl section subrectangular, widest at lateral tubercles above umbilical margin. Venter flattened, slightly concave, square-shouldered. Umbilicus 13% of diameter. Seven lateral tubercles are placed on broad folds, which bulge slightly below mid-flank. From here the folds are indistinctly divided and flatten, rising again into a third row of low, obliquely placed clavi, situated just below ventral edge. They begin at about 80 mm shell diameter. From these clavi ribs turn forward, ending in distant, elongate ventrolateral clavi. The ribs seem to branch very indistinctly from the lower lateral tubercles above the umbilical edge. The suture shows bifid rounded saddles which are characteristic for *Knemiceras* (Text fig. 32).

Measurements, holotype: Dm 150 mm, Wh 80 (0.53), Ww 50 (0.33), U 21 (0.13).



Text fig. 32
Suture line of *Knemiceras laraense* Renz, MBJ20667, Pl. 11, Fig. 2, 1.5X.

Family Lyelliceratidae Spath, 1921

Genus *Neophlycticeras* Spath, 1921

Type species: Ammonites brottianus d'Orbigny, 1841.

Occurrence: France, England, North Africa, Madagascar, Ecuador (Breistroffer, 1952), Venezuela.

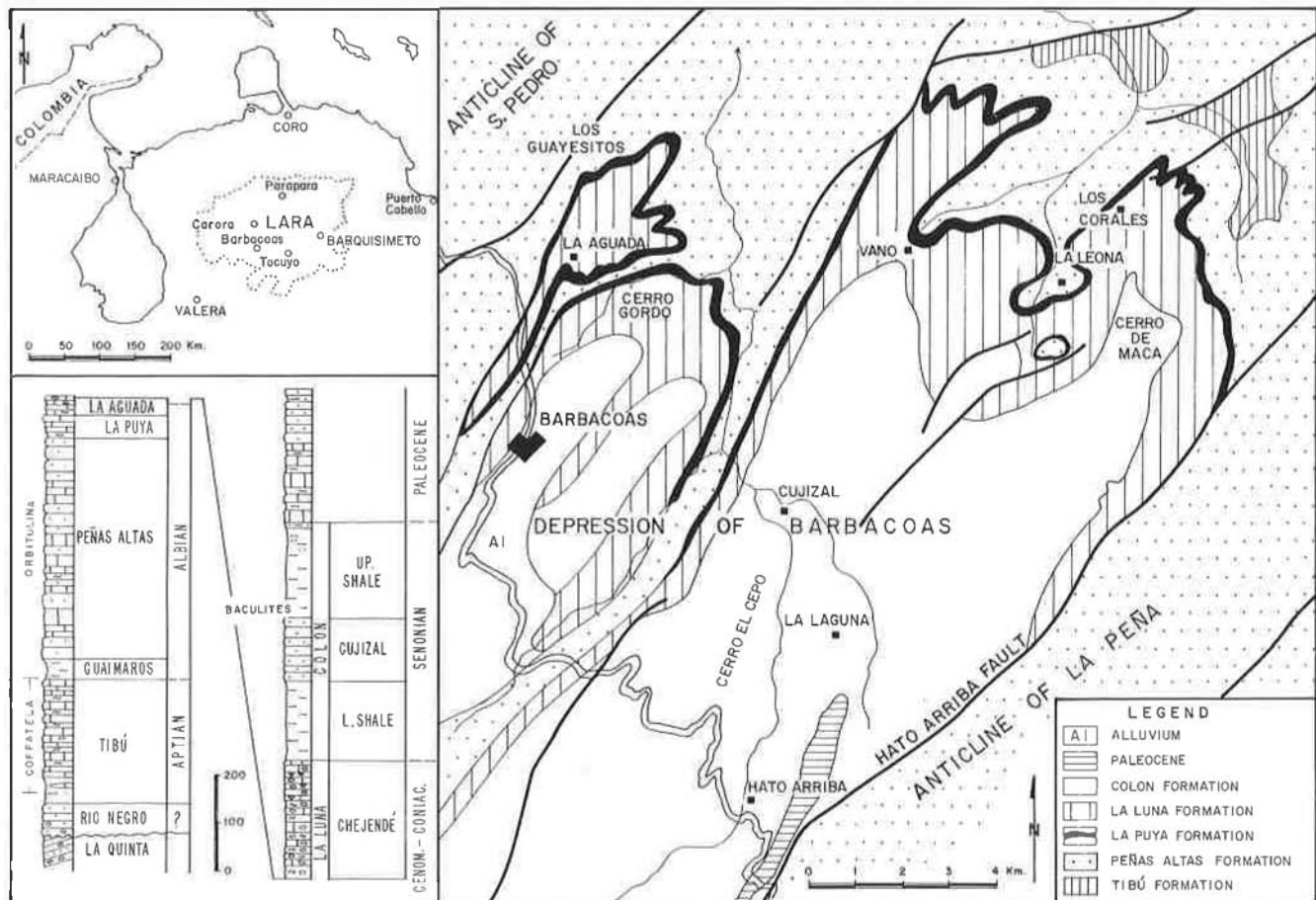
Neophlycticeras are rare ammonites which represent only about 0.5% of the ammonite assemblage so far known from the La Puya Formation.

Neophlycticeras madagascariense (Collignon) Pl. 11, Fig. 4a-b, 5a-b

- 1932 *Tissotia* (*Protissotia*) *madagascariensis* Collignon, p. 12, pl. 1, fig. 12-16.
- 1957 *Protissotia* = *Neophlycticeras*, Wright, in Treatise, p. L410.
- 1963 *Protissotia madagascariensis* Collignon, p. 181, pl. 316, fig. 1340.
- 1970 *Neophlycticeras madagascariense* (Collignon), Renz, p. 1053, pl. 12, fig. 3a-b, 4a-d, 5a-b.
- 1975 *Neophlycticeras* (*Protissotia*) *madagascariense* (Collignon), Amedro, p. 109.

Lectotype: Tissotia (*Protissotia*) *madagascariensis* Collignon, pl. 1, fig. 14a-b, selected by Renz, 1970, p. 1053.

Location: Barbacoas syncline, near the houses of La Aguada, in upper layer of La Puya Formation, found in association with *Hysterocheras orbignyi*, late Albian.



Text fig. 33
Ammonite locations in the region of Barbacoas (State of Lara).

Description: MBJ20735, MBJ20736. Small-sized ammonites, rather involute. Whorl section on phragmocone broad-oval, venter with high siphonal crests on body chamber. Umbilical slope falls off evenly, without margin. Towards the body chamber the whorl section on ribs gradually becomes flat-sided, with parallel flanks and prominent ventrolateral tubercles on shoulder. Umbilicus 27% of diameter (MBJ20735). Ribs radial, straight, broadly round-topped. Some are single, others branch below or above mid-flank. Intercalatory ribs occur which also end around mid-side. Towards the body chamber ribs strengthen and widen conspicuously, rising into ventrolateral tubercles and ending in the highly elevated siphonal crests. Ontogeny of suture (Renz, 1970, p. 1053, fig. 12) as in *Lyelliceras* ($U_2, U_3, U_5/U_4, U_1$ I). Owing to the small size of *Neophlycticeras madagascariense* (whorl height where suture was analyzed, about 5 mm) the suture appears "primitive" (Amedro, 1975, p. 109). Lobe formula: E L $U_2 U_3 U_5 U_6/U_4 U_1$ I (Renz, 1970, p. 1053).

Measurements:	Dm	Wh	Ww	U
MBJ20735, Pl. 11, Fig. 4	26 mm	11 (0.42)	8 (0.31)	7 (0.27)
MBJ20736, Pl. 11, Fig. 5	21 mm	9 (0.43)	6,5 (0.31)	5.5 (0.26)

Distribution: Madagascar, Venezuela.

Neophlycticeras cf. *duffaudi* Destombes
Pl. 11, Fig. 3

- 1969 *Neophlycticeras duffaudi* Destombes, p. 51, pl. 1, fig. 1-3, Text fig. 2.
1970 *Neophlycticeras* cf. *brottianum* (d'Orbigny), Renz, p. 1054, pl. 12, fig. 7a-b.

Location: Barbacoas syncline, near the houses of La Aguada in upper layer of La Puya Formation, found in association with *Hysterocheras orbigny*, late Albian.

Description: MBJ20738. Single specimen, diagonally deformed during Andean orogeny. Shell moderately involute. Body chamber about three fourths of outer whorl, apparently scaphitoid-like egrading on its outer quarter. Aperture, as far as exposed simple, following last rib which is reduced in width. Whorl section oval near end of phragmocone and on body chamber. Sides declining gently towards umbilical seam without margin. Undeformed ribs roughly cross straight over venter, rising on phragmocone into elongated siphonal tubercles. Few intercalatory ribs exposed on first third of body chamber. Ribs tend to broaden and flatten as they approach the end of the body chamber where they fade towards the venter, which here is rounded, without siphonal tubercles. Suture poorly preserved on opposite side of specimen.

Distribution: Morocco, Venezuela.

Family Brancoceratidae Spath, 1933

Subfamily Brancoceratinae Spath, 1933

Genus *Hysterocheras* Hyatt, 1900

Type species: *Ammonites varicosus* J. de C. Sowerby, 1824.

Occurrence: Europe, Nigeria, Angola, South Africa, Madagascar, Iran, Pakistan (Spath, 1930), Greenland, (Spath, 1946), Mexico, Venezuela.

In Venezuela the known occurrence of the genus is restricted to the La Puya Limestone and to the lowermost part of the Aguada Member in Lara and Trujillo. After *Venezolliceras* and *Parengonoceras* this genus is the most common of the ammonites found in the La Puya Formation.

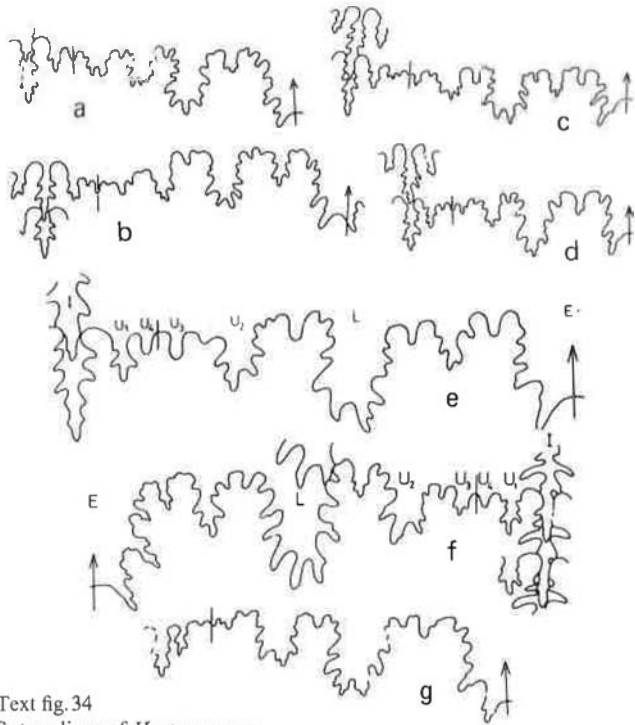
Hysterocheras orbigny Spath Pl. 11, Fig. 6a-b; Text fig. 34a

- 1841 *Ammonites varicosus* Sowerby, d'Orbigny, p. 294, pl. 87, fig. 3 only.
1847 *Ammonites varicosus* Sowerby, Pictet in Pictet and Roux, p. 356, pl. 9, fig. 3 only.
1922 *Brancoceras orbigny* Spath, p. 22.
1934 *Hysterocheras orbigny* (Spath), p. 483, pl. 49, fig. 4; pl. 50, fig. 2-5; pl. 52, fig. 2, 4, 8; pl. 56, fig. 15; text fig. 161a-d, 166a, cum synonymy.
1936 *Hysterocheras hoffati* Spath, Venzo, p. 98, pl. 9, fig. 6 only.
1942b *Hysterocheras orbigny* (Spath), Haas, p. 26.
1955a *Hysterocheras orbigny* (Spath), Reymont, p. 28, pl. 4, fig. 1.
1963 *Hysterocheras orbigny* Spath, Collignon, p. 123, pl. 289, fig. 1262-1264.
1966 *Hysterocheras orbigny* Spath, Collignon, p. 17, pl. 3, fig. 7, 7a-b.
1966 *Hysterocheras orbigny* (Spath), Schindewolf, p. 707.
1968 *Hysterocheras orbigny* (Spath), Wiedmann and Dieni, p. 137, pl. 13, fig. 1-3.
1971 *Hysterocheras orbigny* (Spath), Renz, p. 578, pl. 1, fig. 1, 2, 4, 6, 7, 8; pl. 3, fig. 4-6.
1976 *Hysterocheras orbigny* (Spath), Marcinowski and Naidin, p. 103, pl. 12, fig. 1, 3, 4.

Holotype: *Ammonites varicosus* J. de C. Sowerby in d'Orbigny, 1841, pl. 87, fig. 3, refigured in Spath, 1934 (fig. 166a, p. 485).

Location: Barbacoas syncline, houses of La Aguada. La Puya Formation, late Albian, *H. orbigny* Zone.

Description: MBJ20801. Test preserved. Whorl section on end of phragmocone subquadratic, thickest on blunt umbilical tubercles which flatten on body chamber. Umbilicus 46% of diameter. Distinct keel on internal volutions fades out over body chamber. 31 ribs on outer whorl, the majority bifurcating from umbilical bullate tubercles but occasionally single. On venter, ribs turn forward against keel; on body chamber, where keel fades out, ribs connect to form forward directed chevrons. Suture (Text fig. 34a) typical for genus (E, L, $U_2, U_3/U_4, U_1$, I). U_1 is not further split. Sutural lobes are not developed. Single umbilical lobes show an alternating



Text fig. 34

Suture lines of *Hysteroceras*:

- a. *H. orbigny* Spath, MBJ20801, Pl. 11, Fig. 6a-b, 3×.
- b. *H. aff. aguilerae* Böse, MBJ20777, Pl. 11, Fig. 8a-b, 3×.
- c. *H. carinatum* Spath, MBJ20783, Pl. 11, Fig. 11a-b, 3×.
- d. *H. aff. subbinum* Spath, MBJ20772, Pl. 11, Fig. 12, 3×.
- e. *H. aff. bucklandi* Spath, MBJ20794, Pl. 12, Fig. 4a-c, 3×.
- f. *H. andinum* Renz, MBJ20767, Pl. 12, Fig. 1a-c, 3×.
- g. *H. hoffati* Spath, MBJ20784, Pl. 12, Fig. 2a-b, 3×.

arrangement. A very long internal lobe (Schindewolf, 1966, p. 707) is an additional characteristic.

Measurements: MBJ20801, Dm 30 mm, Wh 9 (0.30), Ww 11 (0.36), U 14 (0.46).

Distribution: Europe, Africa, Madagascar, Venezuela.

Hysteroceras aff. aguilerae Böse
Pl. 11, Fig. 7a-c, 8a-b; Text fig. 34b

- 1895 *Schloenbachia aff. inflata* Sowerby, Castillo y Aguilera, p. 18, fig. 1.
- 1906 *Schloenbachia aff. inflata* Sowerby, Burckhardt, p. 8.
- 1923 *Schloenbachia Aguilerae* Böse, p. 167, pl. 11, fig. 33-36.
- non 1928 *Pervinquieria aguilerae* Böse, Adkins, p. 233, p. 12, fig. 6.
- 1934 *Hysteroceras aguilerae* Böse, Spath, p. 487.
- 1942b *Hysteroceras aguilerae* Böse, Haas, p. 41.
- ?1955 *Pervinquieria aguilerae* Böse, Eristavi, p. 141, pl. 6, fig. 3.
- 1971 *Hysteroceras aff. aguilerae* (Böse), Renz, p. 582, pl. 1, fig. 9-12; pl. 3, fig. 7-9; text fig. 2f-i, 3b.

Lectotype: *Schloenbachia Aguilerae* Böse, 1923, pl. 11, fig. 33, 35, 36, selected by Renz, 1971, p. 582.

Location: Syncline of Barbacoas, La Aguada. La Puya Formation, late Albian, *H. orbigny* Zone.

Description: MBJ20790, MBJ20777. The author agrees with Spath's view (1934, p. 487) that the description by Böse (1923) of *H. aguilerae* may just as well be applicable for *H. orbigny*.

The rib number on the outer whorl of *H. orbigny* (MBJ20801) is 31, and of *H. aguilerae* (MBJ20790) 38. The ribs may thus just be slightly closer together on *H. aguilerae*. Umbilicus 46% of diameter, against 0.50 on *H. aguilerae*. For a final decision on the taxonomic status of *H. aguilerae* better preserved material from the type locality (Camacho, in Zacatecas, Mexico) would be required. Suture as on *H. orbigny* (Text fig. 34b).

Measurements, end of phragmocone:

	Dm	Wh	Ww	U
MBJ20790, Pl. 11, Fig. 7	33 mm	9.8 (0.30)	10 (0.30)	16 (0.50)
MBJ20777, Pl. 11, Fig. 8	27 mm	8 (0.30)	9.5 (0.35)	13.5 (0.50)

Distribution: Mexico, Venezuela.

Hysteroceras carinatum Spath
Pl. 11, Fig. 9a-b, 10a-b, 11a-b; Text fig. 34c

- 1841 *Ammonites varicosus* d'Orbigny, p. 294, pl. 87, fig. 4.
- 1930 *Inflatoceras varicosum* Sowerby, Besairie, p. 633, pl. 67, fig. 6-8 only.
- 1934 *Hysteroceras carinatum* Spath, p. 482, pl. 51, fig. 5; pl. 53, fig. 4, 5, 10, 11; text fig. 161m-n, 166d.
- 1936 *Hysteroceras subbinum* Spath, Venzo, p. 98, pl. 8, fig. 4.
- 1942 *Hysteroceras carinatum* Spath, Haas, p. 37, pl. 5, fig. 7-17; pl. 6, fig. 12-14; pl. 9, fig. 2; text fig. 5a.
- 1963 *Hysteroceras carinatum* Spath, Collignon, p. 124, pl. 289, fig. 1265.
- 1966 *Hysteroceras carinatum* Spath, Collignon, p. 16, pl. 3, fig. 3, 4, 4a-b.
- 1968 *Hysteroceras carinatum* Spath, Wiedmann and Dieni, p. 136, pl. 17, fig. 12.
- 1971 *Hysteroceras carinatum* Spath, Renz, p. 583, pl. 1, fig. 13-17; pl. 2, fig. 1-3; pl. 3, fig. 10-12.

Location: Barbacoas syncline, La Aguada (MBJ20769 and 20783); Los Guayesitos (MBJ20792), La Puya Formation, late Albian, *H. orbigny* Zone.

Description: Test preserved. Whorl section subrectangular, slightly higher than wide (MBJ 20769) or as wide as high (MBJ20792).

Costation close, with 43 ribs on MBJ20769 and with only 37 ribs on MBJ20792. The latter, fewer-ribbed variety, may represent a transitional form to *H. orbigny*. Ribs more sigmoidal than on *H. orbigny*; umbilical bullae faintly developed. The keel which begins earliest in ontogeny persists on body chamber as far as preserved. **Suture** (Text fig. 34c) same as on *H. orbigny* (Text fig. 34a).

Measurements:

	Dm	Wh	Ww	U
MBJ20769, pl. 11, Fig. 9	27.5 mm	9 (0.33)	8 (0.29)	12.5 (0.45)
MBJ20792, pl. 11, Fig. 10	28.5 mm	8.5 (0.30)	9 (0.31)	12 (0.45)

Distribution: England, France, Sardinia, Madagascar, Zululand, Angola, Venezuela.

Hysteroceras aff. subbinum Spath
Pl. 11, Fig. 12a-b; Text fig. 34d

- 1934 *Hysteroceras subbinum* Spath, p. 481, pl. 52, fig. 5-7; pl. 53, fig. 6, 7; pl. 56, fig. 3, 4.

- 1936 *Hysterocheras subbinum* Spath, Venzo, p.98, pl.8, fig.3a-b only.
 1942 *Hysterocheras* cf. *subbinum* Spath, Haas, p.34, pl.4, fig.23; pl.6, fig.8 (suture).
 1947 *Hysterocheras subbinum* Spath, Breistroffer, p.52.
 1950 *Hysterocheras* cf. *subbinum* Spath, Collignon, p.72, fig.5, 5a.
 1971 *Hysterocheras* aff. *subbinum* Spath, Renz, p.586, pl.2, fig.5-9; pl.3, fig.13; text fig. 2m-o, 3g-h.

Holotype: *Hysterocheras subbinum* Spath, 1934, pl.56, fig.3.

Location: Barbacoas syncline, Los Guayesitos (MBJ20772); La Puya Formation, late Albian *H. orbignyi* Zone.

Description: MBJ20772. Test preserved, influencing whorl height, and strength of ribs. All Venezuelan specimens are of small size in comparison with the holotype from Folkestone, England. They can best be compared with those from Glynde in Sussex (Spath, 1934, pl.53, fig.6, 7). Whorl height surpasses whorl width. Sides parallel, flattened. Venter keeled, also on body chamber. Umbilical bullae appear stronger than on *H. carinatum*, as ribs are lower, especially near mid-flank. Suture typical for genus (Text fig. 34d).

Measurements: MBJ20772, pl.11, fig.12: Dm 20 mm, Wh 7 (0.35), Ww 6 (0.30), U 8 (0.40).

Distribution: England, France, Madagascar, Angola, South Africa (Zululand), Venezuela.

Hysterocheras bucklandi (Spath)
 Pl. 12, Fig. 3a-b, 4a-b; Text fig. 34e

- 1922 *Brancocheras bucklandi* Spath, p.99.
 1934 *Hysterocheras bucklandi* (Spath), p.488, pl.56, fig.1; text fig. 169b-c, 170.
 1947 *Hysterocheras Bucklandi* Spath, Breistroffer, p.52.
 1971 *Hysterocheras bucklandi* (Spath), Renz, p.588, pl.2, fig.10-13; pl.3, fig.14; text fig.2q-r, 3e.
 1971 *Hysterocheras*, group of *H. bucklandi* (Spath), Renz, p.590, pl.3, fig.3a-c; text fig.2s, 3f.

Holotype: *Hysterocheras bucklandi* Spath, 1934, (refigured after Buckland, 1836, text fig. 170a-b, p.489).

Location: Barbacoas syncline, La Aguada. La Puya Formation, late Albian, *H. orbignyi* Zone.

Description: MBJ20775, MBJ20794. The present determination is based on a specimen from the Isle of Wight figured by Spath (1934, text fig.170c-d, p.489). It is a larger sized *Hysterocheras*. Test only partly preserved. Whorl section about as high as wide, thickest at umbilical tubercles. Sides rather flattened, rounding into widely arched venter. Venter with distinct median keel. Keel fades towards end of body chamber, where ribs nearly touch, forming chevrons, similarly as in *H. orbignyi*. Umbilicus 45 to 50% of diameter. Venter of specimen MBJ20794 (Pl. 12, Fig.4) faintly grooved on both sides of keel. 37 to 41 ribs on outer volution. Suture as on other *Hysterocheras* (Text fig.34e).

<i>Measurements:</i>	Dm	Wh	Ww	U
MBJ20775, Pl. 12, Fig. 3	34 mm	10 (0.30)	11.5 (0.34)	15.5 (0.45)
MBJ20794, Pl. 12, Fig. 4	50 mm	13.5 (0.27)	14 (0.29)	25 (0.50)

Distribution: England (*auritus* Zone), France (together with *H. orbignyi*, *H. carinatum*, *H. subbinum* and *Mortonicerias pricei*; Breistroffer, 1947, p.52).

Hysterocheras andinum Renz
 Pl. 12, Fig. 1a-c, Text fig. 34f

- 1971 *Hysterocheras andinum* Renz, p.591, pl.3, fig.1a-c; text fig.2u, 3k.

Location: Barbacoas syncline, La Aguada, La Puya Limestone, late Albian, *H. orbignyi* Zone.

Description: MBJ20767, holotype. Test preserved. Body chamber, slightly crushed diagonally, forms half of outer volution. Whorl section sub-rectangular, slightly higher than wide, broadest on umbilical bullae. Sides parallel, flattened, rounding into venter. Latter provided with prominent keel which rises above level of ventrolateral shoulder. Costation dense; 50 sigmoidally curved ribs on outer volution, strongly projected forward, from shoulder towards keel on venter. Most ribs begin in pairs from umbilical bullae within lower third of flank. Short intercalatory ribs end around mid-flank. Suture (Text fig.34f) characterized by exceptionally slender, elongate internal lobe provided with a pair of conspicuous lateral folioles.

Measurements of holotype: Dm 40 mm, Wh 12.5 (0.31), Ww 12 (0.30), U 18 (0.45).

Remark: None of the forms described here are comparable with the numerous species of *Hysterocheras* figured by van Hoepen (1944) from South Africa.

Hysterocheras choffati Spath
 Pl. 12, Fig. 2a-b; Text. 34g

- 1905 *Schloenbachia varicosa* Sowerby, Choffat, p.34, pl.4, fig.6a-b.
 1922 "*Schloenbachia varicosa*" Choffat non Sowerby, Spath, p.107, 157.
 1925a *Hysterocheras choffati* Spath, p.187, pl.28, fig.1a-b, 4, holotype; pl.30, fig.5a-b.
 1934 *Hysterocheras choffati* Spath, p.489.
 1939 *Mortonicerias (Hysterocheras) Choffati* Spath, Laffite, p.165.
 1942b *Hysterocheras choffati* Spath, Haas, p.29, pl.4, fig.8, 9.
 1947 *Hysterocheras choffati* Spath, Breistroffer, p.52.
 1971 *Hysterocheras choffati* Spath, Renz, p.590, pl.2, fig.14a-b.

Location: Barbacoas syncline, La Aguada. La Puya Formation, late Albian, *H. orbignyi* Zone.

Description: MBJ20784. Single specimen with partly preserved test. Whorl section nearly rounded, widest on umbilical tubercles. Venter rounded, without keel on exposed whorl section. 37 ribs on outer whorl cross straight over venter and are faintly depressed on siphonal line; on sides rib-pattern identical to that of other *Hysterocheras*. Traces of original keel indicated on inter-

spaces as on holotype and specimens from Angola (Haas, 1942, p. 19). Suture (Text fig. 34g) comparable to other species of genus.

Measurements:	Dm	Wh	Ww	U
Holotype, based on figure	47 mm	15 (0.32)	14 (0.30)	20 (0.42)
MBJ20784, Pl. 12, Fig. 2	31 mm	10 (0.32)	10 (0.32)	12.5 (0.40)

Distribution: France (with other species of *Hysteroceras* and *Mortonicerases pricei* Spath; Breistroffer, 1947, p. 52), Algeria, Angola, Venezuela.

Subfamily Mortoniceratinae Spath, 1925

Within the La Puya Limestone Mortoniceratinae are restricted to *Prohysteroceras* and *Mortonicerases*. *Neoharporoceras* Spath 1921, which is abundant in the upper Albian of Europe and *Neokentroceras* Spath, 1921, abundant in the upper Albian of Angola (Haas, 1942; Reymont, 1955) have not been observed in Venezuela.

Genus *Prohysteroceras* Spath, 1921

Subgenus *Goodhallites* Spath, 1932

Type species: *Ammonites goodhalli* J. Sowerby, 1820.

Occurrence: England, France, Algeria, Madagascar, Angola, Texas (Adkins, 1928), Queensland (Whitehouse, 1926).

Prohysteroceras (Goodhallites) goodhalli (J. Sowerby) Pl. 12, Fig. 7; Text fig. 35

- 1820 *Ammonites Goodhalli* J. Sowerby, p. 100, pl. 255.
- 1849 *Ammonites Goodhalli* J. Sowerby, Brown, pl. 14, fig. 10.
- 1934 *Prohysteroceras (Goodhallites) goodhalli* (J. Sowerby), Spath, p. 447, pl. 50, fig. 1; pl. 56, fig. 9; text fig. 153-155, 158a, p. 447, cum synon.

- 1939 *Mortonicerases (Prohysteroceras) Goodhalli* J. Sowerby, Laffite, p. 164.
- 1947 *Neoharporoceras (Goodhallites) Goodhalli* Sowerby, Breistroffer, p. 52.
- 1971 *Prohysteroceras (Goodhallites) goodhalli* (J. Sowerby), Renz, p. 593, pl. 3, fig. 15; text fig. 15.

Holotype: *Ammonites Goodhalli* J. Sowerby, 1820, refigured by Spath, 1934, text fig. 154, p. 450.

Occurrence: England, France, Algeria, Madagascar, Angola, Texas (Young, 1957), Venezuela, Australia (Whitehouse, 1926).

Location: Barbacoas syncline, La Aguada, La Puya Formation, late Albian, *H. orbignyi* Zone.

Description: MBJ20820. Large, entirely chambered specimen. Whorl section compressed, high-rectangular, parallel sides. Venter subtabulate with prominent keel, elevated above ventrolateral shoulder. Ribs feebly sigmoidal, bi- and occasionally tri-furcating from umbilical bullae; commonly single towards end of outer volution. All ribs are tuberculated on ventrolateral shoulder, from where they bend forward against high keel. External suture (Text fig. 35) as drawn by Spath (1934, text fig. 158a, p. 461).

Distribution: England, France, Venezuela.

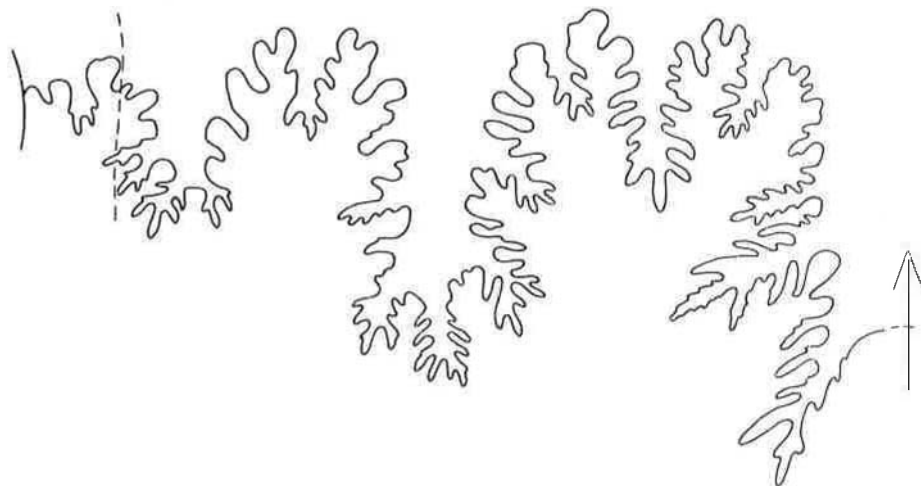
Remark: *Prohysteroceras (G.) richardsi* Whitehouse (1926, p. 222, pl. 36, fig. 2) appears to be comparable to the present species (Spath, 1932, p. 452).

Genus *Mortonicerases* Meek, 1876

Type species: *Ammonites vespertinus* Morton, 1834.

Occurrence: Europe, Africa, India, North and South America.

The genus represents an evolutionary sequence beginning with simple, bituberculate forms much as *Morto-*



Text fig. 35
Suture line of *Prohysteroceras (Goodhallites) goodhalli* (J. Sowerby),
MBJ20820, Pl. 12, Fig. 7, 2x.

