

GEOLOGICAL SURVEY OF NIGERIA

BULLETIN No. 25

THE CRETACEOUS AMMONOIDEA
OF SOUTHERN NIGERIA
AND THE SOUTHERN CAMEROONS

with 25 plates and 46 text figures

BY

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*Occasional Paper No. 8.	The Geology of the Plateau Tinfields (Interim Report No. 2)	— —
Geological Map of the Nigerian Tinfields	21 0	

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Preface

This bulletin deals with the Lower and Upper Cretaceous ammonoidea of south-eastern Nigeria and the Southern Cameroons. The investigation leading up to its production was undertaken to assist in providing a sound basis for the stratigraphic subdivision of the Nigerian Cretaceous rocks—a task for which ammonites are eminently suitable. A full understanding of the stratigraphic succession is of the greatest importance, as it materially affects the economic exploration of many of the sedimentary areas of the country, where such substances as coal, oil, and lead-zinc ores are being sought.

My thanks are due to the Keeper of Geology in the British Museum (Natural History) for permitting Mr. Reymont to work in his department in 1952 and again in 1954. I am also indebted to Dr. L. F. Spath of the Museum for the advice given during the preparation of this bulletin and to Mr. C. W. Wright for his ever-ready assistance at all times and for his critical reading of the manuscript.

The co-operation of Shell D'Arcy Petroleum Development Company of Nigeria Limited and of Amalgamated Tin Mines of Nigeria Limited is gratefully acknowledged.

R. R. E. JACOBSON,
Director.

Kaduna Junction.
1955.

Contents

THE CRETACEOUS AMMONOIDEA OF SOUTHERN NIGERIA AND THE SOUTHERN CAMEROONS

Introduction	...	...	...	9
Stratigraphy	...	...	...	10
Systematic description of the fossils	...	...	...	12
Family PHYLLOCERATIDAE	...	...	...	12
Genus <i>Phylloceras</i> Suess	...	...	...	12
P. cf. <i>velledae</i> (Michelin)	...	...	...	12
Family ANISOCERATIDAE	...	...	...	12
Genus <i>Anisoceras</i> Pictet	...	...	...	12
A. <i>perarmatum</i> Pictet and Campiche	...	...	...	12
A. sp. indet.	...	...	...	13
Family TURRILITIDAE	...	...	...	13
Genus <i>Turrilites</i> Lamarck	...	...	...	13
Subgenus <i>Euturrilites</i> Breistroffer	...	...	...	13
T. (E.) <i>scheuchzerianus</i> Bosc	...	...	...	13
Family NOSTOCERATIDAE	...	...	...	13
Genus <i>Didymoceras</i> Hyatt	...	...	...	13
D. <i>hornbyense</i> (Whiteaves)	...	...	...	13
Genus <i>Bostrychoceras</i> Hyatt	...	...	...	15
B. sp....	...	...	...	15
Family BACULITIDAE	...	...	...	15
Genus <i>Baculites</i> Lamarck	...	...	...	15
B. cf. <i>asper</i> Morton	...	...	...	15
Family ACONECERATIDAE	...	...	...	15
Genus <i>Gyaloceras</i> Whitehouse	...	...	...	15
G. <i>ibo</i> sp. nov.	...	...	...	15
Family PACHYDISCIDAE	...	...	...	16
Genus <i>Pachydiscus</i> Zittel	...	...	...	16
P. <i>aff. stallauensis</i> (Imkeller)	...	...	...	17
Family DESMOCERATIDAE	...	...	...	17
Subfamily DESMOCERATINAE	...	...	...	17
Genus <i>Desmoceras</i> Zittel	...	...	...	17
D. <i>latedorsatum</i> (Michelin)	...	...	...	17
Subgenus <i>Pseudouhligella</i> Matsumoto	...	...	...	18
D. (P.) <i>calabarensis</i> sp. nov.	...	...	...	18
Genus <i>Pachydesmoceras</i> Spath	...	...	...	19
P. <i>karnerunense</i> (von Koenen)	...	...	...	19
Genus <i>Onitshoceras</i> Reymont	...	...	...	19
O. <i>matsumotoi</i> Reymont	...	...	...	19
Family SCHLOENBACHIIDAE	...	...	...	19
Subfamily SCHLOENBACHIINAE	...	...	...	19
Genus <i>Euhystrochoceras</i> Spath	...	...	...	19
E. <i>occidentale</i> sp. nov.	...	...	...	19
Subfamily FORBESICERATINAE	...	...	...	21
Genus <i>Forbesiceras</i> Kossmat	...	...	...	21
F. <i>sculptum</i> Crick	...	...	...	21
Family BRANOCERATIDAE	...	...	...	22
Subfamily MOJSISOVICZIINAE	...	...	...	22

CONTENTS—*continued*

E. cf. intermedium Spath	...	...	...	42
E. sp. indet.	...	...	...	42
E. aff. densicostatum (Crick MS.) Spath			...	42
E. sp subelobiense Spath	...	...	...	43
E. sp. nov. indet.	...	...	...	43
E. newtoni Spath	...	...	...	43
Genus <i>Neoharpoceras</i> Spath	...	...	...	43
N. densicostatum sp. nov.	...	...	...	43
Genus <i>Prohysteroferas</i> Spath	...	...	...	45
P. sp. juv.	...	...	...	45
P. wordiei	...	...	...	45
Family LYELLICERATIDAE	...	...	...	45
Genus <i>Stoliczkaia</i> Neumayr	...	...	...	45
S. africana Pervinquière	...	...	...	45
Family ACANTHOCERATIDAE	...	...	...	46
Subfamily ACANTHOCERATINAE	...	...	...	46
Genus <i>Romaniceras</i> Spath	...	...	...	46
R. uchauxiense Collignon	...	...	...	46
R. aff. deverioide (de Grossouvre)	...	...	...	46
R. cf. deveriae (d'Orbigny)	...	...	...	47
Subfamily MANTELLICERATINAE	...	...	...	47
Genus <i>Calycoceras</i> Hyatt	...	...	...	47
C. sp. indet.	...	...	...	47
Subfamily METOICOCERATINAE	...	...	...	47
Genus <i>Metoicoceras</i> Hyatt	...	...	...	47
M. aff. ornatum Moreman	...	...	...	47
M. sp. juv.	...	...	...	49
M. sp. indet.	...	...	...	49
Subfamily MAMMITINAE	...	...	...	49
Genus <i>Mammites</i> Laube and Bruder	...	...	...	49
M. dixeyi dixeyi sp. nov.	...	...	...	50
M. d. laevis subsp. nov.	...	...	...	51
M. mutabilis mutabilis sp. nov.	...	...	...	51
M. m. benueensis subsp. nov.	...	...	...	53
M. cf. afer Pervinquière	...	...	...	53
Genus <i>Pseudaspidoceras</i> Hyatt	...	...	...	53
P. curvicostatum sp. nov.	...	...	...	55
Genus <i>Watlinoceras</i> Warren	...	...	...	55
W. aff. reesidei Warren	...	...	...	55
W. aff. amudariense (Arkhanguelskey)	...	...	...	57
Genus <i>Benueites</i> Reymont	...	...	...	57
B. spinosus Reymont	...	...	...	57
B. benueensis Reymont	...	...	...	57
Genus <i>Kamerunoceras</i> Reymont	...	...	...	59
K. jacobsoni sp. nov.	...	...	...	59
K. eschii (Solger)	...	...	...	59
Family VASCOCERATIDAE	...	...	...	61
Genus <i>Nigericeras</i> Schneegans	...	...	...	62
N. ogujaense sp. nov.	...	...	...	62

CONTENTS—continued

Genus <i>Gombeoceras</i> Reymont	...	...	63
<i>G. gongilense</i> (Woods)	...	...	63
Genus <i>Paravascoceras</i> Furon	...	...	63
<i>P. aff. chevalieri</i> (Furon)	...	...	63
Genus <i>Pachyvascoceras</i> Furon	...	...	65
<i>P. costatum</i> Reymont	...	...	65
Genus <i>Ezilloella</i> Reymont	...	...	65
<i>E. ezilloensis</i> Reymont	...	...	65
Genus <i>Neptychites</i> Kossamat	...	...	65
<i>N. perovalis</i> (von Koenen)	...	...	66
<i>N. telingaeformis</i> Solger	...	...	66
<i>N. crassus</i> Solger	...	...	67
Family COLLIGNONICERATIDAE			67
Subfamily BARROISICERATINAE	...		67
Genus <i>Barroisiceras</i> de Grossouvre			67
<i>B. (Barroisiceras) sp. indet.</i>			67
Genus <i>Forresteria</i> Reeside	...		69
<i>F. (F.) serrata</i> sp. nov.	...		69
Subgenus <i>Reesideoceras</i> Basse			69
<i>F. (R.) camerounensis</i> Basse			69
Family TISSOTIIDAE	...	...	69
Subfamily PSEUDOTISSOTIINAE		...	70
Genus <i>Pseudotissotia</i> Péron		...	70
Subgenus <i>Bauchioceras</i> Reymont	...	...	71
<i>P. (B.) nigeriensis</i> (Woods)	...	...	71
Subgenus <i>Wrightoceras</i> Reymont	...	...	71
<i>P. (W.) wallsi</i> (Reymont)	...	...	71
Genus <i>Choffaticeras</i> Hyatt	...	...	72
<i>C. (Choffaticeras) spathi</i> sp. nov.	...	...	72
Subgenus <i>Leoniceras</i> Douvillé	...	...	75
<i>C. (L.) cf. massipianum</i> (Pervinquière)	...	...	75
Subfamily COILOPOCERATINAE	...	...	75
Genus <i>Glebosoceras</i> Reymont	...	...	75
<i>G. glebosum</i> Reymont	...	...	75
<i>G. sp.</i>	...	...	77
Genus <i>Coilopoceras</i> Hyatt	...	...	77
<i>C. aff. lesseli</i> Brüggen	...	...	77
<i>C. sp. indet.</i>	...	...	77
<i>C. ? sp.</i>	...	...	77
<i>C. aff. colleti</i> Hyatt	...	...	77
Genus <i>Hoplitooides</i> von Koenen	...	...	77
<i>H. cf. wohltmanni</i> (von Koenen)	...	...	78
<i>H. koeneni</i> Solger	...	...	78
<i>H. ingens</i> <i>ingens</i> (von Koenen)	...	...	79
<i>H. i. costatus</i> Solger	...	...	81
<i>H. i. laevis</i>	...	...	81
<i>H. gibbosulus</i> <i>gibbosulus</i>	...	...	81
<i>H. g. bipartitus</i> Solger	...	...	82
<i>H. g. makurdiensis</i> subsp. nov.	...	...	83
<i>H. crassicostatus</i> sp. nov.	...	...	83

~7~

CONTENTS—*continued*

Subfamily LENTICERATINAE	...	...	83
Genus <i>Eulophoceras</i> Hyatt	...	...	83
E. <i>sp.</i>	...	...	83
Subfamily TISSOTIINAE	...	...	85
Genus <i>Tissotia</i> Douvillé	...	...	85
T. awguensis awguensis sp. nov.	...	...	85
T. a. collignoni subsp. nov.	...	...	85
T. a. falconeri subsp. nov.	...	...	85
T. latelobata Solger	...	...	87
T. cf. polygona Solger	...	...	87
T. sp. juv.	...	...	87
Family SPHENODISCIDAE	...	...	87
Genus <i>Sphenodiscus</i> Meek	...	...	87
S. aff. lobatus (Tuomey)	...	...	87
S. sp. indet.	...	...	89
S. cf. pleurisepa (Conrad)	...	...	89
Genus <i>Libycoceras</i> Hyatt	...	...	89
L. afikpoense sp. nov.	...	...	89
L. sp. juv.	...	...	90
Family PERONICERATIDAE	...	...	90
Genus <i>Peroniceras</i> de Grossouvre	...	...	90
P. czörnigi (Redtenbacher)	...	...	90
P. cf. westphalicum australe Venzo	...	...	91
P. ? sp.	...	...	91
P. sp.	...	...	93
P. sp. indet.	...	...	93
Genus <i>Texanites</i> Spath	...	...	93
T. cf. quattuornodosus (Lasswitz)	...	...	93
Genus <i>Submortoniceras</i> Spath	...	...	95
S. ? aff. soutoni (Baily)	...	...	95
List of new species and subspecies	...	...	95
Discussion of the faunas	...	...	97
Comparison with other countries	...	...	100
Bibliography	...	...	102
Index	...	...	109

THE CRETACEOUS AMMONOIDEA

OF SOUTHERN NIGERIA AND THE SOUTHERN CAMEROONS

By R. A. REYMENT, M.Sc.

Introduction

Cretaceous rocks have long been known in Nigeria and the Cameroons. The first ammonites were described from the Mungo River by von Koenen (1897, 1898), who assigned them to the Lower Cretaceous. Later, Solger (1904) worked on a larger collection from the same area made by the Esch expedition of 1899, and came to the conclusion that the sequence ranged from the Lower Turonian (possibly Cenomanian) to Coniacian. Guillemain and Harbort (1909) published the results of the former's expedition of 1907 to the Cameroons, and suggested that the Mungo River section belonged to the Coniacian, although no convincing evidence was brought forward to support this view. The Lower Turonian fossils collected by Falconer in 1908-9 during the Mineral Survey of Northern Nigeria were described by Woods (1911). The first Albian ammonites from Nigeria were identified as such by Spath (1928) in material forwarded by Wilson of the Geological Survey.

Since 1946 much work has been done on the sedimentary rocks, particularly in south-eastern Nigeria, where Shell D'Arcy¹ are engaged in exploration for oil. Shell D'Arcy and the Geological Survey have shown that, in addition to the Albian, Turonian, and Coniacian, the Cenomanian, Upper Turonian, Santonian, and Maestrichtian are also present, and that ammonites occur at numerous horizons. It was decided to make a systematic study of the ammonites as a preliminary to using them as a basis for stratigraphic subdivisions. Certain older collections of ammonites, made by

F. Temple, J. D. Falconer, and R. C. Wilson, had been deposited in the British Museum (Natural History). After the war, much material was collected by several officers of the Geological Survey in the course of other work ; this was supplemented by the writer's extensive collection from Ogoja, Benue, Calabar, and Cameroons Provinces. The Shell D'Arcy Petroleum Development Company of Nigeria Limited made many ammonites available, and certain valuable specimens, now in the British Museum (Natural History), were obtained by the Amalgamated Tin Mines of Nigeria Limited, while prospecting in Benue and Ogoja Provinces. Arrangements were made for the author to spend from April to October 1952 and from December 1953 to March 1954 at the British Museum (Natural History) studying this material. Two short papers on new genera and species of ammonites, mainly from northern Nigeria, were published by the author in 1954, and included descriptions of *Gomebooceras*, *Bauchioceras*, *Wrightoceras*, *Ezilloella*, *Kamerunoceras*, *Glebosoceras*, *Benueites*, and *Onitshoceras* from the Turonian and Coniacian. The present bulletin deals principally with forms from south-eastern Nigeria.

The author wishes to express his sincere thanks to the Keeper of Geology, British Museum (Natural History), for permission to carry out the work in the Geology Department, and his gratitude to Dr. L. F. Spath and Mr. C. W. Wright for help and guidance freely given during the course of the investigation. Professor T. Matsumoto has given valuable advice on several occasions and Mr. A. Rixon has been of great assistance in solving problems concerning the extraction of the fossils from their matrix. Thanks are also due to the Shell D'Arcy Petroleum Development Company of Nigeria Limited and Amalgamated Tin Mines of Nigeria Limited.

¹ The abbreviation "Shell D'Arcy" stands for the Shell D'Arcy Exploration Parties, which in 1951 became the Shell D'Arcy Petroleum Development Company of Nigeria Limited, a joint subsidiary of the British Petroleum Company and the Royal Dutch Shell group.

Stratigraphy

The Cretaceous rocks, which rest directly on the Pre-Cambrian Basement Complex, are the oldest fossiliferous sediments known in Nigeria, and their distribution is shown in Plate XXV. The Upper Coal Measures of uppermost Cretaceous age pass

up conformably into the Imo Clay Shales of Paleocene and Eocene age. The general succession and correlation of major lithological units is given in Table I.

TABLE I
Correlation of Cretaceous Lithological Units

STAGE	SUBSTAGE	SOUTHERN NIGERIA	NORTHERN NIGERIA	SOUTHERN CAMEROONS
Upper Cretaceous	Maestrichtian	Nkporo Shales, sandstones at Auchi, Enugu Shales, Upper and Lower Coal Measures, Falsebedded Sandstones, Awgu Sandstone Series	Shales near Gombe, shales at Damagum, Illo Group ? Rima Series, Nupe Sandstones ? Lokoja Series ?	—
	Senonian	Campanian Lower part of the Nkporo Shales ?	?	Upper part of the sandstones at Balangi
		Santonian ?	?	Mungo River Formation (sandstones at Balangi)
		Coniacian Awgu-Ndeaboh Shales	Argillaceous Beds, Upper Limestones	Mungo River Formation (beds around Bombe)
	Turonian	Upper Turonian ?	?	Mungo River Formation (beds around Ediki)
		Lower Turonian i. Younger zone : Limestone at Wadatta, limestones and shales at Igumale, sandstones at Keana	—	Mungo River Formation (beds at Mundame)
			—	Mungo River Formation (sandstones at Mundock) ?
		ii. Older zone : Eze-Aku Shales, Amaseri Sandstone Group, calcareous-shales at Okpauku, limestones and shales at Ezillo, Odukpani Formation (uppermost part), limestones and shales at Igumale (lowermost part)	Transition beds, Lower Limestones, Calcareous Beds, Limestone-Shale Series	Mungo River Formation (sandstones at Mundock) ?
	Cenomanian		Odukpani Formation	Muri Sandstones ? Bima Sandstones and Grits ? Guyok Sandstones ? Gateri Grits ?
Lower Cretaceous	Albian	Upper Albian Zone 5 Shales at Ishiagu Zone 4 Asu River Series, shales at Abakaliki, limestone at Arufu, sandstones at Nwofe Zone 3 Sandy shales at Ibenta	Unconformity	
		Middle Albian Zone 2 Shales at Nkpume Zone 1 Sandstones and shales, Tiv Division		

Pre-Cambrian

Granites and gneisses

ALBIAN

No Lower Albian has yet been found in Nigeria, but the Middle and Upper Albian are represented by a thick, folded series of shales with subordinate sandstones and limestones. Characteristic Albian faunas have been found at various localities and five faunal zones have been distinguished. The oldest fauna, which is oxytropidoceratan, is found in the sandstones and shales of Tiv Division, Benue

Province. The second and third zones are represented by the shales at Nkpume, Abakaliki Division, Ogoja Province, and the sandstones at Ibenta and contain diploceratan and early mortoniceratan faunas. The fourth zone is best seen in the shales at Abakaliki, which carry a rich fauna of *Mortoniceras* and *Elobiceras* species. The fifth, which may be correlated with the *dispar* zone of Europe, has been recognized in the shales at Ishiagu, Afikpo Division, Ogoja Province.

CENOMANIAN

The only rocks of Cenomanian age definitely known in Nigeria are those found near Odukpani, Calabar Province. They were seen along an old trace for about two and a half miles north of Odukpani and also in cuttings in the Calabar-Arochuku road about half a mile to the west. The succession, for which the name Odukpani Formation is proposed, rests directly on the Pre-Cambrian and is about 2,000 feet thick ; it has a gentle regional dip of about 6° to the south. The general sequence is as follows :—

Unexposed

5. Flaggly shales and calcareous sandstone with Turonian ammonites.
4. Sandy shales with sandstone bands and calcareous sandstones.
3. Alternating limestones and shales with Cenomanian ammonites.
2. Limestone and calcareous sandstones with fragmentary crinoids and algae.
1. Basal sandstones and conglomerates.

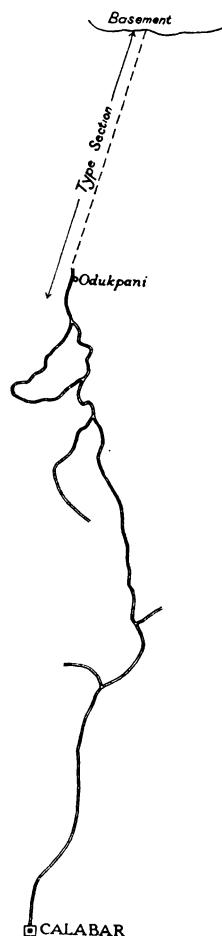
Pre-Cambrian

The type section occurs between Odukpani and a point about four and a half miles to the north where the sediments rest on the Pre-Cambrian, along the Post and Telegraph Department's trace (fig. 1). Most of the Odukpani Formation belongs to the Cenomanian, but the uppermost beds, exposed immediately north of Odukpani, have yielded Lower Turonian fossils.

TURONIAN

The Turonian stage is widely distributed in eastern Nigeria. In the south-east, it rests unconformably on the Albian, except at Odukpani, where it passes conformably downwards into beds of Cenomanian age. The Lower Turonian is well characterised by its rich ammonite faunas, but the scarcity of diagnostic fossils makes the recognition of the Upper Turonian more difficult. It is only in the Mungo River ~~Region~~, in Cameroons Province, that the Turonian has been seen to pass conformably up into Coniacian. Two zones have been recognized in the Lower Turonian (Reyment, 1954a), the lower of which is the more widely distributed. In south-eastern Nigeria, this zone occurs in the limestones and shales at Ezillo, in the calcareous shales in the Okpauku River, and at the top of the Odukpani Formation. The Eze-Aku

Shales and their lateral equivalents, the Amasari Sandstone Group of Shell D'Arcy, are probably of the same age, although no diagnostic fossils have been found. The zone may be represented in the southern Cameroons by the unfossiliferous sandstones at Mundock, at the base of the Mungo River Formation. The upper zone is typically developed



TEXT-FIG. 1.—Sketch map showing the situation of the type locality of the *Odukpani Formation*. Scale 1 : 250,000.

at Mundock in the lowest part of the Mungo River Formation. It is also well represented by the faunas of the limestones and shales at Igumale, the sandstones at Keana, and the limestone at Wadatta, near Makurdi, and the lower part of the sequence in the Konshisha River, near Oturkpo.

The Coniacian is best known from the faunas of the beds around Bombe in the upper part of the Mungo River Formation ; the Awgu-Ndeaboh Shales of Onitsha Province have yielded a comparable fauna. Faunas from the Upper Limestones of Adamawa Province in north-eastern Nigeria in part resemble those from Bombe, but no correspondence has been found with those from the Awgu-Ndeaboh Shales.

The Santonian substage is known only from the sandstones at Balangi, in the upper part of the Mungo River Formation. The beds are partly Coniacian in age and the Santonian fossils were collected from the middle of a shallow syncline.

The Campanian has not been recognized on the evidence of fossils, although Campanian deposits are known in the Gold Coast (Cox, 1952). It is

possible that part of the Nkporo Shales belong to this substage.

MAESTRICH TIAN

The Maestrichtian stage is known in south-eastern, north-eastern and western Nigeria, but not in the Cameroons. The richest faunas have been found in the Nkporo Shales. Others have been collected near Auchi, Gombe, Damagum,¹ and from the Rima Series of Sokoto Province. The following lithological units, which have not yielded ammonites, have been assigned to the Maestrichtian : the Enugu Shales, the Upper and Lower Coal Measures, the Awgu Sandstone Series, and the False-bedded Sandstones.

¹ No ammonites have been discovered at this locality ; the age has been determined from fish remains discussed by E. I. White and the author in unpublished departmental reports. The following species are known : *Enchodus lamberti* Arambourg & Joleaud, *Schizorhiza stromeri* Weiler, ?*Stratodus apicalis* Cope, and *Lamna serrata* (Agassiz).

Systematic Descriptions

Family PHYLLOCERATIDAE

Genus **Phylloceras** Suess, 1865

Phylloceras cf. velledae (Michelin)

[Synonymy in Diener (1925) ; Haas (1942, p. 146)]

1949 *Phylloceras velledae* Mich., Collignon, p. 45, figs. 5, 6 ; pl. VII, figs. 1, 1a.

1950 *Phylloceras Velledae* Mich., var., Collignon, p. 35.

1954 *Phylloceras cf. velledae* (Michelin), Donovan, p. 5.

1954b *Phylloceras* sp., Reyment, p. 21.

Remarks : A large fragment is tentatively attributed to this well-known species. It is not septate, but the ornament of blunt ribs separated by flat interspaces agrees well with the figures in the literature. The ribs are fine and numerous, the venter is rounded, and the flanks flat, almost parallel. *P. seresitense* Pervinquieré is also similar. *P. velledae* is very common in the Albian and Cenomanian of Africa. The genus *Phylloceras* has not previously been recorded from Nigeria.

Occurrence : Cenomanian ; Odukpani Formation, 3 miles north of Odukpani, Calabar Province.

*Repository*¹ : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. St. 614).

Collector : J. P. Studer, Shell D'Arcy.

Family ANISOCERATIDAE

Genus **Anisoceras** Pictet, 1854

Anisoceras perarmatum Pictet & Campiche

Plate I, figs. 1a, b

[Synonymy in Spath (1938, p. 548)]

1954b *Anisoceras cf. perarmatum* Pictet et Campiche, Reyment, p. 20.

Description : Whorl section roughly hexagonal, becoming slightly depressed at the bends. Each rib bears lateral and ventrolateral tubercles united with each other by looped riblets across the venter and the shoulders. Some of the loops on the flanks have one rib stronger than the other. Dorsum rounded and almost smooth, apart from flat folds which are visible only on the well-preserved fragments. The tubercles are small, rounded and button-shaped on the smaller fragments, but on a large, crushed specimen the lower ones become sharp and bullate on the final part of the shaft.

Remarks : The Nigerian specimens closely resemble figured examples of this species. The position of the lateral tubercles is variable, judging from published whorl sections. *A. perarmatum* is widespread in the Upper Albian and occurs, e.g., in England, Switzerland, and Angola. It was first recorded from Nigeria by Spath (1928, p. 51) as *Anisoceras cf. perarmatum*. A crushed specimen from

¹ Unless otherwise stated, all specimens are preserved in the Department of Geology, British Museum (Natural History), London.

near Ishiagu in shales belonging to zone 4 or zone 5 is probably referable here.

Occurrence : Top of the Upper Albian ; shales at Ishiagu, zone 5, Afikpo Division, Ogoja Province.

Anisoceras sp. indet.

A few badly eroded fragments from the same locality as the above-recorded species are referred here. The whorl section is more rounded and the ornament appears to be different.

Family TURRILITIDAE

Genus **Turrilites** Lamarck, 1801

Subgenus **Euturrilites** Breistroffer, 1953

Type species : *Turrilites scheuchzerianus* Bosc.

Diagnosis : Shell turrilate with high, embracing whorls and the siphon situated at the upper suture. The ornament consists of ribs which may be interrupted, but which are without tubercles.

Remarks : Recently Dubordieu (1953, p. 39) made a revision of the Turrilitidae in which the genus *Turbinites*¹ was proposed with *Turrilites scheuchzerianus* Bosc as type species. This genus was considered to differ from the related *Turrilites* Lamarck (type species : *T. costatus* Lamarck) in that its whorls, although ribbed, are always without tubercles ; *Turrilites*, on the other hand, bears three or more rows of tubercles, and ribs may also occur. As Breistroffer (1953) has pointed out, the name *Turbinites* is occupied by *Turbinites* Martin, 1809, and he has replaced it with *Euturrilites*. In the present paper *Euturrilites* is regarded as a subgenus of *Turrilites*. It may eventually prove desirable to include this group under *Turrilites* without any particular distinction.

Age : Cenomanian.

¹ The name *Turbinites* is originally a pre-Linnean name (Langius, 1708, *Hist. lapidum figur. Helv.*, vol. 32, p. 112, fig. 6) and as such is not eligible for consideration. In connection with this group it thus dates from Dubordieu (1953).

Turrilites (Euturrilites) scheuchzerianus Bosc

Plate I, fig. 2

[*Synonymy* in Diener (1925)]

1951 *Turrilites scheuchzerianus* Roissy, Wright & Wright, p. 17.

1953 *Turrilites scheuchzerianus* Bosc, Dubordieu, p. 39.

1954b *Turrilites a.s. desnoyersi* d'Orbigny, Reyment, p. 21.

Description : A *Turrilites* with strong, slightly curved ribs and no tubercles. The specimen studied con-

sists of three large whorls. The first two whorls have their ribs depressed at the middle of the whorl side. Gradually the depressions become less pronounced, until on the last part of the third whorl the ribs are entire. The flanks are fairly flat and the ribs are strongest on the upper part of the whorls.

Remarks : This species is distinguished from all other species of *Turrilites* by the typical ornament of ribs interrupted on the early whorls, becoming entire on later whorls. The earlier whorls of this species resemble *T. costatus* Pictet. The name *Turrilites desnoyersi* d'Orbigny is synonymous with *T. scheuchzerianus* Bosc and was originally given to some immature whorls of that species. *T. (E.) scheuchzerianus* is known from the Cenomanian of Germany, France, Switzerland, Italy, England, North Africa, West Africa, and South Africa.

Occurrence : Cenomanian ; Odukpani Formation, 3 miles north of Odukpani, Calabar Province.

Repository : Shell D'Arcy, Owerri.¹

Collector : D. Watt, Shell D'Arcy.

¹ Plaster cast in the British Museum (Natural History), London.

Family NOSTOCERATIDAE

Genus **Didymoceras** Hyatt, 1900

Didymoceras hornbyense (Whiteaves)

Plate I, fig. 3 ; text-fig. 2b

[*Synonymy* in Usher (1952)]

1953 *Didymoceras hornbyense* (Whiteaves) Haughton, Spath, p. 50.

1954b *Didymoceras hornbyense* (Whiteaves), Reyment, p. 21.

Description : A helicoid form whose ornament consists of two rows of asymmetrically situated tubercles with slightly oblique ribs running across the venter, but disappearing on the inner side of the whorl. These ribs are slightly flexed and are usually simple. They do, however, bifurcate occasionally near a tubercle. The whorl section is almost circular.

Remarks : This species is widely distributed. It was first recorded from Hornby Island, British Columbia, as *Heteroceras hornbyense* (Whiteaves, 1876), and later was found in Angola. Specimens from Canada and Angola were examined by the author ; they agree in all details with the Nigerian examples.

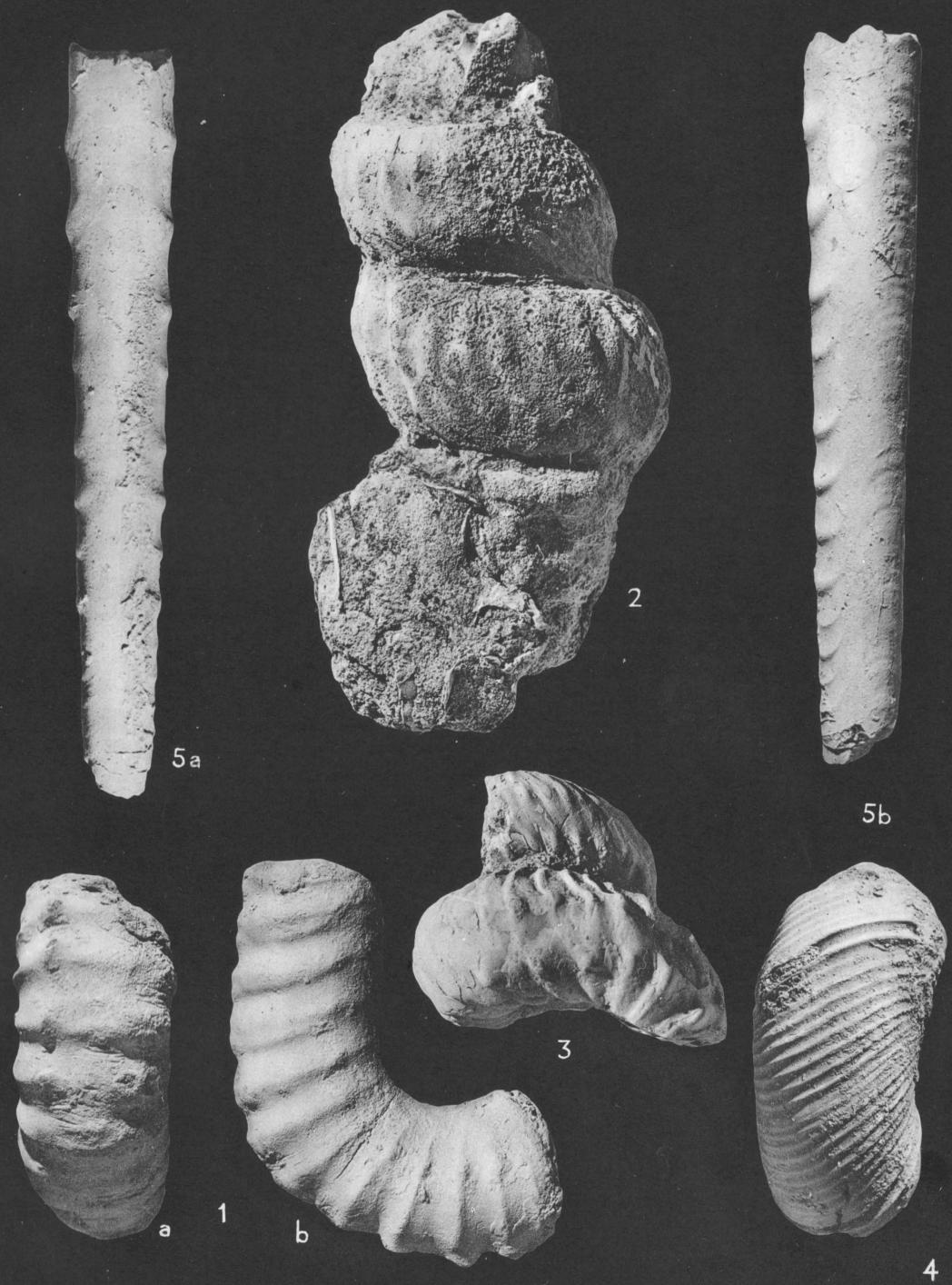
Occurrence : Maestrichtian ; Nkporo Shales, Owutu Edda, Ngusu, Afikpo Division, Ogoja Province.

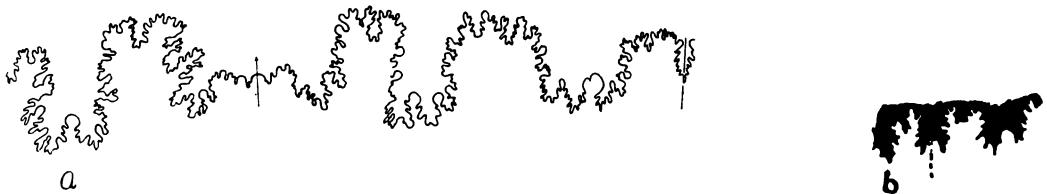
Collector : The author.

PLATE I
(opposite)

- FIG. 1. *Anisoceras perarmatum* Pictet & Campiche. (a) Ventral view showing the tuberculation ; (b) side view. Fragment from Ishiagu, Ogoja Province. Top of the Upper Albian. Page 12.
- FIG. 2. *Turrilites (Euturrilites) scheuchzerianus* Bosc. Fragment from the Odukpani Formation, Calabar Province. Cenomanian. This specimen is kept at N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland. Page 13.
- FIG. 3. *Didymoceras hornbyense* (Whiteaves). Fragment from the Nkporo Shales, Owutu Edda, Ogoja Province. Maestrichtian. (B.M. No. C.47406). Page 13.
- FIG. 4. *Bostrychoceras* sp. Fragment from the Nkporo Shales, Anofia, Ogoja Province. Maestrichtian. (B.M. No. C.47412). Page 15.
- FIG. 5. *Baculites* cf. *asper* Morton. A large fragment from the Nkporo Shales, Amamgbala, Ogoja Province. (a) Dorsal view showing the smooth dorsum and the tubercle-like beginning of the ribs at the dorsolateral margin ; (b) side view. Maestrichtian. (B.M. No. C.47413). Page 15.

(Unless otherwise indicated, all figures are natural size.)





TEXT-FIG. 2—*a*, *Baculites* cf. *asper* Morton. Suture of example represented in Plate I, figs. 5a, b; B.M. No. C.47413. *b*, *Didymoceras hornbyense* (Whiteaves). Specimen from Owutu Edda. The first suture is reproduced at twice natural size; the other suture line is shown at natural size.

Genus ***Bostrychoceras*** Hyatt, 1900

Bostrychoceras sp.

Plate I, fig. 4

1954 *Bostrychoceras* sp., Reament, p. 21.

Remarks : Two fragments from the Cross River are referred here. The ornament consists of moderately flexed ribs and regular deep constrictions with a raised rib on either side. The ribs are strongest on the venter and become weak, or may disappear, on the dorsum. Although the larger fragment is septate, none of the sutures is sufficiently well preserved for reproduction. The whorl section is circular.

Occurrence : Maestrichtian ; Nkporo Shales, Anofia, Afikpo Division, Ogoja Province.

Collector : The author.

Family BACULITIDAE

Genus ***Baculites*** Lamarck, 1801

Baculites cf. *asper* Morton

Plate I, figs. 5a, b; text-fig. 2a

[*Synonymy* in Diener (1925)]

1954b *Baculites* cf. *asper* Morton, Reament, p. 21.

Description : Whorl section roughly oval, venter sharper than dorsum. The flanks bear crescent-shaped ribs which begin at the dorsolateral margin in a backward directed curve and half way across the flanks begin to sweep forwards. They fade out before reaching the ventrolateral margin, but sigmoidal riblets continue from them to the venter. The suture is composed of broad saddles and narrow lobes. It is markedly asymmetrical.

Remarks : The figure given by Römer (1852, p. 36, pl. II, fig. 2) and that given by Stanton (1893, p. 167, pl. XXXVI) resemble the Nigerian specimens quite closely. Meek's figures of the species are, however, not so similar. Picard (1929) reported *B. asper* from the Maestrichtian of Palestine. The fragmentary *Baculites* figured by Solger (1904) as *B. cf. gracilis* (Shumard) is of

rather doubtful affinities. The present collection contains 17 specimens, most of which are considerably eroded.

Occurrence : Maestrichtian ; Nkporo Shales, Amamgbala, Afikpo Division, Ogoja Province.

Collectors : J. R. T. Hazell, the author.

Family ACONECERATIDAE

Genus ***Gyaloceras*** Whitehouse, 1927

Type species : *Gyaloceras smithi* Whitehouse.

Diagnosis : Differs from *Aconeoceras* by its greater inflation, and by the more obtuse angle of the venter. In degree of involution, smoothness of shell, type of radial line and septal sutures it agrees closely with *Aconeoceras*, from which it is apparently derived. On the outer whorls a feeble keel is usually developed above the rounded shoulders and is finally lost.

Remarks : *Gyaloceras* was originally recorded from the Aptian of the Walsh River, Queensland. The present occurrence is undoubtedly Upper Albian in age, which implies that either *Gyaloceras* is a very long-ranging ammonite genus or the original specimen actually comes from Albian deposits. The apertural drawing of the type species given by Whitehouse (1927, p. 113, text-fig. 8) shows a form bearing an entire keel throughout. Since the specimen, as indicated in the figure, is not complete, it is possible that the keel did not exist on the latest part of the outer whorl.

Age : Aptian to Upper Albian.

Gyaloceras ibo sp. nov.

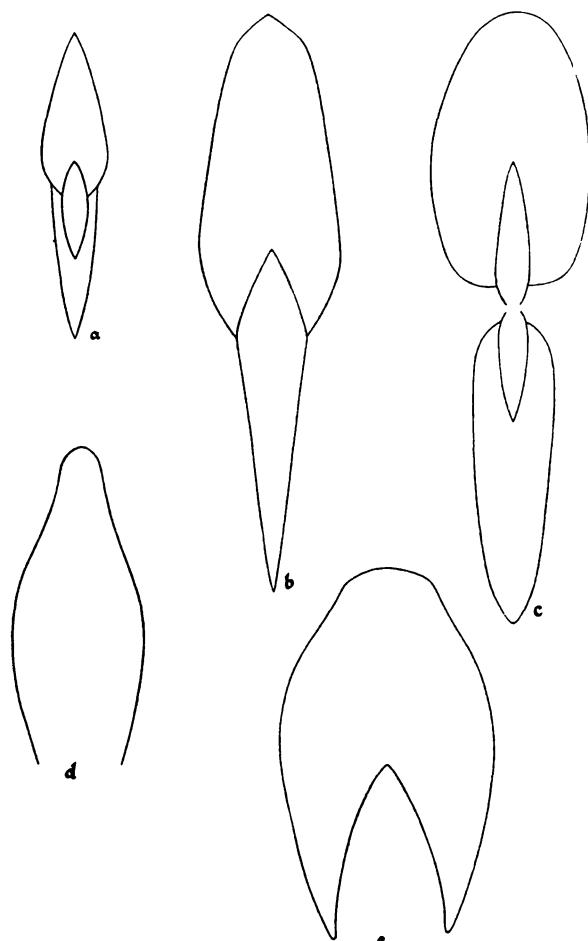
Plate II, figs. 1, 2, 3a, b; text-figs. 3, 4

1954b *Beudanticeras* sp., Reament, p. 20.

1954b *Aconeoceras* sp., Reament, p. 20.

Holotype : B.M. No. U.3545 ; the Bansara area, zone 4. Plate II, figs. 3a, b; text-figs. 3b, 4.

Description : Young with very sharp venter and smooth, very slightly inflated flanks bearing only

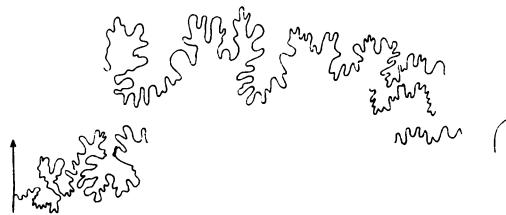


TEXT-FIG. 3—*Gyaloceras ibo* sp. nov. a, At a diameter of 42 mm., B.M. No. U.100. b, Whorl section of the holotype B.M. No. U.3545 at a diameter of 78 mm. c, Specimen B.M. No. U.3546 at a diameter of 89 mm. d, Section of an example showing pronounced inflation of the flanks, B.M. No. U.3553. e, Apertural view of a mature specimen, B.M. No. U.3555; the whorl section is lower and the flanks more inflated than in the case of less developed specimens. All figures natural size.

sickle-shaped growth lines (as in U.100). The flanks gradually become flatter (see text-fig. 3) and at an advanced growth stage the sharp venter becomes fastigate, then weakly keeled and finally broadly rounded. The flanks become very inflated (see text-fig. 3). The diameter at which rounding begins is variable. At all growth stages the ammonite is highly involute except in large individuals. In these, the umbilicus is a little wider than in the inner whorls (one specimen, however, at a diameter of 84 mm. has an umbilicus that is one-fifth of this measurement).

The suture is typically aconecerasitid. The external lobe is short, the external saddle broad and strongly tripartite (see text-fig. 4). The first lateral saddle is higher than the external saddle. The final lobes and saddles are only slightly divided.

Remarks : It is not without a certain amount of hesitation that the writer refers this species to Whitehouse's genus. *Gyaloceras* is known only from a single imperfect specimen that did not allow of an adequate description. *G. ibo* differs from *G. smithi* in becoming more inflated in the adult and in having a less prominent keel.



TEXT-FIG. 4—*Gyaloceras ibo* sp. nov. Suture line of the holotype, B.M. No. U.3545. Twice natural size. This specimen is also figured on Plate II, figs. 3a, b.

Measurements :

U.3545, holotype
diameter 78 mm. = 1·00
thickness 20 mm. = 0·25
umbilicus 4 mm. = 0·05
height of last whorl 44 mm. = 0·56

Occurrence : Upper Albian ; sandstones at Nwofe, Abakaliki, zone 4, Bansara Road, half way between the Cross River and Abakaliki, Abakaliki Division, Ogoja Province.

Collector : The author.

Family PACHYDISCIDAE Genus *Pachydiscus* Zittel, 1884

Synonym *Parapachydiscus* Hyatt, 1900

Type species : *Ammonites neubergicus* von Hauer.

Remarks : In the present state of our knowledge, the genus *Pachydiscus* seems to be poorly represented in the Upper Cretaceous of the west coast of Africa. Apart from the Nigerian and Cameroons occurrences mentioned below, we have reference to a crushed pachydiscid from Benguela, Angola (Spath, 1951, p. 6), and a note of the presence of the related genus, *Eupachydiscus*, from Egito, Angola (Spath, 1951, p. 8). The genus is, however, widely distributed in Madagascar and North

Africa, and Spath (1921) recorded several species from the Senonian of South Africa.

Pachydiscus aff. *stallauensis* Imkeller
Text-figs. 5b, c

- 1901 *Pachydiscus neubergicus* von Hauer var. *stallauensis* Imkeller, p. 57, pl. III, fig. 5.
- 1922 *Parapachydiscus stallauensis* (Imkeller), Spath, p. 123.
- 1925 *Parapachydiscus stallauensis* (Imkeller), Diener, p. 118.
- ?1932 *Parapachydiscus* cf. *stallauensis* Imk., Riedel, p. 121, pl. XXV, figs. 2, 2b.
- 1951a *Pachydiscus Stallauensis* Imk., Collignon, p. 64.

Description : The collection contains a single, well-preserved fragment (U.3672) that bears traces of the shell. It is ornamented with well-spaced, slightly flexed ribs that begin inside the umbilicus and cross the venter, where they weaken. They are sharp and thin; on the flanks they are of even strength and bend slightly forwards. Intercalatories occur between the main ribs; these begin about half way up the flanks and are always weaker than the main ribs; their distribution is uneven. The whorl section is somewhat higher than broad (17 mm. : 15 mm.) (see text-fig. 5c).

The suture line of the specimen studied is well preserved and has the following characteristics: The external lobe and the external saddle are divided almost symmetrically; the first lateral lobe is deeply incised and divided into three main prongs of unequal size; it is deeper than the external lobe. The first lateral saddle is divided in the middle and is approximately as tall as the external saddle (see text-fig. 5b).

Remarks : This specimen is very close to the form described from the Coniacian of the Mungo River Formation by Riedel (1932, p. 121) as *Parapachy-*

and more definitely tripartite (see pl. XXV, fig. 2b); the ribbing is also denser. These differences, however, are slight and may be due to growth disparities, so that the two forms may eventually prove to be conspecific. According to Riedel (p. 122), the holotype of *P. stallauensis* from the Upper Campanian of Bavaria is crushed. Even so, it can be seen that it is more compressed than both the Nigerian and Cameroons forms, although it possesses similar ornament. According to Riedel, the ribbing on the original is denser than that on the Cameroons specimen and the umbilicus is somewhat wider. The Nigerian example is almost certainly a new species, but it is too fragmentary to warrant description as such. It is here placed with the group of *P. stallauensis* to indicate its affinities, but it is certainly not specifically identical. *P. ambatryensis* Collignon (1951, p. 63) is also similar, but the ribbing is coarser and there are umbilical tubercles. *P. subrobustus* Seunes and *P. lamberti* Collignon are also comparable, but differ mainly in the nature and density of their ribbing. The former, moreover, has a widely different suture and a higher whorl section.

Occurrence : Maestrichtian; Nkporo Shales, Owutu Edda, Afikpo Division, Ogoja Province.

Collector : The author.

Family DESMOCERATIDAE

Subfamily DESMOCERATINAE Spath

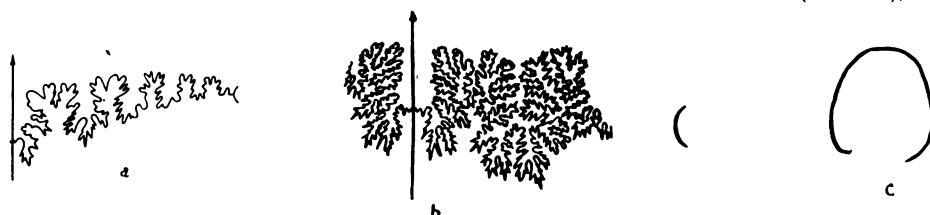
Genus **Desmoceras** Zittel, 1884

Desmoceras latedorsatum (Michelin)

Plate II, figs. 6, 7; text-fig. 5a

[**Synonymy** in Collignon (1949, p. 62)]

- 1950 *Latidorsella latidorsata* Mich., var. Collignon, p. 68, pl. XI, figs. 3, 3a.
- 1950 *Latidorsella latidorsata* Mich., Collignon, p. 43.
- 1954b *Desmoceras latedorsatum* (Michelin), Reyment, p. 21.



TEXT-FIG. 5—*a*, *Desmoceras latedorsatum* (Michelin). Suture at radius of 10 mm. Twice natural size. *b*, *Pachydiscus* aff. *stallauensis* Imkeller. Suture line. Twice natural size. *c*, *P. aff. stallauensis* Imkeller. Whorl section. Natural size. (Figs. 5b, c, specimen No. B.M. U.3672).

discus cf. *stallauensis*, but differs in that the whorl section of the latter ammonite is squarer and the first lateral lobe of the suture line less complicated

Remarks : The collection contains numerous examples of this widespread species. All belong to the variety *b* of Kossmat, which is less inflated than

variety *a* and has flatter flanks (Kossmat, 1895, p. 107). All specimens seen bear the typical ornament of the species, i.e., constrictions that are directed forwards on the venter.

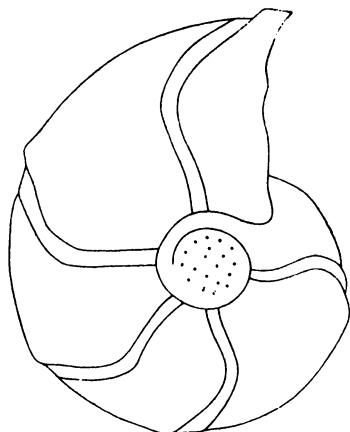
Occurrence : Cenomanian ; Odukpani Formation, 3 miles north of Odukpani, Calabar Province.

Collector : The author.

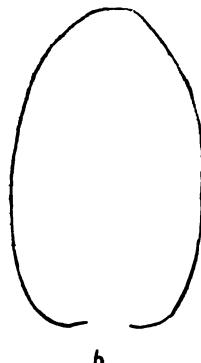
Subgenus **Pseudouhligella** Matsumoto, 1938

Type species : *Desmoceras japonicum* Yabe.

Diagnosis : Similar to *Desmoceras* s. str. in general features, but the whorls become compressed, the umbilical wall sharp and the umbilicus larger. The constrictions are slightly flexed on the flanks



a



b

TEXT-FIG. 6—*a*, *Desmoceras (Pseudouhligella) calabarensis* sp. nov. Diagrammatic representation of the holotype, B.M. No. U.3535. Natural size. *b*, Whorl section of *Anapachydiscus aff. linderi* (de Grossouvre) ? Half natural size.

and curve strongly forwards on the venter. In later growth stages, faint riblets ornament the ventral parts of the whorls.

Suture line similar to that of *Desmoceras* s. str.

Remarks : Apart from the Nigerian occurrence, *Pseudouhligella* appears to be confined to the Japanese Cenomanian (Paleogylkian).

Desmoceras (Pseudouhligella) calabarensis sp. nov.

Plate II, fig. 8, plate III, figs. 1a, b ; text-figs. 6, 7

1954b *Puzosia* sp., Reyment, p. 21.

Holotype : B.M. No. U.3535 ; Odukpani Formation, 3 miles north of Odukpani. Plate II, fig. 8, Plate III, figs. 1a, b ; text-figs. 6, 7.

Description : Moderately involute, whorl fairly high. Flanks flat and almost parallel in the adult. Umbilical margin sharp, umbilical walls steep. There are five constrictions at irregular distances on the whorl of the specimen examined (see text-fig. 6). These are moderately sickle-shaped on the flanks and swing strongly forward on the venter. The surface of the shell is smooth apart from growth lines.

The suture is composed of seven regular lobes. The saddles are bisected by strong auxiliary lobes. The suture, particularly the last three lobes, is slightly dependent, although not so strongly as in *Puzosia* (see text-fig. 7).



TEXT-FIG. 7—*Desmoceras (Pseudouhligella) calabarensis* sp. nov. Suture line of holotype, U.3535, at a radius of 28 mm. Twice natural size.

Measurements :

U.3535 (inner whorl of holotype)	
diameter	53 mm. = 1·00
thickness	19 mm. = 0·35
umbilicus	10 mm. = 0·19
height of last whorl	25 mm. = 0·47

Remarks : This species closely resembles *D. (Pseudouhligella) japonicum* Yabe from the Cenomanian of Japan, but that species has more strongly flexed constrictions and is more involute. *P.*

ezoanus Matsumoto has much feebler constrictions and the flanks are more inflated.

Occurrence : Cenomanian ; Odukpani Formation, 3 miles north of Odukpani, Calabar Province.

Collector : The author.

Genus **Pachydesmoceras** Spath, 1922

Pachydesmoceras kamerunense (von Koenen)

1898 *Desmoceras Kamerunense* von Koenen, p. 55, pl. VII, figs. 1-3.

1904 *Puzosia Denisoniana* Stoliczka, Solger, p. 103, pl. III, figs. 1a, 1b ; text-figs. 5, 6.

Description : Whorl section inflated, venter broadly rounded ; umbilicus fairly broad, umbilical wall sharply vertical. Ornamented with narrow, prominent main ribs with less prominent intermediaries. The ribs are almost straight, but bend slightly forwards on nearing the venter. On the inner whorls only a few of the ribs reach the umbilical margin, but on the outer whorls the ribbing becomes stronger and almost all ribs originate at the umbilical margin. They thicken slightly on the venter where they also swing forwards a little. There are occasional branched ribs.

Remarks : *P. kamerunense* resembles closely the type species, *P. denisonianum* (Stol.), but the ribbing is much straighter and finer. The whorl section is also more inflated. As Solger noted (1904, p. 105), this form is similar to *Austinoceras austeni* (Sharpe). A fragment of a large ammonite (Shell D'Arcy specimen No. Bl.144) from the Ezibilago creek, near Lokpauku, may be referable here. It also resembles the Coniacian species *Anapachydiscus linderi* (de Grossouvre) (see text-fig. 6b).

Occurrence : Lower Turonian ; lower part of the Mungo River Formation, Southern Cameroons.

Genus **Onitshoceras** Reymont, 1954

Type species : *Onitshoceras matsumotoi* Reymont.

Diagnosis : Flanks slightly inflated, venter broad, gently rounded, umbilicus narrow. Ornament consists of numerous irregular prosiradiate ribs, swinging forwards and thickening on the venter. In the young they begin at mid-flank, but in the adult at the umbilical margin.

Remarks : The suture of this genus shows it to belong to Desmoceratidae. The difference between *Onitshoceras* and *Desmoceras* lies in the details of their sutures and the nature of the ornament.

Age : Coniacian.

Onitshoceras matsumotoi Reymont

Plate II, fig. 9

1954b *Epigoniceras* sp., Reymont, p. 21.

1954c *Onitshoceras matsumotoi* Reymont, p. 249, pl. III, figs. 1a, b, 2 ; pl. V, fig. 7 ; text-figs. 1a, b, c.

Description : The young bear short, irregular ventral ribs, the mature individuals fine, irregular ribs that begin at the umbilical margin. The ribs appear early in the development of the species. The venter, which is arched fairly strongly on early whorls, soon flattens out.

Remarks : " *Desmoceras* " *ponsianum* de Grossouvre resembles *O. matsumotoi* but it is not nearly so strongly ornamented and appears to have a different kind of suture, judging from the photographs. *Desmoceras pyrenaicum* de Grossouvre is also similar, but it is more evolute and the sutures are like those of *Desmoceras* s. str.

Occurrence : Coniacian ; upper part of the Awgu-Ndeaboh Shales, Awgu, Onitsha Province.

Collector : The author.

Family SCHLOENBACHIIDAE

Subfamily SCHLOENBACHINAE

Genus **Euhystrichoceras** Spath, 1923

Euhystrichoceras occidentale sp. nov.

Plate II, figs. 4, 5 ; text-fig. 8

1954b *Hysteroceras* sp. indet., Reymont, p. 21.

Holotype : B.M. No. U.3534, Odukpani Formation, 2 $\frac{3}{4}$ miles north of Odukpani. Plate II, fig. 5.

Description : This species is based on two fragments, one a body chamber, the other a portion of a septate inner whorl. The smaller fragment (U.2524, paratype) has a prominent keel, prominent ribs and occasional umbilical tubercles, situated a little above the umbilical margin. Occasional ventrolateral swellings were also observed. The ribs, which are strongly curved, bend sharply forwards on the venter and cease abruptly before reaching the keel. The flanks are flat and parallel, and the venter is broad and slightly rounded. The larger fragment (U.3534, holotype) represents the adult stage of the species. The ribbing is coarser and more widely spaced, and some ribs almost unite with the keel. The ribs visible on the smaller fragment do not bifurcate, but those on the larger specimen divide irregularly. They bear flat ventrolateral swellings and bend sharply forwards on the venter. Every second or third rib bears long, bullate umbilical tubercles. The flanks are more rounded than in the smaller

PLATE II
(opposite)

- FIG. 1. *Gyaloceras ibo* sp. nov. Paratype. Large fragment from Bansara, Ogoja Province. Middle of the Upper Albian. (B.M. No. U.3554). Page 15.
- FIG. 2. *Gyaloceras ibo* sp. nov. Paratype. Presence of weak keel shown. Middle of the Upper Albian, Bansara, Ogoja Province. (B.M. No. U.3555). Page 15.
- FIG. 3. *Gyaloceras ibo* sp. nov. Holotype. Middle of the Upper Albian, Nwofe, Ogoja Province. (a) Side view; (b) ventral view, showing the fastigate periphery. (B.M. No. U.3545). Page 15.
- FIG. 4. *Euhystrichoceras occidentale* sp. nov. Paratype. Cenomanian. Odukpani Formation, Calabar Province. ($\times 3$). (B.M. No. U.3524). Page 19.
- FIG. 5. *Euhystrichoceras occidentale* sp. nov. Holotype. Cenomanian. Odukpani Formation, Calabar Province. ($\times 3$). (B.M. No. U.3534). Page 19.
- FIG. 6. *Desmoceras latedorsatum* (Michelin). Cenomanian. Odukpani Formation, Calabar Province. Page 17.
- FIG. 7. *Desmoceras latedorsatum* (Michelin). Side view of a small individual. Cenomanian. Odukpani Formation, Calabar Province. Page 17.
- FIG. 8. *Desmoceras (Pseudouhligella) calabarensis* sp. nov. Holotype. Ventral view. Cenomanian. Odukpani Formation, Calabar Province. (B.M. No. U.3535). Page 18.
- FIG. 9. *Onitshoceras matsumotoi* Reyment. Side view. Coniacian. Awgu-Ndeaboh Shales, near Awgu, Onitsha Province. Page 19.
- FIG. 10. *Hysterooceras aff. multifalcatum* (van Hoepen). Ventral view of fragment. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. Page 29.
- FIG. 11. *Dipoloceras* sp. indet. Side view. Lower Upper Albian. Ndi Ofia, Ogoja Province. (B.M. No. C.21980). Page 24.



specimen and the venter is broadly rounded. The suture is simple and typical of the genus.



TEXT-FIG. 8—*a*, *Euhystrichoceras occidentale* sp. nov. Suture line of the paratype, B.M. No. U.2524. Twice natural size. *b*, *Forbesiceras sculptum* Crick. Suture line of specimen No. F.M. 14 A (a). Natural size.

Remarks : This species is a typical *Euhystrichoceras*, as is borne out by the simple suture line (text-fig. 8), the ribbing, and the keel. It most closely resembles the type species, *E. nicaisei* (Coquand), which is, however, more inflated. The sutures of the two forms are closely comparable. *E. nicaisei* appears to be quite variable as regards inflation and density of costation. Its ribs are less strongly bent forwards on the venter, which is subacute, its keel is thinner and higher, and the ribbing finer. *E. simplex* Spath and *E. constrictum* Spath, both from the Lower Cenomanian of Warminster, England, differ from the Nigerian species in that the former has a less depressed whorl section and closer ribbing, and the latter is larger and has much coarser ornament. *E. remolinense* Böse has a more acute venter on which the ribs are less strongly bent forwards. The ribbing is also finer. The genus is known from England, Algeria, Tunisia, Madagascar and Mexico.

Occurrence : Cenomanian ; Odukpani Formation, 2½ miles north of Odukpani, Calabar Province.

Collector : The author.

Subfamily FORBESICERATINAE

Wright (1952, p. 220) has distinguished this subfamily on the basis of the high-whorled, compressed, involute form and the fine, dense, sigmoidal or falcate ribs of its genera. Furthermore, the suture lines are more complicated than those of the rest of Schloenbachidae. The subfamily comprises the genera *Forbesiceras* Kossmat, *Tropitoides* Spath, and *Prohauericeras* Nowák. Only the first genus is known from Nigeria.

Genus *Forbesiceras* Kossmat, 1897

Type species : *Ammonites largilliertianus* d'Orbigny.

Remarks : This genus is represented in Nigeria by one fragmentary specimen from the Cenomanian

Odukpani Formation. The following species are known : *F. largilliertianum* (d'Orbigny), *F. obtectum* (Sharpe), *F. sculptum* Crick, *F. nodosum* Crick, *F. subobtectum* (Stoliczka), *F. flicki* Pervinquière, and *F. conlini* Stephenson. *Forbesiceras* ranges from the lowest almost to the highest English Cenomanian, i.e., from the lowest zone but one by world standards to the highest but one.

Forbesiceras sculptum Crick

Text-fig. 8b

- 1907 *Forbesiceras sculptum* Crick, p. 182, pl. XI, figs. 7, 7a.
1951 *Forbesiceras sculptum* Crick, Wright & Wright, p. 24.

Description : The fragment studied consists of about one-third of a whorl. The whorl section is very compressed, the flanks slightly convex ; the venter is narrow and truncated. The ornament consists of numerous flat, moderately strong, sigmoidal ribs that become stronger and thicker towards the venter ; they cross the venter, where they become broader and flatter. There is a row of small, sharp clavate ventrolateral tubercles on each side of the periphery, and a row of feeble, bullate mediolateral tubercles on each flank. The mediolateral tubercles do not occur on each rib. The suture line is shown in text-fig. 8b.

Remarks : The Nigerian fragment agrees well with the specimen figured by Crick (1907), although the ribbing appears to be slenderer and the ventrolateral tubercles slightly finer. *F. largilliertianum* (d'Orbigny) is more finely and feebly ribbed, the ventrolateral tubercles are weaker and more numerous, and there are no mediolateral tubercles. *F. obtectum* (Sharpe) has similar ornament, but differs, however, in that the sculpture is finer and the mediolateral tuberculation, on the inner whorls at least, is stronger and more regular. *F. conlini* Stephenson is also similarly ornamented, but the venter is narrower, the ribbing straighter as well as irregular, and the umbilical tubercles stronger. *F. subobtectum* (Stoliczka) differs in the nature of the ribbing and the whorl section. *F. nodosum* Crick resembles *F. subobtectum* closely as regards ornament, but has a different whorl section. There has been some doubt about the validity of Crick's species (see Basse, 1931, p. 39), but in the present author's opinion, the whorl sections are sufficiently different to warrant specific separation (cf. Crick, 1907, pl. XI, fig. 8a, and Stoliczka, 1863, pl. XLIX, fig. 2a).

In England, *F. sculptum* occurs in the Cenomanian *varians* zone ; it is very rare. The species is known from England and South Africa.

Occurrence : Cenomanian ; Odukpani Formation, from the Odukpani road, Calabar Province.

Collector : F. van Morkhoven, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. F.M. 14A (a)).

Family BRANOCERATIDAE

Subfamily MOJSISOVICZIINAE

Genus **Oxytropidoceras** Stieler, 1920

Oxytropidoceras s. str.

Type species : *Ammonites roissyanus* d'Orbigny.

Diagnosis : Very compressed, strongly keeled and rather involute. Ribs fine, single, untuberculate, more or less flattened, steep in front and sloping gently behind.

Oxytropidoceras (*Oxytropidoceras*) cf. *bravoense* (Böse)
Plate III, fig. 2

- 1910 *Schloenbachia bravoensis* Böse, p. 69, pl. III, fig. 6 ;
pl. IV, figs. 1-5.
1927 *Oxytropidoceras bravoense* (Böse), Adkins, pp. 39,
52, 55.
1928 *Oxytropidoceras* aff. *bravoense* (Böse), Adkins, p. 227,
pl. IV, fig. 2.
1936 *Oxytropidoceras* *bravoense* Böse, Collignon, p. 181,
pl. XX, fig. 3.

Description : A single rather crushed fragment (U.3537) is referred here. The ribs are single, widely spaced and rounded. They are curved forward but are not sigmoidal, and are most bent near the umbilicus, after which they swing round gradually. They become slightly flatter and broader towards the venter.

Remarks : This specimen is closely comparable with *O. bravoense*. It seems, however, to have somewhat stronger ribs that do not definitely divide. The figure of the species given by Collignon (1936) differs in having somewhat sharper ribs, particularly dorsally. *O. boulei* Collignon is somewhat similar but it has more sigmoidal ribbing ; *O. colcanapi* Collignon is also similar, but the ribs are weaker and more curved.

Occurrence : Middle of the Middle Albian ; sandstones and shales of Tiv Division, zone 1, Benue Province.

Collector : Mr. K. Paulo, A.T.M.N.¹

Subgenus **Androiavitae** Collignon, 1936

Type species : *Oxytropidoceras* (*Androiavitae*) *besairiei* Collignon.

Subgeneric diagnosis : This subgenus is typified by its rather distinct ribs with strong, irregular umbilical tubercles on the inner whorls, which on later whorls tend to move up the sides and then disappear.

Oxytropidoceras (*Androiavitae*) aff. *paucituberculatum*
Collignon

Plate III, figs. 6, 7

1936 *O. (Androiavitae) paucituberculatus* Collignon,¹ p. 187,
pl. XVIII, fig. 4.

1954b *Adkinsites* sp., Reymont, p. 22.

Description : Two specimens are available. One is almost complete and has simple sigmoidal ribbing, somewhat bent forwards. The shell is moderately compressed and fairly involute ; the umbilical walls are high and curve into the flanks. The ribs are strong and distant from each other. No umbilical tubercles are discernible on this specimen.

The other specimen consists of a half whorl with rather sigmoidal ribbing. A few bullate umbilical tubercles are present a short distance from the umbilical margin.

Remarks : The specimens most closely resemble *O. (Androiavitae) paucituberculatum* Collignon from Madagascar, although that species appears to have somewhat stronger umbilical tubercles. The smaller, more complete, specimen has perhaps lost its tubercles at an unusually early stage. The ribbing and whorl section of the Nigerian ammonites agree well with Collignon's figures, although the whorl section of the Malagasy forms appears to be a little higher and their ribbing slightly finer.

Occurrence : Middle of the Middle Albian ; zone 1, sandstones and shales of Tiv Division, Uomba River, Benue Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland.²

¹ Referred to as " *Adkinsites paucituberculatus* Collignon nov. sp." in the explanation to pl. XVIII, fig. 4.

² Plaster cast in the British Museum (Natural History), London.

Oxytropidoceras (*Androiavitae*) cf. *besairiei* Collignon
Text-fig. 9d

1936 *O. (Androiavitae) besairiei* Collignon, p. 186, pl.
XVIII, fig. 3 ; pl. XX, fig. 4 ; text-fig. 12m.

Description : The specimen studied consists of a

¹ Amalgamated Tin Mines of Nigeria Limited.

large fragment ornamented with almost straight ribs, one side of which are noticeably steep and the other gently sloping. The ribs are club-shaped. The keel is strong and sharp. An occasional rib may continue up on to the keel.

Remarks : The fragment is too incomplete and eroded to permit of a more precise attribution than that given. It most closely resembles *O. (A.) besairiei*, but it is not certain that the two forms are conspecific. *O. (A.) paucituberculatum* Collignon has sigmoidal ribs and a more compressed whorl section, and the ribs are not noticeably club-shaped. *O. (A.) besairiei* is known from the Middle Albian of Madagascar.

Occurrence : Middle of the Middle Albian ; zone 1, sandstones and shales of Tiv Division, Uomba River, Benue Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. Br.116b).

Subgenus **Manuaniceras** Spath, 1925

Type species : *Pseudophacoceras manuanense* Spath.

Subgeneric diagnosis : Like *Oxytropidoceras* s. str., but with fine or coarse ribs, branching once or twice, tending to disappear on the outer whorls. Inflated, involute.

Oxytropidoceras (*Manuaniceras*) aff. *ornatum*
Besairie

Text-fig. 9c

1936 *Manuaniceras ornatus* Besairie, p. 190, pl. XVII, figs. 1, 2.

Description : Two fragments were available for study. Both show strong ornament for the genus ; the flanks bear sickle-shaped ribs that develop a weak swelling at the ventrolateral margin. The ribs are slightly club-shaped and their thickness increases a little towards the keel, which is sharp. A few ribs may continue on to the keel, but most fade about a centimetre below it, and thus end in the swelling. The whorl section is fairly inflated.

Remarks : The two fragments recorded here most closely resemble *Oxytropidoceras* (*Manuaniceras*) *ornatum* Besairie from the Middle Albian of Madagascar, but are too fragmentary for precise determination. They appear to differ in the strength and density of the ribbing, and may be distinguished from all other *Manuaniceras* by the coarseness of the ornament. *O. (M.) appplanatum* Collignon is somewhat similar, but has a higher whorl section and a much sharper and higher keel.

O. (M.) bösei Knechtel is less strongly ornamented, has a different whorl section and shows a much blunter keel.

Occurrence : Middle of the Middle Albian ; zone 1, sandstones and shales of Tiv Division, bed of the Uomba River, Benue Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimens Nos. Br.115D, 115G).

Oxytropidoceras (*Manuaniceras*) aff. *appplanatum*

Collignon

Text-fig. 9b

1936 *Oxytropidoceras appplanatus* Collignon, p. 183, pl. XVIII, fig. 5.

?1950 *Oxytropidoceras* sp. indet. aff. *appplanatum* Coll., Collignon, p. 71.

Measurements :

diameter 83 mm. = 1.00

thickness 18 mm. = 0.22

umbilicus 13 mm. = 0.16

Description : A large, poorly-preserved fragment is referred here, as well as a number of smaller pieces of the same or a closely related species. The large fragment, which carries a suture line not well enough preserved for reproduction, is ornamented with sigmoidal ribs arched in a gently backwards-directed bow. The whorl section is moderately compressed. The fragment shows the umbilicus, which is narrow. There are about 13 ribs to a half whorl ; the ornament decreases somewhat in strength with increase in size. The venter bears a sharp keel. Study of the smaller fragments shows that the ribs remain of equal strength along their length and that there is considerable variation in the strength of the ornament of different specimens. There is a gradation between forms with moderately strong ornament and those which are almost smooth, although, as already mentioned, all tend towards smoothness. One small fragment (U.5551) is almost smooth at a radius of 18 mm.

Remarks : The features of *O. (M.) appplanatum* are the weakness of the ornament and the compressed form. The Nigerian examples differ in being more inflated although they agree well in all other features with Collignon's description. The form described by Collignon as *Oxytropidoceras* sp. indet. aff. *appplanatum* from the Albian of Mokaraha appears particularly close. The measurements of the Nigerian example agree well with the figures given by Collignon. The Malagasy specimen is apparently fragmentary ; it is greatly compressed

and feebly ornamented, according to Collignon's description. Furthermore the body chamber is almost entirely smooth. The form here recorded differs from the other species of *Manuaniceras* known from Nigeria by virtue of its compressed whorls and feeble ornament. *O. (M.) manuanense* (Spath) is rather similar, but the ribbing, although even and fine, is denser and more persistent, and the ribs bifurcate frequently. The keel is also slenderer.

Occurrence : Middle of the Middle Albian ; zone 1, sandstones and shales of Tiv Division, Uomba River, Benue Province.

Collectors : R. Blaser, Shell D'Arcy, the author.

Repository : Part of the material is kept at N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimens Nos. Br.115C, Br.115E, Br.115K, Br.116).

Oxytropidoceras (Manuaniceras) aff. bösei Knechtel
Plate III, figs. 3a, b ; text-fig. 9a

1921 *Schloenbachia* sp. (cf. *acutocarinata* Böse non Shumard)
Douglas, p. 269, pl. XVI, fig. 1.
1947 *Oxytropidoceras (Manuaniceras) bösei* Knechtel, p. 109, pl. XXVII, fig. 1.

Description : The collection contains a single fragment of this *Manuaniceras* (U.3536). The ribs are stronger on the inner part of the cast and flatten out towards the periphery. They are bent near the umbilicus, but further out on the flanks they tend to straighten. Occasional bifurcation of a rib occurs near the umbilical margin. The venter is moderately sharp and the umbilical margin broadly rounded. A prominent keel is present on the inner whorls.

Remarks : The suture line of the specimen described here (text-fig. 9) closely resembles that of *O. (M.) jacobi* Besairie from Madagascar, which, however, is more strongly ribbed, particularly ventrally. *M. bösei* Knechtel has similarly divided ribs and a closely comparable whorl section, although the ribs appear to be thinner and more numerous.

Occurrence : Middle of the Middle Albian ; sandstones and shales of Tiv Division, zone 1, Benue Province.

Collector : K. Paulo, A.T.M.N.

Genus *Dipoloceras* Hyatt, 1900

Type species : *Ammonites cristatus* (Deluc MS.) Brongniart.

Diagnosis : Rather evolute, usually fairly inflated or depressed. Keel prominent. Ribs vary between dense and widely separated, rounded or sharp, usually a mixture between single and branched,

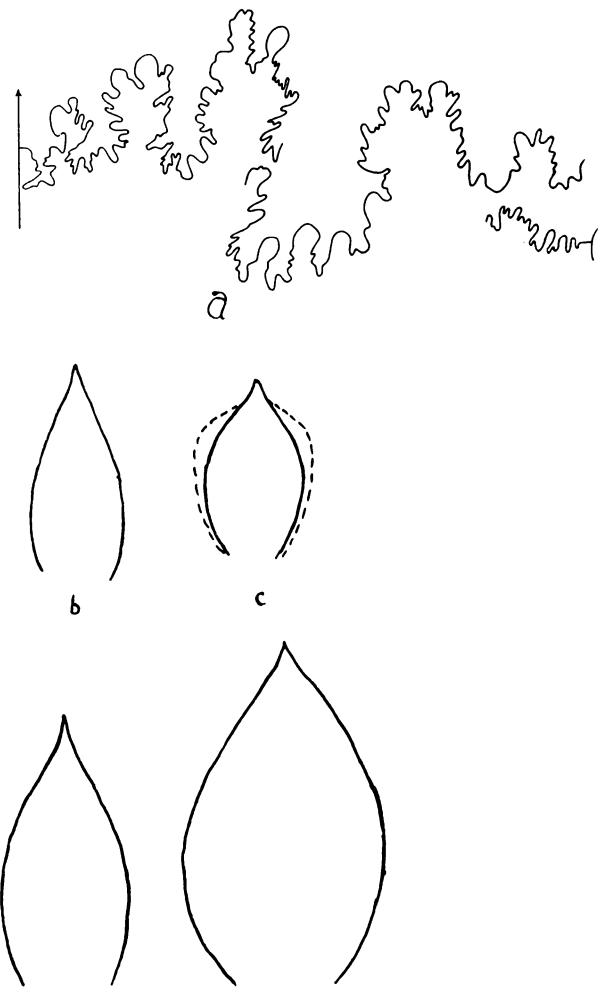
the latter often flared at the point of dichotomy. Umbilical tubercles are usually absent except in a group of forms, to which the present species belong, that foreshadow Mortoniceratinae. The genus ranges from the Middle Albian to the bottom of the Upper Albian.

Dipoloceras sp. indet.

Plate II, fig. 11 ; text-fig. 10a

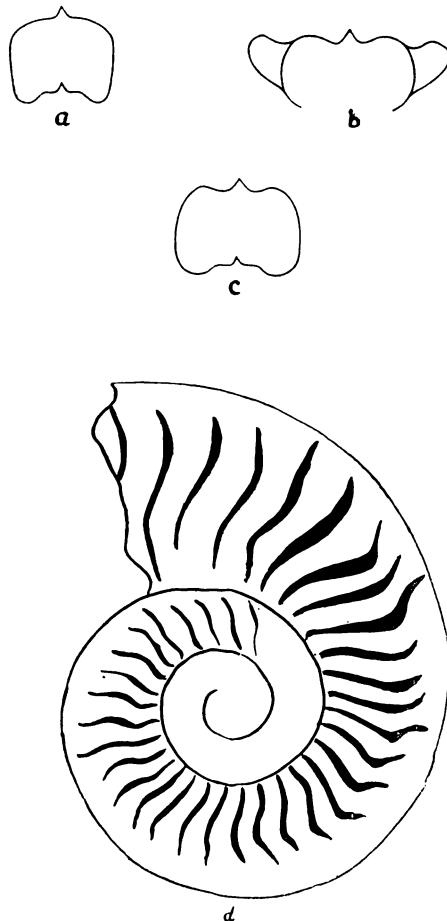
1928 *Dipoloceras* sp. indet., Spath, p. 52.

Description : The ribs on the fragments referred



TEXT-FIG. 9—*a*, *Manuaniceras* aff. *bösei* Knechtel. Suture line of specimen No. U.3536. *b*, *Manuaniceras* aff. *applanatum* Collignon. Whorl section of fragment. Two-thirds natural size. *c*, *Manuaniceras* aff. *ornatum* Besairie. Whorl section of fragment. Two-thirds natural size. *d*, *Andriavites* cf. *besairiei* Collignon. Whorl section of fragment. Two-thirds natural size. *e*, *Dipoloceras* aff. *bouchardianum* (d'Orbigny). Whorl section. Two-thirds natural size.

here bifurcate occasionally at the umbilicus, where weak umbilical tubercles may also develop. The ribbing is rather dense and the ribs are more or less strongly sigmoidal and bend strongly forwards on the venter. They thicken slightly at the ventro-lateral margin. The whorl section is approximately square (text-fig. 10a) and the venter is gently rounded. On some fragments, the whorls may be slightly higher than broad. A weak keel is present.



TEXT-FIG. 10—*a*, *Dipoloceras* sp. indet., B.M. No. C.21980. Twice natural size. *b*, *Dipoloceras* aff. *cristatum* (Deluc MS.) Brongniart, B.M. No. C.21881. Twice natural size. *c*, *Dipoloceras quadratum* Spath, B.M. No. U.2121. Twice natural size. *d*, *Dipoloceras* aff. *bouchardianum* (d'Orbigny). Diagrammatic representation of the ornament of specimen No. Br.125. Half natural size.

Remarks : The forms grouped here most closely resemble *D. bouchardianum*, but differ in that they do not become so strongly ornamented on later

whorls. *D. quadratum* Spath has a flatter and more carinate-sulcate venter.

Occurrence : Top of the Middle Albian to the bottom of the Upper Albian ; shales at Nkpume, zone 2, Ndi Ofia, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : A. Kitson.

Dipoloceras aff. *bouchardianum* (d'Orbigny)

Text-figs. 9e, 10d

[Synonymy in Spath (1931, p. 274)]

1931 *Dipoloceras bouchardianum* (d'Orbigny), Spath, p. 374, pl. XXXII, fig. 19 ; pl. XXXIII, fig. 5 ; pl. XXXIV, figs. 4-7 ; text-figs. 122c, d, 124a-c.

Measurements :

diameter 150 mm. = 1·00

thickness 42 mm. = 0·28

umbilicus 48 mm. = 0·32

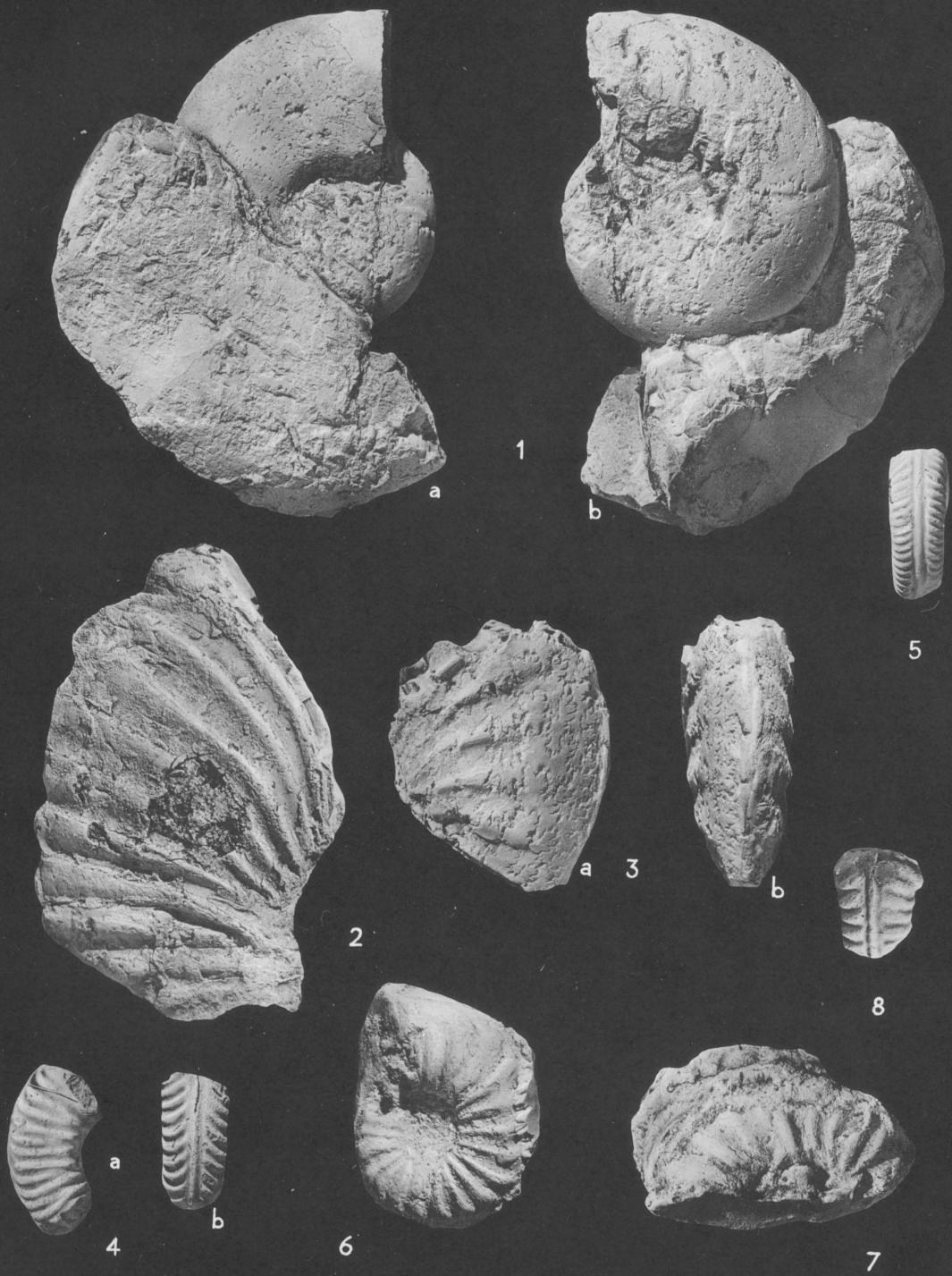
height of last whorl 60 mm. = 0·40

Description : The collection studied contains a single large cast of an almost complete specimen. The flanks are ornamented with close, strong, sharp, sigmoidal ribs which are strongest ventrally. The venter bears a strong, sharp keel. The ribs are all simple ; flared ribs are rare, but when they occur they are weak. The ribs usually stop short of the keel, but occasionally one passes up on to it. The whorl section has a strongly fastigate periphery (see text-fig. 9e) and roughly oval sides. The suture line is not preserved.

Remarks : Although *D. bouchardianum* is known to be a variable species, and the Nigerian specimen agrees rather well with figured examples, I have refrained from unreservedly referring it to that form on the following grounds : The whorl section appears to be far more fastigate and inflated than in typical specimens of *D. bouchardianum*, the size is very much greater, the ribbing does not seem to be as dense, and the ribs appear to be somewhat more sigmoidal. Boule, Lemoine and Thévenin (1907, p. 39, pl. IX, fig. 11) figured a large example from the Malagasy Albian as *Schloenbachia* cf. *bouchardiana* which may possibly belong together with the form here described. Spath (1931, p. 377) is of the opinion that it may be referable to *D. pseudonaon moniliformis* Spath, particularly since its inner whorls resemble those of that subspecies. Unfortunately the Nigerian ammonite is not well enough preserved to show the ornament of the inner whorls. *D. bouchardianum* may also possess bifurcated ribs and may develop umbilical tubercles. Neither tubercles nor divided ribs occur on the specimen studied. *D. cristatum* (Deluc MS.)

PLATE III
(opposite)

- FIG. 1. *Desmoceras (Pseudouhligella) calabarensis* sp. nov. Holotype. (a) Side view showing portion of outer whorl ; (b) side view showing constriction. Cenomanian. Odukpani Formation, Calabar Province. (B.M. No. U.3535). Page 18.
- FIG. 2. *Oxytropidoceras (Oxytropidoceras) cf. bravense* (Böse). Fragment from Tiv Division, Benue Province. Middle of the Middle Albian. (B.M. No. U.3537). Page 22.
- FIG. 3. *Oxytropidoceras (Manuaniceras) aff. bösei* Knechtel. (a) Side view showing sutures ; (b) ventral aspect. Middle of the Middle Albian. Tiv Division, Benue Province. (B.M. No. U.3536). Page 24.
- FIG. 4. *Dipoloceras quadratum* Spath. (a) Side view ; (b) ventral view. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.2121). Page 27.
- FIG. 5. *Dipoloceras quadratum* Spath. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.2044). Page 27.
- FIG. 6. *Oxytropidoceras (Androiavitae) aff. paucituberculatum* Collignon. Plaster cast of original. Middle of the Middle Albian. Uomba River, Benue Province. This specimen is kept at N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland. Page 22.
- FIG. 7. *Oxytropidoceras (Androiavitae) aff. paucituberculatum* Collignon. Plaster cast of original. Middle of the Middle Albian. Uomba River, Benue Province. Repository the same as for the specimen listed immediately above. Page 22.
- FIG. 8. *Dipoloceras aff. cristatum* (Deluc MS.) Brongniart. Lower Upper Albian. Ndi Ofia, Ogoja Province. (B.M. No. C. 21981). Page 27.



Brongniart also develops flared ribs, but the flares are more frequent and much stronger and the venter is strongly quadrate to carinati-sulcate. *D. fredericksburgense* Scott is similarly ribbed, but the ribs are straighter and the keel feebler. *D. pseudoan* Spath has a squarer whorl section and crenulated ribs, although the arrangement of the ornament is similar.

Occurrence : Lower ? Upper Albian, open field (not *in situ*) between Awe and Azara, Lafia Division, Benue Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. Br.125).

Dipoloceras quadratum Spath

Plate III, figs. 4a, b, 5 ; text-fig. 10c
1921 *Dipoloceras quadratum* Spath, p. 278, pl. XXV,
figs. 3a-c.

Description : In most cases the whorl section is broader than high, but in forms transitional to *D. bouchardianum* the whorls become squarer. Venter broad, carinati-sulcate ; ribs sigmoidal, directed forwards, thicker towards the venter. Very weak, bullate umbilical tubercles may also occur. The ventral terminations of the ribs are faintly notched spirally. The ribs branch at the umbilical margin.

Remarks : A number of fragments are referred here. These are all apparently inner whorls, but agree well with the figures given by Spath, apart from the fact that the flanks of the West African specimens are generally flatter (see text-fig. 10c).

Occurrence : Bottom of the Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

Dipoloceras aff. cristatum (Deluc MS.) Brongniart

Plate III, fig. 8 ; text-fig. 10b

1928 *Dipoloceras* sp. nov. (*cristatum* group), Spath, p. 52.

Description : Whorl section very depressed, ribs strong, flared (see text-fig. 10b), branching at the umbilical margin where fairly strong tubercles are formed. Keel moderately strong. Venter strongly carinati-sulcate, ribs thickest on the venter and slightly bent. The ventral termination of the ribs bear feeble spiral notches.

Remarks : This specimen differs from *D. cristatum*, as Spath (1931, p. 371) pointed out, in having

stronger umbilical tubercles. It is probably new, but more material is required before a decision can be made.

Occurrence : Top of the Middle Albian to the bottom of the Upper Albian ; shales at Nkpume, zone 2, between Ndi Ofia and Umpuna Awka, Abakaliki Division, Ogoja Province.

Collector : A. Kitson.

Subfamily BRANCOERATINAE

Genus *Hysteroceras* Hyatt, 1900

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

Diagnosis : Inner whorls keeled, often sharply, and keel frequently persists into the ribbed stage. The ribs may bifurcate or may be alternately long and short. There are umbilical tubercles and sometimes blunt ventrolateral ones. The ribbing varies widely from sharp and high to broad and flat.

Remarks : This genus is relatively common in the Nigerian Albian. In 1938, Spath recorded *H. aff. binum* from Ndi Ofia.

Hysteroceras sp. nov.

Plate IV, figs. 4a, b.

1928 *Hysteroceras* sp. nov. (*binum* group), Spath, p. 52.
1932 *Hysteroceras* sp. nov. (*binum* group), Spath, p. 480.

Description : A single rather worn fragment, with whorl section much higher than broad. Ribs sigmoidal, thicker towards the venter. Some ribs bifurcate at the umbilicus and some occur as intercalatories. Keel prominent on the inner whorls, but degenerates on later whorls and becomes bluntly crenulated through union with the strong terminations of the ribs. The ribs bend forwards on the venter, and on their ventral ends bear spiral striae.

Remarks : As Spath noted (1934, p. 480), this specimen differs from the closely related *H. binum* in that the ribbing is closer, more reclined and more continuous. Umbilical tubercles also appear to be lacking. *H. orbignyi* (Spath) has a squarer whorl section, a weaker keel and strong umbilical tubercles as well as straighter ribs. *H. scitum* van Hoepen is similar as regards the nature of the ornamentation, but its whorl section varies between very depressed to subquadrate.

Occurrence : Top of the Middle Albian to the bottom of the Upper Albian ; shales at Nkpume, zone 2, Umpuna Awka, Abakaliki Division, Ogoja Province.

Collector : A. Kitson.

Hysteroceras aff. binum (J. de C. Sowerby)

Plate IV, fig. 3

Description : Three living chambers are referred here. The ribs are flexed and the keel is moderately strong. The ribs are separated from the keel by slight indentations and they weaken on the middle of the flanks. The whorl section is almost square, though usually a little higher than wide. Ribs fairly close and sometimes bifurcated. The small fragments possess weak, spinate umbilical tubercles that disappear quickly. The large fragment has ventrolateral swellings on the ribs. The flanks are parallel to each other and the venter is arched.

Remarks : This form most closely resembles *H. binum*, but the ribbing is denser and the whorl section squarer. *H. orbignyi* is another similar species, but its ribbing is weaker.

Occurrence : Bottom of the Upper Albian ; beds at Ibenta, zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Hysteroceras binum (J. de C. Sowerby)

Plate IV, figs. 5a, b ; fig. 6

[**Synonymy** in Spath (1934, pp. 478, 479) ; Haas (1942, p. 30)]

?1950 *Hysteroceras cf. subbinum* Spath, Collignon, p. 72, pl. XI, figs. 5, 5a.

Description : Evolute, whorls higher than wide, and with weak but continuous keel. Ribs fairly coarse, confined almost exclusively to the outer part of the flank and are strongest on the ventrolateral margin. They are slightly sigmoidal and bent forwards on the venter. They are alternately long and short on the casts studied, and some of the long ribs reach the umbilical margin on the body chamber. Very faint umbilical tubercles occur. Venter arched. Suture simple.

Remarks : This form resembles closely the feebly-ribbed varieties of *H. binum* as figured by Spath (e.g. Spath (1934) text-fig. 165). *H. aff. semileve* Haas (see below) is similar in appearance to the form here discussed, but differs in the strength of the ornament. *H. strangulatum* van Hoepen is more strongly ribbed and has a weaker keel. *H. carinatum* Spath is more strongly keeled and is more uniformly and strongly ornamented.

Occurrence : Bottom of the Upper Albian ; beds at Ibenta, zone 3, Abakaliki Division, Ogoja Province.

Collector : The author.

Hysteroceras orbignyi (Spath)

Plate IV, fig. 1

[**Synonymy** in Spath (1934, p. 483) ; Haas (1942, p. 26)]

Description : Whorls flat-sided, higher than wide, slightly compressed. Keel present on last whorl and is blunt and relatively broad. Venter rounded, rather arched. Umbilical tubercles discernible on the inner whorls but not present on the last whorl. The ribs on the last whorl, which may be branched or alternately long and short, develop ventrolateral swellings. The ribs bend forwards on the venter and are weakly united over the keel. The ribbing appears at an early stage and is then dense and fine. Suture simple.

Remarks : This species most closely resembles *H. choffati* Spath, but its section is less oval and more angular and the ribs cross the venter in chevrons. *H. orbignyi* has been recorded from the Upper Albian of England, France, Angola and Portuguese East Africa.

Occurrence : Bottom of the Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

Hysteroceras aff. semileve Haas

Plate IV, fig. 2

1942 *Hysteroceras semileve* Haas, p. 42, pl. V, figs. 19a-c ; pl. VII, figs. 8-11 ; text-figs. 5c, d.

Description : The specimen available for study is slightly crushed on the last part of the last whorl. Flanks flat, whorl section rectangular, venter rounded, keel present. The ribs are fairly strong on the ventrolateral margin, but weaker on the flanks. On the last whorl, the ribs do not continue past the ventrolateral margin and the flanks are flat and smooth. Weak bullate umbilical tubercles occur on the inner whorls but not on the last whorl. The ribs are sigmoidal, and there are 25 of them to half a whorl.

Remarks : The form here described is clearly close to *H. semileve* Haas, but is less involute. In mature specimens of *H. semileve* the ribs are confined to the outer part of the whorl. In comparison with this specimen, *H. propinquum* Haas appears to have more widely spaced and broader ribs and *H. carinatum* Spath is much more strongly ribbed and is keeled throughout.

Occurrence : Bottom of the Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Hysterooceras aff. *multifalcatum* (van Hoepen)

Plate II, fig. 10

1944 *Komeceras multifalcatum* van Hoepen, p. 182, pl. XXVI, figs. 1-3.

Description : A few fragments, and a badly preserved, but more complete, specimen are referred here. They most closely resemble *H. multifalcatum*; they have the same whorl section and the ribs bend forwards equally strongly on the venter. The ribs are flexed. On earlier whorls they stop short of the keel, but later they unite over it. They weaken near the umbilicus. Very weak umbilical tubercles are present. The venter and flanks are flat, and the greatest thickness occurs at the umbilical margin.

Remarks : The specimens here described differ from the forms figured by van Hoepen (1944) only in that the umbilical tubercles are much weaker. *H. falcostatum* Haas also appears to be closely related, but its ribs are less strongly bent forwards on the venter. *H. orbignyi* Spath and *H. choffati* Spath are also slightly similar.

Occurrence : Bottom of the Upper Albian; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

Subfamily MORTONICERATINAE
Genus **Mortoniceras** Meek, 1876

Type species : *Ammonites vespertinus* Morton.

Diagnosis : More or less evolute, with square, rectangular or trapezoidal whorl section. Prominent umbilical and usually ventrolateral tubercles at least, and sometimes up to two lateral and one upper ventrolateral in addition. The keel may be either high or low.

Range : Top of the Middle Albian to the top of the Upper Albian.

Remarks : There has been considerable confusion concerning the nature of the type species of this genus, since Morton's original figure of *Ammonites vespertinus* is not very helpful. Examination of a cast of the holotype and various specimens of *Mortoniceras vespertinum* in the C. W. and E. V. Wright collection leaves no doubt in the author's mind that the species is a normal trituberculate *Mortoniceras* and thus that *Inflaticeras* Stieler, *Pervinquieria* Böhm and *Subschloenbachia* Spath are pure synonyms. *Mortoniceras* has by some authors been used for the Senonian group of *Ammonites texanus* Römer now referred to *Texanites* Spath and allied genera.

The Nigerian Albian contains species of two of Spath's subgenera, *Angolaites* and *Durnovarites*, erected in the Gault Monograph, and an example of the group of *Mortoniceras wintoni* (Adkins) hitherto known only from Texas. Two well-preserved fragments representing a development similar to that of *Mortoniceras (Cantabrigites)* Spath are another interesting find. They derive from an evolute, densely ribbed form (Plate V, fig. 1) with a faintly keeled, subacute venter; they were found together with *Dipoloceras*, *Hysterooceras* and bituberculate *Mortoniceras* in the bottom beds of the Upper Albian of Nkpugwu Onyikwo. The exact position of this form is as yet uncertain and it could as well be an offshoot of *Hysterooceras*¹ as an early side development of *Mortoniceras* (*Mortoniceras*).

¹ Some undescribed American forms in the C. W. & E. V. Wright collection, London, from the Upper Dutch Creek Marl, Tarrant County, Texas (collected by Mr. J. P. Conlin), (Plate XXIV, figs. 2a, b, 3a, b) offer a rather close analogy. They are Lower Upper Albian in age and appear to be derived from *Hysterooceras*. The specimens differ from the Nigerian form in having flatter flanks, more sigmoidal ribbing and generally coarser ribs. It should be borne in mind, however, that the resemblance of the Nigerian material to the American forms figured here may be only superficial.

Mortoniceras s. str.

Diagnosis : Ribs fine to very coarse, branching at the umbilical tubercles on early whorls, becoming single later. There are umbilical, mediolateral, and single — occasionally double — ventrolateral tubercles; the mediolateral tubercles are usually the weakest and often disappear on the outer whorls.

Mortoniceras (Mortoniceras) evolutum (Spath)

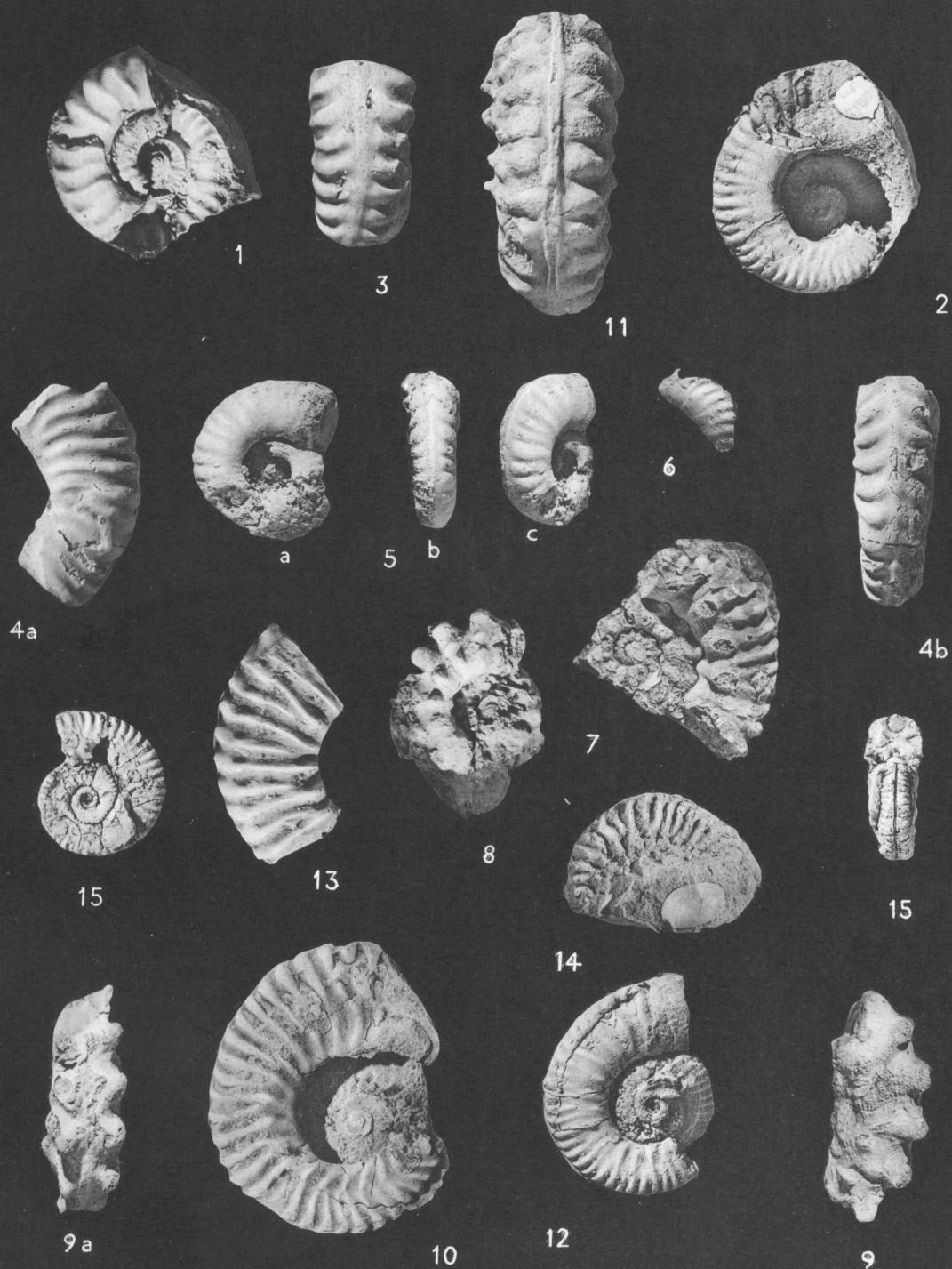
Plate V, figs. 2a, b; text-fig. 11b

- 1905 *Schloenbachia lenzi* Szajnocha, Choffat, p. 37 (67), pl. III, figs. 2a, b.
- 1922 *Subschloenbachia evoluta* Spath, p. 124.
- 1942 *Pervinquieria evoluta* (Spath), Haas, p. 78, pl. XV, figs. 1a, b; text-fig. 7e.
- ?1942 *Ophryoceras jugosum* van Hoepen, p. 93, figs. 56-58.
- ?1942 *Pervinquieria salebrosa* van Hoepen, p. 115, figs. 96-98.
- ?1946 *Ophryoceras jugosum* van Hoepen, van Hoepen, p. 216, figs. 200, 204.
- ?1946 *Ophryoceras crassinodosum* van Hoepen, p. 219, figs. 207, 208.

Description : Very evolute, whorl section somewhat higher than broad (see text-fig. 11b). Flanks may be flat or a little inflated. Venter fairly narrow, and with a keel that on the inner whorls lies lower than the ventrolateral tubercles, but higher than the tubercles on mature whorls. The ribs on the inner whorls frequently divide, but on later whorls

PLATE IV
(opposite)

- FIG. 1. *Hysteroceras orbignyi* Spath. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.3542). Page 28.
- FIG. 2. *Hysteroceras* aff. *semileve* Haas. Bottom of the Upper Albian. Specimen from Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.2189). Page 28.
- FIG. 3. *Hysteroceras* aff. *binum* (Sowerby). Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. Page 28.
- FIG. 4. *Hysteroceras* sp. nov. (a) Side view; (b) ventral view. Bottom of the Upper Albian. Ndi Ofia, Ogoja Province. (B.M. No. C.21979). Page 27.
- FIG. 5. *Hysteroceras binum* (Sowerby). (a) Side view; (b) ventral view; (c) angled view showing the nature of the ribbing. Bottom of the Upper Albian. Ibenta, Ogoja Province. (B.M. No. U.3545). Page 28.
- FIG. 6. *Hysteroceras binum* (Sowerby). Bottom of the Upper Albian. Ibenta, Ogoja Province. (B.M. No. U.3601). Page 28.
- FIG. 7. *Neokentroceras curvicornu crassicornutum* subsp. nov. Holotype. Specimen showing body chamber. Middle of the Upper Albian. Abakaliki, Ogoja Province. (B.M. No. U.3571). Page 41.
- FIG. 8. *Neokentroceras curvicornu crassicornutum* subsp. nov. Paratype. Specimen showing feeble lower ventrolateral tubercles. Middle of the Upper Albian. Abakaliki, Ogoja Province. (B.M. No. U.3570). Page 41.
- FIG. 9. *Neokentroceras curvicornu curvicornu* Spath. (9) Side view; (9a) ventral view. Middle of the Upper Albian. Ameka, Ogoja Province. (B.M. No. U.86). Page 41.
- FIG. 10. *Mortoniceras* (*Mortoniceras*) *pricei* Spath. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province (B.M. No. U.2158). Page 31.
- FIG. 11. *Mortoniceras* (*Mortoniceras*) aff. *wintoni* (Adkins). Middle of the Upper Albian. Abakaliki, Ogoja Province. (B.M. No. U.1903). Page 37.
- FIG. 12. *Mortoniceras* (*Mortoniceras*) aff. *pricei* Spath. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. Page 33.
- FIG. 13. *Mortoniceras* (*Angolaites*) *gregoryi* (Spath). Middle of the Upper Albian. Echi Aliki, Ogoja Province. (B.M. No. U.3548). Page 37.
- FIG. 14. *Mortoniceras* (*Durnovarites*) sp. juv. Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47326). Page 39.
- FIG. 15. *Mortoniceras* (*Mortoniceras*) sp. juv. Bottom of the Upper Albian. Ibenta, Ogoja Province. Side view and ventral view. Page 29.



they are simple ; some may be shorter than the majority. Adult whorls have three rows of tubercles. The ventrolateral are strong and somewhat pinched-up, the mediolateral weak and bullate, and the umbilical low and elongated transversely. On the inner whorls there are strong, bullate, umbilical tubercles, weak mediolateral, and low, swollen, clavate, ventrolateral tubercles. On very small whorls the umbilical tubercles are more important, although always bullate, the mediolateral tubercles are small but prominent, sharp and spinate, and the ventrolateral tubercles are flattened, bullate and elongated. At this stage the ammonite resembles the adult stage of *M. quadrinodosum* Spath. The ribs usually are slightly flexed and quite rarely one may divide on the last whorl. Weak spiral notching is visible on some specimens.

Mortoniceras (Mortoniceras) evolutum amekaense subsp.
nov.

Plate V, fig. 4

Holotype : B.M. No. U.91 ; shales at Abakaliki, Ameka, Plate V, fig. 4.

Description : This form differs from *M. (M.) evolutum* in that the inner whorls are more strongly ornamented, the ribs are more widely spaced and on the last whorl the umbilical tubercles disappear altogether. The ventrolateral tubercles on the inner whorls are prominent and are elongated at right angles to the keel ; beneath them there is a shallow depression that gives the ammonite the appearance of being quadrituberculate. This form may represent a transition to *M. (Mortoniceras) quadrinodosum* Spath.

Remarks : The Nigerian specimens agree well with the figures given by Choffat (1905, pl. III, figs. 2a, b, c) although the keel is missing on part of this figured specimen. The inner whorls, the whorl section, etc., resemble the figures given by van Hoepen for *Ophryoceras jugosum* and *O. crassinodosum*, but on mature whorls the features agree with Choffat's figures. The umbilical tubercles are often stronger on the Nigerian specimens than those on Choffat's specimen.

Occurrence : Middle of the Upper Albian ; zone 4, sandstones at Nwofe, shales at Abakaliki ; Ameri ; Ameka ; Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) cf. pachys (Seeley)

Plate VI, figs. 2a, b ; text-fig. 11a
[Synonymy in Spath (1932, p. 405)]

Description : Whorl section slightly broader than high (see text-fig. 11a), approximately square ; venter gently rounded, broad and with a low keel. Flanks slightly inflated. The ribs divide at the umbilical margin, but simple ribs also occur. Umbilical tubercles bullate, ventrolateral tubercles weak and rounded. The ribs, which thicken somewhat towards the venter, bend forwards at the ventrolateral tubercle and continue on almost to the keel. This portion of the rib bears spiral striations. The ribs are very slightly sigmoidal.

Remarks : Compared with the specimens of *M. pachys* from the English Gault, the Nigerian form differs in that its ribs are moderately flexed on the flanks, and the flanks and venter are slightly rounded, whereas those of *M. pachys* are flat. *M. africanum* (Spath) agrees well as regards whorl section and general features but lacks a mediolateral row of tubercles. The ribbing of the Nigerian form is not so dense as the English examples and it is possibly transitional to *M. kiliani* (Lasswitz). Two specimens from Ibenta are doubtfully referred here. They are less densely ribbed, and U.2312 has very strong umbilical tubercles ; U.3560 has a higher whorl section. These may also represent transitional forms to *M. kiliani*.

Occurrence : Middle of the Upper Albian ; shales at Abakaliki, zone 4, Ameri, Ameka, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) pricei (Spath)

Plate IV, fig. 10

[Synonymy in Spath (1932, p. 391)]

- 1932 *Mortoniceras (Pervinquieria) pricei* (Spath), p. 391, pl. XXXVI, figs. 11, 12 ; pl. XXXVII, fig. 3 ; pl. XXXVIII, fig. 5 ; text-figs. 130e, 131, 132, 137c.
- 1936 *Mortoniceras (Pervinquieria) pricei* (Spath), Venzo, p. 89, pl. VIII (IV), fig. 2.

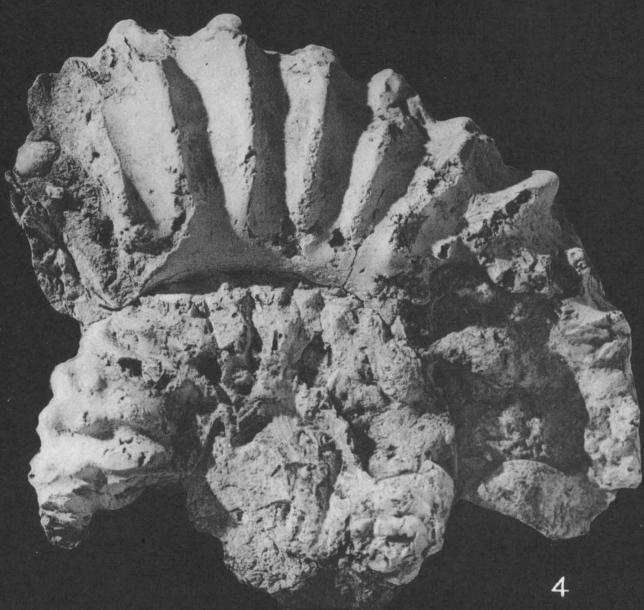
Description : Whorl section somewhat higher than broad, ribbing fairly dense, sigmoidal. Moderately strong, bullate, umbilical tubercles present. The ribs are rounded and slender, but thicken somewhat on the venter, beginning at the ventrolateral margin. They usually branch and bend forwards slightly on the venter. The keel is moderately prominent.

PLATE V
(opposite)

- FIG. 1. *Hysteroceras* ? sp. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.2220). Page 29.
- FIG. 2. *Mortoniceras* (*Mortoniceras*) *evolutum evolutum* (Spath). Middle of the Upper Albian. Nwofe, Ogoja Province. (a) Side view; (b) ventral view. (B.M. No. U.3549). Page 29.
- FIG. 3. *Mortoniceras* (*Mortoniceras*) *kilianii* (Lasswitz). Bottom of the Upper Albian. Ibenta, Ogoja Province. (B.M. No. U.2315). Page 33.
- FIG. 4. *Mortoniceras* (*Mortoniceras*) *evolutum amekaense* subsp. nov. Middle of the Upper Albian. Ameka, Ogoja Province. (B.M. No. U.91). Page 31.



1



4



2a



2b



3

Remarks : The specimen studied (U.3563) agrees well with the example figured by Spath (1932, pl. XXXVI, figs. 12a, b) in details of ornament. It differs from the specimen figured on Plate IV, fig. 12 as *M. aff. pricei* in having more sigmoidal ribs less densely set. All examples referred to the latter form are densely-ribbed inner whorls with strong umbilical tubercles and ventrolateral swellings. They were collected from a low horizon in the Albian at Nkpugwu Onyikwo, from the place where *M. pricei* was also collected.

Occurrence : Bottom of the Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) kiliani (Lasswitz)

Plate V, fig. 3

[Synonymy in Spath (1932, p. 408)]

Description : Evolute, whorl section rather high, whorls with slightly convergent sides, so that the greatest thickness occurs about the umbilical margin. Venter gently rounded and carinat-sulcate. The ribs, which are almost straight, usually divide. There are three rows of tubercles ; umbilical tubercles which are strong and bullate, somewhat weaker mediolateral tubercles, and ventrolateral tubercles that are stronger than the mediolateral tubercles, but weaker than the umbilical tubercles. The ribs bend strongly forwards on the venter.

Remarks : The specimen studied is septate throughout, although the sutures are not well enough preserved to permit reproduction. This species is closely related to *M. pachys* (Seeley), but the whorl section is higher and the ribbing more spaced.

Occurrence : Bottom of the Upper Albian ; zone 3, Ibenta, Abakaliki Division, Ogoja Province.

Collector : The author.

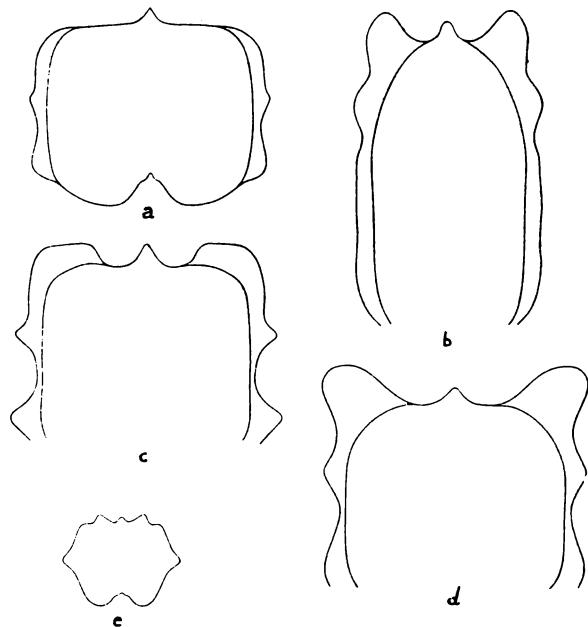
Mortoniceras (Mortoniceras) cf. romeri (Haas)

Text-fig. 11d

1942 *Pervinquieria romeri* Haas, p. 73, pl. XI, figs. 1a-c, 2a-c ; text-fig. 7a.

Description : Venter narrow, broadest over the umbilical region ; flanks converge towards the venter. Ribs straight, simple on the fragment studied. Umbilical tubercles long and bullate, mediolateral tubercles fairly strong, rounded ; ventrolateral tubercles strong and blunt and

project outwards and slightly upwards (see text-fig. 11d).



TEXT-FIG. 11—Whorl sections of *Mortoniceras (Mortoniceras)*.
a, *Mortoniceras (Mortoniceras) cf. pachys* (Seeley). b, *Mortoniceras (Mortoniceras) evolutum* (Spath). c, *Mortoniceras (Mortoniceras) quadrinodosum* Spath. Section across the body chamber. d, *Mortoniceras (Mortoniceras) cf. romeri* (Haas). e, *Mortoniceras (Mortoniceras) subtrotundum* (Spath). All figures natural size.

Remarks : The fragment available is too small to permit accurate identification. As Haas indicated (1942, p. 74), this species resembles *M. stoliczkae*, but differs mainly in the nature of the ventrolateral tubercles. The specimen studied resembles also C.21707 (Spath, 1922, p. 120) but the whorl section is rounder.

Occurrence : Bottom of the Upper Albian ; zone 3, Ibenta, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) quadrinodosum Spath

Text-figs. 11c, 12a, b

1922 *Subschloenbachia quadrata* Spath, p. 116 (footnote 3).
1932 *Mortoniceras quadrinodosum* Spath, p. 410, pl. XLII, figs. 8a, b ; pl. XLIV, fig. 3.

Description : Whorls more or less square, but usually broader than high. On some examples the greatest thickness occurs over the umbilical tubercles, and on others over the mediolateral tubercles. Keel moderately strong. The ribs are straight and usually bifurcate. They are prominent

on most specimens studied, but on some specimens they may vary. The tuberculation is moderately strong ; the umbilical tubercles are long and bullate, the mediolateral bullate and fairly strong and the ventrolateral tubercles long and prominent (see text-fig. 11c). Venter only slightly rounded. Suture preserved and has narrow saddles and deep first lateral lobe.

figured as text-fig. 12a, resembles that species more than the other fragments studied and may be a passage form to *M. nanum*, as also the fragments from the Nyeba area.

Occurrence : Middle of the Upper Albian ; zone 4, Naufu Aliki ; between Nyeba and Abakaliki ; Nyeba District ; Ameka bridge.

Collector : The author.



TEXT-FIG. 12—Suture lines of *Mortoniceras (Mortoniceras) quadrinodosum* Spath. a, Slightly eroded fragment, B.M. No. U.1632. Three times natural size. b, Incomplete suture from a small example, B.M. No. U.1791. Three times natural size.

Remarks : The Nigerian examples agree well with Spath's type (B.M. No. 88718). On unweathered specimens the tubercles are as strong as those on the Gault specimen. Some additional fragments are probably inner whorls of this species ; they are more depressed than the adult whorls studied, but the nature of the tuberculation and the ribbing is identical. *M. quadrinodosum* differs from *M. (Durnovarites) quadratum* Spath in that the latter species has definitely-separated upper and lower ventrolateral tubercles, whereas the species here discussed at best has a gentle depression in the middle of the elongated, single ventrolateral tubercle. It also appears at a much earlier horizon. *M. commune* Spath has a stronger keel and coarser ribbing. *M. nanum* Spath is also similar. The Nigerian example (U.1632), whose suture is

Mortoniceras (Mortoniceras) subrotundum (Spath)
Text-fig. 11e

1922 *Subschloenbachia rotunda* Spath, p. 116, pl. IV, figs. 1a-c.

Description : Whorl section very depressed (text-fig. 11e), venter broad and flat. Ribbing moderately dense, fine. There are strong umbilical tubercles at the points of dichotomy of the ribs, weak mediolateral tubercles and occasional weak ventrolateral tubercles. The ribs continue beyond the ventrolateral margin on to the venter where they bend rather sharply forwards and also become a little thicker and flatter. On large whorls the ventral parts of the ribs may develop a shallow depression. Spiral notching is present.

Remarks : Comparison of the Nigerian specimens with the specimens figured by Spath (1922) shows good agreement. The species discussed resembles

M. (Durnovarites) depressum (Spath) particularly as regards the shape of the whorls, but that species is more clearly quadrituberculate, has coarser ribs and belongs, besides, to a younger horizon (zone 5, shales at Ishiagu, Afikpo Division, Ogoja Province).

Occurrence : Lower Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) cf. barbouri (Haas)

1942 *Pervinquieria barbouri* Haas, p. 75, pl. XII, figs 2a-c.

Description : A single fragment agrees quite well with *M. barbouri*. The keel is fairly strong ; there are weak mediolateral and rather strong ventrolateral tubercles. The latter are round and feebly clavate. The ribs are strong, simple, slightly flexed and spirally striated. The whorls are roughly as high as broad. The umbilical margin is rounded. *Remarks* : This specimen also resembles *M. romeri* (Haas) and *M. perarmatum* (Haas), but is closer to *M. barbouri* as the ventrolateral tubercles are not directed outwards and the fragment has apparently been part of a very evolute ammonite. It has, however, weaker umbilical tubercles and thicker ventrolateral tubercles than are shown in Haas's figures of *M. barbouri*.

Occurrence : Middle of the Upper Albian ; zone 4, north of Abakaliki town, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) aff. multicostatum (van Hoepen)

1942 *Pervinquieria multicostata* van Hoepen, p. 99, figs. 67-70.

1951 *Pervinquieria (Styphloceras) multicostata* van Hoepen, p. 300, text-figs. 321-25.

Description : Two fragments, an inner whorl and part of a living chamber, have strong, simple ribs, upper and lower ventrolateral tubercles and long, bullate, umbilical tubercles. On the inner whorls, the lower ventrolateral tubercles are situated nearer to the dorsum than they are on the body chamber and thus might be termed mediolateral tubercles. The keel is strong and higher than the outer ventrolateral tubercles.

Remarks : The whorl section of the fragments resembles closely that given by van Hoepen (1951) but the details of ornament are different. Van Hoepen's species is more densely ribbed, and the ribs bifurcate, on the inner whorls at least. The two fragments studied are not sufficiently complete to permit of accurate identification, but it is

apparent they belong to the same group as *M. multicostatum*.

Occurrence : Bottom of the Upper Albian ; zone 3, Ibenta, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) cf. nodoso-costatum (van Hoepen)

Plate VI, fig. 1

1942 *Pervinquieria nodoso-costata* van Hoepen, p. 101, figs. 71-76.

1951 *Pervinquieria (Styphloceras) nodoso-costata* van Hoepen, van Hoepen, p. 300.

Description : Whorl section subquadrate, venter carinat-sulcate, keel higher than the outer row of tubercles. Umbilical tubercles bullate, mediolateral tubercles weakly rounded, ventrolateral tubercles long and bullate, broadening towards the median line. Ribs generally straight, though some divide ; the point of dichotomy is usually situated on the umbilical margin, but may occur on the ventrolateral margin. The ribs may be flared or irregularly twisted.

Remarks : The forms figured by van Hoepen appear to be somewhat more depressed than the specimen here recorded. Furthermore, the South African examples seem to be more densely ribbed. The unusual ornament is exactly the same in both.

Occurrence : Middle of the Upper Albian ; zone 4, Ameka, Naifu Aliki, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) sp.

Text-fig. 13

Remarks : A few fragments of a species with whorl section higher than broad have a moderately strong keel and straight, sharp, prominent ribs with occasional weak, bullate, umbilical tubercles. Strong, flattened, ventrolateral tubercles, elongated at right angles to the keel, line the ventrolateral margin. The lower ventrolateral tubercles sit well down on the flanks and are rounded. The



TEXT-FIG. 13—Suture line of *Mortoniceras (Mortoniceras) sp.*
Twice natural size.

PLATE VI
(opposite)

- FIG. 1. *Mortoniceras* (*Mortoniceras*) cf. *nodoso-costatum* (van Hoepen). Middle of the Upper Albian. Large, pyritized specimen from the mine workings at Ameka, Ogoja Province. Page 35.
- FIG. 2. *Mortoniceras* (*Mortoniceras*) cf. *pachys* (Seeley). Middle of the Upper Albian. Ameka, Ogoja Province. (a) Side view ; (b) ventral view. (B.M. No. U.87). Page 31.
- FIG. 3. *Mortoniceras* (*Angolaites*) *gregoryi* (Spath). (a) Side view ; (b) ventral view. Middle of the Upper Albian. Echi Aliki, Ogoja Province. (B.M. No. U.3544). Page 37.
- FIG. 4. *Mortoniceras* (*Durnovarites*) *quadratum* (Spath). Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47324). Page 38.
- FIG. 5. *Mortoniceras* (*Durnovarites*) *quadratum* (Spath). Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47315). Page 38.



venter is gently arched and the flanks are almost flat. The suture of one of the specimens is shown in text-fig. 13.

Occurrence : Bottom of the Upper Albian ; zone 3, Ibenta, Abakaliki Division, Ogoja Province.

Collector : The author.

Mortoniceras (Mortoniceras) aff. wintoni (Adkins)

Plate IV, fig. 11

Description : Whorl section trapezoidal, broader than high, thickest near the umbilical margin. Keel low, feebly carinat-sulcate. Flanks with strong ribs that divide at the umbilical tubercles ; intercalatories also present. Each rib has upper and lower ventrolateral tubercles ; on one specimen a few very feeble mediolateral tubercles occur. The umbilical tubercles are much stronger than the others.

Remarks : The fragments described clearly belong to the group of *Mortoniceras wintoni* (Adkins) as is shown by the presence of strongly developed umbilical tubercles and the shape of the whorl section. The Nigerian form differs from *M. wintoni* (Adkins) in that feeble mediolateral swellings occasionally occur. However, some specimens of *M. wintoni* in the private collection of C. W. and E. V. Wright have occasional mediolateral swellings. Further differences between *M. wintoni* and the form discussed here are : the venter of the Nigerian ammonite seems to be somewhat flatter and the ribbing rather denser.

Occurrence : Middle of the Upper Albian ; zone 4, Abakaliki-Enugu road, 6 miles from Abakaliki town, Abakaliki Division, Ogoja Province.

Collector : The author.

Subgenus **Angolaites** Spath, 1932

Type species : *Subschloenbachia gregoryi* Spath.

Diagnosis : Whorl section rather compressed ; ribs simple from a comparatively early stage, although the first whorls bear frequently-divided ribs. There are umbilical, weak mediolateral and prominent ventrolateral tubercles ; on mature whorls only the last are present.

Mortoniceras (Angolaites) gregoryi (Spath)

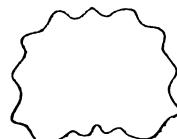
Plate IV, fig. 13 ; Plate VI, figs. 3a, b

1922 *Subschloenbachia gregoryi* Spath, p. 127, pl. III, figs. 1a, b.

1922 *Subschloenbachia* sp. n. ? aff. *gregoryi* Spath, p. 127, pl. III, figs. 2a-c.

Description : Evolute ; adult whorls compressed ; whorl section higher than broad. Ribs straight, prominent on adult whorls. Spiral striation is often present on the outer ventrolateral tubercles, but

may extend along the ribs and intercostals almost to the umbilical margin. The outer ventrolateral tubercles are prominent and rounded, the inner ventrolateral tubercles are much weaker. Keel strong and venter comparatively narrow ; flanks almost flat, a trifle inflated on mature whorls, converging towards the venter. The ribs are slightly concave and have a shallow depression below the inner ventrolateral tubercle. The inner



TEXT-FIG. 14—*Mortoniceras (Durnovarites) depressum* (Spath). Specimen B.M. No. C.47317. Natural size.

whorls have flatter sides, branched ribs, intercalatories, and bullate umbilical tubercles. The ribs are more flexed than on mature whorls.

Remarks : *M. (Angolaites) angolaense* (Boule, Lemoine & Thévenin, 1907, p. 41, text-fig. 21) appears to be similar to the species here recorded and may be conspecific. Its ribs, however, are more curved and only one row of ventrolateral tubercles is visible in the figure. The Nigerian specimens agree well with the Angolan forms described by Spath (1922) with the exception that the ribbing of the latter seems to be flatter. *M. (A.) gregoryi* has recently been found in zone 5 at Ishiagu. *M. (Angolaites) simplex* (Choffat) differs in that the inner as well as the outer whorls have only upper and lower ventrolateral tubercles.

Occurrence : Middle of the Upper Albian to top of the Upper Albian ; zones 4-5, Echi Aliki, Ishiagu, Ogoja Province.

Collectors : K. Paulo, A.T.M.N., and the author.

Subgenus **Durnovarites** Spath, 1933 (1932, nom. nud.)

Type species : *Subschloenbachia perinflata* Spath.

Diagnosis : Quadrituberculate *Mortoniceras* with square or trapezoidal whorl section. There are at least four tubercles to each rib, equally spaced, the outer one as prominent as the rest and often clavate.

Mortoniceras (Durnovarites) depressum (Spath)

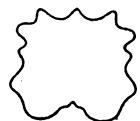
Plate VII, fig. 4 ; text-fig. 14

1922 *Subschloenbachia depressa* Spath, p. 114, text-figs. B, 2a-d.

1928 *Pervinquieria depressa* (Spath), Spath, p. 51.

Description : Whorl section depressed (see text-fig. 14), shell evolute ; venter broad, keel moderately

strong, with broad, shallow furrows on either side. The ribs branch definitely at the umbilical tubercles or are alternately long and short. There are four rows of tubercles. On some of the specimens studied, faint spiral striations occur on the outer part of the shell. The umbilical tubercles are strong and spinate to bullate, the mediolateral tubercles are rounded, and the inner and outer ventrolateral tubercles are clavate. The umbilical wall is high and rounded. The ribs bend forwards rather strongly on the venter, but on the flanks are quite straight. The short ribs have only three rows of tubercles.



TEXT-FIG. 15—*Mortoniceras (Durnovarites) quadratum* (Spath). Specimen B.M. No. C.47314. Diagrammatic representation of whorl section. Natural size.

Remarks : This species is common in the Nigerian Upper Albian (*dispar* zone). The examples studied agree well with the figures of the species given by Spath (1922) although the umbilical tubercles appear to be stronger. As Spath pointed out, the inner whorls bear a slight resemblance to *Neoken-troceras*. The most closely related species appears to be *M. (Durnovarites) quadratum* (Spath), but it has squarer whorls and straighter ribs. Spath (1922) has given some further comparisons.

Occurrence : Top of the Upper Albian ; zone 5, Ishiagu, Afikpo Division, Ogoja Province.

Collector : The author.

Mortoniceras (Durnovarites) quadratum (Spath)
Plate VI, figs. 4, 5 ; Plate VII, fig. 3 ; text-fig. 15

[See Spath (1933, p. 432) for earlier synonymy]

1926 *Pervinquieria quadrata* (Spath), Spath, p. 423.

1928 *Pervinquieria quadrata* (Spath), Spath, p. 51.

1933 *Mortoniceras (Durnovarites) quadratus* (Spath), Spath, p. 432, pl. XLV, fig. 3 ; pl. XLVI, fig. 6 ; pl. XLIX, fig. 12 ; text-fig. 151.

1951 *Durnovarites spinosus* van Hoepen, p. 323, figs. 380-83.

Description : Whorl section almost square, a little broader than high ; flanks flat, almost parallel. The keel is separated from the tubercles and ribs by furrows on either side. There are four rows of tubercles on each flank. The ribs are either simple or branch at an umbilical tubercle ; they are strong. On the venter they may be directed slightly forwards from the inner ventrolateral tubercles to join the outer ventrolateral tubercles obliquely. All rows of tubercles are equally strong. The ventrolateral tubercles are clavate, the medio-

lateral spinate, and the umbilical spinate to bullate.

Remarks : The specimens studied closely resemble the figures given by Spath. *M. (Durnovarites) subquadratum* Spath is rather like the species here recorded, but it has less-inflated whorls (see text-fig. 15). *M. (Durnovarites) deppressum* (Spath) has rounder whorls and a more depressed whorl section (compare text-figs. 14 and 15).

Occurrence : Top of the Upper Albian ; zone 5, Ishiagu, Afikpo Division, Ogoja Province.

Collector : The author.

Mortoniceras (Durnovarites) levecostatum sp. nov.

Plate VII, fig. 2

Holotype : B.M. No. C.47321 ; zone 5, Ishiagu brickfields. Plate VII, fig. 2.

Description : Evolute ; whorl section almost square, venter broad. Four rows of tubercles present. These are at first weak and spinate, but later they become thin, prominent and bullate. Umbilical and mediolateral tubercles weak, inner ventrolateral tubercles moderately large, rounded, finally bullate, outer ventrolateral tubercles strong, bullate at first, finally clavate. Ribs slightly flexed on the flanks, bent forwards on the venter. Keel carinat-sulcate. There may be spiral striations on and between the ribs. Sides rather flat.

Remarks : This species resembles *Mortoniceras (Durnovarites) subquadratum crassicostatum* Spath closely, but the ribbing of the Nigerian form is thinner and much more prominent, the venter is broader and the flanks more inflated. *M. (Durnovarites) ishiaguense* sp. nov. is more closely ribbed on the inner whorls and is more regularly ornamented. *M. (Durnovarites) quadratum* (Spath), from the same locality, is more regularly ornamented and the ribbing is less prominent.

Occurrence : Top of the Upper Albian ; zone 5, shales at Ishiagu, Afikpo Division, Ogoja Province.

Collector : The author.

Mortoniceras (Durnovarites) ishiaguense sp. nov.

Plate VII, figs. 1a, b

Holotype : B.M. No. C.47312 ; zone 5, Ishiagu brickfields. Plate VII, figs. 1a, b.

*Measurements*¹ :

C.47312

diameter 91 mm. = 1·00

thickness 36 mm. = 0·40

umbilicus 47 mm. = 0·51

height of last whorl 38 mm. = 0·42

¹ Made on the uncrushed part of the shell. The total diameter of the specimen is 115 mm.

Description : Evolute, whorl section somewhat higher than broad. Venter broad, strongly carinat-sulcate. Whorls flat-sided. Living chamber ornamented with strong tubercles, of which there are four rows, and with moderately spaced ribs. Umbilical tubercles bullate, prominent, the mediolateral row clavate and bearing a slight impression. The lower ventrolateral tubercles are strong and clavate and stand straight out from the flanks ; the outer ventrolateral tubercles are strongest and are clavate. The inner ventrolateral row is situated nearer the mediolateral row than the outer ventrolateral row. The ribs are almost straight.

The umbilicus discloses that the ribbing is much denser on the inner whorls than on the outer, and so far as could be ascertained, increasingly so on the innermost whorls. Specimen C.47326 (Plate IV, fig. 14), although juvenile, probably represents this growth stage. The ribs on the adult whorls are simple ; they branch on the inner whorls, where they are flexed, and bend slightly forwards on the venter. The tubercles on the inner whorls are feeble and only the umbilical row is noticeable.

Remarks : This species resembles *M. (Durnovarites) subquadratum* Spath in the adult, but the ribbing of its inner whorls is much denser and straighter, and the whorl section is appreciably higher than broad. Furthermore, the ribbing on the inner whorls is more variable than that on other species of *Durnovarites*. *M. (Durnovarites) deppressum* (Spath), from the same locality, has a more depressed whorl section and *M. (Durnovarites) quadratum* (Spath) is more regularly ornamented, and has more widely spaced ribs at all comparable stages.

Occurrence : Top of the Upper Albian ; zone 5, shales at Ishiagu, Afikpo Division, Ogoja Province.
Collector : R. C. Wilson.

Genus **Neokentroceras** Spath, 1922

Type species : *Neokentroceras curvicornu* Spath.

Diagnosis : Small ammonites, as a rule with feeble ribs and very strong umbilical and ventrolateral tubercles, the latter sometimes extreme. Either weak, clavate, lower ventrolateral tubercles or feeble, rounded mediolateral tubercles may be present.

Remarks : The whorl section of the holotype of *N. curvicornu* (B.M. No. C.20116) is slightly higher than broad and the greatest width occurs across the umbilical margin. On inner whorls, only two rows of tubercles are apparent, but on the septate last whorl of the specimen there are three rows.

The umbilical and the ventrolateral rows are very much stronger than the lower ventrolateral tubercles, which do not occur on every rib. The outer ventrolateral tubercles are at first prominent and blunt, but later they bend backwards and become spine-like. The ribs are weak and bifurcate at times. During part of development, the umbilical tubercles move up the flanks, but the last tubercle present on the holotype is situated on the umbilical margin. The indefinite inner ventrolateral tubercles are obliquely clavate. The keel becomes fairly high, but on advanced whorls it degenerates (see, however, *N. curvicornu crassicornutum*—description of holotype ; here the keel is rejuvenated). Examination of the other species of this genus preserved in the British Museum (Natural History) shows them to agree well with the original diagnoses. *N. pseudovaricosum* Spath has rather closely spaced ribs that are flat and weak, and sometimes divide at the umbilical tubercle. *N. subtuberculatum* Spath is strongly trituberculate, with moderately strong ribs that occasionally divide at the umbilical tubercles. *Neokentroceras* sp. nov., so often mentioned by Spath (Ansorge Collection, B.M. Nos. C.14819, C.14821, C.14818, C.14820 and C.20285), bears strong, spinate tubercles and is trituberculate. It has a low keel that strengthens on the last part of the last whorl of C.20285. A specimen, C.36204 (A. G. Davies Collection) from Lobito, Angola, is related to the Ansorge species, but is more strongly ornamented. It is also trituberculate, and is doubtless a new species. Neither of these forms appears to be among the material figured by Haas (1942).

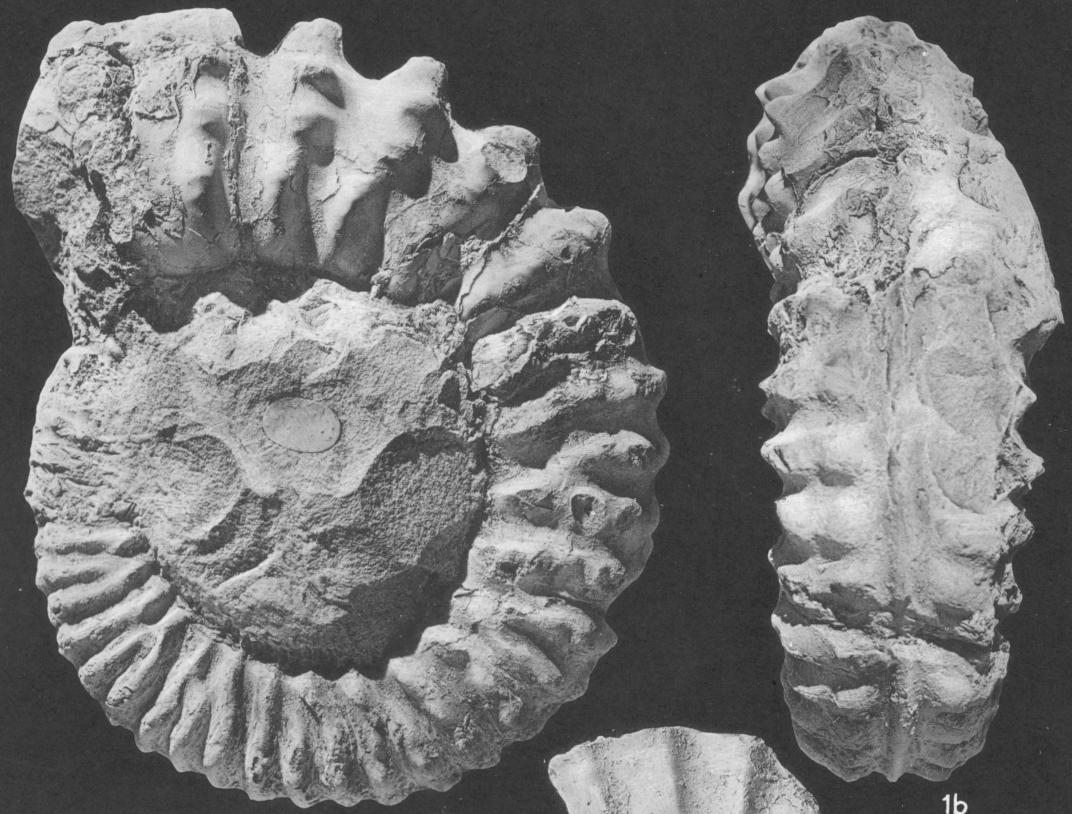
The large holotype of *N. curvicornu crassicornutum* subsp. nov., which is trituberculate, throws light on the relationships of this genus. The body chamber (plate IV, fig. 7), shows a *Mortoniceras*-type of ornament, and illustrates the origin of this group in trituberculate *Mortoniceras*.

The typical features of *Neokentroceras*, the bituberculation and the feeble ribbing, are thus coenogenetic. Spath's original suggestion (1922, p. 106) that *Neokentroceras* is closely related to quadrituberculate *Mortoniceras* is apparently more correct than Haas's (1942, p. 141) later view that *Neokentroceras* is a close relative of *Hysterooceras*.

The specimen, C.21956, referred by Spath (1928, p. 52) to *Neokentroceras* sp. nov., but later classed as an indeterminate trituberculate *Mortoniceras*, is in all probability a *Neokentroceras*. It is not well enough preserved to permit any further comment.

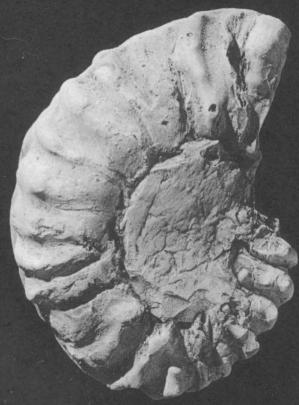
PLATE VII
(opposite)

- FIG. 1. *Mortoniceras (Durnovarites) ishiaguense* sp. nov. Holotype. The body chamber of this specimen is crushed. (a) Side view ; (b) ventral view. Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47312). Page 38.
- FIG. 2. *Mortoniceras (Durnovarites) levecostatum* sp. nov. Holotype. Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47321). Page 38.
- FIG. 3. *Mortoniceras (Durnovarites) quadratum* (Spath). Ventral view of the specimen figured in Plate VI, fig. 4. Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47324). Page 38.
- FIG. 4. *Mortoniceras (Durnovarites) depresso* (Spath). Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47239). Page 37.
- FIG. 5. *Stoliczkaia africana* Pervinquière. (a) Side view ; (b) ventral view. Top of the Upper Albian. Ishiagu, Ogoja Province. (B.M. No. C.47239). Page 45.
- FIG. 6. *Elobiceras* sp. indet. Middle of the Upper Albian. Nyeba, Ogoja Province. (B.M. No. C.21958). Page 42.

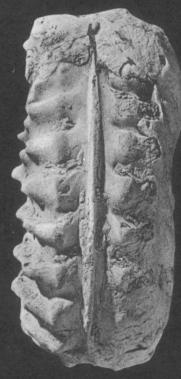


1a

1b



2



3



4



5



6

a b

Neokentroceras curvicornu Spath

Plate IV, figs. 9a, b

- 1922 *Neokentroceras curvicornu* Spath, p. 139, text-fig. D.1, 1a, 2.
- 1942 *Neokentroceras speciosum* Haas, p. 61, pl. VIII, figs. 14-17 ; pl. IX, figs. 10a b ; text-figs. 6n, o.
- ?1942 *Neokentroceras curvicornu* Spath ?, Haas, p. 63, pl. VIII, figs. 20-22 ; text-fig. 6q.
- 1942 *Neokentroceras singulare* Haas, p. 64, pl. IX, fig 11 ; pl. X, figs. 1a-c ; text-figs. 6r, s.

Description : The inner whorls of the specimens here recorded resemble those of B.M. No. C.20118 (figured by Spath, 1922), but differ in that the lower ventrolateral tubercles appear somewhat earlier than in the Angolan form. The outer ventrolateral tubercles are prominent and horn-like, and the umbilical tubercles are prominent and spinate. The lower ventrolateral tubercles are obliquely clavate. There are weak ribs that almost disappear on the middles of the flanks. The venter is flattened ; keel low.

Remarks : The Nigerian specimens agree well with the Angolan ones. From comparison with the original material, it seems that the Angolan specimens gain their adult ornament more rapidly than do the Nigerian examples. Slight differences in degree of inflation and strength of ornament are also apparent.

Occurrence : Middle of the Upper Albian ; zone 4, bridge near Ameka-Nyeba turn-off, Abakaliki Division, Ogoja Province.

Collector : The author.

Neokentroceras curvicornu crassicornutum subsp. nov.

Plate IV, figs. 7, 8

Holotype : B.M. No. U.3571 ; zone 4, Abakaliki Town. Plate IV, fig. 7.

Description : Shape and whorl section as *N. curvicornu curvicornu* Spath, but the clavi below the ventrolateral spines are thicker and more prominent and point outwards more definitely. The body chamber develops three rows of prominent tubercles, on fairly strong ribs, and thus differs radically in appearance from earlier whorls. The mediolateral tubercles develop from the clavi below the ventrolateral tubercles. On the last part of the last whorl the ventrolateral tubercle tends to develop a central depression.

Remarks : The holotype of this subspecies (U.3571) is of particular interest as its body chamber is preserved. All specimens of *N. curvicornu curvicornu* described by Spath (1922) lack body chambers,

hence his observations concerning the species (and thus the genus) are necessarily incomplete, particularly so as the ammonite undergoes important changes on its body chamber. In this subspecies the body chamber is clearly trituberculate, with umbilical, mediolateral, and ventrolateral tubercles.

Occurrence : Middle of the Upper Albian ; zone 5, Abakaliki town, Abakaliki Division, Ogoja Province.

Collector : The author.

Genus *Elobiceras* Spath, 1922

Type species : *Schloenbachia elobiensis* Szajnocha.

Diagnosis : Rather involute, compressed and high-whorled, with flat sides and high, thin keel. Simple ribs with very distinct spiral notching, which expand into flat bulges on the shoulders.

Elobiceras lobitoense (Crick MS.) Spath

Plate VIII, figs. 1a, b ; text-fig. 16a

- 1922 *Elobiceras lobitoense* (Crick MS.) Spath, p. 136, pl. I, fig. 2.
- 1928 *Elobiceras cf. lobitoense* (Crick MS.) Spath, Spath, p. 52.
- 1942 *Elobiceras lobitoense* (Crick MS.) Spath, Haas, p. 113, pl. XXVII, figs. 1, 2.
- 1954b *Elobiceras lobitoense* (Crick MS.) Spath, Reymont, p. 20.

Description : Somewhat compressed, whorl section high (see text-fig. 16a), sides slightly inflated. Venter broad and almost flat, bearing a rather strong keel. The strong, simple ribs on the flanks are usually slightly flexed. There are strong notches on and between the ribs, which are flat and thin at the umbilical margin, but become thicker and more raised towards the ventral margin where they develop prominent, orally-directed tubercles. These bear shallow depressions. The umbilicus is wide and eccentric in the adult, and the greatest thickness occurs across the umbilical margin.

Remarks : This species is the commonest representative of the genus in the Nigerian Albian. It is distinguished from *E. intermedium* Spath by its flatter flanks and its whorl section, as well as by the weaker keel and very prominent ventrolateral tubercles (see text-fig. 16a).

Occurrence : Middle of the Upper Albian ; zone 4, Pretty Sally Mine, Ameka ; Ameri ; Abakaliki town, Ogoja Province.

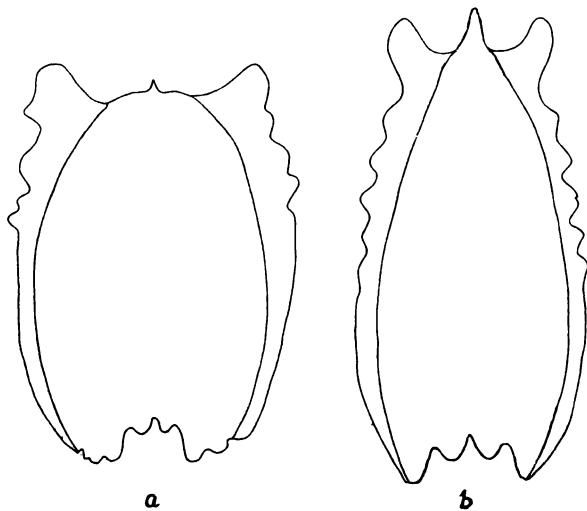
Collectors : A. Kitson, the author.

Elobiceras angustum Spath

Plate VIII, fig. 2 ; text-fig. 16b

- 1922 *Elobiceras angustum* Spath, p. 134, pl. II, fig. 1.
 1922 *Elobiceras* sp. indet., Spath, p. 134, pl. I, fig. 3.
 1928 *Elobiceras* cf. *angustum* Spath, Spath, p. 52.
 1931 *Elobiceras angustum* Spath, Airaghi, p. 850.
 1942 *Elobiceras* cf. *angustum* Spath, Haas, p. 114.
 1954b *Elobiceras angustum* Spath, Reymont, p. 20.

Description : This species is characterized by its strongly compressed whorls, which are much higher than broad. The specimen studied (C.21955) is a large fragment with slightly flexed ribs and a strong keel that is higher than the clavate ventrolateral tubercles (see text-fig. 16b). The ribs are notched more strongly than the intercostals.



TEXT-FIG. 16—Whorl sections of *Elobiceras*. a, *Elobiceras lobitoense* (Crick MS.) Spath. b, *Elobiceras angustum* Spath, specimen B.M. No. C.21955. Both figures natural size.

Remarks : The specimen studied differs from Spath's original figure in that its ribbing is straighter. Nevertheless, the whorl sections are so much alike that the writer feels no hesitation in referring the Nigerian form to *E. angustum*. Spath (1922, p. 134) wrote that the straight ribbing of C.21955 shows it to be transitional to *E. szajnochai* Spath. It is, however, for the time being best grouped with *E. angustum*.

Occurrence : Middle of the Upper Albian ; zone 4, Nyeba, Abakaliki Division, Ogoja Province.

Collector : A. Kitson.

Elobiceras cf. *intermedium* Spath

Plate VIII, fig. 7

- 1922 *Elobiceras intermedium* Spath, p. 134, pl. I, figs. 1a, b.
 1942 *Elobiceras intermedium* Spath, Haas, p. 109, pl. XXVII, figs. 2-5 ; text-figs. 12b, 13ba and β.

Description : A single, rather crushed specimen has fairly strong ribs, occasionally bifurcated and slightly flexed. The ribbing is rather irregular and the ribs are not opposite.¹ The spiral striations are prominent.

Remarks : The specimen (U.2096) agrees well with the original figures in all features it was possible to compare. The ventral swelling of the ribs is stronger than is the case in *E. subelobiense* Spath, to which the species here discussed is related. A closer determination is not possible, because of the fragmentary nature of the specimen.

Occurrence : Bottom of the Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

¹ This may be due to crushing. See Spath (1922) p. 134 and pl. I, fig. 1b.

Elobiceras sp. indet.

Plate VII, fig. 6.

- 1928 *Elobiceras* sp. indet., Spath, p. 52.

Remarks : A well-preserved fragment (C.21958) with widely separated ribs that bear only feeble striations, is referred here. The ribs are club-shaped and slightly bent, and are weak at the umbilical end.

Elobiceras aff. *densicostatum* (Crick MS.) Spath

Plate VIII, fig. 3

- 1922 *Elobiceras densicostatum* (Crick MS.) Spath, p. 135, pl. II, figs. 4a, b.

Description : A number of casts and moulds strongly resemble the inner whorls of *E. densicostatum*. The ribbing is typically dense ; the ribs are thin, uniform and flexed, and bear strong spiral notches. They often bifurcate ; they are flattened and the notches are stronger on their orad side. The flanks are flat and the umbilicus open—*vide* specimen U.3541.

Remarks : *E. lobitoense* has, as Crick's description indicates, coarsely ribbed inner whorls. At advanced growth stages the ribbing of *E. densicostatum* becomes more widely spaced than that of any other species of *Elobiceras*.

Occurrence : Middle of the Upper Albian ; zone 4, Abakaliki town, Abakaliki Division, Ogoja Province.

Collector : The author.

Elobiceras cf. subelobiense Spath

Plate VIII, fig. 6

- 1905 *Schloenbachia elobiense* Szajnocha, Choffat, p. 37, pl. IV, fig. 5.
- 1922 *Elobiceras subelobiense* Spath, p. 132, pl. II, figs. 2a, b.
- 1931 *Elobiceras subelobiense* Spath, Airaggi, p. 849.
- 1942 *Elobiceras subelobiense* Spath, Haas, p. 113, pl. XXVIII, figs. 3a-c.

Description : A fragment (U.2095) with almost parallel flanks is referred here. The venter is almost flat, the keel strong, higher than the ventrolateral terminations of the ribs, which are slightly flexed and typically flat. True ventrolateral tubercles do not result. The slight prominence of the ribs at the venter (shown in Plate VIII, fig. 6) is due to crushing.

Remarks : The Nigerian specimen differs from *E. subelobiense* in that it has a narrower venter (possibly due to slight crushing). The venter is also narrower than that of the closely related *E. intermedium* and the ribbing is denser. The ribs of *E. lobitoense* are stouter and more flexed, the venter is broader and more arched, and the umbilical tubercles are prominent. Venzo (1936, p. 96, pl. XII, fig. 7) referred a specimen to *E. subelobiense*, but it seems rather doubtful whether the determination is correct, since the figured whorl section is quite different from that of the type.

Occurrence : Bottom of the Upper Albian ; zone 3, Nkpugwu Onyikwo, Abakaliki Division, Ogoja Province.

Collector : The author.

Elobiceras sp. nov. indet.

Description : A badly eroded specimen from Nwofe, that differs from all other figured *Elobiceras*, is placed here. The whorl section is very high and the venter flat. The ventrolateral tubercles are moderately prominent and flat, and form a continuation of the flat venter. The keel is low and separate from the ribs. The ribbing is dense and the ribs often divide.

Remarks : This specimen (U.3542) bears some resemblance to *E. browni* Haas as regards the whorl section and ventrolateral tubercles, but the keel is lower and the ribbing finer. *E. lobitoense* has a similar low keel, but the whorl section is not as high, the whorls are less compressed, the ribbing is coarser, and the ventrolateral tubercles are much more prominent and differently shaped.

Occurrence : Middle of the Upper Albian ; zone 4, Nwofe, Abakaliki Division, Ogoja Province.

Collector : The author.

Elobiceras newtoni Spath

- 1922 " *Mortoniceras* " cf. *lenzi* Crick MS., Spath, p. 103 (footnote).
- 1925 *Elobiceras newtoni* Spath, p. 186, pl. XXX, figs. 1a, b ; pl. XXIX, fig. 3.
- 1928 *Elobiceras newtoni* Spath, Spath, p. 53.

Description : Ribs on inner whorls notched at an early stage. The later whorls are roughly rectangular with almost parallel sides, and finally subquadrate. Keel prominent, with deep grooves on either side. Ribs in almost direct contact with keel.

Remarks : This species is regarded by Spath as similar to *E. intermedium* Spath and *E. lobitoense* (Crick MS.) Spath. The sole Nigerian example (C.20274) is fragmentary.

Occurrence : Upper Albian ; limestone at Arufu, Benue Province.

Genus *Neoharpoceras* Spath, 1921

Type species : *Ammonites hugardianus* d'Orbigny.

Diagnosis : Compressed, involute, with rounded venter and low keel ; dense sinuous ribs and no tubercles.

Neoharpoceras densicostatum sp. nov.

Plate VIII, figs. 8a, b

1954b *Neoharpoceras* sp. nov., Reymert, p. 20.

Holotype : B.M. No. U.889 ; Ohio, Ogoja Province. Plate VIII, figs. 8a, b.

Description : Form compressed, venter rather sharp, keel moderately strong, solid ; umbilicus narrow. Ribs fine, sigmoidal ; they divide two or three times. They are weak on the umbilical margin, but become prominent towards the venter without becoming thicker. Fragments of larger whorls show that the ribs become more widely spaced on the venter than is the case with the holotype. The umbilical walls are vertical but not high.

Remarks : This new species differs from all other described *Neoharpoceras* by its extremely dense, fine ribbing. *N. hugardianum* (d'Orbigny) is less delicately ribbed and has a rounder venter ; *N. irregularis* Spath has umbilical swellings on the ribs and coarse ribbing. *N. conditum* Haas resembles the Nigerian species rather closely but is less involute, its keel is undercut, and there are fewer ribs per whorl.

Occurrence : Upper Albian ; Ohio, near Okpartu River, Ogoja Province.

Collector : J. Watson, A.T.M.N.

PLATE VIII

(*opposite*)

- FIG. 1. *Elobiceras lobitoense* (Crick MS.) Spath. Middle of the Upper Albian. Ameka Mine, Ogoja Province. (a) Ventral view ; (b) side view. (B.M. No. U.1942). Page 41.
- FIG. 2. *Elobiceras angustum* Spath. Middle of the Upper Albian. Nyeba, Ogoja Province. (B.M. No. C.21955). Page 42.
- FIG. 3. *Elobiceras aff. densicostatum* (Crick MS.) Spath. Middle of the Upper Albian. Abakaliki Town, Ogoja Province. (B.M. No. U.2131). Page 42.
- FIG. 4. *Prohysteroferas wordiei* Spath. Middle of the Upper Albian. Abakaliki Town, Ogoja Province. (B.M. No. U.1566). Page 45.
- FIG. 5. *Prohysteroferas* sp. juv. Middle of the Upper Albian. Ameka, Ogoja Province. ($\times 5$). (B.M. No. C.21983). Page 45.
- FIG. 6. *Elobiceras cf. subelobioense* Spath. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.2095). Page 43.
- FIG. 7. *Elobiceras cf. intermedium* Spath. Bottom of the Upper Albian. Nkpugwu Onyikwo, Ogoja Province. (B.M. No. U.2096). Page 42.
- FIG. 8. *Neoharpoceras densicostatum* sp. nov. (a) Side view ; (b) ventral view. Upper Albian. Near Ogoja, Ogoja Province. (B.M. No. U.889). Page 43.



Genus *Prohysteroferas* Spath, 1921

Type species : Prohysteroferas wordiei Spath.

Diagnosis : Somewhat evolute, compressed with high keel. In the young, however, the whorl section is sometimes subquadrate. Ribs rather weak, branching, fine, close and sinuous. Umbilical and ventrolateral tubercles present, but often subdued in the adult.

Prohysteroferas sp. juv.

Plate VIII, fig. 5

1928 *Prohysteroferas* sp. juv., Spath, p. 52.

Remarks : A small mould (diameter—10 mm.) is evolute and has fine, branched ribs, small umbilical tubercles and feeble ventrolateral tubercles. It is moderately compressed and the venter is sharply rounded. The keel is sharp.

Occurrence : Middle of the Upper Albian ; zone 4, Ameka, Abakaliki Division, Ogoja Province.

Prohysteroferas wordiei Spath

Plate VIII, fig. 4 ; text-fig. 17

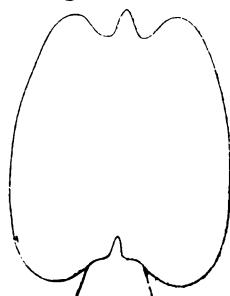
1922 *Prohysteroferas wordiei* Spath, p. 143, pl. III, figs. 4-6.

1924 *Prohysteroferas wordiei* Spath, Haughton, p. 92.

1933 *Prohysteroferas wordiei* Spath, Spath, pp. 441, 443, 444, 461 ; text-fig. 158g.

1942 *Prohysteroferas wordiei* Spath, Haas, p. 125, pl. XXXI, fig. 5 ; pl. XXXIII, figs. 2a-d, 3.

Description : Compressed, whorl section high, flanks slightly inflated and roughly parallel. Venter comparatively broad, carinato-sulcate, keel prominent. The ribs are simple or branch irregularly in the outer third of the side. Some ribs are very weak at the umbilical margin, but others begin with a bullate swelling. The ventral ends of the ribs flatten a little, beginning at the ventrolateral margin, and here they, as well as the intercostals, are rather strongly striated spirally. The notching decreases in strength towards the umbilicus and disappears about the middle of the flanks. Some of the ribs have a faint, but readily discernible, ventrolateral swelling.



TEXT-FIG. 17—*Prohysteroferas wordiei* Spath. Whorl section of specimen B.M. No. U.4156. Natural size.

Remarks : The Nigerian fragment resembles in all respects the species as originally described by Spath (1922) ; comparison with the holotype (C.20086) bears this out. The whorl section (text-fig. 17) is somewhat more compressed than in *P. wordiei wordiei* and is close to that of *P. wordiei compressum* Spath from the same beds. Haas (1942) included the original of Spath's pl. III, figs. 6a, b—but not fig. 5—in his new species, *P. gracile* ; in the writer's opinion, this does not seem to be fully justified. It is apparent, nevertheless, that the two species are closely related. *P. wordiei* is allied to *P. (Goodhallites) candolianum* (Pictet), but differs in being somewhat more inflated and in having a lower and stouter keel. The figures of *P. gracile* are unfortunately not clear enough to permit of detailed comparisons.

Occurrence : Middle of the Upper Albian ; zone 4, Abakaliki Town, Ogoja Province.

Collector : The author.

Family LYELLICERATIDAE

Genus *Stoliczkaia* Neumayr, 1875

Stoliczkaia africana Pervinquière

Plate VII, figs. 5a, b

1907 *Stoliczkaia dispar* d'Orbigny var. *africana*, Pervinquière, p. 389, text-fig. 149 ; pl. XII, figs. 10a, b.

1928 *Stoliczkaia* sp. nov., Spath, p. 51.

1931 *Stoliczkaia africana* Pervinquière, Spath, pp. 330, 332.

1954b *Stoliczkaia dispar* (d'Orb.), Reymont, p. 20.

Description : Sides flat to faintly concave, venter rounded, umbilicus moderately wide. Strongly ornamented with prominent ribs and occasional bullate umbilical tubercles. Not all ribs reach the umbilical margin on both sides ; some begin at one umbilical margin, but fade out before they reach the other one. About every third rib forms a thin, bullate umbilical tubercle and is there strongly bent. The ribbing is inclined strongly forwards at the ventrolateral margin and thickens considerably on the venter.

Remarks : This species resembles *S. dispar* (d'Orbigny), but it develops the adult ornament very rapidly. *S. rhamnonotus* (Seeley) has a more inflated whorl section and more ribs per whorl. *S. notha* (Seeley) is not so flat-sided and the ribs are much straighter.

Occurrence : Top of the Upper Albian ; zone 5, Ishiagu, Afikpo Division, Ogoja Province.

Family ACANTHOCERATIDAE

Subfamily ACANTHOCERATINAE

Genus **Romaniceras** Spath, 1923

Type species : *Ammonites deveriae* d'Orbigny.

Diagnosis : Evolute, characterized by the presence of nine to eleven rows of tubercles. The ribs are thick, fairly well spaced and sometimes interrupted on the venter. The suture is similar to that of *Acanthoceras*.

Remarks : The occurrence of this genus in the rocks of the Mungo River, Southern Cameroons, overlying beds of Middle Lower Turonian age (Reyment, 1954a), implies the existence of Upper Turonian. Unfortunately, there is now some doubt about the restriction of *Romaniceras* to this substage, so for the moment, these beds are best regarded as being of possible Upper Turonian age. Recently, the author identified *Romaniceras* in a collection from the Alome River, Benue Province, of Lower Turonian age.

Distribution : Upper Cenomanian to Upper Turonian?, France, England, India, Madagascar, Syria, Southern Cameroons, Nigeria, U.S.A.

Romaniceras uchauxiense Collignon

Plate IX, fig. 2 ; text-fig. 18a

1913 *Acanthoceras Deverianum* Roman & Mazeran, p. 25, pl. III, fig. 1 ; non pl. III, fig. 2.

1939 *Romaniceras uchauxiense* Collignon, p. 94, pl. X, figs. 1, 1a.

1954a *Romaniceras* aff. *uchauxiense* Collignon, Reyment, p. 150.

Description : The specimen studied is a large fragment of a strongly tuberculated but rather feebly-ribbed form. The ribs are well spaced, broad, and are continuous across the venter. The ventrolateral tubercles are prominent and tend to develop concave tops ; as Plate IX, fig. 2 illustrates, the process clearly gives rise to a second row of ventrolateral tubercles, which develop asymmetrically. The siphonal tubercles are less prominent than the ventrolateral rows. The siphonal lobe and part of the external saddle are shown in text-fig. 18a.



TEXT-FIG. 18—Sutures of *Romaniceras*. a, *Romaniceras uchauxiense* Collignon. b, *Romaniceras* aff. *devereioides* (de Grossouvre). Both sutures natural size.

Remarks : The specimen here recorded closely resembles the figures given by Collignon (1939, pl. X, figs. 1, 1a) and Roman and Mazeran (1913), particularly the last authors' pl. III, fig. 1. The Nigerian example differs slightly, however, in showing a strong tendency for the ventrolateral tubercles to divide, first by a flattening of the tops and then by the development of a concavity. This process is only indefinitely indicated in the specimen figured by Collignon, on which some of the ventrolateral tubercles show signs of flattening. Whether this feature of the Nigerian specimen is to be attributed to gerontic development, or is to be regarded as of subspecific or specific importance, can only be decided when better material comes to hand. *R. uchauxiense* differs from other species of the genus by the presence of strongly clavate siphonal and ventrolateral tubercles and by the well-spaced, flat ribs. Collignon regards the beds at Masiaposa, from which his specimen was obtained, as being of Upper Turonian age.

Occurrence : Upper? Turonian ; Mungo River Formation, near Ediki, Southern Cameroons.

Collector : J. U. Kappeler, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. K6(1)).

Romaniceras aff. *devereioides* (de Grossouvre)

Plate IX, figs. 1a, b ; text-figs. 18b, 19

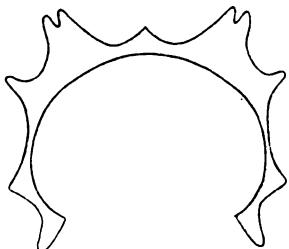
1899 *Ammonites devereioides* de Grossouvre, p. 524, pl. XII.

1938 *Acanthoceras Deverianum* (de Grossouvre), Basse, p. 180, pl. VIII, figs. 1a, b.

1939 *Romaniceras devereioides* (de Grossouvre), Collignon, p. 33 (94).

1954a *Romaniceras* aff. *devereioides* (de Grossouvre), Reyment, p. 150.

Description : Fairly evolute, whorls slightly broader than high (text-fig. 19), ornamented with strong, well-spaced ribs that cross the rounded venter. The ribs usually bear nine tubercles, but the outer ventrolateral tubercles may divide to form two sharp, clavate tubercles mounted on the same base. The siphonal tubercles are also clavate and pinched. The ventrolateral rows are sharp and are situated close to each other. Two rows of sharp mediolateral tubercles occur on the flanks and a less prominent row lines the umbilical margin. Intercalatories occur between the principal ribs and these usually bear five rows of tubercles. An almost complete suture is shown in text-fig. 18b.



TEXT-FIG. 19—Whorl section of *Romaniceras* aff. *deverioide* (de Grossouvre). Natural size.

Remarks : The Nigerian specimen, although close to *R. deverioide*, differs in the following respects : the tubercles situated dorsally from the middle of the flanks differ in shape, the ribbing is stronger, and the whorl section is more inflated. Collignon considers this species to be Upper Turonian in age and has recorded it from Madagascar. The specimen from the Alome River, Oturkpo Division, already remarked upon above, may belong here. *R. ornatissimum* (Stoliczka) 1863, p. 75, pl. XL) also bears eleven rows of tubercles, but these are more evenly spaced on mature whorls, and younger whorls tend to develop a double inner ventrolateral row of tubercles (cf. the double outer row of ventrolateral tubercles developed by the form recorded here). The whorl section is also much more depressed (compare Stoliczka's pl. XL, fig. d with text-fig. 19).

Occurrence : Upper? Turonian ; Mungo River Formation, near Ediki, Southern Cameroons.

Collector : J. U. Kappeler, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. K6(2)).

Romaniceras cf. *deveriai* (d'Orbigny)

- 1840 *Ammonites Deverianus* d'Orbigny, p. 365, pl. CX.
- ?1854 *Ammonites Deverianus* d'Orbigny, Sharpe, p. 43, pl. XIX, figs. 5a, b.
- 1872 *Ammonites Deverianus* d'Orbigny, Fritsch & Schlönbach, p. 32, pl. VII, figs. 4, 5.
- 1913 *Acanthoceras Deverianum* d'Orbigny, Roman & Mazeran, p. 25, pl. III, figs. 2, 2a.
- 1939 *Romaniceras Deveriae* d'Orb., var. *masiapense* Collignon, p. 37, pl. IX, figs. 2, 2a, 2b.
- ?1951 *Romaniceras* sp., Wright & Wright, p. 29.

Remarks : A single poorly preserved fragment is referred here. It consists of the venter and part of the flank of a form closely resembling *Romaniceras deveriae* (d'Orbigny), particularly the specimen figured by Collignon (1939, pl. IX, figs. 2, 2a, 2b) as *R. d. masiapense*. The venter is broad and

slightly convex ; the whorl section is slightly depressed. The specimen also bears some resemblance to *R. ornatissimum* (Stoliczka), but the whorl section is much less depressed.

Occurrence : Turonian ; Lower Cross River area, about 4½ miles E.N.E. of Arochuku, Calabar Province.

Collector : J. P. Studer, Shell D'Arcy.

Repository : Shell D'Arcy Headquarters, Owerri (specimen No. St.125).

Subfamily MANTELLICERATINAE

Genus *Calycoceras* Hyatt, 1900

Type species : *Ammonites navicularis* Mantell.

Calycoceras sp. indet.

Remarks : A poorly preserved fragment with a trapezoidal whorl section is referred here. It is ornamented with strong, straight, sharp ribs, the strongest of which bear elongated, bullate umbilical tubercles. The specimen is too poorly preserved to permit further comment.

Occurrence : Cenomanian ; Odukpani Formation, from the Odukpani Road, Calabar Province.

Collector : F. van Morkhoven, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. F.M. 14A(b)).

Subfamily METOICOCERATINAE

Genus *Metoicoceras* Hyatt, 1903

Type species : *Ammonites swallovi* Shumard.

Metoicoceras aff. *ornatum* Moreman

Plate IX, figs. 6, 7

1942 *Metoicoceras ornatum* Moreman, p. 211, pl. XXXII, fig. 4 ; text-fig. 2c.

Description : Moderately evolute, whorl section high, rather compressed. Venter slightly convex, ventrolateral margin flattened and with upper and lower ventrolateral tubercles. Ribs thin, flexed and closely spaced, sometimes branched. Intercalations present. Some of the ribs end in feeble, bullate tubercles at the umbilical margin. The ribs degenerate into flat swellings on the venter.

Remarks : Unfortunately, the specimen is in several fragile pieces embedded in a hard limestone matrix and could not be satisfactorily developed. The ammonite attained a fairly large size and also became more strongly ornamented than the fragment figured in Plate IX, fig. 6, suggests. It resembles *M. ornatum*, but appears to have denser and weaker ribs. The venter of *M. ornatum* is also

PLATE IX
(opposite)

- FIG. 1. *Romaniceras* aff. *deverioide* (de Grossouvre). (a) Side view ; (b) ventral view. Upper (?) Turonian. Mungo River Formation, near Ediki, Cameroons. This specimen is kept at N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland. Page 46.
- FIG. 2. *Romaniceras uchauxiense* Collignon. Ventral view of a large fragment. Upper (?) Turonian. Mungo River Formation, near Ediki, Cameroons. Repository the same as for *R. aff. deverioide* above. Page 46.
- FIG. 3. *Mammites* cf. *afer* Pervinquière. Ventral view of a small fragment. Lower Turonian. Icheri River, Benue Province. (B.M. No. C.47410). Page 53.
- FIG. 4. *Mammites dixeyi dixeyi* sp. nov. Paratype. Inner whorls of a large fragment. Abazi River, near Ezillo, Ogoja Province. (B.M. No. U.3360). Page 50.
- FIG. 5. *Metoicoceras* sp. juv. A small, slightly damaged specimen without living chamber. Cenomanian. Odukpani Formation, Calabar Province. This specimen is preserved at Shell D'Arcy Headquarters, Owerri, eastern Nigeria. Page 49.
- FIG. 6. *Metoicoceras* aff. *ornatum* Moreman. Cenomanian. Three miles north of Odukpani, Odukpani Formation, Calabar Province. Repository the same as for *M. sp. juv.* above. Page 47.
- FIG. 7. *Metoicoceras* aff. *ornatum* Moreman. Cenomanian. Inner whorls of the specimen figured in fig. 6 on this plate. ($\times 4$). Page 47.



reported to be concave, whereas that of the specimen studied is slightly rounded. *M. whitei* Hyatt is similar, inasmuch as it has flat flanks and feeble umbilical tubercles, although it is more coarsely ribbed. The Nigerian form may prove to lie between the two closely related American species.

Occurrence : Cenomanian ; Odukpani Formation, 3 miles north of Odukpani, Calabar Province.

Collector : D. Watt, Shell D'Arcy.

Repository : Shell D'Arcy Headquarters, Owerri.

Metoicoceras sp. juv.

Plate IX, fig. 5

Description : Whorls flat-sided. Clavate upper and lower ventrolateral tubercles and bullate umbilical tubercles present. The outer ventrolateral and the umbilical tubercles are strong. The venter is unusually broad and the ribs stout, well spaced and straight. The suture is typical of *Metoicoceras*.

Remarks : This specimen is not sufficiently mature to permit close comparisons. It does, however, bear some resemblance to the inner whorls of *M. swallovi* (Shumard). The broad venter is a unique feature and the form is almost certainly new. Stephenson (1952, p. 209, pl. LIII, figs. 1-9 ; pl. LIV, figs. 9-11) has figured a new species of broad-ventered *Metoicoceras*, *M. latoventer*, from the Woodbine Formation of Texas that resembles this form but is more inflated and less strongly ribbed.

Occurrence : Cenomanian ; Odukpani Formation, Calabar Province.

Collector : D. Watt, Shell D'Arcy.

Repository : Shell D'Arcy Headquarters, Owerri.

Metoicoceras sp. indet.

1954b *Metoicoceras* sp. indet., Reyment, p. 21.

This specimen consists of a fragment of the periphery of a large ammonite. The venter, which is rather broad, is bounded by clavate ventrolateral tubercles that cap feeble ribs.

Occurrence : Cenomanian ; Odukpani Formation, Calabar Province.

Collector : E. Reyment.

Subfamily MAMMITINAE

Diagnosis : Evolute ammonites with a row of umbilical and two rows of ventrolateral tubercles. Venter broad and flat, at times concave ; suture simple.

Remarks : The Mammitinae, which are obviously derived from the Acanthoceratidae, are regarded by some authors as a family. For the purposes of

this paper the subfamilial attribution is retained. The subfamily comprises the genera *Mammites*, *Pseudaspidoceras*, *Metasigaloceras*, *Watinoferas*, *Benuites*,¹ and *Kamerunoceras*.¹ The Mammitinae are confined to the Lower Turonian.

¹ Both of these genera were placed in Collignoniceratidae by the author in recent papers (Reyment, 1954a, c). Examination of further material, however, makes it apparent that their affinities lie more with Mammitinae. It has also become apparent that *Mammites* (as also *Benuites*) is derived directly from *Watinoferas*. The position of *Kamerunoceras* is not quite clear as yet, but this genus represents an offshoot of Acanthoceratinae distinct from the lineage of *Watinoferas*, *Mammites*, and *Benuites*.

Genus *Mammites* Laube & Bruder, 1887

Type species : *Ammonites nodosoides* Schlotheim.

Diagnosis : Since there seems to be a certain amount of confusion in the literature as to what constitutes a *Mammites*, the original generic description is here cited in translation.¹ "The flanks of the shell bear coarse ribs, which in the vicinity of the umbilical and ventral margins bear blunt, usually nipple-shaped tubercles. The venter is truncated, slightly concave and a weak, blunt keel² marks the median line. This often no more than suggested. The lobes are short, only slightly denticulated and hand-shaped. The external lobe and the first lateral lobe are of equal length. The external saddle is noteworthy owing to its extreme breadth and takes up almost half of the venter. There is only one definite auxiliary lobe."

Distribution : The Lower Turonian of Spain, Tunisia, Nigeria, Madagascar, North and South America, Germany, Russia, England, etc.

Remarks : It is of interest to compare the little-known genus *Metasigaloceras* Hyatt, 1903 (type species : *Ammonites rusticus* Sowerby) with *Mammites*. Examination of the specimen figured by Sharpe (1858, pl. XX, fig. 1)³ yielded the following information, apart from the observations made in Sharpe's original diagnosis. The mediolateral

¹ Original text. "Das Gehäuse ist auf den Seiten mit groben Rippen bedeckt, welche in der Nähe der Nabel- und Externkante stumpfe, meist zitzenförmige Höcker tragen. Die Externseite ist abgestumpft, schwach ausgehölt, in der Medianlinie tritt ein schwach stumpfer Kiel—and dies oft nur angedeutet—hervor. Die Loben sind kurz, wenig verästelt, handförmig. Extern- und Laterallobus sind gleich lang. Der Externsattel zeichnet sich durch eine auffallende Breite aus und nimmt fast die ganze Hälfte der Externseite ein. Nur ein deutlicher Auxiliarlobus."

² Specimens that have lost their covering of shell show a false keel due to the prominence of the siphuncle (author's observation).

³ No. 36932, Geological Survey and Museum, London.

tubercles are situated on broad, flat, fold-like ribs which divide there and continue on to the ventrolateral tubercles. Occasionally a ventrolateral tubercle may be without a connecting rib. The specimen figured by Sharpe is rather badly distorted. The mediolateral tubercles are blunt and very large, and stronger than the ventrolateral ones. The difference from *Mammites* lies in that *Metasigaloceras* lacks umbilical tubercles and has a row of mediolateral and a row of ventrolateral tubercles instead of two ventrolateral rows.

Karrenberg (1935, p. 131) described an important ammonite fauna from the Cretaceous of northern Spain which somewhat resembles the mammitid fauna here treated. He observed that the external appearance of *Mammites* may vary considerably; the whorl section may be broad, trapezoidal or compressed; the ribs straight or sickle-shaped, and the umbilical tubercles of variable shape and strength. He also noted that,¹ "Common to all the forms referred here, however, is the occurrence of three rows of tubercles, one in the vicinity of the umbilicus and two ventrolateral rows, as well as the absence of a median row of tubercles in every stage of growth. The venter is always flattened or even concave. Above all, however, the suture line always shows the same features, namely a broad external saddle that is usually asymmetrically divided by a subsidiary lobe and has parallel sides, a first lateral lobe of variable width but which is always bipartite."

The Spanish species occur together with *Vascoceras*, as does one of the forms described below. None of the Nigerian species exhibits any signs of a keel, and it is the author's opinion that previous reports of keeled *Mammites* are based on either crushed specimens² or prominent siphons.

Those Cenomanian forms from Madagascar referred to *Mammites* by Boule, Lemoine and Thévenin (1907) and later by Collignon³ are

¹ Original text: "Gemeinsam aber ist allen hierher gehörigen Formen das Auftreten von drei Knotenreihen, einer in der Nähe des Nabels und zwei beieinander stehender an der Externseite, sowie das Fehlen einer medianen Knotenreihe in jedem Wachstumstadium. Die Externreihe ist stets abgeflacht oder gar ausgehöhlt. Vor allem aber zeigt die Lobenlinie immer wieder dieselben typischen Merkmale, nämlich einen breiten durch einen Hilfslobus meist unsymmetrisch geteilten Externsattel mit parallelen Seiten, einem in der Breite schwankenden, stets zweifingerigen ersten Laterallobus."

² E.g., the holotype of *Mammites michelobiensis* Laube & Bruder.

³ *M. prenodosoides* Boule, Lemoine & Thévenin, and *M. subnodosoides* Collignon.

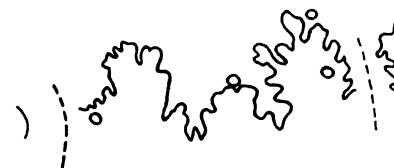
obviously in no way directly connected with that genus. Besides umbilical and lower and upper ventrolateral tubercles, these forms possess a siphonal row of tubercles and are clearly true acanthoceratids. This confusion has no doubt arisen from the attribution of a supposedly tricarinate species (actually crushed), *M. michelobiensis*, to *Mammites* by Laube and Bruder. Stephenson (1952, p. 204, pl. XLIX, fig. 3; pl. LI, figs. 8-11) has described and figured *Mammites? bellsanus*. This appears to be more closely related to *Metoicoceras* Hyatt. The species recorded as *Mammites melleguensis* by Dubordieu (1953, p. 37, pl. IV, figs. 53, 54) is a *Paramammites* close to *P. polymorphus* (Pervinquier).

Mammites dixeyi sp. nov.

Plate IX, fig. 4; Plate XI, figs. 2a, b; text-figs. 20, 21

1954b *Mammites* sp. nov., Reyment, p. 20.

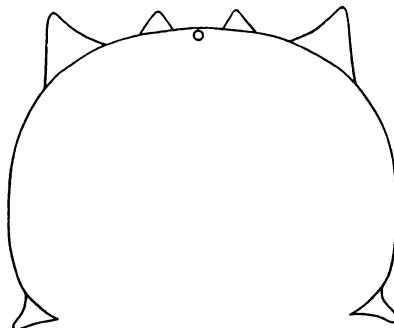
Holotype: B.M. No. C.47400; limestones and shales at Ezillo, Abazi River. Plate XI, figs. 2a, b; text-figs. 20, 21.



TEXT-FIG. 20.—Suture line of the holotype of *Mammites dixeyi* sp. nov., B.M. No. C.47400. Natural size. The small circles represent the positions of the tubercles.

Description: Evolute, moderately large, whorl section roughly square at a radius of 35 mm. and rectangular at a radius of 65 mm., being somewhat broader than high (see text-fig. 21). Venter broadly arched, but almost flat along the median line. Shell with very strong tubercles but weak, broad ribs; these are at times, however, strong and raised. Specimen U.3360 (Plate IX, fig. 4) represents the inner whorls and has six rows of strong, irregular tubercles; the umbilical are usually bullate and the ventrolateral rows clavate; at this stage the whorl section is higher than in the holotype. A smaller fragment of an inner whorl, U.3342, shows that the ornament of the inner whorls is perfectly regular. In the more mature holotype there is usually one ventrolateral to two inner ventrolateral to three outer ventrolateral tubercles at a radius of 40 mm., but at a radius of 60 mm. the ratio is 3 : 5 : 7. The umbilical tubercles may be clavate or nodate. The inner ventrolateral tubercles are

usually high and rounded, and a tubercle may occasionally fail to form or may be low and bullate. This takes place at regular intervals. The outer ventrolateral tubercles are small, regular and usually bullate, at times nodate. The umbilical row and the inner ventrolateral rows are connected by irregular ribs. The outer ventrolateral row may be connected to a prominent inner ventrolateral tubercle by a small raised rib. The tubercles of the outer ventrolateral row, unless united with the inner ventrolateral row, are joined across the venter by low, flat ribs. The ornament becomes coarse and irregular with increase in size. The suture line, depicted in text-fig. 20, although slightly damaged during development, is clearly typical of the genus.



TEXT-FIG. 21.—*Mammites dixeyi* sp. nov. Whorl section of the holotype, B.M. No. C.47400. Natural size.

Remarks : *M. dixeyi* differs from *M. nodosoides* (Schlotheim) in both ornament and suture line. The suture of the Nigerian species is similar to that given for *M. michelobiensis*¹ by Laube and Bruder (1887, p. 231), but the ornament is different. *M. mutabilis* sp. nov. (below) has a different suture, smaller size and less prominent tuberculation. *M. conciliatum* (Stoliczka) appears to be closest to the Nigerian form and has a similar shape, but its ornament, particularly the tuberculation, is more regular, the suture line different and the venter distinctly concave.

¹ See previous footnotes concerning this species.

Mammites dixeyi laevis subsp. nov.

Plate X, fig. 3

Holotype : B.M. No. U.3353 ; limestones and shales at Ezillo, Abazi River. Plate X, fig. 3.

Remarks : This form differs from *M. d. dixeyi* in being much less strongly ornamented and in apparently not attaining the same size. Its living

chamber is completely smooth at a radius where *M. d. dixeyi* is strongly ornamented ; in particular, the lower ventrolateral tubercles are much weaker. **Occurrence :** Lower Turonian ; Abazi River, Ezillo, Nkalagu Division, Ogoja Province.

Collector : The author.

Mammites mutabilis sp. nov.

Plate X, figs. 1a, b

1954b *Mammites* sp. nov., Reyment, p. 22.

Holotype : B.M. No. C.47394 ; Wadatta, near Makurdi, Benue Province. Plate X, figs. 1a, b.

Description : Size moderate, whorl section broader than high. Umbilical tubercles prominent and spinate, with a tendency towards radial elongation. A broad rib runs from each umbilical tubercle and may be either raised or low. These ribs terminate at the venter in a row of prominent, spinate tubercles that are however less well-developed than those of the umbilical row. The tubercles of the outer ventrolateral row are raised and may be stronger than those of the inner row. Most of these tubercles are clavate, but some may be bullate and connected by a rib across the venter. The inner and outer ventrolateral rows may be joined by a broad, high riblet.

The tubercles of the outer ventrolateral row are more numerous than those of the other two rows. On the body chamber all ribbing disappears and there are no tubercles on the last 2 cm. of the last whorl of the holotype.

The external lobe is taller than the first lateral lobe ; the external saddle is divided into four clearly marked minor saddles. The first lateral lobe is finely denticulated, and the second lateral lobe is much smaller than the first lateral.

Measurements :

C.47394

diameter 80 mm. = 1·00

thickness 32 mm. = 0·40

umbilicus 19 mm. = 0·24

height of last whorl 31 mm. = 0·39

Remarks : This new species clearly belongs to the group of *M. nodosoides* (Schlotheim). It is close, in particular, to *Mammites afer* Pervinquière (1907, p. 310, pl. XVIII, figs. 2, 3) from Tunisia ; it differs in having finer tubercles, weaker ribbing in the adult, and squarer whorls. *M. binicostatus* Petrascheck is not unlike *M. mutabilis*, but is more involute, has a higher whorl section and its ornament is more regular. *M. lapparenti* Pervinquière has more regular ribs and less prominent tubercles.

PLATE X
(opposite)

- FIG. 1. *Mammites mutabilis mutabilis* sp. nov. Holotype. (a) Side view ; (b) ventral view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47394). Page 51.
- FIG. 2. *Mammites mutabilis bennensis* subsp. nov. Holotype. (a) Side view ; (b) ventral view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47395). Page 53.
- FIG. 3. *Mammites dixeyi laevis* subsp. nov. Holotype. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. U.3353). Page 51.
- FIG. 4. *Neptychites perovalis* (von Koenen). Lower Turonian. Mungo River Formation, Mundame, Cameroons. (B.M. No. U.4000). (a) Side view ; (b) ventral view. Page 66.



1a



4a



1b



2a



3



4b



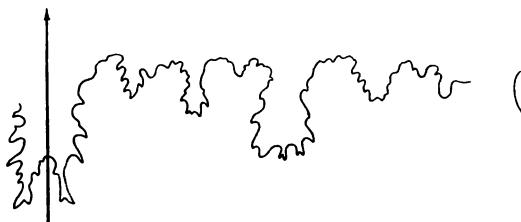
2b

A large specimen (diameter—84 mm.) has unusually inflated whorls and thus resembles the subspecies, *M. m. benueensis*, described below, but its ornament is that of *M. m. mutabilis*. It is probably best regarded as being intermediate between the subspecies and the typical form.

Mammites mutabilis benueensis subsp. nov.

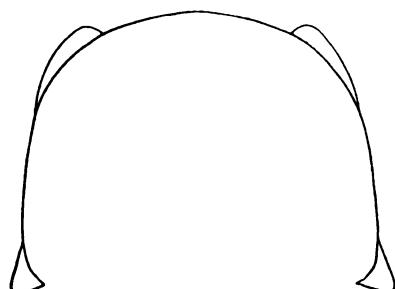
Plate X, figs. 2a, b ; text-figs. 22, 23

Holotype : B.M. No. C.47395 ; Wadatta. Plate X, figs. 2a, b.



TEXT-FIG. 22—Suture line of the holotype of *Mammites mutabilis benueensis* subsp. nov., B.M. No. C.47395. Twice natural size.

Description : The subspecies differs from the typical form in the following respects. The inner ventrolateral are usually much stronger than the umbilical tubercles, which are bullate and prominent. On the body chamber, the latter tubercles are variable and may be either feeble or stronger than those of the inner ventrolateral row. The ventrolateral tubercles are always clavate. The body chamber bears sigmoidal ribs of variable strength that pass from the umbilical tubercles through the other two rows and across the broad, slightly convex, periphery. A great increase in the number of intercalaries takes place on the body chamber and the tubercles are almost completely absorbed into these ribs. On the last half of the body chamber the outer ventrolateral tubercles suddenly disappear (see text-fig. 23) and the inner ventrolateral



TEXT-FIG. 23—Diagram of the apertural view of *Mammites mutabilis benueensis* subsp. nov.

tubercles weaken, and become bullate. The suture is similar to that of the typical form, except that the external lobe is shorter (see text-fig. 22).

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Tiv Division, Benue Province.

Collector : The author.

Mammites cf. *afer* Pervinquieré

Plate IX, fig. 3

- 1907 *Mammites nodosoides* var. *afer* Pervinquieré, p. 310, text-fig. 118 ; pl. XVII, figs. 2, 3.
- 1907 *Mammites nodosoides* Laube & Bruder, Pervinquieré, p. 309, pl. XVIII, figs. 1a, b.
- ?1910 *Mammites nodosoides* var. *afer* Pervinquieré, Brüggen, p. 736.
- 1954 *Mammites* cf. *nodosoides* (Schlotheim), Reyment, p. 22.

Description : A fragment with a quadrate whorl section (18 mm. × 18 mm.). External lobe of suture deep. Tuberculation closely resembles that shown in Pervinquieré's figures.

Remarks : *Mammites nodosoides* (Schlotheim) has been assigned a number of varieties by various authors. It is inevitable that such a well-known species should have suffered a good deal of variable interpretation ; it is probable that the variety *spinosa* Basse, at least, is separable as a definite species. The variety *chivensis* Arkhangelskey is, however, almost certainly a true subspecies of *M. nodosoides*.

Occurrence : Lower Turonian ; limestones and shales near Igumale in the Icheri River, Idoma Division, Benue Province.

Collector : The author.

Genus *Pseudaspidoceras* Hyatt, 1903

Type species : *Ammonites footeanus* Stoliczka.

Diagnosis : Characterized by the gradual and very regular increase in the height and breadth of the whorls. Whorl section roughly quadrate in most species, venter broad and concave, sides flat. The ribs are well spaced and there are umbilical and upper and lower ventrolateral tubercles.

Remarks : This genus, typical of the lowest part of the Lower Turonian, is represented in Nigeria by two species. One of these, *P. paganum*, was described in a recent paper (Reyment, 1954c, p. 253), the other is described below.

Occurrence : Lower Turonian¹ ; India, Nigeria, Tunisia, Mexico, Brazil, Japan, etc.

¹ *Pseudaspidoceras* has been recorded from a few doubtful Cenomanian localities. Until a substantiated Cenomanian occurrence of this genus is published, it is better to regard it as being solely Lower Turonian.

PLATE XI
(opposite)

- FIG. 1. *Pseudaspidoceras curvicostatum* sp. nov. Holotype. Ventral view of the specimen figured on Plate XII. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. U.3357). Page 55.
- FIG. 2. *Mammites dixeyi dixeyi* sp. nov. Holotype. (a) Side view ; (b) ventral view. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. C.47400). Page 50.
- FIG. 3. *Ezilloella ezilloensis* Reyment. (a) Ventral view ; (b) apertural view. Lower Turonian. Aboine River, near Ezillo, Ogoja Province. (B.M. No. C.47414). Page 65.
- FIG. 4. *Neptychites telingaeformis* Solger. (a) Ventral view ; (b) side view. Lower Turonian. Mungo River Formation, Mundame, Cameroons. (B.M. No. U.3600). Page 66.



Pseudaspidoceras curvicostatum sp. nov.

Plate XI, fig. 1, Plate XII ; text-fig. 24

Holotype : B.M. No. U.3357 ; Ezillo, Abazi River,
Plate XI, fig. 1, Plate XII ; text-fig. 24.

Measurements :

U.3357	
diameter	176 mm. = 1·00
thickness	56 mm. = 0·32
umbilicus	70 mm. = 0·40
height of last whorl	65 mm. = 0·37



TEXT-FIG. 24—*Pseudaspidoceras curvicostatum* sp. nov. Suture line of the holotype, B.M. No. U.3357. Natural size.

Description : Whorl section much higher than broad, venter rounded ; strongly ribbed. The outer ventrolateral tubercles are large and pointed, the inner ventrolateral tubercles clavate, strong and slightly bent forwards, usually joined to the outer row by short, raised ribs of variable strength. These tubercles are the strongest. The umbilical tubercles are bullate and, although low, extend out on to the umbilicus as continuations of the ribs (see Plate XII). The ribs are strong and recurved. They are of unequal strength, and increase somewhat in size on the body chamber.

The growth lines follow the same course as the ribs. Occasional intercalatories occur on which weak ventrolateral tubercles are situated. No intercalatories are present on the living chamber.

The suture line is very unsymmetrical ; the external saddle is moderately broad, the first lateral saddle is narrower but taller than it (see text fig. 24). The external lobe is deeper than the first lateral lobe, which is broad and incised in the middle by a strong auxiliary saddle. The other elements are short.

Remarks : This species differs from all other *Pseudaspidoceras* described in the literature in that the ribs are bent strongly backward. *P. schlüteri* Hyatt (1904, p. 107) has bent ribs but these are directed forwards, the whorl section is broader than high, and there are no intercalatories. *P. paganum* Reyment (1954c, p. 253) has straight ribs and a square whorl section as well as a different ratio between the ventrolateral tubercles. *P. dubertreti* Basse (1937) has a squarer whorl section than *P. curvicostatum* and is also more densely ribbed.

Occurrence : Lower Turonian ; Abazi River, Ezillo, Nkalagu Division, Ogoja Province.

Collector : The author.

Genus **Watinoceras** Warren, 1930

Type species : *Watinoceras reesidei* Warren.

Diagnosis : Compressed, moderately evolute ammonites ; flanks flat, usually almost parallel ; venters arched. The flanks bear almost straight or sigmoidal ribs which curve across the venter acutely. The ribs usually develop variable upper and lower ventrolateral tubercles and umbilical tubercles ; in most cases, all three rows are represented, although the tubercles of one or more rows may occur sporadically.

Remarks : According to Warren, *Watinoceras* occurs in the Lower Turonian, and *W. reesidei* is reported to be a useful horizon-marker for the base of the Turonian. The two Nigerian examples recorded below come from the second zone recognized in the Nigerian Lower Turonian (Reyment, 1954a, p. 150) and thus appear to be somewhat younger than the Canadian occurrences. One of the specimens closely resembles *W. reesidei* Warren, the other recalls *W. amudariense* (Arkhanguelskey) from the Lower Turonian of Turkestan (U.S.S.R.) and also certain undescribed forms of an assemblage from the Lower, but not basal, Turonian of Devonshire. As remarked previously (Reyment, 1954a, p. 153), this group comprises derivatives of *Neocardioceras*, typical representatives of which occur at a slightly earlier horizon. The undescribed forms are transitional to *Watinoceras* and are best placed for the present in that genus. The main points of difference between typical *Watinoceras* and *Benueites* are that the latter has a sulcate venter, finer ribbing, and less regular tuberculation. Further relationships are discussed under *Benueites*. *Watinoceras* occurs in the Lower Turonian of Canada, U.S.A., Turkestan (U.S.S.R.), and England.

Age : Lower Turonian ; lower part of the Mungo River Formation, Southern Cameroons.

Watinoceras aff. reesidei Warren

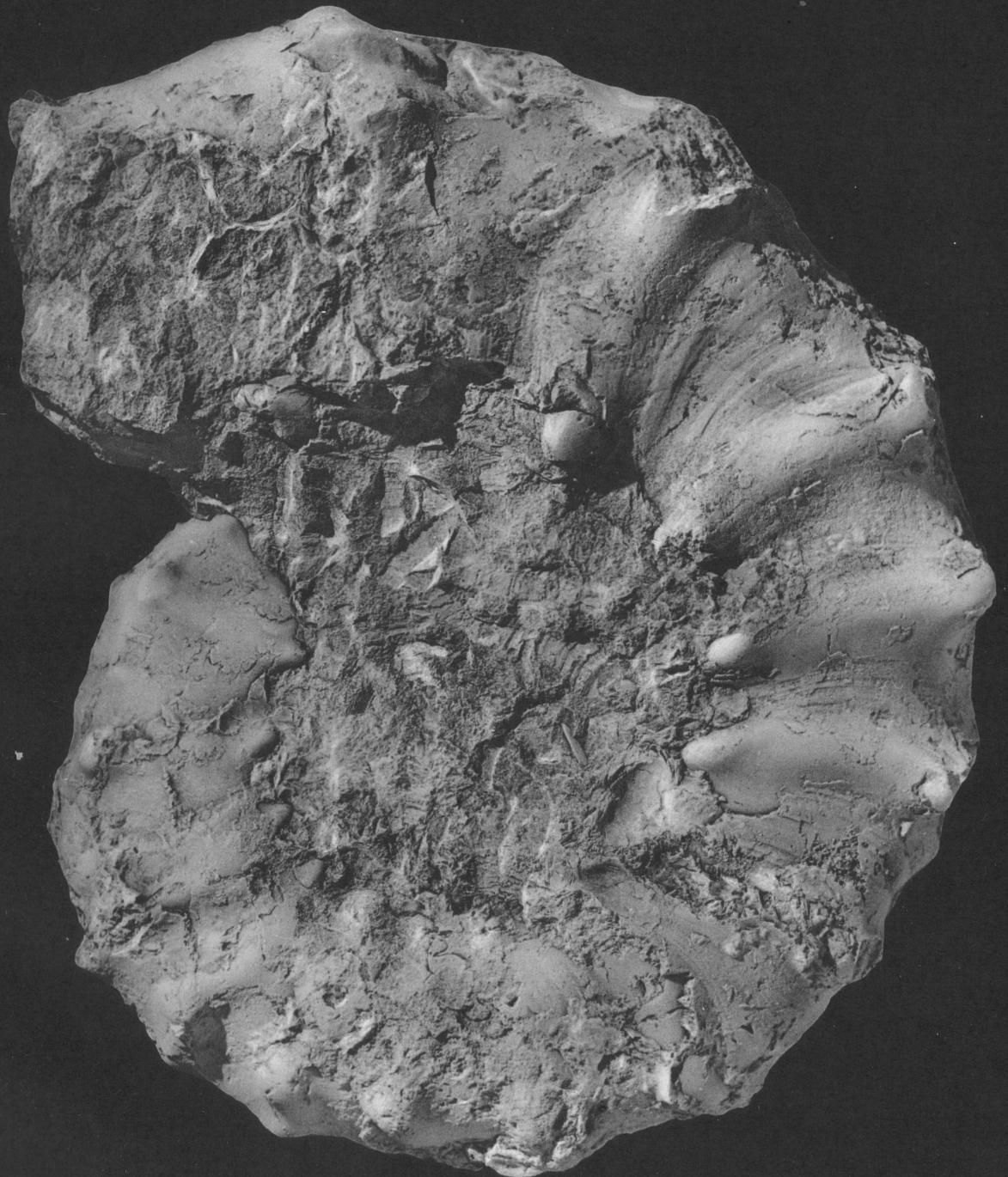
Text-figs. 25b, c

- 1930 *Watinoceras reesidei* Warren, p. 67, pl. III, fig. 2 ; pl. IV, figs. 9-12.
1947 *Watinoceras reesidei* Warren, Warren, p. 122, pl. XXX, fig. 6.

Description : Moderately evolute, compressed, flanks flat, almost parallel, venter broadly rounded. The ornament consists of moderately fine, simple

PLATE XII
(opposite)

Pseudaspidoceras curvicostatum sp. nov. Holotype. Side view of the specimen figured in Plate XI, fig. 1.
Lower Turonian. Abazi River, near Ezillo, Nkalagu Division, Ogoja Province. (B.M. No. U. 3357).
Page 55.



and bifurcated, sigmoidal ribs that weaken slightly where they cross the venter at an acute angle ; each rib bears umbilical, and upper and lower ventrolateral, tubercles. The umbilical tubercles are bullate, the ventrolateral obliquely clavate. The early part of the whorl of the specimen studied is quite smooth ; this appears to be due to weathering. The specimen is slightly crushed.

Measurements :

U.3670

diameter	20 mm.	= 1·00
thickness	6 mm.	= 0·30
umbilicus	6 mm.	= 0·30

height of last whorl	7·5 mm.	= 0·38
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Remarks : The specimen here recorded is close to *W. reesidei* Warren, but differs in that its ribs are more slender and more sinuous. Without further material, it is impossible to ascertain what importance these differences have, and whether the Cameroons form should be definitely referred to the Canadian species, to a subspecies of it, or to a closely related new species. *W. coloradoense* (Henderson) is more coarsely ribbed and more strongly tuberculated. *W. amudariense* (Arkhanguelskey) is more coarsely ribbed on adult whorls and does not develop regular tubercles. *Benueites spinosus* Reymont is of comparable appearance, but it has a deep ventral sulcus in the young which broadens in the adult until it occupies the whole periphery, its ribbing is denser, and the ribs, which are more sigmoidal than those of *W. aff. reesidei*, seldom cross the venter. The tuberculation is also irregular. *Watinoceras reesidei* has been recorded in Canada from the lower beds of the Smoky River Shale, Peace River valley, and from the Bear Rock area in the Mackenzie River valley, where it is a useful guide-fossil for the basal Turonian. The Cameroons ammonite comes from the lower beds of the Mungo River Formation and is thus of upper Lower Turonian age (Reymont, 1954a, p. 150 ; 1955a).

Occurrence : Lower Turonian ; Mungo River Formation, Mundame, Southern Cameroons.

Collector : The author.

Watinoceras aff. amudariense (Arkhanguelskey)

Text-figs. 25d-f

1916 *Acanthoceras amudariense* Arkhanguelskey, p. 48, pl. VII, figs. 8-13 ; (*non var. horridum* = *W. coloradoense* (Henderson)).

Description : Moderately evolute, compressed, flanks flat, venter broadly rounded. The ornament is composed of comparatively coarse, mainly

simple, sigmoidal ribs that begin at the umbilical margin as slight swellings and finally cross the venter, where they thicken slightly, at an acute angle. Intercalatories occasionally occur. On the last part of the last whorl a few relatively strong, irregular, umbilical tubercles develop on the main ribs. Ventrolateral tubercles are absent, although the ribs show slight upper and lower ventrolateral swellings, which suggest the possibility of tubercles appearing at some later growth stage. The early part of the last whorl is smooth and slightly crushed.

Measurements :

U.3671

diameter	22 mm.	= 1·00
thickness	8 mm.	= 0·36
umbilicus	6·5 mm.	= 0·29

height of last whorl	8 mm.	= 0·36
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Remarks : *W. amudariense* (Arkhanguelskey) closely resembles the ammonite here described. The inner whorls bear fine, dense ribs that rapidly become coarser and more widely spaced and do not bear definite tubercles. The Cameroons specimen appears to differ slightly in that it develops moderately strong umbilical tubercles and the ribbing is less regular. *W. reesidei* Warren has straighter ribs and definite upper and lower ventrolateral tubercles ; *W. coloradoense* (Henderson) is much more strongly ornamented. *W. amudariense* occurs in the Lower Turonian of Turkestan (U.S.S.R.) and the assemblage of molluscs recorded by Arkhanguelskey (1916) appears to belong to a stratigraphical level closely comparable with that from which the Cameroons *Watinoceras* was obtained. Some of the undescribed, poorly preserved specimens from the Lower Turonian of Devonshire (in the private collection of C. W. and E. V. Wright, London) are also similar.

Occurrence : Lower Turonian ; Mundame, Mungo River Formation, Southern Cameroons.

Collector : The author.

Genus **Benueites** Reymont, 1954

Type species : *Benueites benueensis* Reymont.

Diagnosis : Compressed, moderately evolute ammonites with flat flanks and arched venters, with a narrow sulcus, deep on the earlier whorls, but gradually becoming shallower. The flanks bear dense sigmoidal ribs and feeble umbilical, and upper and lower ventrolateral, tubercles, the strength of which vary greatly with the species. Suture simple.

Remarks : *Benueites* is in all probability derived from *Watinoceras* Warren, as was pointed out in a previous paper (Reyment, 1954a). *Benueites* and *Watinoceras* were, in that paper, placed in the family Collignoniceratidae, but later research has shown that these two genera are better referred to the subfamily Mammitinae of the family Acanthoceratidae. Comparison of the earlier growth stages of *Mammites* and *Watinoceras* indicates that the former has probably evolved from the latter along a line parallel to that followed by *Benueites*.

B. benueensis Reyment is clearly derived from the more primitive, *Watinoceras*-like, *B. spinosus* Reyment as dissection of specimens of *B. spinosus* indicates. This species is in a state of flux and its inner whorls possess ornament of the type of *B. benueensis* Reyment, i.e., simple, untuberculate ribs. The stage at which the *spinosus*-type ornament makes its appearance is variable.

The form figured by Arkhanguelskey (1916) as *Acanthoceras amudariense* appears to belong to the *Watinoceras-Benueites* group, but may, however, represent a separate lineage from *Watinoceras*.¹ It has the fine, dense ribbing of *Benueites* on its inner whorls, but the ornament rapidly becomes coarser and the ribbing more widely spaced. This form lacks a ventral sulcus and does not develop distinct tubercles. Until more evidence becomes available it is best placed in *Watinoceras*.

Age : Lower Turonian ; Wadatta, near Makurdi, Benue Province.

¹ Represented in the Lower Turonian of Turkestan as *Watinoceras coloradoense* (Henderson) (= *Acanthoceras amudariense* var. *horridum* Arkhanguelskey, non *A. amudariense* s. str.).

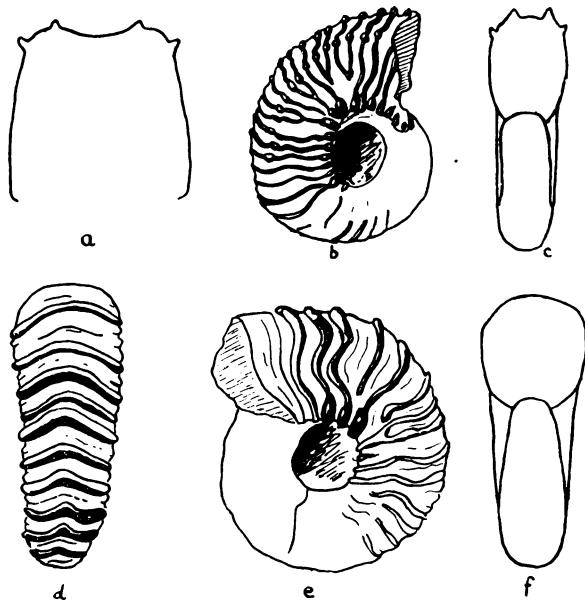
Benueites spinosus Reyment

Plate XIII, figs. 3, 4a, b ; text-fig. 25

1954a *Benueites spinosus* Reyment, p. 156, pl. III, figs. 2, 4 ; text-fig. 3.

Description : Venter arched on earlier whorls, becoming flatter and broader on adult whorls. It bears at first a narrow sulcus, which broadens until it occupies the whole of the ventral area (text-fig. 25). The ornament consists of dense, fine ribs, umbilical, and lower and upper, ventrolateral tubercles. The tubercles appear at a fairly advanced growth stage. Occasional ribs cross the venter.

Remarks : *B. spinosus* clearly shows the connexion with *Watinoceras* Warren and is undoubtedly the ancestor of *B. benueensis*. It resembles *Watinoceras*



TEXT-FIG. 25—a, *Benueites spinosus* Reyment. Diagrammatic representation of whorl section. b, c, *Watinoceras aff. reesidei* Warren. d-f, *Watinoceras aff. amudariense* (Arkhanguelskey). All figures twice natural size.

coloradoense (Henderson), but this species is more strongly tuberculate and lacks a ventral furrow.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Tiv Division, Benue Province.

Collector : The author.

Benueites benueensis Reyment

Plate XIII, fig. 2

1954a *Benueites benueensis* Reyment, p. 155, pl. III, figs. 1, 1a ; text-fig. 2.

Description : The ornament consists of numerous, fine, sigmoidal ribs, becoming slightly tuberculate on the body chamber. There are a few umbilical tubercles and usually one row of ventrolateral tubercles, although a row of lower ventrolateral tubercles may be present.

Remarks : The suture line of this species closely resembles that of *Protacanthoceras* and other late acanthoceratids. The species here described differs from *B. spinosus* in that it is slightly more compressed and much less strongly ornamented. The specimen figured in Plate XIII, fig. 1 as *Benueites* sp. juv. (C.47396) ($\times 3$) may belong here.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Tiv Division, Benue Province.

Collector : The author.

Genus **Kamerunoceras** Reyment, 1954

Type species : *Acanthoceras eschii* Solger.

Diagnosis : Evolute, whorl section nearly square. Ornamented with siphonal, upper and lower ventrolateral and feeble umbilical tubercles. Weak and variable ribs present ; these become numerous on mature whorls. Suture simple.

Remarks : This genus bears a certain resemblance to the group of “*Acanthoceras*” *amphibolum* Morrow from the Upper Cenomanian of the Frontier Formation, Montana, U.S.A. as was pointed out by the author previously (Reyment, 1954c). The resemblance does not seem to be so close as was at first thought and while *A. amphibolum* is directly derived from *Acanthoceras*, *Kamerunoceras* is probably an offshoot of the *Protacanthoceras* stock that produced *Mammites*, *Watinoceras* and *Benueites*. It is best placed in Mammitinae, but *Kamerunoceras jacobsoni* sp. nov. clearly indicates the border-line status of this genus, and it may ultimately prove necessary to place *Kamerunoceras* with *Selwynoceras* and *Collignonoceras* in Collignoniceratidae.

Age : Lower Turonian ; Nigeria and the Cameroons.

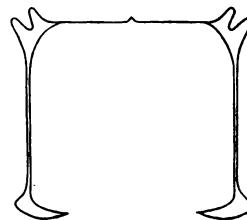
Kamerunoceras jacobsoni sp. nov.

Plate XIII, fig. 5 ; text-fig. 26

1954a *Collignonoceras* Breistroffer, Reyment, p. 150.
1954b *Collignonoceras* sp. nov., Reyment, p. 22.

Holotype : B.M. No. C.47393 ; Wadatta. Plate XIII, fig. 5.

Description : Very evolute, moderately large and with broadly rounded to flattened venter. Whorls slightly broader than high (see fig. 26). The adult ornament consists of strong, well-spaced, straight ribs which end abruptly on the ventrolateral margin. The ribs bear umbilical and upper and lower mediolateral tubercles. The umbilical tubercles are distinctly bullate, the outer ventrolateral large and nodate, and the inner ventrolateral row nodate or at times spinate. The ribs do not unite across the venter. On the inner whorls the ribs are alternately strong and weak, the stronger often having umbilical swellings. It is not before a radius of 20 mm. that the ribbing becomes regular. The strength of the ornament increases with growth. The keel when first discernible is low and crenulated, with a very shallow sulcus on either side. The crenulation becomes increasingly exaggerated until, at a radius of 35 mm., the keel breaks up into detached, flattened tubercles. All tubercles become very prominent on the body chamber and thicken towards the aperture.



TEXT-FIG. 26—*Kamerunoceras jacobsoni* sp. nov. Diagrammatic representation of whorl section of the holotype, B.M. No. C.47393. Natural size.

Measurements :

C.47393

diameter 110 mm. = 1·00

thickness 39 mm. = 0·35

umbilicus 38 mm. = 0·35

height of last whorl 42 mm. = 0·38

Remarks : This species resembles *K. eschii* (Solger) which is possibly derived from it. *K. jacobsoni* represents an earlier evolutionary stage than *K. eschii*. Both species possess, however, low, weak, spirally elongated median tubercles at some stage, but in *K. jacobsoni* these are produced by the degeneration of a low, feeble keel, while in *K. eschii* they develop into spinate tubercles. In both species the outer ventrolateral tubercles are strongest. *K. jacobsoni* has regular, bullate umbilical tubercles only on the last whorl ; in *K. eschii* the occurrence of umbilical tubercles is sporadic and none are present on the last whorl. Some of the figures given by Haas (1947) of *Collignonoceras woollgari* (Mantell) resemble the species here described. *Selwynoceras boreale* (Warren) also has a low line of siphonal tubercles, but the ribbing on both the inner and outer whorls is not the same, the tubercles are elongated in a different manner and there is no keel present on the inner whorls.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Benue Province.

Collector : The author.

Kamerunoceras eschii (Solger)

1904 *Acanthoceras eschii* Solger, p. 124, pl. IV, figs. 1-4.

1932 *Prionoceras seitzi* Riedel, p. 140, pl. XXX, figs. 7, 7a, b ; pl. XXXII, fig. 22.

1954b *Collignonoceras*, Reyment, p. 21.

1954c *Kamerunoceras eschii* (Solger), Reyment, p. 251, pl. III, fig. 5 ; pl. V, figs. 3, 6 ; text-figs. 2a, b.

Description : Evolute, whorl section higher than broad, upper and lower ventrolateral tubercles and occasional umbilical tubercles on the earlier whorls. The flanks bear straight ribs that increase considerably in density on the body chamber. The

PLATE XIII
(opposite)

- FIG. 1. *Benueites* sp. juv. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47392). ($\times 3$). Page 58
- FIG. 2. *Benueites benueensis* Reyment. Specimen showing fairly strong ornament on the body chamber. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C. 47392). Page 58.
- FIG. 3. *Benueites spinosus* Reyment. Paratype. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47389). Page 58.
- FIG. 4. *Benueites spinosus* Reyment. (a) Ventral view showing the presence of an unusually broad furrow ; (b) side view showing strongly sigmoidal ribs and feeble umbilical tubercles. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47390). Page 58.
- FIG. 5. *Kamerunoceras jacobsoni* sp. nov. Holotype. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C. 47393). Page 59.
- FIG. 6. *Nigericeras ogujaense* sp. nov. Holotype. Ventral view of specimen figured in Plate XIV, fig. 3. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. C.47401). Page 62.



1



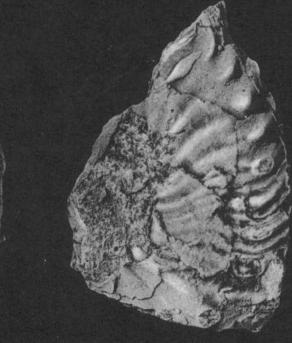
2



3



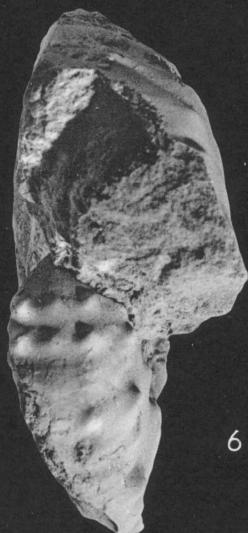
a



b



5



6

median tubercles are at first flat and spirally elongated, but become prominent and spinate on the last whorl; the ventrolateral tubercles also become prominent, spinate and united by a low fold, until on the body chamber the fold disappears and the inner ventrolateral tubercles become bulbose. There are no umbilical tubercles on adult whorls. The body chamber is much higher than broad; near the aperture the ribs become closely crowded and strongly sigmoidal.

Remarks : *K. jacobsoni* is a larger species and is more strongly and regularly ornamented. The author recently identified *K. eschii* in a small collection

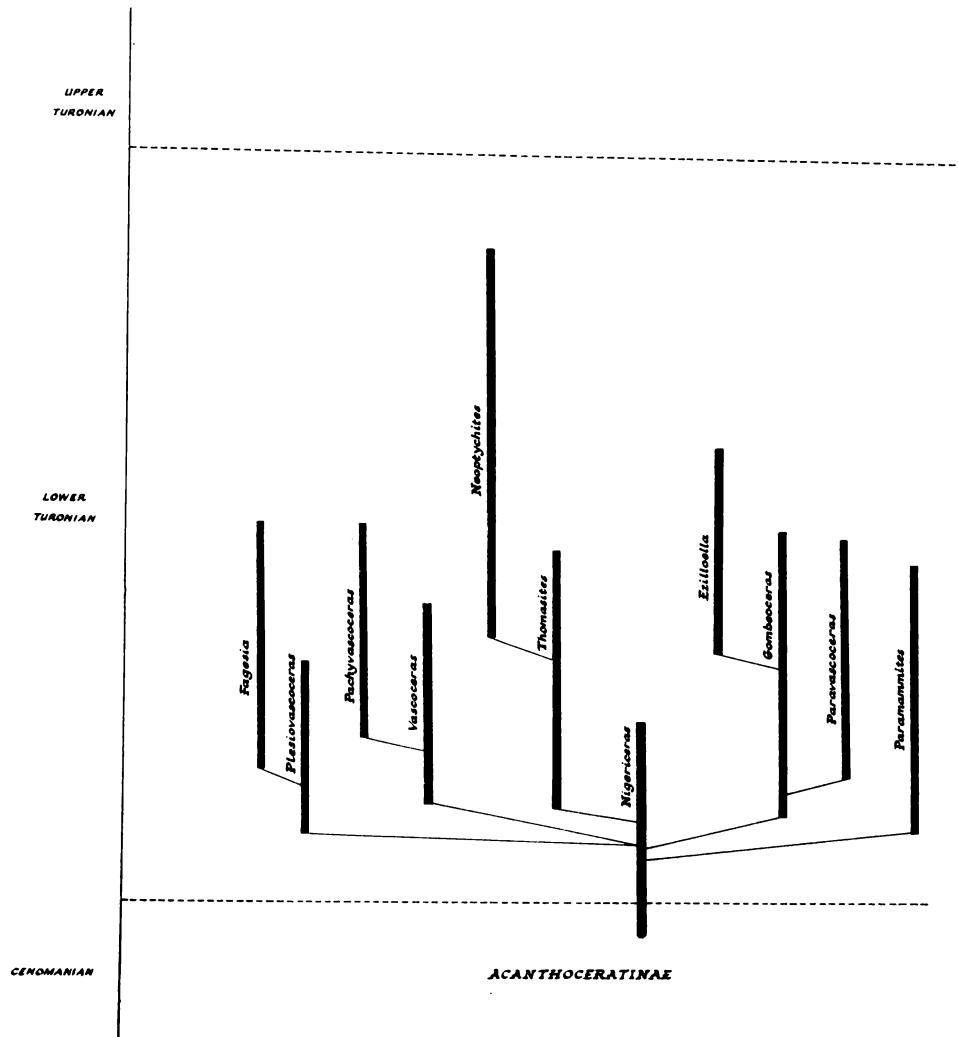
from the Alome River, Oturkpo Division, near Makurdi, kindly lent by Shell D'Arcy.

Occurrence : Lower Turonian; Mungo River Formation, Mundame, Southern Cameroons.

Collector : The author.

Family VASCOCERATIDAE

Several members of this family, which is well represented in Nigeria, were discussed by the author in two recent papers (Reyment, 1954a, 1954c). The second paper gave a general treatment of the whole family and included descriptions



TEXT-FIG. 27—Phylogenetic diagram showing one possible interpretation of the interrelationships within the Vascoceratidae. The differences in age of the groups are not absolutely definite.

of two new Nigerian genera, *Gombeoceras* and *Ezilloella*.

Vascoceras is represented in Nigeria by one species only, *V. nigeriense* (Woods), and the closely related *Pachyvascoceras* has three species. *Paravascoceras* has one species in Nigeria. The group of the more strongly ornamented vascoceratids, comprising *Gombeoceras*, *Thomasites*, *Paramammites*, and *Nigericeras*, is represented by a number of species of *Gombeoceras* and *Nigericeras*. *Ezilloella* is an extreme development of *Gombeoceras* and *Neopychites*, which is represented by three species, is probably a later development of *Thomasites*.

The probable interrelationships in the family are illustrated in text-fig. 27.

The Vascoceratidae are confined to the Lower Turonian and occur in West Africa, North Africa, India, Brazil, Mexico, Texas, Portugal, Spain, England, France, and Turkestan (U.S.S.R.).

Until recently, *Gombeoceras* Reymont had not been found in Nigeria south of the Benue River. Shell D'Arcy have, however, collected *Gombeoceras gongilense* (Woods), together with species of *Pseudotissotia* (*Bauchioceras*), *Pseudotissotia* (*Wrightoceras*), and *Pseudaspidoceras* from the Konshisha River, near Oturkpo, Benue Province. *Gombeoceras* is known only from Nigeria and Turkestan (U.S.S.R.), in both of which places *Gombeoceras koulabicum* (Kler)¹ occurs. The other recorded species of this genus are *G. gongilense* (Woods) (see Plate XIV, fig. 5), *G. subtenue* Reymont (1954c, p. 261) and *G. ? bulbosum* Reymont (1954c, p. 263).

Recently (1954), Kummel and Decker described a Lower Turonian fauna from Texas and Mexico in which the vascoceratid genus *Spathites* was erected. It is an involute form with umbilical and upper and lower ventrolateral tubercles which are confined to the inner whorls and, as these authors have pointed out, *Spathites* is in all probability a derivative of *Gombeoceras*; it is also closely related to *Nigericeras*.

¹ Cf. Reymont, 1954c, p. 261.

Genus **Nigericeras** Schneegans, 1943

Type species : *Nigericeras gignouxi* Schneegans.

Diagnosis : Medium sized; inner whorls with ornament similar to that of *Acanthoceras*, consisting of fairly prominent ribs, strong on the flanks, weaker on the venter. The ribs bear siphonal and upper and lower ventrolateral tubercles, and the major ones umbilical tubercles as well. The ornament tends to disappear at a fairly early stage. Suture much as in *Vascoceras*, but less simplified.

Remarks : The early stages of *Nigericeras* are similar to the ancestral *Acanthoceras* in ornament. *Nigericeras* is clearly transitional from *Acanthoceratinae* and represents the stock from which subsequent vascoceratids have evolved. As regards family attribution, it might equally well be placed with *Acanthoceratidae* as with *Vascoceratidae*, but, as it shows the beginnings of the incoming vascoceratid characters, it is here grouped with that family.

Age : Lower Turonian ; French Equatorial Africa, Nigeria, and Turkestan (U.S.S.R.).

Nigericeras ogojaense sp. nov.

Plate XIII, fig. 6 ; Plate XIV, fig. 3 ; text-fig. 28
1954b *Nigericeras* sp. nov., Reymont, p. 20.

Holotype : B.M. No. C.47401 ; Ezillo, near the Abazi River. Plate XIII fig. 6 ; Plate XIV fig. 3 ; text-fig. 28.

Description : Moderately evolute; whorl section roughly square. Ornament composed of weak ribs that bear seven rows of tubercles. The median tubercles disappear before those of the other rows. Schneegans's note (1943, p. 118) to the effect that the ribs of this genus weaken on the venter is not true of the species here described for the opposite is the case. The ventrolateral tubercles are paired and flat; indistinct swellings may occur between pairs. The body chamber has rather strong ornament of flattened tubercles and broad, low ribs, but these weaken on the last part of the last whorl. It also bears prominent growth striae and occupies a little more than half of the last whorl.

The external lobe is approximately square and not so deep as the first lateral lobe, which is broad and divided into two prongs by a single, denticulate, subsidiary saddle; the second lateral lobe is much smaller. The external saddle is narrow and rectangular. The suture is very asymmetrical (text-fig. 28).



TEXT-FIG. 28—*Nigericeras ogojaense* sp. nov. Suture line of the holotype, B.M. No. C.47401. Natural size. The positions of the tubercles are marked with crosses and the asymmetrically situated siphuncle is shown with an entire arrow.

Remarks : A Malagasy specimen figured by Basse as *Vascoceras polymorphum* Pervinquière (1931, p. 37 ; pl. V, figs. 10, 11 ; pl. XII, figs. 4a, b) appears to

be similar to the species here described and may be identical with it, although more regularly and strongly ribbed. The photographs show a row of feeble siphonal tubercles, and thus preclude the possibility of its being a *Paramammites*. *N. ogojaense* differs from all the species described by Schneegans (1943) in having considerably stronger ornament. An ammonite from Turkestan (U.S.S.R.) figured by Kler (1908, p. 167, text-fig. 6 ; pl. VIII, fig. 3) and not named but compared with *Pseudotissotia* and *Acanthoceras*, is similar to the Nigerian form, although it seems to be more strongly ornamented.

Occurrence : Lower Turonian ; Abazi River, Ezillo, Nkalagu Division, Ogoja Province.

Collector : The author.

Genus **Gombeoceras** Reymont, 1954

Type species : *Vascoceras gongilensis* Woods.

Remarks : This genus has recently been discussed by the author (Reymont, 1954a, 1954c). It has not been collected from any stratigraphical level higher than the lowermost zone of the Nigerian Turonian.

Gombeoceras gongilense (Woods)

Plate XIV, fig. 5 ; Plate XXI, fig. 4

- 1911 *Vascoceras gongilensis* Woods, p. 282, pl. XXI, fig. 7 ; pl. XXII, fig. 1.
?1920 *Thomasites jordani* Pervinquier, Chudeau, p. 466.
1954a *Gombeoceras gongilense* Woods, Reymont, p. 151, pl. III, fig. 6 ; pl. II, fig. 1 ; text-fig. 1.

Remarks : Numerous examples of this species have been collected from the Konshisha River area, near Oturkpo, Idoma Division, Benue Province. The species has been extensively treated in a recent paper by the author (Reymont, 1954a, p. 151).

Repository : Shell D'Arcy Headquarters, Owerri.

Collector : R. Blaser.

Genus **Paravascoceras** Furon, 1935

(Synonym *Paracanthoceras* Furon)

Type species : *Vascoceras cauvini* Chudeau.

Diagnosis : Moderately inflated, fairly involute, venter rather sharply rounded at first, becoming rounder ; with weak ventral ribs that may be sub-tuberculate in the young. Adult with ventrolateral bulges that strengthen into ribs that bend obliquely forwards.

Remarks : The Copenhagen Congress of Zoology (see, "Copenhagen Decisions on Zoological Nomenclature", Fourteenth International Congress of Zoology, Copenhagen, August, 1953 ; London) reinstated the principle of "First Revision" in place of

"Page Priority", thus reversing the decision reached by the Paris Congress in 1948. In a previous paper (Reymont, 1954c), the present author stated *Paravascoceras* to be a synonym of *Paracanthoceras* on the basis of page priority. Schneegans (1943, p. 127), however, selected *Paravascoceras* Furon and made *Paracanthoceras* Furon a synonym of it, so that in the light of the decision made by the Copenhagen Congress (1953, para. 124 (a), p. 67), *Paravascoceras* will have to replace *Paracanthoceras* as the valid generic name. Schneegans in his discussion of the group also included *Pachyvascoceras* Furon in *Paravascoceras*. In his revision of the Vascoceratidae (Reymont, 1954c) the writer has shown *Pachyvascoceras* is a distinct genus, and so *Paravascoceras* includes only the species *P. chevalieri* (Furon) and *P. cauvini* (Chudeau).

The sutures of *Paravascoceras* are particularly variable, as noted by Schneegans (1943, p. 127). *Paravascoceras* differs from *Gombeoceras*, from which it is apparently derived, in having an arched whorl section and, on the whole, very much feebler ornament, and in being more involute and lacking umbilical tubercles. *Ezilloella* has more compressed whorls, more prominent ornament, distinctive bulges on the flanks, and a characteristic suture line. *Pachyvascoceras* has, as a rule, much more inflated whorls, is more involute and depressed, and often displays umbilical tubercles. Both genera develop ventral riblets, but those of *Paravascoceras* are confined to the venter and are subtuberculate (cf. *Gombeoceras*), whereas those of *Pachyvascoceras* stretch from one umbilical margin to the other.

Age : Lower Turonian ; Niger Territory (A.O.F.), Nigeria.

Paravascoceras aff. *chevalieri* (Furon)

Plate XIV, figs. 1a, b

- 1935 *Vascoceras* (*Paracanthoceras*) *Chevalieri* Furon, p. 59, pl. IV, figs. 1a, b.
1943 *Paravascoceras* *Chevalieri* Furon, Schneegans, p. 132, pl. IV, fig. 7.
1954b *Paracanthoceras* aff. *chevalieri* Furon, Reymont, p. 20.

Description : Moderately inflated but not globose. Whorl section higher than broad on inner whorls, later subquadrate. Moderately involute, umbilicus less than one-fifth diameter of shell and with steep walls. Venter rather narrowly rounded, flanks slightly convex. The adult is ornamented with short ventral ribs on which faint siphonal and occasional ventrolateral bulges are discernible.

PLATE XIV
(opposite)

- FIG. 1. *Paravascoceras* aff. *chevalieri* Furon. (a) Side view ; (b) ventral view. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. C.47398). Page 63.
- FIG. 2. *Pachyvascoceras costatum* Reyment. Holotype. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. C.47399). Page 65.
- FIG. 3. *Nigericeras ogjaense* sp. nov. Holotype. Side view of specimen figured in Plate XIII, fig. 6. Lower Turonian. Abazi River, near Ezillo, Ogoja Province. (B.M. No. C.47401). Page 62.
- FIG. 4. *Pachyvascoceras costatum* Reyment. Specimen showing indefinite ventral ornament. Lower Turonian. Gombe Division, Bauchi Province. (B.M. No. C. 47298). Page 63.
- FIG. 5. *Gomeoceras gongilense* (Woods). Lower Turonian. Gombe Division, Bauchi Province. (B.M. No. C.47164). Page 63.



1a



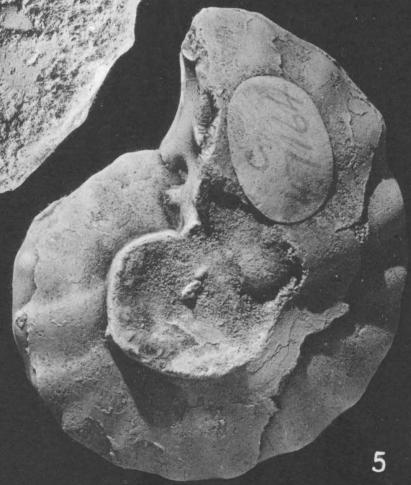
2



1b



3



5



4

Remarks : *Paravascoceras cauvini* (Chudeau) resembles this species in some respects, but differs in the shape of the last whorl, the degree of evolution, and the more homogeneous nature of the ventral ribbing. *P. chevalieri* comes originally from the Lower Turonian, Damergou, Niger Territory (A.O.F.).
Occurrence : Lower Turonian ; Ezillo, Nkalagu Division, Ogoja Province.
Collector : The author.

Genus **Pachyvascoceras** Furon, 1935

Type species : *Pachyvascoceras crassum* Furon.

Diagnosis : Cadicones, with or without feeble umbilical tubercles, and usually with, but sometimes without, moderately strong ribs in the adult.

Remarks : This genus is represented by three species in the Nigerian Lower Turonian : *P. costatum* Reymont, *P. globosum* Reymont, and *P. proprium* Reymont. The last two species are known only from northern Nigeria ; the first is common in both southern and northern Nigeria.

Age : Lower Turonian ; France, Portugal, Niger Territory (A.O.F.), Nigeria, Peru, Brazil.

Pachyvascoceras costatum Reymont

Plate XIV, figs. 2, 4

1908 *Vascoceras amieirensis* Choffat, Lisson, pls. IX, IXa, IXb.

1954b *Pachyvascoceras* sp. nov., Reymont, p. 20.

1954c *Pachyvascoceras costatum* Reymont, p. 257, pl. III, fig. 6 ; pl. IV, fig. 3 ; pl. V, fig. 2 ; text-figs. 3a, 3b, 5.

Description : Globose, widest at umbilical shoulder. Adult with comparatively strong ribs that stretch from umbilicus to umbilicus. Inner whorls smooth except for faint ventral bulges (see Plate XIV, fig. 4) that herald the appearance of the ribs.

Remarks : This species is similar in shape and ornament to *P. crassum* Furon, but it is less globose and has a much less depressed whorl section. *P. costatum* occurs also in the Lower Turonian of Peru.

Occurrence : Lower Turonian ; Ezillo near the Abazi River, Nkalagu Division, Ogoja Province.
Collector : The author.

Genus **Ezilloella** Reymont, 1954

Type species : *Ezilloella ezilloensis* Reymont.

Diagnosis : Moderately evolute, whorl section subquadrate, venter sharply arched on inner whorls, broad and rounded on mature whorls. Flanks ornamented with well-spaced, prominent bulges. Inner whorls without ventral ornament, but weak siphonal and clavate ventrolateral tubercles appear on later whorls.

Remarks : As was pointed out in a previous paper (Reymont, 1954c, p. 263), *Ezilloella* is a late offshoot of *Gomeoceras*.

Horizon : Lower Turonian ; Nigeria.

Ezilloella ezilloensis Reymont

Plate XI, figs. 3a, b

1954c *Ezilloella ezilloensis* Reymont, p. 264, pl. III, fig. 4 ; text-fig. 10.

Description : Compressed, moderately evolute, venter sharply arched to an advanced growth stage, later broad and rounded. The whorls are slightly inflated in the adult and develop three rows of ventral swellings at advanced growth stages.

Remarks : This species most closely resembles the group of *Gomeoceras* ? *bulbosum*. That species includes forms with umbilical tubercles on the inner whorls, but only ventral bulges on outer whorls. Some of the more compressed representatives tend to develop bulges on the flanks and have thus finally resulted in *E. ezilloensis*. *Pseudojacobites* (?) *rotalinus* (Stoliczka) resembles the species here described in having a similar whorl section and comparable, although stronger, ornament, but differs, however, in also having mediolateral tubercles and a more involved suture line (see Stoliczka (1863, pl. XXXIV, figs. 2, 2a)).

Occurrence : Lower Turonian ; Western Aboine River, Ezillo, Nkalagu Division, Ogoja Province.
Collector : The author.

Genus **Neptychites** Kossmat

Type species : *Ammonites cephalotus* Courtiller (= *Ammonites telinga* Stoliczka).

Diagnosis : Involute, compressed, with slightly convex flanks. Venter keelless and sharply rounded. The whorls are smooth at first, but develop furrows, then broad folds, and finally ribs. The ribs eventually disappear and the flanks become smooth again. Umbilicus very narrow ; suture of vascoceratid pattern, but rather complicated.

Remarks : *Neptychites* is closely related to *Thomasites* Pervinquier, as is shown by the similar sutures and the development of the early stages. *Thomasites*, however, is rather strongly tuberculate, whereas *Neptychites* is quite without tubercles. The Nigerian Cretaceous has yielded three species of *Neptychites* : *N. perovalis* (von Koenen), *N. telingaeformis* Solger, and *N. crassus* Solger, of which the first two are represented in the collection.

Horizon : Lower Turonian ; India, Tunisia, Syria, West Africa, France, Texas, and Mexico.

Neptychites perovalis (von Koenen)

Plate X, figs. 4a, b ; text-fig. 29

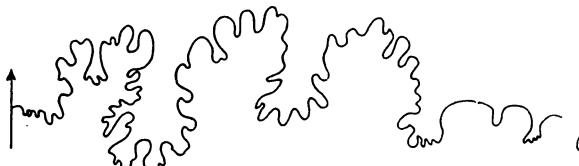
1897 *Pulchellia perovalis* von Koenen, p. 10, pl. I, fig. 3 ; pl. II, fig. 6.

1904 *Neptychites perovalis* von Koenen sp., Solger, p. 122.

1932 *Neptychites* sp., Riedel, p. 123, pl. XXVI, figs. 6, 6a.

1932 *Neptychites perovalis* von Koenen, Riedel, p. 123, pl. XXVI, figs. 7a, b.

Description : Involute, compressed, venter sharply rounded, umbilicus narrow. The ornament consists of numerous weak, sigmoidal ribs that begin at the umbilicus, become stronger towards the venter, and then weaken on it. Slight thickening of the ribs may take place at the ventrolateral margin. Only every third rib begins at the umbilical margin ; the others are intercalatories. The suture line (text-fig. 29) is typical of *Neptychites* and is strongly asymmetrical.



TEXT-FIG. 29—*Neptychites perovalis* (von Koenen). Suture line of the specimen figured in Plate XI, figs. 3a, b, B.M. No. U.3511. Three times natural size.

Remarks : This species rather closely resembles *N. telingaeformis* Solger, but differs in that the ribs are

more numerous and sickle-shaped. The ribs of *N. telingaeformis* are straighter and all begin at the umbilical margin, whereas in *N. perovalis* only every third rib does so. The suture line of the specimen studied (U.3511) agrees well with that given by Riedel for *N. perovalis* (1932, p. 124, text-fig. 34). The specimen also agrees quite well with von Koenen's original figure (1897, pl. II, fig. 6).

Occurrence : Lower Turonian ; Mungo River Formation, Mundame, Southern Cameroons.

Neptychites telingaeformis Solger

Plate XI, figs. 4a, b ; Plate XV, fig. 1 ; text-fig. 30

1904 *Neptychites telingaeformis* Solger and varieties, p. 108, pl. III, figs. 2, 3 ; text-figs. 9-17.

1932 *Neptychites telingaeformis* Solger var. *discrepans* Solger, Riedel, p. 123, pl. XXVI, figs. 5, 5a, b.

1954b *Neptychites telingaeformis* Solger, Reymert, p. 22.

Description : Involute, very compressed, venter sharply rounded. Ornamented with relatively strong ribs, after a smooth initial stage, to quite an advanced growth stage, after which the flanks become smooth. The ribs begin at the umbilical margin and cross the venter without thinning. The specimen figured in Plate XI, fig. 4 shows that the ribs gradually become flatter and more widely spaced and develop a strong backward bend near the venter. The specimen depicted in Plate XV, fig. 1 is large and has lost all ornament.

Remarks : There has been much discussion concerning the validity of the species here discussed. Solger (1904, p. 109) wrote, "Alles in allem ist es



TEXT-FIG. 30—*Neptychites telingaeformis* Solger. Suture line of specimen B.M. No. C.47419 figured in Plate XV, fig. 1. Twice natural size.

sehr möglich, dass *N. telinga* und *N. telingaeformis* identisch sind. Sollte eine genauere Beschreibung indischer Individuen, auf reicheres Material gestützt, dies einmal ergeben, dann wird die oben getroffenen Wahl eines von vorn herein ähnlichen Namens für die Kameruner Form verhindern, dass Verwirrung entsteht".

There is no doubt that the two species are similar but the ribs of *N. cephalotus* (= *N. telinga* Stoliczka sp.) are much more strongly directed forwards and are considerably coarser. Pervinquier's figures of *N. cephalotus* (Courtiller) illustrate a more inflated form that has thicker ribs than *N. telingaeformis*. *N. gourguechoni* Pervinquier (1907, p. 400, pl. XXVI, figs. 8a, b; 9a, b; text-figs. 155, 156) is very similar to *N. perovalis* (von Koenen) and probably is referable to that species.

Occurrence : Lower Turonian ; Icheri River, Idoma Division, Benue Province ; Mungo River Formation, Mundame, Southern Cameroons.

Collector : The author.

Neptychites crassus Solger

1904 *Neptychites crassus* Solger, p. 119, pl. III, figs. 5a, b; text-figs. 18, 19.

Description : Involute, whorls very inflated, whorl section depressed. Whorls at first smooth, then ornamented with numerous almost straight ribs and about four constrictions per whorl, finally smooth.

Remarks : A single eroded fragment is referred here. *N. crassus* is probably identical with *N. xetra* (Stoliczka).

Occurrence : Lower Turonian ; Mungo River Formation, Mundame, Southern Cameroons.

Collector : J. U. Kappeler, Shell D'Arcy.

Repository : Shell D'Arcy Headquarters, Owerri (specimen No. K6).

Family COLLIGNONICERATIDAE Subfamily BARROISICERATINAE

This subfamily has been the subject in recent years of two important revisionary studies. Reeside (1932) recognized a number of subgenera of *Barroisiceras* : *Harleites*, *Solgerites*, *Texasia*, *Alstadianites*, and *Forresteria*. Basse (1947) published a revised consideration of Reeside's work on the basis of some material from Madagascar and laid the foundations for a sound and useful classification of the group. Basse recognized two main groups within *Barroisiceras* s.l. —those with and those without mediolateral tubercles. In the present

work, the *Barroisiceras* without mediolateral tubercles are regarded as *Barroisiceras* s. str., with the subgenera *Barroisiceras* and *Texasia*. Those forms which have mediolateral tubercles are grouped into the genus *Forresteria*, with the subgenera *Reesideoceras*, *Forresteria*, and *Harleites*.¹ *Solgerites*² Reeside (= *Piveteauoceras* Basse) is regarded as a separate genus with the species *S. tuberculatus*³ Reymont (Plate XVII, fig. 5), *S. brancoi* (Solger), *S. armata* (Solger), *S. eborensis* (Basse), *S. laevis* (Basse), *S. romieuxi* Pervinquier, and *S. congoensis* (Basse).

In common with other recent workers, the writer placed the Barroisiceratinae in Tissotiidae (Reymont, 1954c). In a recent personal communication, however, C. W. Wright drew attention to a new find of an Upper Turonian *Subprionocyclus* that is directly transitional to the group of *Barroisiceras onilahyense* Basse and which has an obliquely trifid first lateral saddle as in *Diaziceras*. This indicates definitely that the Barroisiceratinae must be grouped with Collignoniceratidae. It seems that much of the basis for grouping the Barroisiceratinae with Tissotiidae may have arisen through homeomorphy and from false attribution of certain *Barroisiceras* to *Tissotia*.

¹ Based on unpublished work of C. W. Wright.

² See the author's remarks on this genus and the Barroisiceratinae in general, 1954c.

³ From south of Dukul.

Genus **Barroisiceras** de Grossouvre, 1894

Type species : *Ammonites haberfellneri* von Hauer.

Diagnosis : Rather involute, compressed to inflated, umbilicus narrow except in extreme age, high whorled. A strong crenulate keel usually persists to the outer whorl. Umbilical tubercles widely spaced and give rise to pairs of strong or weak ribs which, with intercalatories, form ventrolateral clavi and then turn sharply forward to the keel.

Horizon : Coniacian ; Europe, West Africa, North Africa, Madagascar, U.S.A., and South America.

Barroisiceras (*Barroisiceras*) sp. indet.

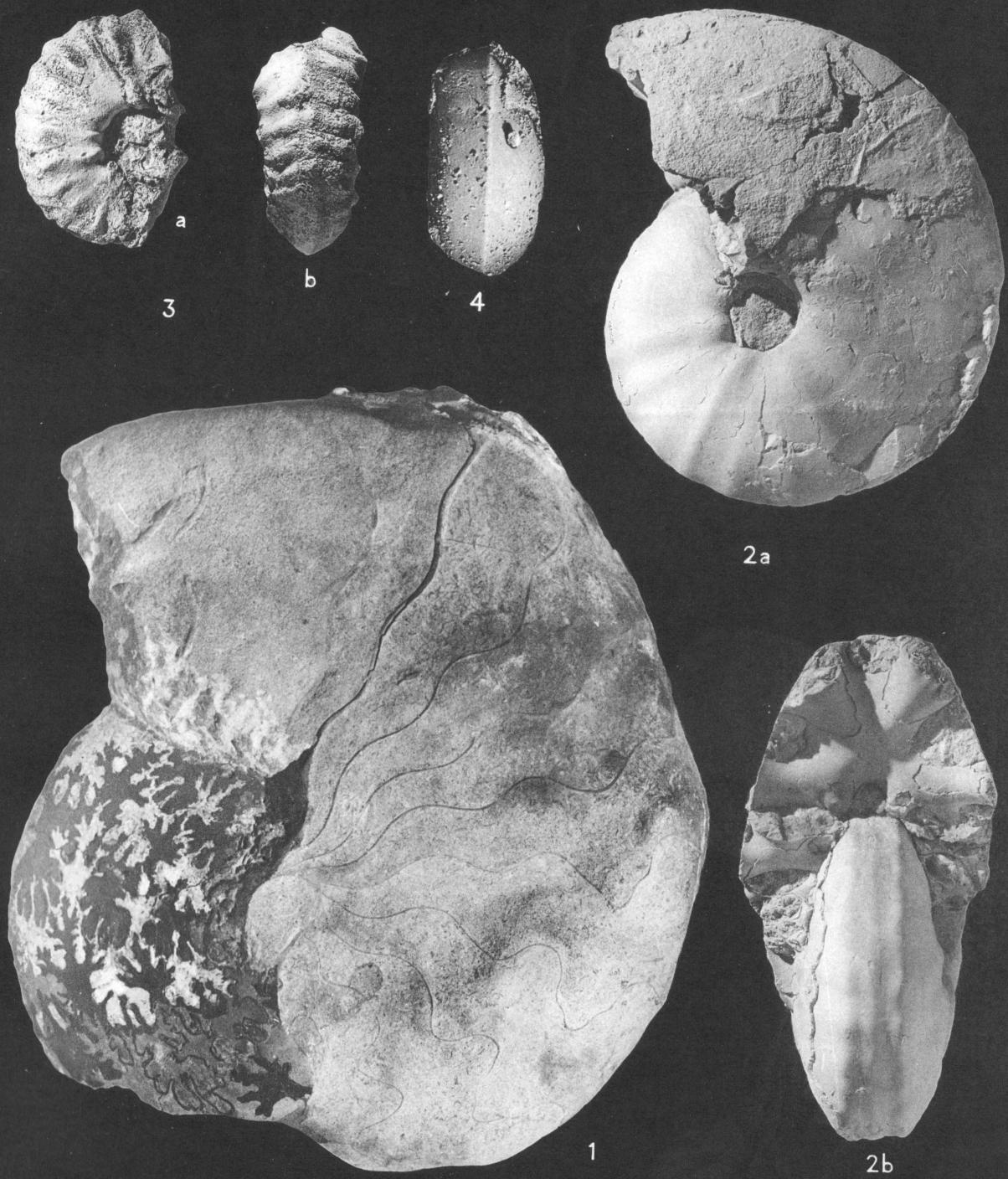
Remarks : A single moderately involute specimen, U.3398, is referred here. It is badly preserved, but a strong crenulate keel is visible at all stages. The whorl section is high and the flanks flat-sided.

Occurrence : Coniacian ; Upper part of the Awgu-Ndeaboh Shales, Awgu, Onitsha Province.

Collector : The author.

PLATE XV
(opposite)

- FIG. 1. *Neptychites telingaeformis* Solger. Fairly large waterworn example. Lower Turonian. Icheri River, Benue Province. (B.M. No. C.47419). Page 66.
- FIG. 2. *Pseudotissotia (Bauchioceras) nigeriensis* (Woods). Specimen figured for comparison with *Hoplitooides*. (a) Side view ; (b) ventral view. Lower Turonian. Bauchi Province. (B.M. No. C. 47282). Page 71.
- FIG. 3. *Forresteria (Forresteria) serrata* sp. nov. Holotype. (a) Side view ; (b) ventral view. Coniacian. Awgu-Ndeaboh Shales, near Enugu. (B.M. No. U.3519). Page 69.
- FIG. 4. *Tissotia awguensis awguensis* sp. nov. Paratype. Specimen showing the presence of a prominent keel at an early growth stage. Coniacian. Awgu-Ndeaboh Shales, Onitsha Province. (B.M. No. U.2452). Page 85.



Genus *Forresteria* Reeside, 1932

Type species : Barroisiceras (Forresteria) forrestieri Reeside.

Diagnosis : Whorl section and ornament variable, umbilicus large. On the earlier whorls there are umbilical, mediolateral and ventrolateral tubercles, The mediolateral row either fuses with the umbilical or ventrolateral rows or disappears. Ribs weak.

Horizon : Coniacian ; France, Madagascar, West Africa, Peru, U.S.A.

Subgenus *Forresteria sensu stricto*

Diagnosis : Mediолateral tubercle usually fuses in the course of growth with the ventrolateral. Whorl section moderately to very inflated.

Horizon : Coniacian ; Madagascar, West Africa, Peru, U.S.A.

Forresteria (Forresteria) serrata sp. nov.

Plate XV, figs. 3a, b

Holotype : B.M. No. U.3519 ; Awgu-Ndeaboh Shales, near Enugu. Plate XV, figs. 3a, b.

Description : Umbilicus moderately narrow, flanks roughly parallel to each other, venter comparatively broad. There are three rows of tubercles to a flank and also a row of siphonal tubercles. The latter tubercles are small, spinate and numerous, the ventrolateral ones small and unimportant. The mediolateral row contains prominent tubercles that are fewer in number than those of the other rows mentioned owing to the presence of intercalaries which do not always begin at a mediolateral tubercle. The umbilical tubercles are small and bullate, as are also the ventrolateral (but not the mediolateral) tubercles. The ribs are fairly strong and irregular and number 13-14 per half whorl. The venter is arched. The mediolateral tubercles eventually fuse with the ventrolateral tubercles.

Remarks : The species most closely resembling *F. (F.) serrata* is *F. (F.) alluaudi* (Boule, Lemoine & Thévenin), but that form is less strongly ornamented and the ribs are more strongly directed forwards at the ventrolateral margin. Furthermore, the Malagasy species has divided ribs and a less arched venter.

F. (F.) forrestieri Reeside has stronger siphonal tubercles and fewer ribs per whorl as well as a higher whorl section. *F. (F.) stantoni* Reeside has a higher whorl section, fewer siphonal tubercles per

whorl, weaker mediolateral tubercles and much stronger ventrolateral tubercles.

Occurrence : Coniacian ; Awgu-Ndeaboh Shales, near Enugu.

Collector : The author.

Subgenus *Reesideoceras* Basse, 1947

Type species : Reesideoceras gallicum Basse.

Diagnosis : Less inflated than *F. (Forresteria)* and the mediolateral tubercles fuse in the course of growth with the umbilical. The keel disappears on the last whorl leaving a flat or concave venter bordered by ventrolateral clavi.

Horizon : Coniacian ; France, West Africa, Madagascar.

Forresteria (Reesideoceras) camerounensis (Basse)

1904 *Barroisiceras haberfellneri* von Hauer var. *alstadenensis* (Schlüter) Grossouvre, Solger, p. 170, figs. 56, 57 ; pl. IV, figs. 6a, b.

1947 *Reesideoceras camerounense* Basse, p. 137.

Description : Keel distinctly crenulated ; ventrolateral, mediolateral and umbilical tubercles present. Ribs sigmoidal and moderately strong.

Remarks : This species does not occur in the present collection, but is included for reference. It differs from the forms with which Solger compared it by having prominent sigmoidal ribs. The keel is also much stronger.

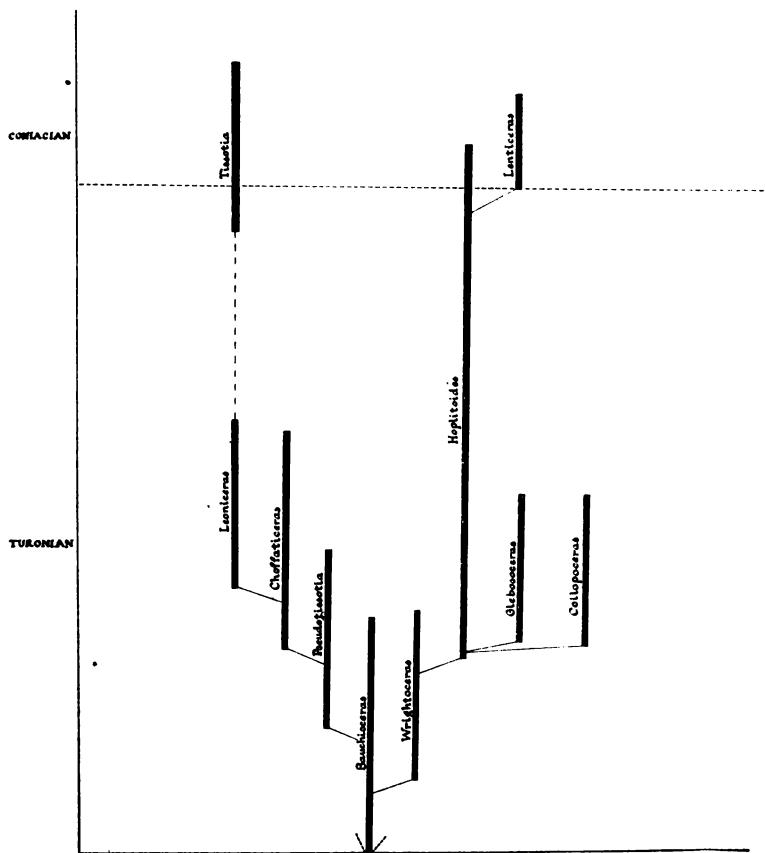
Occurrence : Coniacian ; Bombe, Mungo River Formation, Southern Cameroons.

Family TISSOTIIDAE

The family Tissotiidae is represented in the Nigerian Upper Cretaceous by the subfamilies Pseudotissotiinae, Tissotiinae, Coilopoceratiniae¹ and Lenticeratiniae. The family is important in both number of genera and abundance of species. It ranges from the Lower Turonian at least to the Coniacian.

Members of the Pseudotissotiinae and Coilopoceratiniae have been described by the author in two previous papers and certain aspects of these subfamilies were discussed. The probable interrelationships of the Nigerian genera are diagrammatically represented in text-fig. 31.

¹ Recent unpublished work on University of California material from South America by C. W. Wright suggests that this group of ammonites may ultimately prove to have a separate development from the *Pseudotissotia-Tissotia* lineage. If this should be so, then Coilopoceratiniae would require family status. Furthermore, it seems possible that Lenticeratiniae may have evolved from topmost Turonian Collignoniceratidae and not from Coilopoceratiniae. For the purposes of this paper, the usual attributions are retained.



TEXT-FIG. 31—Phylogenetic diagram showing one possible interpretation of the interrelationships within the Tissotiidae. The differences in age of the groups are not absolutely definite.

As indicated in the above figure, the field evidence is strongly in support of *Bauchioceras* being the ancestor of subsequent tissotiids. It begins very low in the Nigerian Lower Turonian.

Subfamily PSEUDOTISSOIIINAE

This subfamily comprises the following genera and subgenera : *Pseudotissotia* (*Pseudotissotia*) Péron, *Bauchioceras* Reyment, *Wrightoceras* Reyment, *Choffaticeras* (*Choffaticeras*) Pervinquieré, *Leoniceras* Douvillé and *Plesiotissotia* Péron. All of these genera and subgenera are represented in the Nigerian Turonian, except *Pseudotissotia* s. str. and *Plesiotissotia*.

Recently (1954), Kummel and Decker described some tissotiids from Mexico and Texas referable to *Bauchioceras* and *Wrightoceras*¹ and expressed the

opinion that these forms ought to be placed in Pseudotissotiinae of Tissotiidae rather than in Vascoceratidae. This view was also put forward by the author (1954a) and is retained here (see also my statements on the Vascoceratidae (1954c, p. 260)).

Genus *Pseudotissotia* Péron, 1896

Type species : *Ammonites galliennei* d'Orbigny.

Diagnosis : Involute, whorl section high, venter truncated. Ornamented with prominent, well-spaced, thick, club-shaped ribs. Has three weak, indistinct ventral keels. Does not lose its ornament.

Remarks : This genus is confined to the Turonian, but so little is known about it that it is uncertain whether it occurs solely in the Lower Turonian or ranges throughout the whole of the stage. *P. (Pseudotissotia)* is clearly derived from the earlier *Bauchioceras*, which differs from it in being less strongly ribbed with sigmoidal ribs that are slender and of variable strength, in having more prominent keels, and in losing the ornament on the flanks at

¹ *Pseudotissotia* (*Bauchioceras*) *adkinsi* and *Pseudotissotia* (*Wrightoceras*) cf. *munieri*; these authors were fully aware of the necessity of the subgenera *Bauchioceras* and *Wrightoceras* (see pp. 310-319), but refrained from publishing names for them since they knew the present author to be preparing an account based on more comprehensive material.

an early stage. No species of *Pseudotissotia* s. str. have yet been identified amongst the Nigerian faunas.

Subgenus **Bauchioceras** Reyment, 1954

Type species : *Hoplitoïdes nigeriensis* Woods.

Diagnosis : Involute, flanks almost flat, in some species slightly inflated. Venter truncated, bearing three prominent keels in the young and middle growth stages, but in very large adults these keels may disappear completely. When fully grown, the flanks are perfectly smooth, but in young specimens there are a few fairly strong, rounded, sigmoidal ribs to each whorl. These first appear as swellings united with the bullate umbilical tubercles and gradually grow out to meet the ventrolateral margin. Shortly afterwards they weaken and disappear.

Remarks : The writer regarded *Bauchioceras* at first as a distinct genus of *Pseudotissotiinae* (Reyment, 1954a), but later researches indicate that it is probably best placed as a subgenus of *Pseudotissotia*. The following species of the subgenus have been recorded from Nigeria : *P. (Bauchioceras) nigeriensis* and *P. (Bauchioceras) tricarinata* (Reyment).

Pseudotissotia (Bauchioceras) nigeriensis (Woods)

Plate XV, fig. 2 ; Plate XXII, fig. 3

- 1911 *Hoplitoïdes nigeriensis* Woods, p. 284, pl. XXIII, fig. 3.
1943 *Hoplitoïdes* cf. *nigeriensis* Woods, Schneegans, p. 135, pl. IV, figs. 4a, b ; text-fig. 16.
1954a *Bauchioceras nigeriense* (Woods), Reyment, p. 158, pl. II, fig. 2 ; text-fig. 4b.
1954 " *Hoplitoïdes* " *nigeriensis* Wood, Kummel & Decker, p. 319, pl. XXXII, fig. 4, text-figs. 7c, 9.

Remarks : Numerous examples of this species have been collected from the Konshisha River section, near Oturkpo, Idoma Division, Benue Province. It is confined to the lowermost zone of the Nigerian Turonian. For further remarks on *P. (B.) nigeriensis* see Reyment (1954a, p. 284).

Repository : Shell D'Arcy Headquarters, Owerri.

Collector : R. Blaser, Shell D'Arcy.

Subgenus **Wrightoceras** Reyment, 1954

Type species : *Bauchioceras (Wrightoceras) wallisi* Reyment.

Diagnosis : Involute, compressed in the adult, inflated around the umbilical margin in the young, whorl section high. Venter markedly concave and flanked by two prominent keels. Venter on adult may be merely truncated and without the keels. Young with a few short, inflated ribs per whorl

that begin at strong, bullate umbilical tubercles. The ornament is soon lost and the adult is compressed and smooth.¹

Remarks : This subgenus differs from *P. (Bauchioceras)* mainly in having only two keels instead of three, in having weaker ornament and in attaining a much larger size. *Pseudotissotia* also has three keels, is more strongly ornamented and does not lose its ribs. To date only one Nigerian species is known and it occurs in both northern and southern Nigeria. The known species of this subgenus are : *P. (Wrightoceras) wallisi* (Reyment), *P. (Wrightoceras) mirabilis* (Pervinquier²), *P. (Wrightoceras) munieri* (Pervinquier²), *P. (Wrightoceras) ilarenei* Karrenberg, and *P. (Wrightoceras) gagnieri* Faraut. The author has recently identified some well-preserved examples of *P. (W.) wallisi* from the Aboine River, Aza, in the Enugu-Mpu area, the Konshisha River section, and from km. 8 on the Route Kanga, Libreville, Gabon (collection at Shell D'Arcy, Owerri).

Horizon : Lower Turonian ; West Africa, North Africa, Mexico, Spain, and France.

¹ It is of interest to note that *Pseudotissotia (Wrightoceras) wallisi* has a very closely similar homeomorph, *Episageceras dallalmae* (Diener) from the lowest Eo-Trias, Shalshal Cliff, Himalayas.

² As was pointed out on a previous occasion (Reyment, 1954a), these two species may well prove to be identical.

Pseudotissotia (Wrightoceras) wallisi (Reyment)

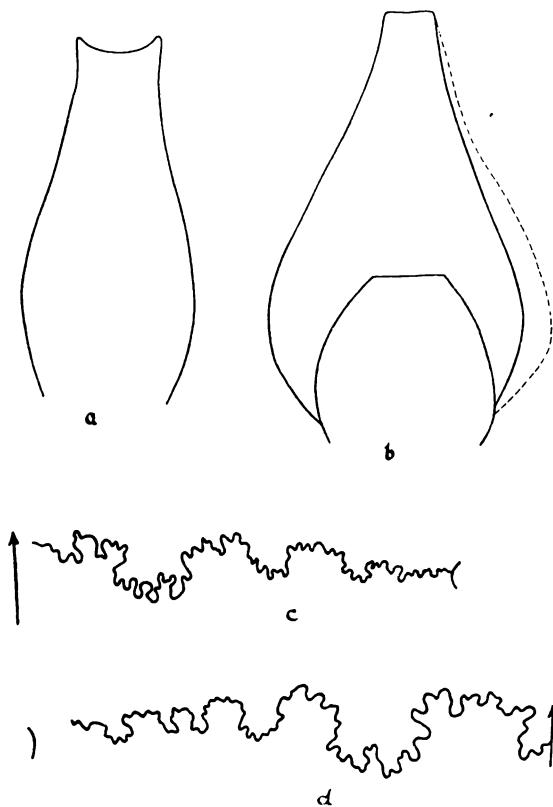
Plate XXIV, fig. 1 text-figs. 32a, c, d

- 1954a *Bauchioceras (Wrightoceras) wallisi*, Reyment, p. 160, pl. II, fig. 4 ; pl. III, figs. 3, 3a.

Description : Large ammonites with high whorl section (see text-fig. 32a) and truncated venter, bicarinate. Early whorls strongly inflated around the umbilical margin, mature shell compressed with almost parallel flanks. There are a few prominent ribs on each whorl, which are strongest near the umbilical margin, but which weaken before reaching the ventrolateral margin, and a few bullate, flat umbilical tubercles to a whorl in the early stages. Suture lines of two specimens are shown in text-figs. 32c, d. Fig. 32c is slightly eroded.

Remarks : This species is much less compressed and is more prominently bicarinate (see text-fig. 32a) than the two Tunisian species, *P. (Wrightoceras) mirabilis* (Pervinquier) and *P. (Wrightoceras) munieri* (Pervinquier). *P. (Wrightoceras) ilarenei* Karrenberg is quite similar to the species here recorded. This form is involute, has a high whorl

section (text-fig. 32b) and similar umbilical tubercles and ribs. It also has two rows of keels and a concave venter. The differences between this species and *P. (W.) wallsi* are as follows : the Spanish species has much more depressed inner whorls, and stronger ribs that form weak, bullate ventrolateral tubercles. Adult specimens of both species are difficult to distinguish from each other since all ornament is lost in both cases. *P. (W.) wallsi* has, however, slenderer whorls. *P. (W.) gagnieri* Faraut (1951, p. 149) has a higher, more rounded whorl section and apparently ventrolateral tubercles instead of ventrolateral keels.



TEXT-FIG. 32.—*Pseudotissotia (Wrightoceras) wallsi* (Reyment). a, whorl section of a specimen from the Icheri River, Idoma Division, Benue Province, B.M. No. U.3525. b, Whorl section of *Pseudotissotia (Wrightoceras) ilarenai* Karrenberg. Reproduced (after Karrenberg, 1935) for comparison. c, Suture line of specimen B.M. No. U.3525. d, Suture line of a specimen from Bauchi Province, B.M. No. U.3386. All figures natural size.

A specimen from the Icheri River, U.3525, has a slightly narrower venter than the specimens from northern Nigeria, but in all other respects agrees closely. The inner whorls of some specimens on

which the shell has been lost may show a false median keel owing to the prominence of the siphuncle.

Occurrence : Lower Turonian ; Kanawa, Deba Habe, Bauchi Province ; Icheri River, Idoma Division, Benue Province.

Collectors : R. Walls, the author.

Genus **Choffaticeras** Hyatt, 1903

Type species : *Pseudotissotia meslei* Pérón.

Diagnosis : Whorl section more or less cordate or lanceolate. Form involute, venter sharp with strong median keel and with subdued ventrolateral keels or rows of tubercles (*Choffaticeras*) or smooth (*Leoniceras*). The early whorls may be costate.

Remarks : Both *C. (Choffaticeras)* and *C. (Leoniceras)* are represented in the Nigerian Turonian. The author's suggestion (1954c) that *Choffaticeras* arose through such a form as *P. (Bauchiceras) tricarinata* (Reyment) is strengthened by the existence of *Choffaticeras ? kenehense* (Douvillé) (1931) which closely resembles *P. (B.) tricarinata* but lacks ornamentation on the flanks. At a growth stage where true *Choffaticeras* have galleate venters this form is still tricarinata. *Choffaticeras* has clearly given rise to *Tissotia*, and this view is supported by the discovery of an ammonite representing a transition between *Choffaticeras* and *Tissotia* (Plate XVI, figs. 2a, b) from the Upper Turonian ? of Numan Division. This form is involute, with a fastigate venter which has three keels on the inner whorls. On the last whorl the siphonal keel weakens, and feeble, clavate, ventrolateral tubercles take the place of the ventrolateral keels.

Horizon : Turonian ; West Africa, North Africa, Syria, Egypt.

Subgenus **Choffaticeras sensu stricto**

Venter galleate in adult, tricarinata in the young ; involute.

Choffaticeras (Choffaticeras) spathi sp. nov.

Plate XVI, figs. 1a, b; text-figs. 33a, b, 34a, b, c.

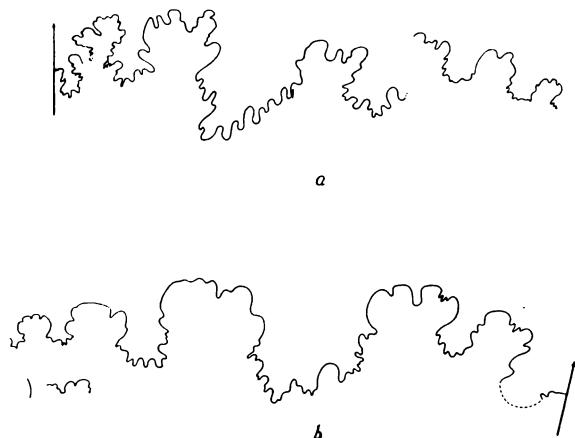
1954b *Choffaticeras* sp. nov., Reyment, p. 20.

Holotype : B.M. No. C.47415 ; 5 miles south of Keana. Plate XVI, figs. 1a, b ; text-fig. 34a.

Description : Venter sharp, galleate (text-fig. 34c). The flanks attain their greatest thickness about one-third of the distance from the umbilicus. The inner whorls bear weak, flat ribs that disappear before the last whorl, where they are replaced by

faint, flat folds.¹ A row of feeble ventrolateral tubercles occurs on each flank. The inner whorls are strongly fastigate until a considerably advanced growth stage (see text-fig. 34a). The shell is moderately inflated and involute.

The suture (text-figs. 33a and b) is of the same type as that of *C. (Leoniceras ?) philippii* (Solger) and



TEXT-FIG. 33—*Choffaticeras (Choffaticeras) spathi* sp. nov. a, Suture line of the holotype, B.M. No. C.47414. b, Suture line of the paratype, B.M. No. U.3572. Both these figures are twice natural size.

is variable, particularly the external saddle. External lobe deep, deeper than the first lateral lobe. External saddle broad and incised by a large subsidiary lobe which is itself strongly denticulated. The remaining elements are weakly crenulated.

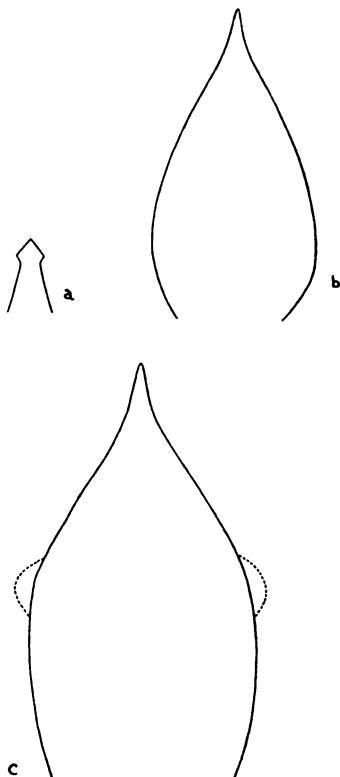
Measurements :

	C.47415	B.56
diameter	112 mm. = 1·00	180 mm. = 1·00
thickness	32 mm. = 0·28	80 mm. = 0·44
umbilicus	17 mm. = 0·15	32 mm. = 0·18
height of last whorl	51 mm = 0·45	80 mm. = 0·44

Remarks : The largest example of this species found yet comes from New Kumberi (B.56). The figure for the thickness of this specimen given in the above table is larger than for smaller examples, since the umbilical area becomes greatly inflated at advanced growth stages.

Solger's species, *C. (Leoniceras ?) philippii* from the Mungo River, Southern Cameroons, has similar sutures but a different whorl section and

¹ These ribs are of exactly the same type as those of *Pseudotissotia*; they are club-shaped and stretch from the umbilical margin to the ventrolateral margin. Cf. *Bauchioceras*, which has another style of ribbing.



TEXT-FIG. 34—*Choffaticeras (Choffaticeras) spathi* sp. nov. a, Inner whorls of B.M. No. C.20281. b, Whorl section of a moderately large specimen, B.M. No. U.93. c, Whorl section of a well-developed example, B.M. No. C.20278. All figures natural size.

lacks ventrolateral keels on the inner whorls, although it has umbilical tubercles and wedge-shaped ribs. *Choffaticeras (Leoniceras) luciae* Pervinquière resembles adult examples of *C. (C.) spathi* in shape, but its inner whorls are always unicarinate. *Choffaticeras (Choffaticeras) koeneni* Riedel is a rather doubtful species and in all probability is a passage form to *Tissotia* of more or less the same type as the example already mentioned and figured (Plate XVI, figs. 2a, b).

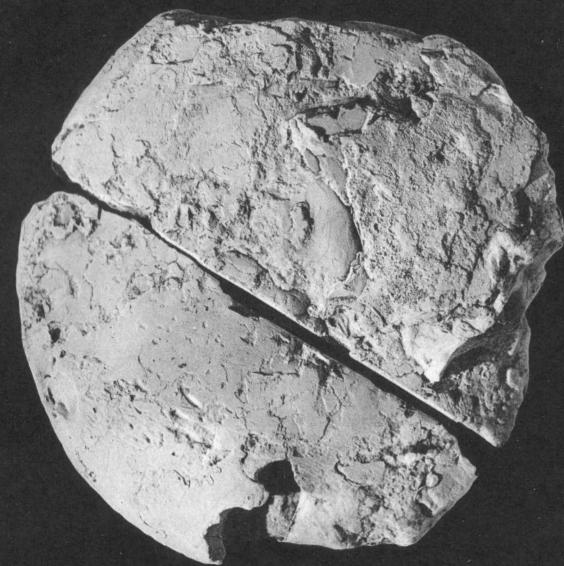
Occurrence : Lower Turonian; 5 miles south of Keana, Lafia Division, Benue Province; Arufu limestone,² Wukari Division, Benue Province; New Kumberi, Adamawa Province.

Collectors : J. D. Falconer, R. Black, H. Piper, the author.

² The occurrence of this Turonian species in contact with beds of undoubted Albian age containing *Elobiceras newtoni* Spath, implies the absence of Cenomanian in this area. Other fossils found with *E. newtoni* are: *Epiaster cf. angolaensis* Haughton, *Cucullaea cf. woodsi* Newton, *Pseudolimea cf. gaultina* (Woods), *Neithea tricostata* (Coquand), and *Pholadomya vigneti* Lartet.

PLATE XVI
(opposite)

- FIG. 1. *Choffaticeras spathi* sp. nov. Holotype. (a) Side view ; (b) ventral view. Lower Turonian. Keana, Benue Province. (B.M. No. C.47415). Page 72.
- FIG. 2. " *Choffaticeras* " sp. (a) Side view ; (b) ventral view. Upper (?) Turonian. Limestone west of Falu, Adamawa Province. (B.M. No. U.3547). Page 72.
- FIG. 3. *Tissotia awguensis falconeri* subsp. nov. Holotype. Coniacian. Awgu-Ndeaboh Shales, Awgu, Onitsha Province. (B.M. No. U.2485). Page 85.
- FIG. 4. *Tissotia* sp. juv. Coniacian. Mungo River Formation, near Bombe, Cameroons. ($\times 3$). (B.M. No. U.2780). Page 87.



2a



2b



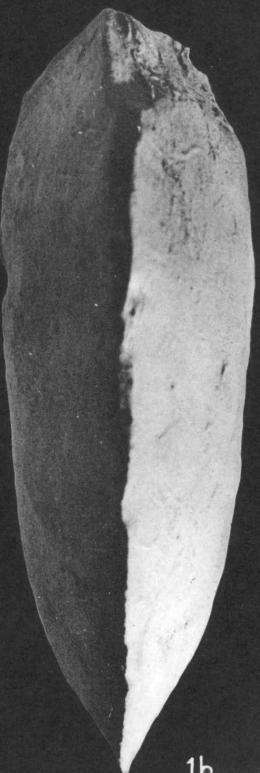
1a



4



3



1b

PLATE XVII
(opposite)

- FIG. 1. *Tissotia awguensis collignoni* subsp. nov. Holotype. Coniacian. Awgu-Ndeaboh Shales, Awgu, Onitsha Province. (B.M. No. C.47168). Page 85.
- FIG. 2. *Tissotia awguensis awguensis* sp. nov. Holotype. (a) Apertural view ; (b) side view. Coniacian. Awgu-Ndeaboh Shales, Awgu, Onitsha Province. (B.M. No. U.2501). Page 85.
- FIG. 3. *Hoplitoïdes crassicostatus* sp. nov. Holotype. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47381). Page 83.
- FIG. 4. *Hoplitoïdes crassicostatus* sp. nov. Paratype. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47380). Page 83.
- FIG. 5. *Solgerites tuberculatus* Reymont. Holotype. Coniacian. South of Dukul, Adamawa Province. Upper Limestones. (B.M. No. C.47418). Page 67.
- FIG. 6. *Tissotia latelobata* Solger. Coniacian. Mungo River Formation, Balangi, Cameroons. (B.M. No. U.3136). Page 87.
- FIG. 7. *Hoplitoïdes koeneni* Solger. (a) Side view ; (b) ventral view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47382). Page 78.
- FIG. 8. *Hoplitoïdes gibbosulus gibbosulus* (von Koenen). Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47379). Page 81.



members of the *Coilopoceratinae* in being strongly ornamented in the adult.

Occurrence : Lower Turonian ; Okpaku River, Ogoja Province ; Alome River, near Mbeki, Oturkpo Division, Benue Province.

Collectors : Shell D'Arcy, the author.

Glebosoceras sp.

Remarks : The collection contains a single specimen (U.3523) consisting of a large fragment showing the prominent swellings on the flanks characteristic of the genus. The flanks achieve maximum thickness some distance from the umbilicus and thereafter slope gradually towards the umbilicus. This form seems to be separate from *G. glebosum*.

Occurrence : Lower Turonian ; Ora River, Nkalagu Division, Ogoja Province.

Collector : J. D. Carter.

Genus ***Coilopoceras*** Hyatt, 1903

Coilopoceras aff. *lesseli* Brüggen

1954b *Coilopoceras* sp. indet., Reyment, p. 20.

Description : A large specimen, rather damaged and badly preserved, is referred here. Shell compressed, venter sharp ; whorls thickest about a third the way up the flanks from the umbilicus. The form is involute. Surface smooth apart from prominent growth lines.

Remarks : Unfortunately the suture of the specimen studied is too badly preserved to permit reproduction, but it is of the *Coilopoceras* type. *C. lesseli* Brüggen resembles this form quite closely. *C. colleti* Hyatt is also similar, but it is more inflated and has a wider umbilicus. *C. novimexicanum* Hyatt is a compressed species, but has a different whorl section and a sharper umbilical margin. *Coilopoceras* has not yet been found in Nigeria above the Lower Turonian, although it is known from the Upper Turonian of North Africa. General Collignon, in a personal communication dated 20 March, 1955, informed the author that in Madagascar *C. requieni* (d'Orbigny) occurs in the Upper Turonian together with *Romaniceras*, *Placenticeras*, *Lewesiceras*, and other ammonites.

Occurrence : Lower Turonian ; Nkalagu, Ogoja Province.

Collector : J. D. Carter.

Coilopoceras sp. indet.

Remarks : A large, poorly preserved specimen (U.3522) is referred here. The fragment, which consists of half a whorl, is ornamented with very

faint waves on its surface. The form is highly involute and greatly compressed, and has a sharp venter.

Occurrence : Lower Turonian ; Odukpani Formation, half mile north of Odukpani, Calabar Province.

Collector : The author.

Coilopoceras ? sp.

Remarks : A fragment from the limestone at Wadatta is placed here (B.M. No. U.4). It bears weak, wave-like ribs on its flanks and is highly compressed.

Collector : J. W. du Preez.

Coilopoceras aff. *colleti* Hyatt

Text-fig. 37b

1903 *Coilopoceras colleti* Hyatt, p. 91, pl. X, figs. 5-21 ; pl. XI, fig. 1.

1942 *Coilopoceras colleti* Hyatt, Moreman, p. 218.

Description : Two specimens are referred here. The smaller has a diameter of 150 mm. It is highly involute, moderately compressed, although the flanks are fairly inflated, particularly in the dorsal part of the shell. The venter is slightly galeate and the flanks are ornamented with weak ribs. The larger specimen has a diameter of 240 mm. Its venter is no longer galeate and the whorl section is smoothly rounded in the form of a sharp ellipsoid. The suture of the smaller specimen is figured in text-fig. 37b.

Remarks : The specimens here recorded agree closely with *C. colleti*, although the smaller has a galeate venter. Agreement between the suture lines is very close, particularly when the variability exhibited by this group is taken into account. On the Nigerian specimens no two sutures are exactly identical.

Occurrence : Turonian ; Ogoja area, Ogoja Province.

Collector : J. van der Sluys, Shell D'Arcy.

Repository : Shell D'Arcy Headquarters, Owerri (specimens Nos. SL.273(A), SL.274).

Genus ***Hoplitooides*** von Koenen, 1898

Type species : *Neptychites ingens*¹ von Koenen.

Diagnosis : Moderately involute, compressed. Young with ventral furrow or merely truncated venter. Shell smooth in the adult, but earlier

¹ *Hoplitooides latesellatus* von Koenen, which was designated the type species of *Hoplitooides* by von Koenen (1898) is a synonym of *H. ingens* (von Koenen).

whorls with variable, long sigmoidal ribs that disappear on nearing the sulus. A few weak, bullate umbilical tubercles per whorl may occur. Venter sharp to narrowly rounded on mature individuals.

Suture characterized by the great width of the first lateral lobe. The external saddle is not very wide, and the external lobe is, in the young, deeper than the first lateral lobe, but with age becomes insignificant.

Remarks : When erecting the genus under discussion von Koenen made the following statement, "welche sich von *Hoplites* dadurch besonders unterscheidet, dass der erste Lateral-Lobus in zwei Hauptstämme getheilt ist, welche nochmals gespalten sind, und dass der Nabel recht eng ist". By comparing *Hoplitooides*, which he considered to be of Lower Cretaceous age, with *Hoplites* Neumayr, the true relationships of the genus were obscured. Later, Pervinquier described two ammonites from the Lower Turonian of Tunisia as *Hoplitooides munieri* and *Hoplitooides mirabilis*¹ and emended von Koenen's description to include Lower Turonian forms that remain bicarinata in the adult as distinct from those which became unicarinata in the adult and were considered to be of Lower Senonian age.

Hoplitooides has been recorded from the Coniacian of Otusco, Peru, as *H. cf. ingens* (Brüggen, 1910), the Lower Turonian of Syria as *H. ingens* (Basse, 1940), the Lower Turonian of Nigeria (Reyment, 1954b), and also the Lower Turonian of the Mungo River.

Hoplitooides thus ranges from the Lower Turonian to the Lower Senonian (basal Coniacian). In Nigeria, however, it appears to be confined to the Turonian.

Age : Lower Turonian ; Tunisia, Syria, Egypt, Colombia, West Africa. Coniacian ; Tunisia, Colombia.

¹ 1907, p. 217. Both species are now referred to *Pseudotissotia* (*Wrightoceras*) Reyment. (See also Reyment 1954a).

1954b *Hoplitooides* aff. *wohlmanni* von Koenen, Reyment, p. 22.

Description : Compressed, involute, whorl section high. The venter is about 1·5 mm. wide and bears a faint furrow. The greatest thickness occurs about a third of the way up the flanks from the umbilical shoulder. Flat, sigmoidal folds adorn the flanks. The suture line (text-fig. 36) agrees with the figures given by Solger, particularly figs. 26a and 26b on p. 134.



TEXT-FIG. 36—*Hoplitooides* aff. *wohlmanni* (von Koenen), suture line of specimen B.M. No. C.47397. Twice natural size.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Benue Province.

Collector : The author.

Hoplitooides koeneni Solger

Plate XVII, figs. 7a, b ; Plate XXII, fig. 4 ; text-fig. 37

1904 *Hoplitooides koeneni* Solger, p. 151, pl. IV, figs. 8, 9.
1954b *Hoplitooides koeneni* Solger, Reyment, p. 22.

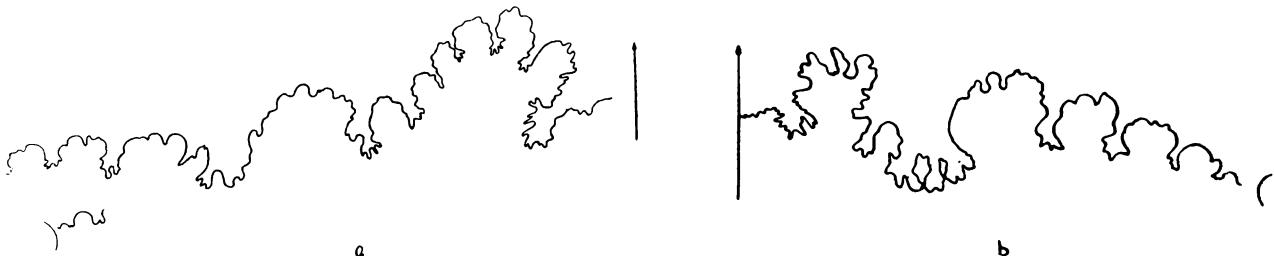
Description : Involute, compressed, venter truncated. Faint ribs and growth lines that follow the sigmoidal course of the ribbing ornament the flanks. The ribbing is like that of *H. ingens* *ingens*, but no umbilical tubercles are formed. There are about 10-11 broad flat ribs per whorl, and every second or third rib reaches the umbilical margin. The ribs are strongest ventrally, and in this respect differ from those of *H. ingens*, whose ribs are not all of equal strength at the ventrolateral margin.

Remarks : This species is represented in the collection by two specimens. The most closely related species is *H. gibbosulus* s. l., particularly *H. gibbosulus makurdiensis* subsp. nov. Both forms are compressed and have similar sculpture at comparable sizes. *H. koeneni* loses its truncated venter at an earlier growth stage, although both venters are equally narrow on juvenile whorls. Some specimens from the lower part of the Mungo River Formation in the present collection show, however, that the truncated venter may persist up to advanced growth stages. *H. g. makurdiensis* has also a different suture line (cf. text-fig. 37 and text-figs. 39b, f.).

Hoplitooides cf. *wohlmanni* (von Koenen)

Plate XVIII, fig. 3 ; text-fig. 36

- 1897 *Neptychites* ? (*Hoplites*) *Wohlmanni* von Koenen, p. 12, pl. I, fig. 2 ; pl. II, figs. 3, 9.
1898 *Neptychites* (?) *lentiformis* von Koenen, p. 11, pl. II, figs. 1, 4, 7.
1904 *Hoplitooides wohlmanni* von Koenen, Solger, p. 133, pl. V, fig. 7 ; text-figs. 24-27a, b, c, d.



TEXT-FIG. 37—*a*, *Hoplitoides koeneni* Solger. Suture line of specimen B.M. No. C.47385. Twice natural size. *b*, *Coilopoceras aff. collecti* Hyatt. Suture line of specimen No. SL.273A. Natural size.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Benue Province ; Mundame, lower part of the Mungo River Formation, Southern Cameroons.

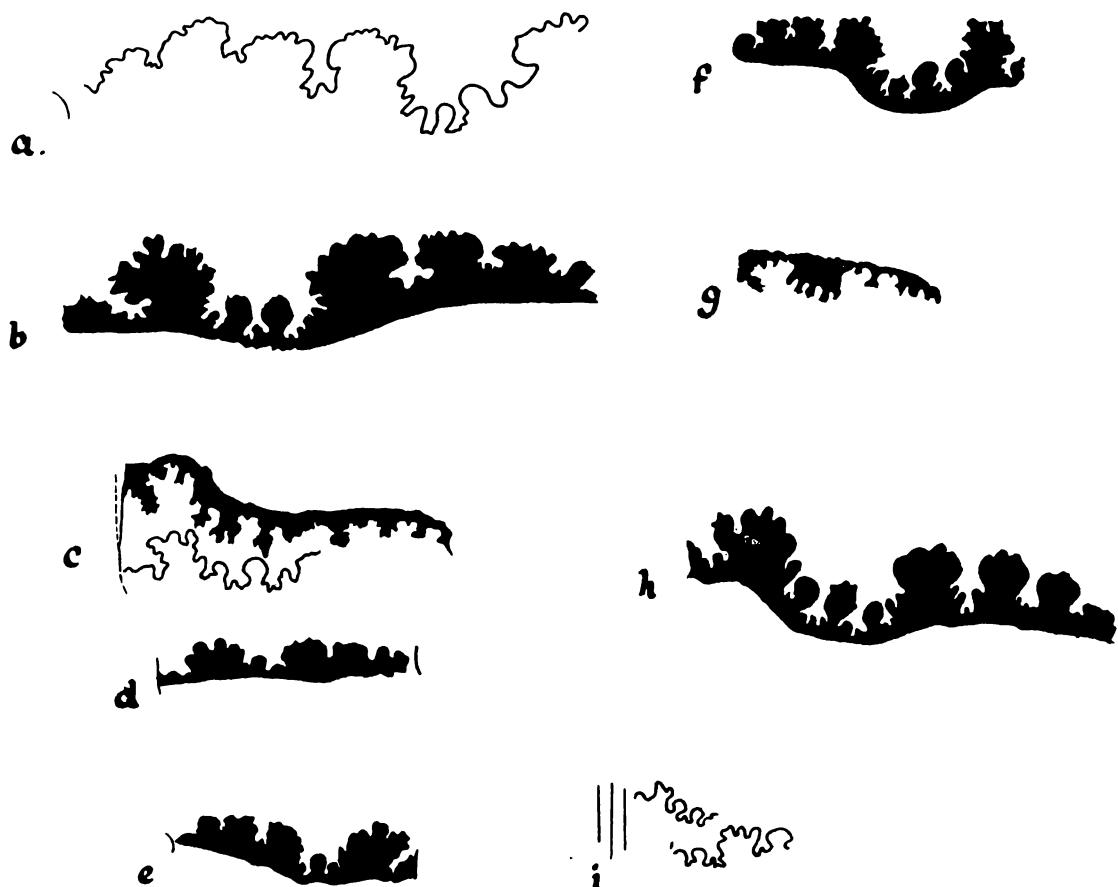
Hoplitoides ingens (von Koenen)
Plate XVIII, figs. 2, 4 ; Plate XIX, fig. 2 ; Plate XX, figs. 1a, b, 2a, b, 3 ; text-fig. 38
This species has three distinct subspecies, the

typical one, *costatus*, and *laevis*, recognized by differences in ornament.

Hoplitoides ingens ingens (von Koenen)
Plate XVIII, fig. 4 ; Plate XX, figs. 1a, b ;

text-figs. 38a-c

- 1896 *Sphenodiscus Requieni* d'Orbigny, Péron, p. 34,
pl. IV, figs. 2, 3 ; pl. XVII, figs. 4, 7.
1897 *Neptychites (?) ingens* von Koenen, p. 12, pl. I,
fig. 4 ; pl. II, figs. 5, 8.



TEXT-FIG. 38—*Hoplitoides ingens* (von Koenen). *a-c*, *H. ingens ingens*. *d, e, g, i*, Sutures of *H. ingens costatus*. *f, h, j*, *H. ingens laevis*. All figures natural size.

PLATE XVIII
(opposite)

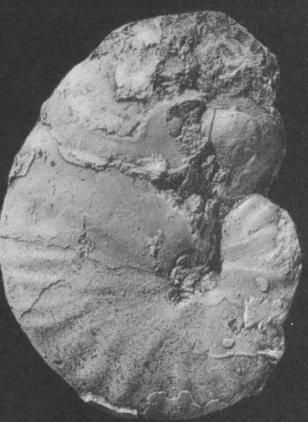
- FIG. 1. *Hoplitooides gibbosulus gibbosulus* (von Koenen). (a) Side view ; (b) ventral view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47378). Page 81.
FIG. 2. *Hoplitooides ingens laevis* Solger. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47386). Page 81.
FIG. 3. *Hoplitooides cf. wohltmanni* (von Koenen). Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47397). Page 78.
FIG. 4. *Hoplitooides ingens* (von Koenen). Lower Turonian. Icheri River, Benue Province. (B.M. No. C.47420). Page 79.



1a



2



3



1b



4

- 1898 *Hoplitoites latesellatus* von Koenen, p. 56, pl. VI, figs. 2, 3a, b.
 1898 *Hoplitoites ingens* von Koenen, p. 58, pl. V, fig. 3 ; pl. VII, figs. 4, 5.
 1898 *Hoplitoites Wilsingi* von Koenen, p. 59, pl. V, fig. 2 ; pl. VI, figs. 6, 7.
 1904 *Hoplitoites ingens nodifer* Solger, text-fig. 29.
 1904 *Hoplitoites ingens* von Koenen, Solger, p. 137, pl. V, figs. 8-10 ; text-figs. 28, 30-41.
 1907 *Hoplitoites ingens* von Koenen, Pervinquieré, p. 219, pl. IX, figs. 8, 9 ; text-figs. 85, 86, 88-90.
 ?1910 *Hoplitoites cf. ingens* von Koenen, Brüggen, p. 735, text-fig. 14.
 1914 *Hoplitoites ingens* von Koenen, Eck, p. 194, pl. XIII, fig. 2 ; text-figs. 3-5.
 1932 *Hoplitoites latesellatus* von Koenen, Riedel, p. 127.
 1932 *Hoplitoites ingens* von Koenen, Riedel, p. 128, pl. XXIV, figs. 1, 1a ; pl. XXVIII, fig. 1, pl. XXIX, fig. 1.
 1932 *Hoplitoites solgeri* Riedel, p. 132, pl. XXVII, figs. 2, 3 ; text-fig. 37.
 1939 *Hoplitoites* sp. juv. cf. *ingens* von Koenen, emend. Solger, Basse, p. 52.
 1940 *Hoplitoites ingens* von Koenen, emend. Solger, emend. Riedel, Basse, p. 461, pl. VIII, fig. 6.
 1954b *Hoplitoites ingens* von Koenen, Reymert, p. 22.

Description : Involute, inner whorls with broad, flat sigmoidal ribs and umbilical bullae. The ornament weakens and eventually disappears, usually at a fairly early stage. The tabulate venter disappears near a radius of 20 mm. and is replaced by a rounded or sharp, axe-like, venter. The venter finally becomes more or less galeate. The suture is characterized by its broad, shallow first lateral lobe and its many subsidiary saddles (see text-fig. 38).

- Hoplitoites ingens costatus* Solger
 Plate XX, figs. 2a, b ; text-figs. 38d, e, g, i
 1904 *Hoplitoites ingens costatus* Solger, p. 144, pl. V fig. 9.
 1907 *Hoplitoites ingens costatus* Solger, Pervinquieré, text-figs. 86, 87.

Description : This subspecies is distinguished by the nature of the ornament of its inner whorls. The ribs are sigmoidal, flat and closely spaced. Tubercles are entirely absent. The ventral furrow, which is about 1 mm. wide, disappears at a radius of about 17 mm. Suture line like that of *H. i. ingens* (see text-figs. 38d, e, g, i).

- Hoplitoites ingens laevis* Solger
 Plate XVIII, fig. 2 ; Plate XIX, fig. 2 ; Plate XX, fig. 3 ; text-figs. 38f, h
 1904 *Hoplitoites ingens laevis* Solger, p. 145, pl. V, fig. 9 ; Text-figs. 38-41.

Description : The early whorls are feebly sculptured and may bear broad, weak ribs or may have no other ornament than the growth lines. It resembles *H. wohltmanni* at this stage. Suture like that of *H. i. ingens* (see text-figs. 38f, h).

Remarks : Solger set up three subspecies of *H.*

ingens : *nodifer*, *costatus*, and *laevis*, but did not describe a typical form of the species. Riedel (1932) proposed that the variety *Hoplitoites ingens nodifer* should be regarded as the typical form. As the typical form of *H. ingens* must be *H. ingens ingens*, the name *H. ingens nodifer* is invalid.

The grounds for Riedel's species *H. solgeri* are too weak to permit it to be considered as separate from *H. ingens*, since the peculiarities of the suture line, to which Riedel attached specific importance, are of common occurrence in *H. ingens*.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Benue Province ; Igumale, Benue Province ; Nkalagu, Ogoja Province ; Mungo River Formation, Mundame, Southern Cameroons.

Collectors : J. W. du Preez, the author.

Hoplitoites gibbosulus (von Koenen)

- Plate XVII, fig. 8 ; Plate XVIII, figs. 1a, b ; Plate XIX, figs. 1a, b, 4 ; Plate XXI, fig. 3 ; Plate XXII, fig. 2 ; text-figs. 39, 40

This species includes three definite subspecies, the typical one, *bipartitus*, and *makurdienensis* nov.

Hoplitoites gibbosulus gibbosulus (von Koenen)

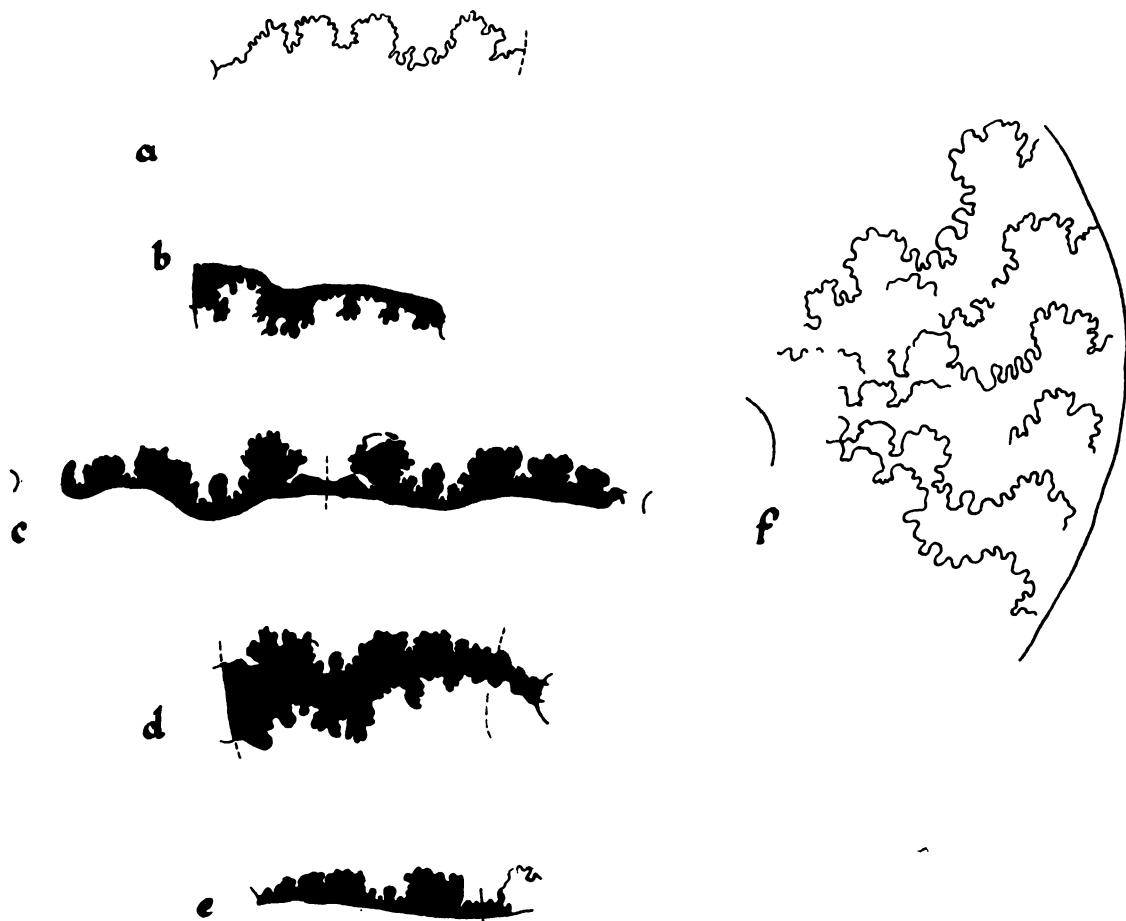
- Plate XVII, fig. 8 ; Plate XVIII, figs. 1a, b ; Plate XXI, fig. 3 ; Plate XXII, fig. 2 ; text-figs. 39a, 40

- 1897 *Pulchellia gibbosula* von Koenen, p. 9, pl. I, fig. 5.
 1898 *Pulchellia* (?) *gibbosula* von Koenen, pp. 53, 58.
 1904 *Hoplitoites gibbosulus* von Koenen, Solger, pp. 153, 154 ; text-figs. 44-46.
 1954b *Hoplitoites gibbosulus* von Koenen, Reymert, p. 22.

Description : Involute, strongly tabulate venter. At first the venter is slightly concave, the edges of the truncated periphery being crenulated owing to the development of flattened ventrolateral tubercles. On some specimens the ribs are alternate, not opposite. At a radius of 35 mm. the venter is quite lumpy and no longer tabulate, although relatively broad and only slightly rounded. The venter is about 3 mm. wide at a radius of 10 mm., and 6 mm. wide at a radius of 20 mm. Both the ribs and the growth lines are strongly sigmoidal, as in other species of *Hoplitoites*. The ribs bifurcate occasionally and intercalatories are present. About every third rib reaches the umbilical margin where it forms a long, weak, bullate umbilical tubercle. All ribs bear ventrolateral tubercles. Von Koenen's figure (1897, pl. I, fig. 5) does not show the presence of umbilical tubercles, although on p. 5 he states, "die letzte Windung lässt über die kurz gerundeten Nabelkante etwa 9 flache breite

Anschwellungen erkennen". Typical sutures are shown in text-figs. 39a and 40.

between the "bipartitus" and the "autenriethi" type.



TEXT-FIG. 39—*Hoplitoides gibbosulus* (von Koenen). a, Suture line of *H. gibbosulus gibbosulus*. c-e, Suture lines of *H. gibbosulus bipartitus*. b, f, Suture lines of *H. gibbosulus makurdiensis* subsp. nov. All figures natural size.

Hoplitoides gibbosulus bipartitus Solger

Plate XIX, figs. 1a, b; text-figs. 39c-e

1904 *Hoplitoides gibbosulus bipartitus* Solger, p. 155, pl IV, fig. 10; text-figs. 47, 48.

1932 *Hoplitoides gibbosulus* von Koenen var. *bipartitus* Solger, Riedel, p. 125, pl. XXVII, figs. 1, 1a, b; text-fig. 35.

1932 *Hoplitoides autenriethi* Riedel, p. 126, text-fig. 86.

Description : Solger based this variety on the "deutliche Zweiteilung des ersten Laterallobus und dessen schmäler, oben mehr oder weniger zusammengezogenen Form". Riedel's species, *H. autenriethi*, based on certain peculiarities of the suture, is a typical example of this variety. On one and the same specimen the sutures may vary

The subspecies *bipartitus* thus contains forms that have the first lateral lobe clearly divided into two sections (see text-figs. 39c-e) as well as a crenulated venter. The ribs are broad, flat and sigmoidal and begin at the umbilical margin, where they result



TEXT-FIG. 40—*Hoplitoides gibbosulus gibbosulus* (von Koenen). Suture line of specimen B.M. No. C.47324. Twice natural size.

in weak, bullate umbilical tubercles and terminate at the ventrolateral margin, where they form clavate tubercles.

Hoplitoites gibbosulus makurdiensis subsp. nov.

Plate XIX, fig. 4 ; text-figs. 39b, f

Holotype : B.M. No. C.47375 ; Wadatta. Plate XIX, fig. 4 ; text-fig. 39.

Description : This subspecies rapidly loses its ornament but retains the tabulate venter to quite an advanced stage. Although the ornament on the inner whorls, particularly the tuberculation, is variable, it is always of the "gibbosulus" type. The venter begins to round off after a radius of 40 mm., at which stage the ammonite is quite smooth. The suture is similar to that of the typical form (see text-figs. 39b, f).

Remarks : The species here discussed can reach a considerable size. An example from the Icheri River, Benue Province, has a diameter of 430 mm. The surface of this specimen is entirely smooth. A number of examples from the Mungo River in the present collection agree well with the Makurdi specimens.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Benue Province ; Icheri River, Idoma Division, Benue Province ; Mungo River Formation, Southern Cameroons.

Collector : The author.

Hoplitoites crassicostatus sp. nov.

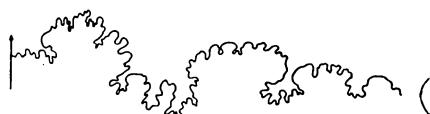
Plate XVII, figs. 3, 4 ; text-fig. 41

Holotype : B.M. No. C.47381 ; Wadatta. Plate XVII, fig. 3. Paratype, C.47380.

Description : This species has unusually strong ornament for the genus. Ribs usually thick and prominent, although some may be feeble and fold-like. Each flank bears two rows of bullate tubercles. The ribs usually divide at the umbilical tubercles and form tubercles at the ventrolateral margin. The venter is broad and often flat, though at times feebly arched. The flanks are flat and approximately parallel on the inner whorls, but become somewhat inflated on the living chamber, particularly around the umbilical region. Living chamber ornamented. The suture line of the paratype, C.47380, is depicted in text-fig. 41.

Remarks : This species is quite variable and is clearly related closely to *H. gibbosulus*. Transitional forms indicate that the latter species has probably originated from *H. crassicostatus*. A form such as C.47380 is a good example of a transition between the two species. Another related specimen, U.3517, has weak umbilical tubercles, but the

ventrolateral tubercles and the ribs are unusually pronounced.



TEXT-FIG. 41—*Hoplitoites crassicostatus* sp. nov. Suture line of the paratype, B.M. No. C.47380. Twice natural size.

The species here described differs from all other *Hoplitoites* yet known in retaining its ornament into the adult state. In this respect it resembles *Glebosoceras*, but it cannot be included in that genus since it has a truncated venter.

Occurrence : Lower Turonian ; Wadatta, near Makurdi, Benue Province.

Collector : The author.

Subfamily LENTICERATINAE

Genus *Eulophoceras* Hyatt, 1903

Type species : *Eulophoceras natalense* Hyatt.

Remarks : In agreement with Hourcq (1949, p. 97), the writer regards *Pelecodiscus* van Hoepen, *Spheniscoceras* (Crick MS.) Spath, and *Prelibycoceras* Douvillé as synonyms of *Eulophoceras*. The subfamily Lenticeratinae¹ thus comprises *Eulophoceras* Hyatt, *Lenticeras* Gerhardt, *Paralenticeras* Hyatt, *Pseudoschloenbachia* Spath, and *Diaziceras* Spath. In a recent personal communication, C. W. Wright stated that this group may eventually require family status. Some South American material being studied by Mr. Wright seems to indicate a derivation from topmost Turonian Collignoniceratidae.

¹ See Wright (1952, p. 221, footnote 37).

Eulophoceras sp.

Plate XXII, fig. 5 ; text-fig. 42

1954b *Eulophoceras* sp., Reyment, p. 21.

Description : Involute, compressed, venter sharp, somewhat galeate, whorl section very high. Surface smooth except for well-spaced, faint folds that are confined to the outer part of the shell. Suture (see text-fig. 42) with broad external saddle divided by a large adventitious lobe. First lateral lobe broader than is usual for the genus. All remaining saddles divided.

Remarks : Hourcq indicated (1949) that although the whorls in this genus are very sharp in the young, the venter of the body chamber rounds off

PLATE XIX
(opposite)

- FIG. 1. *Hoplitooides gibbosulus bipartitus* Solger. (a) Side view ; (b) ventral view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47376). Page 82.
- FIG. 2. *Hoplitooides ingens laevis* Solger. Ventral view of the specimen figured in Plate XX, fig. 3. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47383). Page 81.
- FIG. 3. *Libyoceras* sp. juv. Specimen from shales near Gombe, Bauchi Province. Maestrichtian. ($\times 3$). (See also Plate XX, fig. 4). Page 90.
- FIG. 4. *Hoplitooides gibbosulus makurdensis* subsp. nov. Holotype. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47375). Page 83.



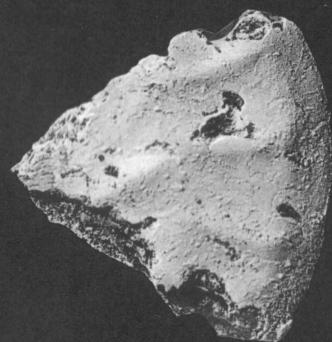
1a



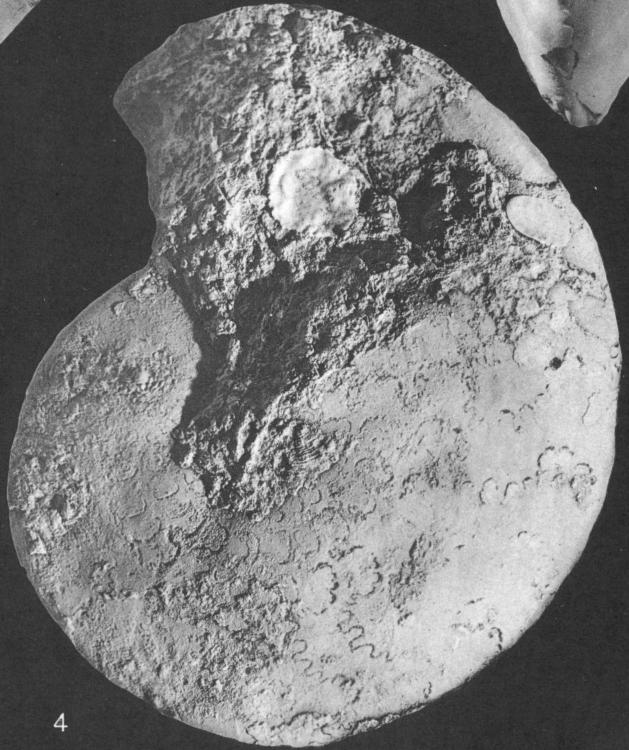
2



1b

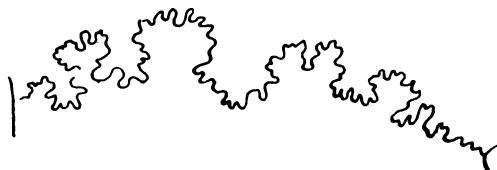


3



4

considerably. The flat ribs in some species may be sickle-shaped.



TEXT-FIG. 42—*Eulophoceras* sp. B.M. No. U.2585. Suture line of the specimen figured in Plate XXII, fig. 5. Natural size.

The specimen studied resembles *Eulophoceras jacobi* Hourcq (1949, p. 95, figs. 6, 7; pl. I, fig. 2) from the upper part of the Santonian of Madagascar. This species is compressed and very involute, and is ornamented with feeble, wave-like ribs. The sutures of the two forms are closely comparable, but the first lateral lobe of the Nigerian example is the wider.

Occurrence : Coniacian ; Upper part of the Awgu-Ndeaboh Shales, Awgu, Onitsha Province.

Collector : The author.

Subfamily TISSOTHINAE

Genus *Tissotia* Douvillé, 1890

Type species : *Buchiceras tissoti* Bayle.

Tissotia awguensis sp. nov.

Plate XV, fig. 4 ; Plate XVI, fig. 3 ;

Plate XVII, figs. 1, 2a, b ; text-fig. 43

This species has three distinct subspecies : the typical one, *collignoni*, and *falconeri*, recognized by differences in ornament.

Tissotia awguensis awguensis sp. nov.

Plate XV, fig. 4 ; Plate XVII, figs. 2a, b ; text-fig. 43

1954b *Tissotia* sp. nov., Reyment, p. 21.

Holotype : B.M. No. U.2501, Awgu-Ndeaboh Shales, Awgu. Plate XVII, figs. 2a, b ; text-fig. 43.

Measurements :

U.2501

diameter 68 mm. = 1.00

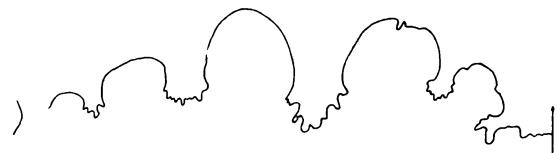
thickness 26 mm. = 0.38

umbilicus 10 mm. = 0.15

height of last whorl 35 mm. = 0.51

Description : Involute, compressed, umbilicus narrow, ornamented with bullate umbilical tubercles. Venter sharp and gently impressed below the keel. The inner whorls also bear feeble bullate

ventrolateral tubercles, which disappear much before the umbilical tubercles. Weak, wave-like ribs join the two rows ; some ribs branch. The external tubercles are somewhat more numerous than the umbilical. Sigmoidal growth lines are present and follow the same course as the ribbing. The earliest whorls have rounded venters and a thicker whorl section than later whorls. The inner whorls rapidly become keeled and increase quickly in height from an early growth stage (Plate XV, fig. 4). The suture line of the holotype of *T. awguensis awguensis*, shown in text-fig. 43 and on Plate XVII, fig. 2, is typical of the genus *Tissotia*.



TEXT-FIG. 43—*Tissotia awguensis* sp. nov. Suture line of the holotype, B.M. No. U.2501. Twice natural size.

Tissotia awguensis collignoni subsp. nov.

Plate XVII, fig. 1

Holotype : B.M. No. C.47168. Plate XVII, fig. 1.

Description : This subspecies rapidly loses its ornament and becomes smooth at an early growth stage. It is also somewhat less inflated than *T. a. awguensis*. The collection contains one fragmentary example from the upper part of the Awgu-Ndeaboh Shales, but Shell D'Arcy obtained many specimens from the Asu River.

Tissotia awguensis falconeri subsp. nov.

Plate XVI, fig. 3

Holotype : B.M. No. U.2485. Plate XVI, fig. 3.

Description : This subspecies differs from the typical form *T. a. awguensis* in being more strongly ornamented and in apparently attaining a larger size. The holotype shows that *T. a. falconeri* also develops strong, spaced, flat, ventrolateral tubercles which persist on to the body chamber of the adult (Plate XVI, fig. 3). The keel on the adult of this subspecies is much weaker than that of the typical form. Specimen B.M. No. U.2457, which is also placed here, is a strongly ornamented form with well-developed, simple ribs and a stronger keel than is usual for the subspecies. Intercalatories occur.

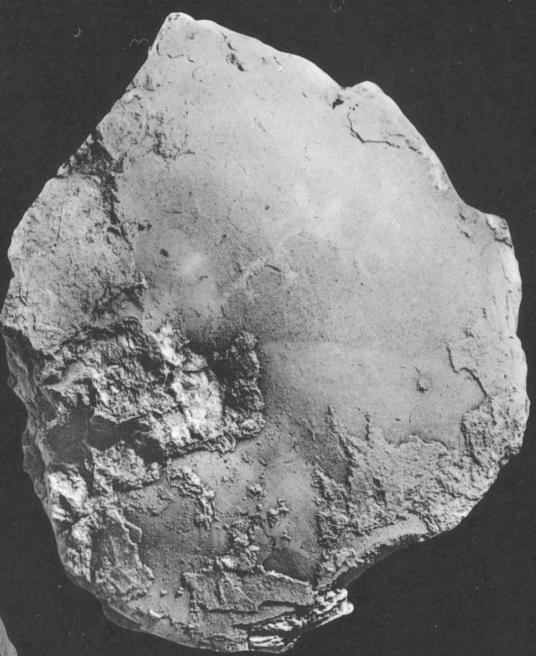
Remarks : *T. reesideana* Knechtel (1947, p. 112, pl. XXXI ; pl. XXXII, fig. 1) possesses a similar

PLATE XX
(opposite)

- FIG. 1. *Hoplitoides ingens ingens* (von Koenen). (a) Side view ; (b) ventral view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47387). Page 79.
- FIG. 2. *Hoplitoides ingens costatus* Solger. Ventral view and side view. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47384). Page 81.
- FIG. 3. *Hoplitoides ingens laevis* Solger. Side view of the specimen figured in Plate XIX, fig. 2. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47383). Page 81.
- FIG. 4. *Libycoceras* sp. juv. Specimen enlarged to show the suture line in full detail. Maestrichtian. Near Gombe, Bauchi Province. ($\times 5$). (See also Plate XIX, fig. 3). Page 90.



1a



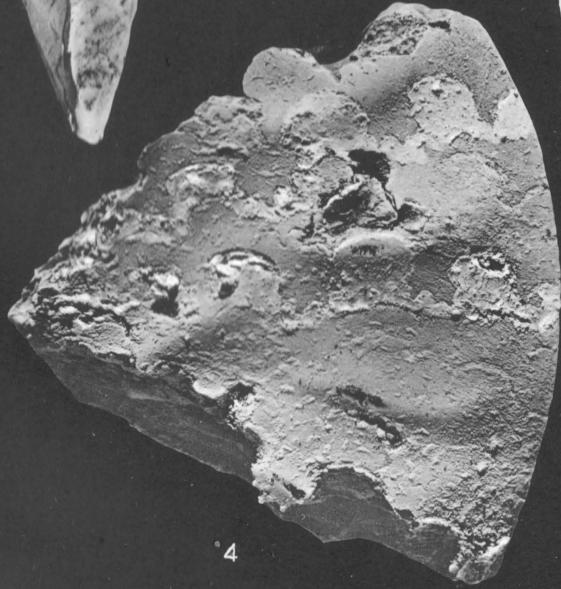
3



2



1b



4



2

suture line to that of the new Nigerian species, but it is more inflated and not so strongly ornamented. The species most closely related to *T. awguensis* appears to be *T. steinmanni* Lisson (1908, p. 1b, pl. I, figs. 1a, b, c ; pl. Ia, figs. 1a, b, c) from the Coniacian of Peru. The shape of the suture line, with a large subsidiary lobe cleaving the external saddle, is similar, but the Peruvian species has entire saddles throughout and a narrower external saddle. *T. latelobata* Solger (1904, p. 159, pl. IV, fig. 6 ; text-figs. 49a, b) from the Coniacian of the Mungo River Formation has a much broader and shallower first lateral lobe than the Nigerian form. The suture lines of the inner whorls of *T. awguensis* resemble those of *T. robini* (Thiollière), but later growth stages of the ammonites diverge, both in suture and the shape of the whorls.

Occurrence : Coniacian ; upper part of the Awgu-Ndeaboh Shales, Awgu, Onitsha Province.

Collector : A. Simpson, the author.

Tissotia latelobata Solger

Plate XVII, fig. 6

- 1904 *Tissotia latelobata* Solger, p. 159, pl. IV, fig. 6 ; text-figs. 49a, b.
- ?1932 *Paratissotia* aff. *latelobata* Solger, Riedel, p. 135, pl. XXXI, fig. 1.
- ?1932 *Paratissotia* cf. *latelobata* Solger, Riedel, p. 136, pl. XXXI, figs. 2, 2a.
- 1954b *Tissotia latelobata* Solger, Reyment, p. 21.

Description : A large fragment from the Mungo River Formation, Southern Cameroons, is compressed, highly involute, with a sharp, rather galleate, venter. Flat sigmoidal folds ornament the ventral half of the shell. Each rib produces a weak, bullate, flat ventrolateral tubercle.

Remarks : Solger considered his species to be related to *T. ficheuri* de Grossouvre as regards the ribbing. *T. latelobata* differs from most *Tissotias* by the nature of its suture line, in which the first lateral lobe is very broad. As Lisson (1908) pointed out, his species, *T. steinmanni*, is undoubtedly related to *T. latelobata*, on the basis of similar sutures.

Occurrence : Coniacian ; Mungo River Formation, Bombe, Southern Cameroons ; upper part of the Awgu-Ndeaboh Shales, Awgu, Onitsha Province.

Collector : The author.

Tissotia cf. *polygona* Solger

- 1904 *Tissotia polygona* Solger, p. 161, figs. 50, 51a, b.

Remarks : A single poorly-preserved specimen with the polygonal outline and general appearance of Solger's species. The venter bears a median keel flanked by ventrolateral keels.

Occurrence : Coniacian ; upper part of the Awgu-Ndeaboh Shales, Awgu, Onitsha Province.

Tissotia sp. juv.

Plate XVI, fig. 4

Remarks : There are several specimens of juvenile *Tissotia*, all clearly belonging to the same species, which apparently is not one of those described above. The most complete specimen, U.2780, is figured (Plate XVI, fig. 4) ; it is involute with smooth whorls that bear a relatively strong keel. The suture line is simple at this stage.

Occurrence : Coniacian ; Mungo River Formation, Bombe, Southern Cameroons.

Collector : The author.

Family SPHENODISCIDAE

Genus *Sphenodiscus* Meek, 1876

Type species : *Ammonites lobatus* Tuomey, 1854 (= *A. lenticularis* Owen, 1852 non Phillips, 1825).

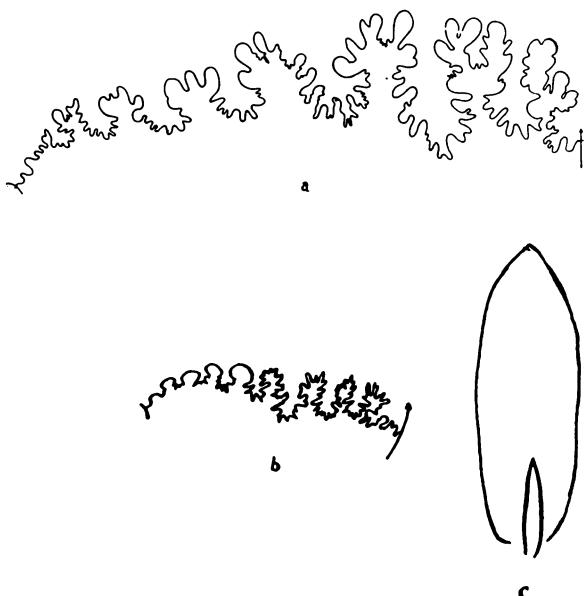
Sphenodiscus aff. *lobatus* (Tuomey)

Plate XXII, figs. 1a, b ; text-fig. 44

[*Synonymy in Diener (1925)*]

- 1954b *Sphenodiscus* aff. *lenticularis* (Owen), Reyment, p. 21.

Remarks : Several fragments, although somewhat weathered, agree well with the figures of *S. lobatus*



TEXT-FIG. 44—*a*, *Sphenodiscus* aff. *lobatus* (Tuomey). Suture line of B.M. No. C.47411. Twice natural size. *b*, *Sphenodiscus* cf. *pleurisepta* (Conrad). Suture line of St.591A. Natural size. *c*, *Sphenodiscus* cf. *pleurisepta* (Conrad). Whorl section (slightly distorted by crushing) of St.591A. Natural size.

PLATE XXI
(opposite)

- FIG. 1. *Libycoceras afikpoense* sp. nov. Paratype. Specimen enlarged to show the suture line. Maestrichtian. Nkporo Shales, Owutu Edda, Ogoja Province. (B.M. No. C.47416). ($\times 3$). Page 89.
- FIG. 2. *Libycoceras afikpoense* sp. nov. Holotype. (a) Side view ; (b) ventral view. Maestrichtian. Nkporo Shales, Owutu Edda, Ogoja Province. (B.M. No. C.47403). Page 89.
- FIG. 3. *Hoplitooides gibbosulus gibbosulus* (von Koenen). Ventral view of the specimen figured in Plate XXII, fig. 2. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47374). Page 81.
- FIG. 4. *Gombeoceras gongilense* (Woods). Specimen transitional to *G. koulabicum* (Kler). Lower Turonian. Gombe Division, Bauchi Province. (B.M. No. C.28297). Page 63.



in the literature, particularly with those of Meek (1876, p. 473, text-fig. 66). The fragments indicate that the ammonite was strongly compressed, with a high whorl section, very narrow umbilicus and a sharp venter. The surface is smooth and the suture like that of *S. lobatus*. *S. beecheri* Hyatt has a similar suture, but is much more inflated (cf. text-fig. 44).

Occurrence : Maestrichtian ; Nkporo Shales, Anofia, Afikpo Division, Ogoja Province.

Collector : The author.

Sphenodiscus sp. indet.

Remarks : The fragments referred here are distinguished from the above by their squat sutural elements and their tendency to develop faint ribs. The venter is sharp. They somewhat resemble *S. pleurisepta* (Conrad).

Occurrence : Maestrichtian ; Nkporo Shales, Anofia, Afikpo Division, Ogoja Province.

Collector : J. R. T. Hazell.

Sphenodiscus cf. *pleurisepta* (Conrad)

Text-figs. 44b, c

1955b *Sphenodiscus* sp., Reyment, p. 128.

Description : An entire, slightly crushed specimen, a sandstone cast, is referred here. Unfortunately it is not well enough preserved to show the surface ornament and it is only possible to state that broad, sigmoidal ribs can be traced on the septate part, but not on the body chamber. Faint traces of five clavate ventrolateral and three weaker mediolateral tubercles are also discernible. The suture is, however, moderately well preserved and is depicted in text-fig. 44b. The early whorls are strongly compressed and the venter sharp. On the last whorl the venter gradually becomes fastigate and finally, on the last part of the last whorl, sharply rounded.

Measurements :

St.591A

diameter 90 mm. = 1·00

thickness 19 mm. = 0·21 (crushed
slightly)

umbilicus ?

height of last whorl 13 mm. = 0·14

Remarks : This form agrees fairly well with *Sphenodiscus pleurisepta* (Conrad) as figured by Hyatt (1903) (see particularly pl. III, figs. 8, 13 ; pl. V, fig. 3). The suture line of the form figured on pl. V, fig. 1 agrees well, although in general the whorl

section of Conrad's species is more inflated. The differences may, however, be due to the slight crushing of the Nigerian specimen. *Sphenodiscus acutodorsatus* Noetling from India is also similar, but its whorl section is different and the suture line more closely resembles that of *Indoceras* Noetling. The suture of the Nigerian species is that of a normal *Sphenodiscus* with two adventitious lobes as large as the first lateral lobe (see text-fig. 44b).

Occurrence : Maestrichtian ; Upper Coal Measures ?, Ubeze stream, near Ifon and Auchi, Auchi Division, Benin Province.

Repository : Shell D'Arcy Headquarters, Owerri.

Collector : J. P. Studer.

Genus **Libycoceras** Hyatt, 1900

Libycoceras afikpoense sp. nov.

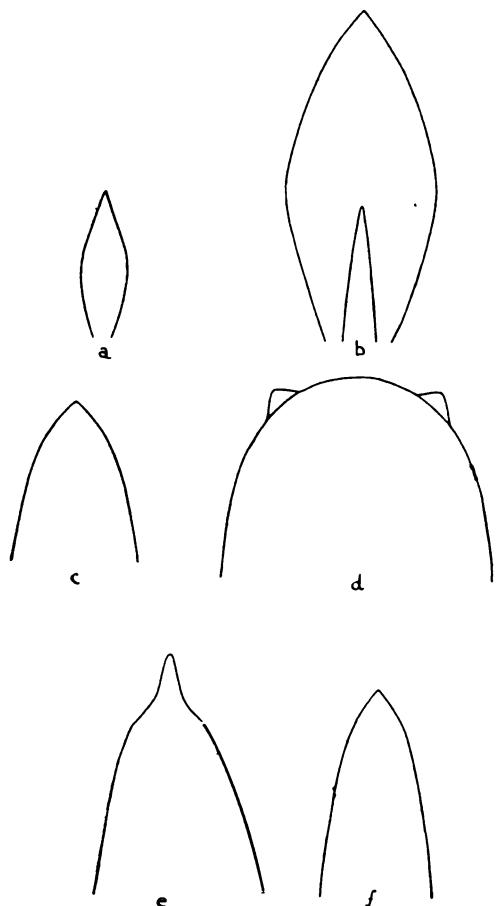
Plate XXI, figs. 1, 2a, b ; Plate XXII, figs. 6a, b ;
Plate XXIII, fig. 2 ; text-figs. 45a-d

1954b *Libycoceras ismaelis* (Zittel), Reyment, p. 21.

Holotype : B.M. No. C.47403 ; Nkporo Shales, Owutu Edda. Plate XXI, figs. 2a, b.

Description : Study of a large number of individuals shows that the development of this species proceeds as follows :—

1. Radius 0·75 mm., whorls globular.
2. Radius 5 mm., venter begins to sharpen and the shell becomes slightly compressed.
3. Radius 17·5 mm., venter now sharp (Plate XXI, fig. 1), flanks bear feeble folds. Suture contains seven saddles.
4. Radius 24·5 mm., keel sharp, maximum thickness 13 mm. dorsad from venter.
5. Radius 30 mm., keel attains maximum development. Faint, clavate tubercles cap broad, feeble ribs and weak mediolateral tubercles appear on the flanks. Two ventrolateral tubercles are united to each mediolateral tubercle.
6. Radius 38 mm., ventrolateral tubercle now stronger and more elongated. Keel blunter.
7. Radius 48 mm., ribs have almost disappeared. Mediолateral tubercles weaker. Venter uneven owing to degeneration of keel. Suture contains nine saddles.
8. Radius 55 mm., ventrolateral tubercles now large, flattened, clavate. Keel entirely absent, venter broadly rounded but with siphonal ridge. Mediолateral tubercles small.



TEXT-FIG. 45—Development of the whorl section in *Libycoceras*.
a-d, Development of the whorl section of *Libycoceras afikpoense* sp. nov. showing the gradual rounding off of the venter with increase in size. e-f, *Libycoceras ismaelis* (Zittel) (after Quaas, 1902); fig. e shows the keeled whorl section of the body chamber and fig. f a rounded, unkeeled inner whorl. Natural size.

Measurements :

C.47403

diameter	135 mm.	= 1.00
thickness	35 mm.	= 0.26
umbilicus	9 mm.	= 0.07

height of last whorl 41 mm. = 0.30

Remarks : Three species of *Libycoceras* have already been described; they are: *L. angolaense* Haughton from Angola, distinguished by its fine ribs that fade dorsally; *L. chargeense* Blanckenhorn from Libya, said to be characterized by its complete lack of ornament; and *L. ismaelis* (Zittel). *L. angolaense* closely resembles *ismaelis* and is probably a variety of it. The writer has examined a fine specimen of

L. chargeense, which shows faint ventrolateral tubercles; it, too, may be a subspecies of *L. ismaelis*.

One variety of the type species, *L. ismaelis soudanense*, has been recorded by Pérébaskine and is distinguished by sutural differences and the nature of the mediolateral tubercles. The species here described differs from its nearest relative, *L. ismaelis*, in losing its keel and developing a smoothly rounded venter (see text-figs. 45a-d), whereas *L. ismaelis* develops a prominent keel on the body chamber and adult whorls (see text-figs. 45e-f).

Some specimens¹ in the present collection, from shale excavated near Gombe, Bauchi Province (Plate XIX, fig. 3; Plate XX, fig. 4) (cf. Reyment, 1954d, p. 503), do not appear to be referable to *L. afikpoense* and are most probably juvenile examples of *L. ismaelis* (Zittel).

Occurrence : Maestrichtian; Nkporo Shales, Anofia, Amamgbala, Owuto Edda, Afikpo Division, Ogoja Province; Nkerefi, Eha Amufu, Nsukka Division, Onitsha Province.

Collectors : J. R. T. Hazell, the author.

¹ All preserved in the British Museum (Natural History), London. Collector—J. H. Thompson.

Family PERONICERATIDAE

Genus **Peroniceras** de Grossouvre, 1894

Type species : *Peroniceras moureti* de Grossouvre.

Remarks : This genus occurs fairly commonly in the Coniacian both of the Cameroons and of Nigeria. From the Mungo River, Solger (1904) recorded *P. dravidicum* (Kossmat). Riedel (1932) identified *P. czörnigi* (Redtenbacher) and *P. aff. cocchi* (Meneghini), and made the new species *P. latelobatum*. All these forms come from localities around Balangi from beds that almost directly underlie the small outcrop of Santonian-Campanian? age containing *Submortoniceras*? and *Texanites*. From Nigeria, the following species have been identified: *P. aff. dravidicum* (Kossmat), *P. czörnigi* (Redtenbacher), and *P. cf. westphalicum australe* Venzo. All these forms occur together in beds with *Tissotia awguensis* sp. nov. and its subspecies.

Peroniceras czörnigi (Redtenbacher)

Text-fig. 46d

- 1872 *Ammonites Czörnigi* Redtenbacher, p. 105, pl. XXIII, figs. 4a-c.
1894 *Peroniceras Czörnigi* Redtenbacher, de Grossouvre, p. 103, pl. XI, figs. 2a, b.

- 1897 *Peroniceras Czörnigi* Redtenbacher, Péron, p. 53, pl. XI, figs. 7, 8.
 1920 *Peroniceras Czörnigi* Redtenbacher, Desio, p. 210, pl. XIV, figs. 5a, b.
 1932 *Peroniceras czörnigi* Redt., Riedel, p. 143, pl. XXX, figs. 5, 5a.

Description : This species is characterized by the dense ribbing and the high whorl section. The venter bears three keels all of equal height, although the median keel is thicker. The ornament is feeble for the genus and consists of weak, spinate, umbilical tubercles and slightly stronger ventrolateral tubercles, set on weak, sigmoidal, slightly club-shaped ribs which often bifurcate. Intercalatories occur. There are about 27-28 main ribs and intercalatories on a half whorl.

Measurements :

Br.337B	
diameter	108 mm. = 1·00
thickness	29 mm. = 0·27
umbilicus	?
height of last whorl	54 mm. = 0·50

Remarks : *P. czörnigi* occurs also in the Coniacian of the upper part of the Mungo River Formation, Southern Cameroons. The specimen figured by Riedel (1932, p. 143) differs from the Nigerian example in that it is without ornament. The whorl sections and the sutures agree closely. *Peroniceras moureti* de Grossouvre differs from the form here recorded in the following respects : the ribbing is stronger and denser, the ribs bifurcate less frequently, the whorl section is squarer, and the ornament is generally stronger.

Occurrence : Coniacian ; Asu River, near Agbani, Udi Division, Onitsha Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. Br.337B).

Peroniceras cf. westphalicum australe Venzo

Text-fig. 46e

- 1936 *Peroniceras westphalicum* (Schl.) var. *australe* Venzo, p. 100, pl. IX, fig. 4 ; pl. XI, fig. 8.

Description : The specimen studied is fragmentary and not well preserved. The flanks are ornamented with well-spaced, flat ribs which weaken considerably about the middle of the flanks. The ribs are simple and each bears a rounded umbilical tubercle and a strong, nodate, ventrolateral tubercle. The whorl section is subquadrate and the venter bears three delicate keels of equal strength. The height of a well-preserved cross-section is 16 mm. and its breadth 19 mm.

Remarks : Unfortunately, the example referred here is too poorly preserved to permit of certain identification, although it closely resembles the figures of *P. w. australe* given by Venzo (1936). The whorl section of Venzo's specimen is less depressed than that of the Nigerian example, the umbilical tubercles are more prominent, and the median keel seems to be slightly more robust. *P. westphalicum westphalicum* (Schlüter) differs from *P. w. australe* Venzo in that its whorl section is less square and there are more ribs per whorl. *P. dravidicum* (Kossmat) is related to *P. westphalicum*, but has a different suture, the ribs do not weaken on the flanks, and the ventral keels are stronger.

Occurrence : Coniacian ; Asu River, near Agbani, Udi Division, Onitsha Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. Br.337C).

Peroniceras ? sp.

Text-fig. 46c

Description : A large, poorly preserved specimen ornamented with strong, bent ribs and three rows of tubercles. The umbilical tubercles are weak and bullate, the inner ventrolateral tubercles are strong and nodate, and the outer ventrolateral tubercles are strong and clavate. The presence of three rows of tubercles appears to be a late feature in the ontogeny of the ammonite ; the clavate row makes its appearance at a relatively advanced growth stage, apparently by development from the inner ventrolateral tubercles through the formation of oblique narrow tubercles which gradually move out on the venter and become stronger and clavate. The ribs are broad and bend forwards, particularly on the ventral part of the shell. There are three keels on the venter ; the median keel is the strongest. There are about 13-14 ribs to a half whorl. The whorl section is fairly high.

Measurements :

Br.337A

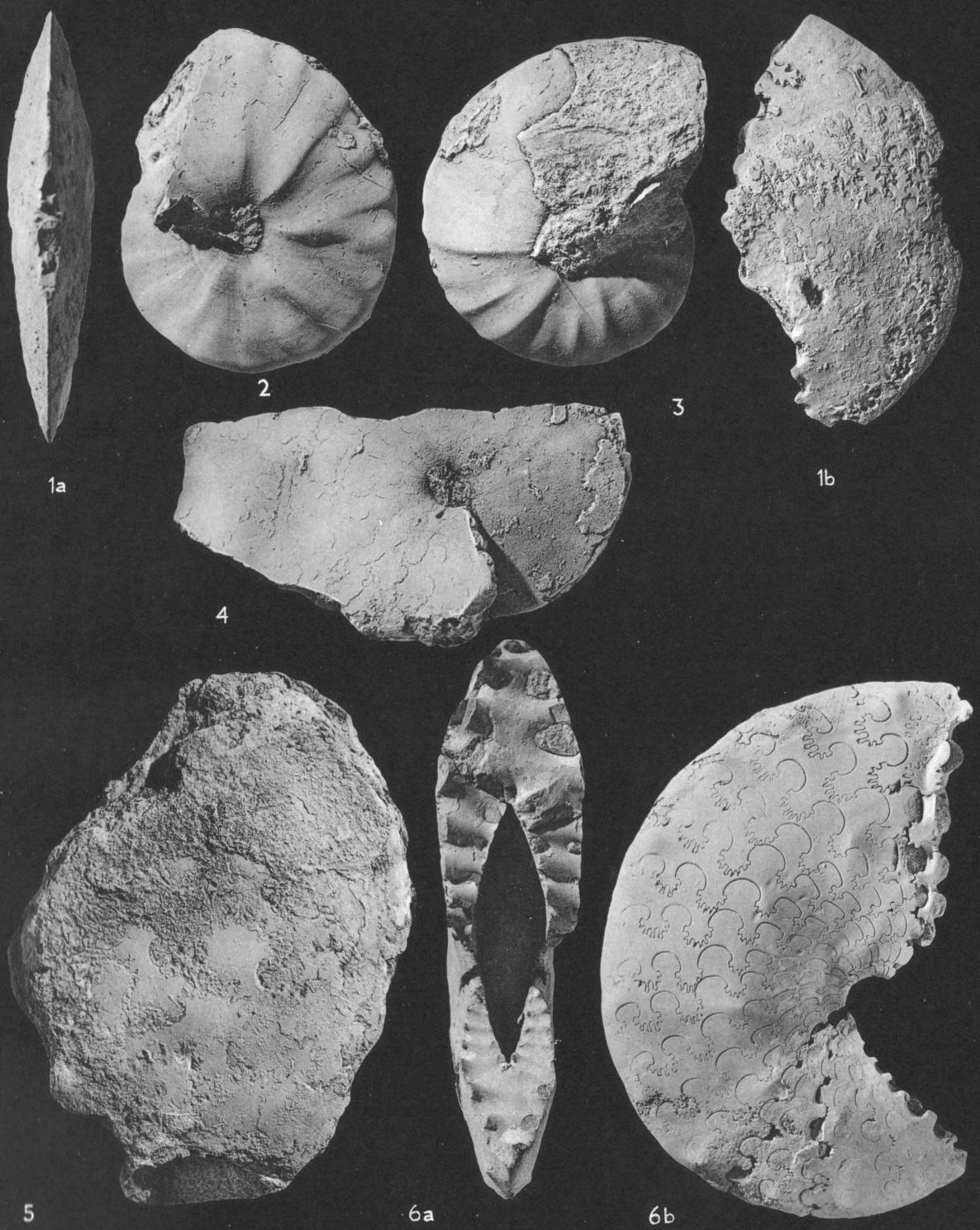
diameter	160 mm. = 1·00
thickness	?
umbilicus	?

height of last whorl 52 mm. = 0·31

Remarks : The specimen here recorded differs from many other *Peroniceras* in having three rows of tubercles, and in this respect it shows affinities with *Texanites* and *Subprionotropis*. In general form it resembles *P. dravidicum* (Kossmat). More material

PLATE XXII
(opposite)

- FIG. 1. *Sphenodiscus* aff. *lobatus* (Tuomey). (a) Ventral view ; (b) side view. Maestrichtian. Nkporo Shales. Anofia, Ogoja Province. (B.M. No. C.47411). Page 87.
- FIG. 2. *Hoplitooides gibbosulus gibbosulus* (von Koenen). Side view of the specimen figured in Plate XXI, fig. 3. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47374). Page 81.
- FIG. 3. *Pseudotissotia (Bauchioceras) nigeriensis* (Woods). Specimen showing the nature of the ornament. Lower Turonian. Gombe Division, Bauchi Province. (B.M. No. C.47407). Page 71.
- FIG. 4. *Hoplitooides* cf. *koeneni* Solger. Lower Turonian. Wadatta, near Makurdi, Benue Province. (B.M. No. C.47385). Page 78.
- FIG. 5. *Eulophoceras* sp. Coniacian. Awgu-Ndeaboh Shales, Awgu, Onitsha Province. (B.M. No. U.2585). Page 83.
- FIG. 6. *Libycoceras afikpoense* sp. nov. Paratype. (a) Inner view of the whorls showing the development of the venter ; (b) side view showing the development of the ornament. Maestrichtian. Nkporo Shales, Owutu Edda, Ogoja Province. (B.M. No. C.47404). Page 89.



is required before the exact affinities of the ammonite can be determined.

Occurrence : Coniacian ; Asu River, near Agbani, Udi Division, Onitsha Province.

Collector : R. Blaser, Shell D'Arcy.

Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland (specimen No. Br.337A).

Peroniceras sp..

Remarks : A single fragment (B.M. No. U.1778), consisting of the inner part of an ammonite shell bearing an almost entire suture and the impression of the ornament, is placed here. The ornament is composed of ribs, a keel, mediolateral and umbilical tubercles. The arrangement of the ornament and the nature of the suture line agree well with the figures given by Riedel (1932) for *P. latelobatum*.

Occurrence : Coniacian ; Mungo River Formation, Bombe, Southern Cameroons.

Collector : The author.

Peroniceras sp. indet.

Remarks : A large number of crushed impressions in black shale are referred here. They are too badly preserved to permit of further identification.

Occurrence : Coniacian ; Awgu-Ndeaboh Shales, near Awgu, Onitsha Province.

Collector : P. Bleser, Shell D'Arcy.

Genus *Texanites* Spath, 1932¹

Texanites cf. *quattuornodosus* (Lasswitz)

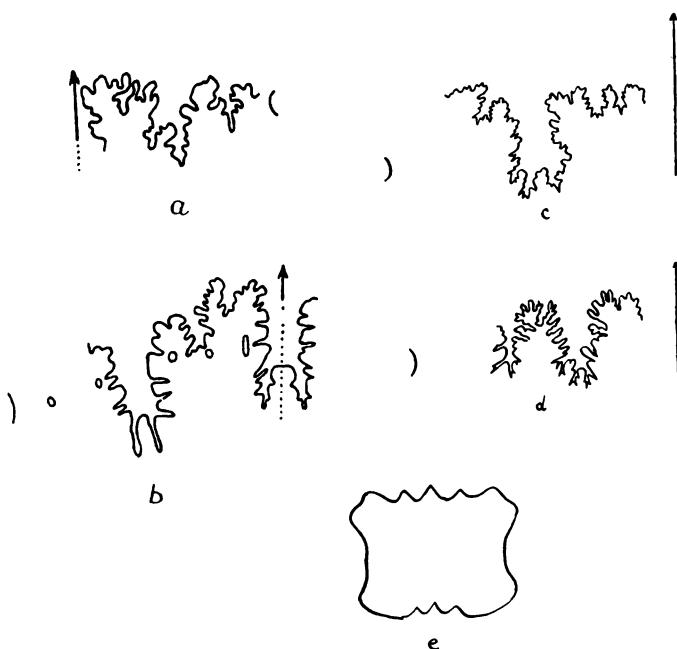
Plate XXIII, figs. 3a, b ; text-fig. 46a

1904 *Schlönbachia quattuornodosa* Lasswitz, p. 31, pl. VII, fig. 3, text-fig. 7.

1948 *Texanites quattuornodosus* Lasswitz, Collignon, p. 42.

Description : Moderately evolute, umbilicus fairly open. Shell much compressed but with flat venter. Keel prominent and without sulci. There are four rows of tubercles on each flank ; an umbilical row of bullate tubercles that eventually become prominent and spinate, a mediolateral row of weak tubercles, and clavate upper and lower ventrolateral tubercles. The ribs are usually divided, but intercalatories also occur on the outer part of the flanks. The specimen studied was originally half a

whorl larger, and has 13-14 umbilical tubercles, 13-14 mediolateral tubercles, and 30-32 ventrolateral tubercles per whorl. The suture is typical of *Texanites* (see text-fig. 46a).



TEXT-FIG. 46—*a*, *Texanites* cf. *quattuornodosus* (Lasswitz). Suture line of B.M. No. U.3400. *b*, *Submortoniceras* ? aff. *soutoni* (Baily). Suture line of specimen preserved at N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland ; the positions of the tubercles are marked. *c*, *Peroniceras* ? sp. Suture line of specimen No. Br.337A. *d*, *Peroniceras* *czornigi* (Redtenbacher). Suture line of specimen No. Br.337B. *e*, *Peroniceras* cf. *westphalicum australe* Venzo. Whorl section of specimen Br.337C. All figures natural size.

Remarks : *Submortoniceras* ? aff. *soutoni* (Baily) from the same locality has simple ribs, is larger, has five rows of tubercles to each flank, and is much more inflated. Lasswitz compared his species with *Texanites bontanti* (de Grossouvre) (1894, p. 77, pl. XVII, fig. 2), but it develops a fifth row of tubercles at an advanced growth stage and has simple ribs. *T. quattuornodosus* has simple ribs on the last whorl but the inner whorls exposed in the umbilicus show bifurcated ribs. Another species with only four rows of tubercles to a flank is *Texanites zeilleri* (de Grossouvre), but their arrangement differs from that on *T. quattuornodosus*, there being only one row of ventral but two of mediolateral tubercles. Collignon (1949) made this species the type of a new subgenus, *Paratexanites*, but as some *Texanites* do not develop a fifth row

¹ In the present Bulletin this group is included in Peroniceratidae. C. W. Wright has, however, been kind enough to point out that recent work of his indicates that Texanitidae Collignon may now have to be accepted. Both groups have diverged from Collignoniceratidae, but whereas they were once considered to be closely related, the present indications are that they are only rather distantly connected.

PLATE XXIII
(opposite)

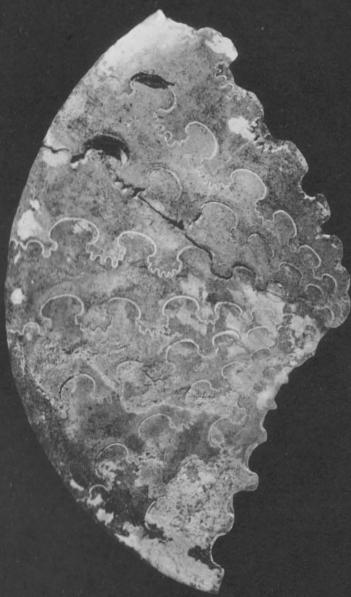
- FIG. 1. *Submortoniceras* (?) aff. *soutoni* (Baily). (a) Ventral view ; (b) side view. Santonian-Campanian (?). Mungo River Formation, Balangi, Cameroons. This specimen is preserved at N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland. Page 95.
- FIG. 2. *Libycoceras afikpoense* sp. nov. Paratype. Maestrichtian. Nkporo Shales. Owutu Edda, Ogoja Province. (B.M. No. C.47405). Page 89.
- FIG. 3. *Texanites* cf. *quattuornodosus* (Lasswitz). (a) Ventral view showing the parallel flanks ; (b) side view. Santonian-Campanian (?). Mungo River Formation, Balangi, Cameroons. (B.M. No. U.3400). Page 93.



1a



1b



2



3a



3b

of tubercles until a very mature stage, it seems doubtful whether *Paratexanites* represents a natural group. Collignon regards this subgenus as being ancestral to the Coniacian *Texanites*.

Occurrence : Santonian-Campanian?; Mungo River Formation, Balangi, Southern Cameroons.

Collector : The author.

Genus **Submortoniceras** Spath, 1926

Type species : *Mortoniceras woodsi* Spath.

Submortoniceras (?) aff. *soutoni* (Baily)

Plate XXIII, figs. 1a, b ; text-fig. 46b

- 1855 *Ammonites soutoni* Baily, p. 455, pl. XI, figs. 1a-c.
- 1895 *Mortoniceras soutoni* (Baily), Kossmat, p. 88, pl. IX, figs. 3, 4.
- 1906 *Mortoniceras soutoni* (Baily), Woods, p. 337, pl. XLIII, figs. 1a, b.
- 1921 *Mortoniceras* sp. aff. *soutoni* (Baily), Spath, p. 235.
- 1921 *Mortoniceras soutoni* (Baily), van Hoepen, p. 38, figs. 19-22, pl. X, XI.
- 1922 *Mortoniceras soutoni* (Baily), Spath, p. 136, pl. VII, fig. 4.
- 1950 *Texanites* cf. *soutoni* (Baily), Collignon, p. 78, pl. IX, figs. 1, 1a.
- 1953 *Submortoniceras soutoni* (Baily), Spath, p. 52.

Description : Evolute, umbilicus wide showing the inner whorls. Whorls higher than broad. Venter bears a continuous keel bordered on both sides by a shallow sulcus. The ribs are straight, fairly stout and low ; the interspaces are wide and shallow.

There are five rows of tubercles ; an umbilical row of high, bullate ones, an inner mediolateral row of inconspicuous tubercles, an outer mediolateral row some distance from the middle of the flanks, a fourth row of clavate ventrolateral tubercles, and a fifth prominent ventrolateral row, also clavate. The suture is shown in text-fig. 46b.

Remarks : This species is represented in the literature very variably, particularly its ribbing. The Cameroons specimen agrees fairly well with some of the figured specimens, notably those of van Hoepen (1921) and Woods (1906, p. 337, pl. XLIII). Collignon (1948) referred a specimen, *T. aff. soutoni*, to the Santonian-Campanian of Madagascar ; the general opinion is that the *soutoni*-group is typical of this period. *S. soutoni* has been recorded from the Upper Santonian of Pondoland.

Spath (1953, p. 52) pointed out that Collignon was in error in assigning *Ammonites soutoni* to *Texanites*. He added that *Submortoniceras soutoni* is close to the type species, *S. woodsi*.

Occurrence : Santonian-Campanian? ; Mungo River Formation, Balangi, Southern Cameroons.

Collector : J. U. Kappeler, Shell D'Arcy.

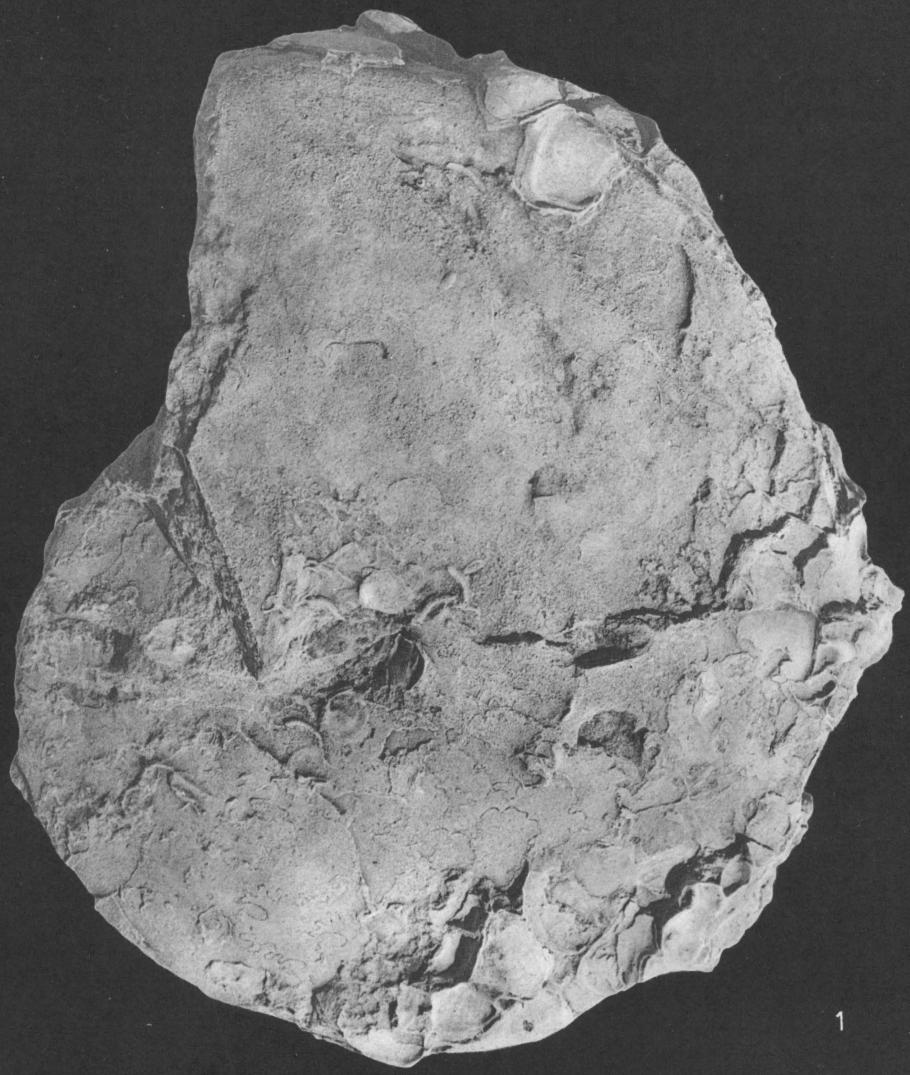
Repository : N. V. De Bataafsche Petroleum Maatschappij, The Hague, Holland.

List of New Species and Subspecies

<i>Gyaloceras ibo</i> sp. nov.	...	...	...	15	<i>Mammites mutabilis mutabilis</i> sp. nov.	51
<i>Desmoceras</i> (<i>Pseudouhligella</i>) <i>calabarens</i> sp. nov.	...	...	...	18	<i>Mammites mutabilis benueensis</i> subsp. nov.	53
<i>Euhystrichoceras occidentale</i> sp. nov.	...	...	...	19	<i>Pseudaspidoceras curvicostatum</i> sp. nov.	55
<i>Mortoniceras</i> (<i>Mortoniceras</i>) <i>evolutum amekaense</i> subsp. nov.	...	...	...	31	<i>Kamerunoceras jacobsoni</i> sp. nov.	59
<i>Mortoniceras</i> (<i>Durnovarites</i>) <i>levecostatum</i> sp. nov.	...	...	...	38	<i>Nigericeras ogojaense</i> sp. nov....	62
<i>Mortoniceras</i> (<i>Durnovarites</i>) <i>ishiaguense</i> sp. nov.	...	...	...	38	<i>Forresteria</i> (<i>Forresteria</i>) <i>serrata</i> sp. nov.	69
<i>Neokentroceras curvicornu crassicornutum</i> subsp. nov.	...	...	...	41	<i>Choffaticeras</i> (<i>Choffaticeras</i>) <i>spathi</i> sp. nov.	72
<i>Neoharpoceras densicostatum</i> sp. nov.	...	...	...	43	<i>Hoplitooides gibbosulus makurdiensis</i> subsp. nov.	83
<i>Mammites dixeyi dixeyi</i> sp. nov.	...	...	...	50	<i>Hoplitooides crassicostatus</i> sp. nov.	83
<i>Mammites dixeyi laevis</i> subsp. nov.	...	...	...	51	<i>Tissotia awguensis awguensis</i> sp. nov.	85
					<i>Tissotia awguensis collignoni</i> subsp. nov.	85
					<i>Tissotia awguensis falconeri</i> subsp. nov.	85
					<i>Libycoceras afikpoense</i> sp. nov.	89

PLATE XXIV
(opposite)

- FIG. 1. *Pseudotissotia (Wrightoceras) wallsi* (Reyment). Lower Turonian. Bauchi Province. (B.M. No. C.47421). Page 71.
- FIG. 2. *Hysteroeras* (?) sp. Upper Albian. The Upper Dutch Creek Marl, Washita Group, Tarrant County, Texas, U.S.A. Page 29.
- FIG. 3. *Hysteroeras* (?) sp. Upper Albian. The Upper Dutch Creek Marl, Washita Group, Tarrant County, Texas, U.S.A. Both the specimens figured as nos. 2 and 3 on this plate were collected by J. P. Conlin, and are preserved in the C. W. and E. V. Wright collection, London. Page 29.



Discussion of the Faunas

LOWER CRETACEOUS

ALBIAN

Although no exact correlation can yet be established with the zones and subzones of the classical Albian of Europe, the general succession of the Nigerian Albian is clear. Five faunas, each with a wide distribution, can be readily distinguished and are already proving useful for stratigraphical purposes. After further research they may provide the basis for a local zonal scheme which might be correlated eventually with the European zones described by Spath (1923-1943) and Breistroffer (1947). Only one stratigraphical name, the Asu River Group, has yet been published in connection with the Albian (Simpson, 1954); the type locality has not yielded any fossils.

1. *Middle of the Middle Albian* : These beds are characterized by the presence of oxytropidoceratids. The following ammonites were collected from various localities in Tiv and Lafia Divisions, Benue Province:

- Oxytropidoceras (Oxytropidoceras) cf. bravoense* (Böse)
- Oxytropidoceras (Androiavitae) aff. paucituberculatum* Collignon
- Oxytropidoceras (Androiavitae) cf. besairiei* Collignon
- Oxytropidoceras (Manuaniceras) aff. bōsei* Knechtel
- Oxytropidoceras (Manuaniceras) aff. appanatum* Collignon
- Oxytropidoceras (Manuaniceras) cf. ornatum* Besairie

2. *Top of the Middle Albian to the bottom of the Upper Albian* : The following fauna was obtained from the shales at Nkpume, about 100 miles south of the area mentioned above, and indicates a slightly younger stratigraphical level:¹

- Diploceras aff. cristatum* (Deluc MS.) Brongniart
- Diploceras aff. bouchardianum* (d'Orbigny)
- Hysteroceras* sp.

About 60 miles north-east of Nkpume, near the town of Ogoja, *Neoharpoceras densicostatum* sp. nov. suggests the presence of slightly younger beds.

3. *Bottom of the Upper Albian* : A fairly rich fauna, in which true *Mortoniceras* first make their appearance, has been collected from Nkpugwu, Onyikwo and Ibenta, immediately south of Ndi Osia and Nkpume.

The fauna from Nkpugwu Onyikwo contains :

- Diploceras quadratum* Spath ?
- Hysteroceras aff. binum* (Sowerby)
- Hysteroceras orbignyi* Spath
- Hysteroceras aff. semileve* Haas
- Hysteroceras aff. multifalcatum* (van Hoepen)
- Mortoniceras (Mortoniceras) priciei* (Spath)
- Mortoniceras (Mortoniceras) aff. priciei* (Spath)
- Mortoniceras (Mortoniceras) subtrotundum* (Spath)
- Elobiceras cf. intermedium* Spath

The fauna from Ibenta contains :

- Hysteroceras binum* (Sowerby)
- Mortoniceras (Mortoniceras) kiliani* (Lasswitz)
- Mortoniceras (Mortoniceras) cf. romeri* (Haas)
- Mortoniceras (Mortoniceras) aff. multicotatum* (van Hoepen)
- Mortoniceras (Mortoniceras) sp.*
- Elobiceras cf. subelobioense* Spath

4. *Middle of the Upper Albian* : Numerous localities in the shales and sandstones around Nwofe, Abakaliki Town, Nyeba, Ameka, and Bansara have yielded ammonites belonging to the *Mortoniceras-Elobiceras* zone of the African Albian.

(a) Nwofe :

- Gyaloceras ibo* sp. nov.
- Mortoniceras (Mortoniceras) evolutum* (Spath)
- Elobiceras* sp. indet.

(b) Abakaliki Town :

- Gyaloceras ibo* sp. nov.
- Neokentroceras curvicornu crassicornutum* subsp. nov.
- Prohysteroceras wordiei* Spath
- Elobiceras lobitoense* (Crick MS.) Spath
- Elobiceras aff. dencostatum* (Crick MS.) Spath
- Mortoniceras (Mortoniceras) quadrinodosum* Spath
- Mortoniceras (Mortoniceras) cf. barbouri* (Haas)
- Mortoniceras (Mortoniceras) aff. wintoni* (Adkins)

(c) Nyeba, Ameka, Ameri :

- Gyaloceras ibo* sp. nov.
- Neokentroceras curvicornu curvicornu* Spath
- Prohysteroceras* sp. juv.
- Mortoniceras (Mortoniceras) cf. pachys* (Seeley)
- Mortoniceras (Mortoniceras) cf. nodoso-costatum* (van Hoepen)
- Mortoniceras (Mortoniceras) quadrinodosum* Spath
- Mortoniceras (Mortoniceras) evolutum amekense* subsp. nov.
- Elobiceras angustum* Spath
- Elobiceras lobitoense* (Crick MS.) Spath
- Elobiceras* sp. indet.

(d) Echi Aliki :

- Mortoniceras (Mortoniceras) quadrinodosum* Spath
- Mortoniceras (Angolaites) gregoryi* (Spath)
- Hamites* ? sp.

(e) Bansara :

- Gyaloceras ibo* sp. nov.
- Mortoniceras (Mortoniceras) quadrinodosum* Spath
- Mortoniceras (Mortoniceras) cf. nodoso-costatum* (van Hoepen)

It is of interest to note the presence of this zone in the limestone at Arufu, Wukari Division, Benue Province,¹ where it is represented by *Elobiceras newtoni* Spath. These deposits occur in contact with Turonian beds containing *Choffaticeras spathi* sp. nov.

5. *Top of the Upper Albian* : This zone is of the same age as the European *dispar* zone. The follow-

¹ Already remarked upon by Spath (1928, p. 52).

¹ See also Spath (1928).

ing species have been found in the shales at Ishiagu :

- Stoliczkaia africana* Pervinquier
Anisoceras perarmatum Pictet and Campiche
Mortoniceras (Durnovarites) depresso Spath
Mortoniceras (Durnovarites) quadratum Spath
Mortoniceras (Durnovarites) levecostatum sp. nov.
Mortoniceras (Durnovarites) ishiaguense sp. nov.
Mortoniceras (Angolaites) gregoryi (Spath)

UPPER CRETACEOUS
CENOMANIAN

The only Cenomanian yet known in Nigeria occurs in the limestones and shales of the Odukpani Formation (see page 11). The following ammonites have been identified :

- Metoicoceras* aff. *ornatum* Moreman
Metoicoceras sp. juv.
Metoicoceras sp. indet.
Phylloceras cf. *velledae* (Michelin)
Desmoceras latedorsatum (Michelin)
Desmoceras (Pseudouhligella) calabarensis sp. nov.
Turritiles (Euturritiles) scheuchzerianus Bosc
Euhystrichoceras occidentale sp. nov.
Forbesiceras sculptum Crick
Calycoceras sp. indet.

The *Euhystrichoceras* and the *Pseudouhligella* were found in a lower horizon than the other forms listed, which suggests that both early and late Cenomanian are present. The association of *T. scheuchzerianus* and *Metoicoceras* is indicative of late Cenomanian.

TURONIAN

In this paper the stage is regarded as consisting of the Upper and Lower Turonian.

LOWER TURONIAN

As mentioned in a previous paper (Reyment, 1954a), two distinct horizons are recognizable in the Nigerian Lower Turonian. Beds with *Choffaticeras spathi* sp. nov. at Arufu, Keana, and New Kumberi are probably of fairly early Lower Turonian age. This species also occurs at Wase together with *Ezilloella* sp. indet. and other vascoceratids.

(a) The Oldest Beds¹ :

The following species have been obtained from the Lower Limestones and the Calcareous Beds in Bauchi and Bornu Provinces :

- Pseudotissotia (Bauchioceras) nigeriensis* (Woods)
Pseudotissotia (Bauchioceras) tricarinata (Reyment)
Pseudotissotia (Wrightoceras) wallsi (Reyment)

- Pseudaspidoferas paganum* Reyment
Gomeoceras koulabicum (Kler)
Gomeoceras gongilense (Woods)
Gomeoceras (?) bulbosum Reyment
Gomeoceras subtenuis Reyment
Pachyvascoferas costatum Reyment
Pachyvascoferas globosum Reyment
Pachyvascoferas proprium *proprium* Reyment
Pachyvascoferas proprium plenum Reyment
Vascoferas nigeriense Woods

The top of the Odukpani Formation has yielded *Glebosoceras glebosum* Reyment, *Pseudotissotia (Bauchioceras) ?* sp., *Coilopoceras* sp. indet., and *Pseudaspidoferas* sp. indet. From the Konshisha River section near Oturkpo poorly preserved examples of *Pseudotissotia (Bauchioceras)*, *P. (Wrightoceras)*, *Gomeoceras*, and *Pseudaspidoferas* have been collected. *Choffaticeras (Leoniceras) cf. massipianum* Pervinquier from the Afikpo area may be of early Turonian age, since the beds from which the specimen was obtained occur in contact with the Upper Albian. The limestones and shales of the Ezillo area, Nkalagu Division, Ogoja Province yielded the following fauna :

- Pseudaspidoferas curvicostatum* sp. nov.
Ezilloella ezilloensis Reyment
Nigericeras ogoense sp. nov.
Paravascoferas aff. chevalieri (Furon)
Pachyvascoferas costatum Reyment
Pachyvascoferas cf. globosum Reyment
Mammites dixeyi dixeyi sp. nov.
Mammites dixeyi laevis subsp. nov.
Coilopoceras aff. lesseli Brüggen

These beds belong to the Eze-Aku Shales.

Anapachydiscus cf. linderi (de Grossouvre) ? has been found near Lokpauku, between Ishiagu and Awgu, in beds probably belonging to this zone. *Coilopoceras aff. colleti* Hyatt and *Glebosoceras glebosum* Reyment have been collected from the Ogoja area.

(b) The Intermediate Beds :

This zone appears to be confined to south-eastern Nigeria and the Cameroons. The following species are known from Mundame in the lower part of the Mungo River Formation.

- Watinoferas aff. reesidei* Warren
Watinoferas aff. amudariense (Arkhanguelskey)
Neptychites telinaeformis Solger
Neptychites perovalis (von Koenen)
Neptychites crassus Solger
Hoplitoites ingens ingens (von Koenen)
Hoplitoites ingens laevis Solger
Hoplitoites ingens costatus Solger
Hoplitoites gibbosulus gibbosulus (von Koenen)
Hoplitoites gibbosulus bipartitus Solger
Hoplitoites wohltmanni (von Koenen)
Hoplitoites koeneni Solger
Kamerunoceras eschii (Solger)
Pachydesmoceras kamerunense (von Koenen)
Choffaticeras (Choffaticeras) koeneni (Riedel)

¹ For an explanation of this terminology see Reyment (1954a).

The following species were collected from the limestone near Makurdi :

- Hoplitoites ingens* (von Koenen)
Hoplitoites gibbosulus gibbosulus (von Koenen)
Hoplitoites gibbosulus bipartitus Solger
Hoplitoites gibbosulus makurdensis subsp. nov.
Hoplitoites crassicostatus sp. nov.
Hoplitoites koeneni Solger
Hoplitoites cf. wohlmanni (von Koenen)
Mammites mutabilis mutabilis sp. nov.
Mammites mutabilis benueensis subsp. nov.
Benuites benueensis Reymont
Benuites spinosus Reymont
Kamerunoceras jacobsoni; p. nov.
Coilo poceras (?) sp.

The limestones and shales at Igumale have yielded the following fauna from their outcrops in the Icheri River :¹

- Neptychites telingaeformis* Solger
Hoplitoites ingens (von Koenen)
Hoplitoites gibbosulus (von Koenen)
Mammites cf. afer Pervinquière

UPPER TURONIAN

This substage is not well known in Nigeria, but it seems probable that the beds at Ediki in the lower part of the Mungo River Formation may belong here. In a previous paper (Reymont, 1954a) the author referred to this horizon as the "Youngest Beds". The following species are known :

- Romaniceras uchauxiense* Collignon
Romaniceras aff. devereioide (de Grossouvre)

It seems likely that the Upper Turonian is present in the Lamja area of north-eastern Nigeria (see p. 72) where an interesting intermediary form has been found in a limestone a short distance west of Falu.

SENONIAN

CONIACIAN

The Coniacian appears to contain two definite horizons, one marked by the presence of species of *Barroisiceras* and the other by species of *Tissotia*, but the relationship between them is not yet clear.

(a) The beds at Bombe in the upper part of the Mungo River Formation contain :

- Solenites brancii* (Solger)
Solenites armatus (Solger)
Forresteria (Reesideoceras) camerounensis (Basse)
Forresteria (Harleites) harlei (de Grossouvre)
Tissotia latelobata Solger
Tissotia polygona Solger
Tissotia spp. indet.
Peroniceras latelobatum Riedel
Peroniceras czornigi (Redtenbacher)
Peroniceras aff. czornigi (Redtenbacher)
Peroniceras aff. cocchi Meneghinini
Pachydiscus cf. stallaensis Imkeller

¹ *Pseudotissotia (Wrightoceras) wallsi* (Reymont) occurs in beds underlying this.

(b) The Upper Limestones near Lamja have yielded the following meagre fauna from a locality south of Dukul :

- Solgerites tuberculatus* Reymont
Solgerites sp. indet.
Forresteria (Harleites) harlei (de Grossouvre)

(c) The following ammonites have been collected from the Awgu-Ndeaboh Shales one mile south of Awgu :

- Tissotia latelobata* Solger
Tissotia cf. polygona Solger
Tissotia awguensis awguensis sp. nov.
Tissotia awguensis collignoni subsp. nov.
Tissotia awguensis falconeri subsp. nov.
Eulophoceras sp.
Onitshoceras matsumotoi Reymont
Peroniceras sp. indet.
Texanites (?) sp.

The following species were collected from the same formation to the north of the above locality :

- Forresteria (Forresteria) serrata* sp. nov.
Barroisiceras (Barroisiceras) sp. indet.

From the Asu River, near Agbani, come the following :

- Tissotia awguensis awguensis* sp. nov.
Tissotia awguensis collignoni subsp. nov.
Tissotia awguensis falconeri subsp. nov.
Peroniceras czornigi (Redtenbacher)
Peroniceras cf. westphalicum australe Venzo
Peroniceras ? sp.

SANTONIAN

The sandstones at Balangi in the upper part of the Mungo River Formation are referred to this substage. The following species have been collected :

- Texanites cf. quattuornodosus* (Lasswitz)
Submortoniceras (?) aff. *soutoni* (Baily)

MAESTRICHTIAN

Some of the Nigerian Maestrichtian is richly fossiliferous, especially in the Afikpo Division of Ogoja Province. The following species were collected from the Nkporo Shales at Anofia,¹ Amamgbala, and Owatu Edda :

- Libycoceras afikpoense* sp. nov.
Sphenodiscus aff. lobatus (Tuomey)
Sphenodiscus sp.
Pachydiscus aff. stallaensis Imkeller
Baculites cf. asper Morton
Bostrychoceras sp.
Didymoceras hornbyense (Whiteaves)

Maestrichtian molluscs together with *Libycoceras* sp. juv. occur in shales about three miles east of Gombe. Fragments of a sphenodiscid have been found with Maestrichtian fish remains near Sokoto. *Sphenodiscus cf. pleurisepta* (Conrad) is known from the sandstones near Auchi, Benin Province.

¹ The gastropods and lamellibranchs were described in a recent paper (Reymont, 1955b).

Comparison with other Countries

(a) *Angola*

The agreement with the Angolan faunas, particularly with those of the Albian and Maestrichtian, is striking and there are many species common to the two areas. *Elobiceras*, originally recorded from the Elobi Islands off the coast of Angola (Szajnocha, 1885), is well represented in Nigeria. Haughton (1925), Haas (1942) and Spath (1922, 1951) have recorded Albian and Maestrichtian forms.

The Albian species common to the two areas are :

- Dipoloceras quadratum* Spath
- Prohysteroferas wördei* Spath
- Neokentroceras curvicornu* Spath
- Elobiceras lobitense* (Crick MS.) Spath
- Elobiceras angustum* Spath
- Elobiceras newtoni* Spath
- Mortoniceras (Angolaites) gregoryi* Spath
- Mortoniceras (Mortoniceras) evolutum* (Spath)
- Mortoniceras (Mortoniceras) subtrotundum* (Spath)
- Mortoniceras (Durnovarites) depresso* Spath
- Mortoniceras (Durnovarites) quadratum* Spath

The Nigerian Maestrichtian has a species of *Didymoceras* in common with Angola, and the following genera are also found in the two countries : *Sphenodiscus*, *Libycoceras*, *Bostrychoceras*, and *Baculites*. The rocks containing them must be regarded as being exactly contemporaneous.

(b) *Niger Territory (A.O.F.)*

It is rather surprising that better agreement does not exist between the Turonian of northern Nigeria and that of Damergou. *Nigericeras*, *Vascoceras*, *Pachyvascoceras*, *Paravascoceras*, *Gombeoceras*, *Pseudotissotia (Bauchioceras)* and *Coilopoceras* indicate that the Damergou fauna is of Lower Turonian age, and roughly equivalent to the oldest beds belonging to that stage. The absence of *Pseudaspidoceras*, however, is unexpected. The presence of Cenomanian in these rocks is indicated by *Neolobites vibreyanus*, a typical Upper Cenomanian species, as yet unknown from Nigeria. *Libycoceras ismaelis* (Zittel) has been recorded from the eastern part of the French Sudan (Pérébaskine, 1932) and it seems probable that the Maestrichtian of Gombe Division is connected directly with the rocks of this area rather than with those of south-eastern Nigeria, where another species of *Libycoceras* occurs (Reyment, 1955b). These deposits belong to the coastal Maestrichtian.

(c) *Gabon*

The Cretaceous of this area is not yet well known.

Choffaticeras, *Pseudotissotia (Bauchioceras)*, and *Fagesia* have been recorded from the Lower Turonian, and *Peroniceras*, *Texanites* (?), and *Solgerites* from the Coniacian. The author has recently identified *Pseudotissotia (Wrightoceras) wallssi* in a collection made near Libreville (see p. 71).

(d) *Madagascar*

There is a considerable correspondence between the faunas of the Malagasy and Nigerian Albian, but less between those of succeeding deposits. Collignon, Besairie, Hourcq, and Basse have brought to light many rich faunas ; the subdivisions of the Albian proposed by Collignon appear to be applicable to Nigeria. Species found in both regions include :

- Hysteroferas orbignyi* Spath
- Hysteroferas binum* (Sowerby)
- Mortoniceras (Mortoniceras) kiliani* (Lasswitz)
- Mortoniceras (Mortoniceras) quadrinodosum* Spath
- Mortoniceras (Durnovarites) depresso* Spath

Closely related species of *Oxytropidoceras (Oxytropidoceras)*, *O. (Manuaniceras)*, and *O. (Androiavitae)* also occur. The Cenomanian of Madagascar contains a large fauna that includes the genera *Euhystrichoceras*, *Forbesiceras*, and *Turrilites*, found also in Nigeria. *Romaniceras uchauense* Collignon and other closely related species of *Romaniceras* occur in the Turonian of both countries, as does *Neptychites telingaeformis* Solger. The Nigerian Coniacian contains a species of *Forresteria* rather similar to *F. (F.) alluaudi*. Many peroniceratids are known from the Malagasy Senonian.

(e) *South Africa*

There is little agreement between the South African and Nigerian Albian faunas, although some related forms occur. It seems probable that the richly fossiliferous horizons in the South African Albian are poorly represented in the Northern Hemisphere. *Forbesiceras*, three species of which occur in Zululand, has been found in the Nigerian Cenomanian.

There appears to be some uncertainty in the literature concerning the dating of the Natal Senonian fauna (Spath, 1953, p. 50), mainly owing to differing interpretations of the stratigraphic ranges of *Eulophoceras* and *Texanites* s. l. An undoubtedly *Eulophoceras* occurs in Nigeria in beds of Coniacian age (see also Hourcq, 1949). The high Maestrichtian *Sphenodiscus-Libycoceras* horizon appears to be absent in South Africa.

(f) *North Africa and the Middle East*

Pervinquieré (1907, 1910) recorded a large Cretaceous fauna from Tunisia and another from Algeria. The North African Albian is more complete than the Nigerian, but the number of species in common is small. The Cenomanian contains *Euhystrichoceras* and *Turrilites*. There is good agreement between the Turonian of Tunisia and north-eastern Nigeria. Younger elements, similar to the fauna found at Makurdi, are also known from Tunisia. The following genera are common to both areas : *Pseudotissotia* (*Wrightoceras*), *Mammites*, *Pseudaspidoceras*, *Fagesia*, *Vascoceras*, *Pachyvascoceras*, *Paramammites*, *Choffaticeras* (*Choffaticeras*), *Choffaticeras* (*Leoniceras*), and *Neptychites*.

The Algerian Turonian contains *Romaniceras*, *Hoplitooides*, *Neptychites*, and *Mammites*, which also occur in Nigeria. The Coniacian contains *Hoplitooides*, *Peroniceras*, *Barroisiceras* s. l., and *Tissotia*, which are also known from Nigeria and the Cameroons. The fauna of the Nigerian Santonian is poor. Pervinquieré attributed a Tunisian fauna containing species of *Bostrychoceras*, *Sphenodiscus*, and *Texanites* s. l. to the Campanian, but it clearly represents both Maestrichtian and Campanian.

The Cretaceous faunas of Syria, Lebanon, and Egypt are similar to those of Tunisia. The Maestrichtian of Libya and Egypt contains *Libyoceras*, which apparently does not occur in Tunisia.

(g) *South America*

The Lower Turonian of Brazil has a fauna that contains *Pachyvascoceras* and *Pseudaspidoceras*; in Colombia the Lower Turonian has yielded *Mammites afer* and *Coilopoceras*. The Coniacian of Colombia resembles that of Nigeria, and the following common genera and species have been recorded : *Barroisiceras*, *Forresteria* (*Harleites*), *Solgerites brancoi* (Solger), and *Hoplitooides* cf. *ingens*. *Solgerites brancoi* has also been recorded from the Lower Turonian of Peru and Venezuela.

(h) *Gulf of Mexico*

Many ammonites similar to Nigerian forms have been recorded from Texas and Mexico. The Texan Albian contains a rich fauna of mortoniceratids that is rather like the Nigerian fauna. *Diploceras*, *Prohysterooceras*, *Mortoniceras*, *Oxytropidoceras*, and *Stoliczkaia* are found in both regions.

The Cenomanian faunas contain related species of *Euhystrichoceras*, *Turrilites*, and *Metoicoceras*. The similarity of the Lower Turonian faunas of Texas

and Nigeria is particularly striking. The following genera are shared : *Pseudotissotia* (*Bauchioceras*), *P. (Wrightoceras)*, *Vascoceras*, *Pachyvascoceras*, *Mammites*, *Pseudaspidoceras*, *Neptychites*, and *Paramammites* (see Böse, 1918 ; Kummel and Decker, 1954). The Maestrichtian rocks of the Gulf Coast contain *Sphenodiscus* and *Pachydiscus*.

(i) *Canada*

The Canadian Lower Turonian genus *Watinoceras* is found in the lower beds of the Mungo River Formation, Southern Cameroons, where a form closely related to the Canadian *Watinoceras reesidei* occurs. The Maestrichtian species, *Didymoceras hornbyense* (Whiteaves), which also occurs in Angola, is abundant in the Nigerian Maestrichtian

(j) *Western Europe*

The standard Albian succession at Folkestone has yielded a number of forms that have been found also in Nigeria. The Nigerian Albian, however, lacks all the hoplitids, so common in the English Gault, as well as representatives of the Phylloceratidae, Lytoceratidae, and Desmoceratidae. The following species are found in the Albian both of Nigeria and England :

- Mortoniceras* (*Mortoniceras*) *pricei* Spath
Mortoniceras (*Mortoniceras*) *kiliani* (Lasswitz)
Mortoniceras (*Mortoniceras*) *quadrinodosum* Spath
Hysteroceras *orbignyi* Spath
Anisoceras *perarmatum* Pictet and Campiche

As yet, no attempt at detailed correlation of the Nigerian with the Folkestone succession has been made. *Elobiceras* is unknown in the European Albian and seems to be confined to West Africa¹. The Nigerian Cenomanian is not yet sufficiently well known to permit of accurate comparisons with the standard European succession. *Turrilites scheuchzerianus* is a common fossil of the European Upper Cenomanian and *Euhystrichoceras* occurs in the Lower Cenomanian Warminster beds of southern England.

Closer correlation may be made in the Turonian, and it is noteworthy that the Lower Turonian (i.e., the beds with abundant vascoceratids—the Salmirian of the French authors) has closely comparable faunas throughout the world. As Spath (1953, p. 51) remarked, ". . . the successive faunal developments that mark our chronology are probably world-wide, at least in the case of

¹ The forms from the United States and other countries which have been referred to *Elobiceras* do not appear to belong to that genus.

ammonites". In Portugal, the Lower Turonian contains *Vascoceras*, *Pachyvascoceras*, *Pseudaspidoceras*, *Paramammites*, *Fagesia*, and *Choffaticeras* (*Leoniceras*). The Lower Turonian of Spain presents a slightly different aspect, but again resembles the Nigerian faunas in part. Genera common to both areas are *Mammites*, *Paramammites*, *Pachyvascoceras*, *Neptychites*, and *Pseudotissotia* (*Wrightoceras*).

The Senonian faunas of Western Europe differ in lacking *Libycoceras*, a truly African genus, in the Maestrichtian, and some of the African *Barroisiceras* do not seem to be known from the European Coniacian. *Eulophoceras*, which occurs in the Nigerian Coniacian and in the Coniacian-Campanian of Madagascar and South Africa, is apparently represented in the Spanish Coniacian (Hourcq, 1949).

(k) Turkestan (U.S.S.R.)

Gomeoceras koulabicum (Kler) occurs in the Lower Turonian both of Turkestan and Nigeria. A *Nigericeras*, similar to the strongly ornamented species described in this Bulletin (p. 63), has also been recorded. *Watinoceras amudariense* (Arkhanguelskey) (non var. *horridum*) is closely related to a form from the lower beds of the Mungo River

Formation, Southern Cameroons. Further work may perhaps show the two countries to have even more closely comparable faunas.

(l) Indo-Pacific Area

It is of interest to note the presence of *Gyaloceras* in both Nigeria and Queensland, although the latter occurrence is reported to be Aptian. Whitehouse (1929) has recorded *Prohysteroferas* from the Queensland Albian. A link with the Japanese Cenomanian is provided by the subgenus *Pseudouhligliella*, which is also found in south-eastern Nigeria. *Pachydesmoceras*, generally considered to be an exclusively Albian genus, occurs in beds of Turonian age in both the Cameroons and Japan.

Comparison of the rich Indian faunas with those of Nigeria shows that many genera and some species are identical, particularly in the Turonian. The Cenomanian has *Forbesiceras*. The Turonian contains related species of *Pseudaspidoceras*, *Mammites*, *Neptychites*, and *Romaniceras*. *Peroniceras dravidicum* (Kossmat) is known from the Coniacian of the Cameroons, and the Maestrichtian of India and Nigeria has yielded species of *Sphenodiscus*. The ubiquitous *Desmoceras latedorsatum* (Michelin) is known from both countries.

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Index

Numbers printed in bold type denote plates ; numbers printed in italics show where diagnoses are given.

- Abakaliki ... 10, 31, 35, 42, 97
 Acanthoceras ... 46, 62, 100
 Acanthoceratidae ... 46, 49, 62
 Acanthoceratinæ ... 46, 58, 61
 Aconeferas ... 15
 Aconeferatidae ... 15
 acutodorsatus, Sphenodus ... 89
 adkinsi, Pseudotissoia(Bauchioceras) 70
 afer, Mammites ... 51, 99, 101
 cf. ... 53; **9**, 3
 afikpoense, Libycoceras 89, 99; **21**, 1, 2;
 22, 6; **23**, 2; text-figs. 45 a-d
 africana, Stoliczkaia 45, 98, 100; **7**, 5
 africanum, Coilopoceras ... 75
 Mortoniceras ... 31
 " ... 10, 97
 Albian ... 101
 Algeria ... 101
 alluaudi, Forresteria (Forresteria) 69
 Alstadenites ... 67
 Amamgbala ... 15, 99
 Amaseri Sandstone Group ... 11
 ambatoryensis, Pachydiscus ... 17
 Ameka ... 97
 Ameri ... 97
 Ammonites
 cephalotus ... 65
 cristatus ... 24
 deveriai ... 46
 footeanus ... 53
 galliennei ... 70
 hugardianus ... 43
 largiliertianus ... 21
 lenticularis ... 87
 lobatus ... 87
 navicularis ... 47
 neubergicus ... 16
 nodosoides ... 49
 rusticus ... 49
 telinga ... 65
 varicosus ... 27
 amphibolum, "Acanthoceras" ... 59
 amudariense, "Acanthoceras" 55, 57,
 59, 102
 " Watinoceras aff.
 57, 98; text-fig. 25d-f
 Androiavites ... 22, 100
 Angola ... 90, 100, 101
 angolaense, Libycoceras 90, 100
 angolaense, Mortoniceras
 (Angolaites) ... 37
 Angolaites ... 29, 37, 100
 angustum, Elobiceras 42, 97; **8**, 2;
 text-fig. 16b
 Anisoceras ... 12, 13, 100
 Anisoceratidae ... 12
 Anofia ... 99
 Ansorge collection ... 39
 apicalis, ? Stratodus ... 12
 applanatum, Oxytropidoceras
 (Manuaniceras) aff. ... 23, 97;
 text-fig. 9b
 Aptian ... 15
 armatus, Solgerites ... 67, 99
 Arufu ... 97, 98
 asper, Baculites cf. ... 15, 99; **1**, 5;
 text-fig. 2a
 Asu River Group ... 97
 A.T.M.N. ... 9, 22
 Auchi ... 9, 12, 99
 austeni, Austinoceras ... 19
 Austinoceras ... 19
 autenriethi, Hoplitoides ... 82
 Awgu ... 99
 awguensis, Tissotia 85, 90; **15**, 4; **17**, 2,
 text-fig. 43
 " ... subsp.
 collignonii 85, 99;
 17, 1
 " ... subsp.
 falconeri 85, 99;
 16, 3
 Awgu-Ndeaboh Shales ... 12, 99
 Awgu Sandstones ... 12
 Baculites ... 15, 100
 Baculitidae ... 15
 Balangi ... 12, 90
 Bansara ... 97
 barbouri, Mortoniceras
 (Mortoniceras) cf. ... 35, 97
 Barroisiceras ... 67, 99, 101, 102
 Barroisiceratinae ... 67
 Basse, E. ... 21, 67
 Bauchi Province ... 22, 72, 98
 Bauchioceras ... 62, 70, 71, 73, 101
 beecheri, Sphenodus ... 89
 Benueites ... 49, 55, 57
 benueensis, Benueites 57, 58, 99; **13**, 2
 Benue Province ... 22, 97
 besairiei, Oxytropidoceras
 (Androavites) ... 22, 23
 besairei, Oxytropidoceras
 (Androavites) cf. 22, 97; text-fig. 9d
 binicostatus, Mammites ... 51
 binum, Hysterooceras 28, 97; **4**, 5, 6
 " ... aff. 27, 28, 97; **4**, 3
 Birme ... 12, 99
 bontanti, Texanites ... 93
 boreale, Selwynoceras ... 59
 bösei, Oxytropidoceras (Manuaniceras) aff. 24, 97; **3**, 3; text-fig. 9
 Bostrychoceras ... 15, 101
 sp. ... 15, 99; **1**, 4
 bouchardianum, Dipoloceras ... 25
 " ... aff.
 25, 97; text-figs. 9e, 10d
 boulei, Oxytropidoceras ... 22
 Brancoceratidae ... 22
 Brancoceratinæ ... 27
 brancoi, Solgerites ... 99, 101
 bravense, Oxytropidoceras
 (Oxytropidoceras) cf. 22, 97; **3**, 2
 Brazil ... 101
 Breistroffer, M. ... 13, 97
 browni, Elobiceras ... 43
 Bruder, G. ... 50
 bulbosum, Gombeoceras (?) 62, 65, 98
 calabarens, Desmoceras
 (Pseudouhligella) 18, 98; **2**, 8; **3**, 1;
 text-figs. 6, 7
 Calabar Province ... 98
 Calcareous Beds ... 98
 Calycoceras ... 47
 " sp. indet. ... 47, 98
 Cameroons Province ... 11
 camerounensis, Forresteria
 (Reesideoceras) ... 69, 99
 Campanian ... 12, 90
 Canada ... 13, 101
 candolianum, Prohysterooceras
 (Goodhallites) ... 45
 Cantabrigites ... 29
 carinatum, Hysterooceras ... 28
 cauvini, Vascoceras ... 63
 Cenomanian ... 11, 61, 75, 98
 cephalotus, Neptychites ... 65, 67
 chargense, Libycoceras ... 90
 chevalieri, Paravascoceras aff. 63, 98; **14**, 1
 choffati, Hysterooceras ... 28, 29
 Choffaticeras ... 70, 72, 101
 ? sp. ... 72, 74; **16**, 2
 cocchi, Peroniceras aff. ... 90, 99
 Coilopoceras ... 70, 75, 77, 101
 Coilopoceratinæ ... 69, 75
 colcanapi, Oxytropidoceras ... 22
 colleti, Coilopoceras ... 77
 aff. 77; text-fig. 37b
 Collignon, M. ... 46, 50, 77, 100
 Collignoniceras ... 59
 Collignoniceratidae 49, 59, 67, 83, 93
 Colombia ... 101
 coloradoense, Watinooceras ... 57
 commune, Mortoniceras ... 34
 conciliatum, Mammites ... 51
 conditum, Neoharpoceras ... 43
 congoensis, Solgerites ... 67
 Coniacian ... 12, 70, 78
 conlini, Forbesiceras ... 21
 constrictum, Euhystrichoceras ... 21
 costatum, Pachyvascoceras 65, 98; **14**, 2, 4
 costatus, Turrilites ... 13
 Cox, L. R. ... 12
 crasicostatum, Mortoniceras (Dur-
 novarites) subquadratum ... 38
 crasicostatus, Hoplitoides 83; **17**, 3, 4;
 text-fig. 41
 crassinodosum, Ophryoceras ... 31
 crassum, Pachyvascoceras ... 65
 crassus, Neptychites ... 65, 67, 98
 Cretaceous, distribution of in
 Nigeria ... 102
 Crick, G. C. ... 21
 cristatum, Dipoloceras aff. 27, 97; **3**, 8;
 text-fig. 10b
 cristatus, Ammonites ... 24
 curvicornu, Neokentroceras 39, 41, 97;
 4, 9
 " ... subsp.
 crassicornutum 39, 41,
 97; **4**, 7, 8
 curvicostatum, Pseudaspidoceras
 55, 98; **11**, 1; **12**; text-fig. 24
 czörnigi, Peroniceras ... 90, 99;
 text-fig. 46d
 Damagum ... 12
 Damergou ... 100
 Davies collection ... 39
 Decker, J. ... 62, 70
 denisonianum, Pachydesmoceras 19

INDEX—*continued*

- densicostatum, Elobiceras aff. 42, 97 ; 8, 3
 " Neoharpoceras 43, 97 ; 8, 8
 depresso, Mortoniceras (*Durnovarites*) ... 35, 37, 38, 39, 98 ; 7, 4 ; text-fig. 14
 Desmoceras ... 17, 19, 98
 Desmoceratidae ... 17, 101
 Desmoceratinae ... 17
 deveriai, Ammonites ... 46
 Romaniceras cf. ... 47
 deverioide, *Romaniceras* aff. 46, 47 99 ; 9, 1 ; text-figs. 18b, 19
 Diaziceras ... 67, 83
 Didymoceras ... 13, 100
 Dipoloceras ... 24, 29, 101
 Dipoloceras sp. 24 ; 2, 11 ; text-fig. 10a
 dispar, Stoliczkaia ... 45, 97
 zone ... 10, 38, 97
 dixeyi, Mammites 50, 98 ; 9, 4 ; 11, 2 ; text-figs. 20, 21
 " subsp. laevis 51, 98 ; 10, 3
 dravidicum, Peroniceras 90 ; 102
 dubertreti, Pseudaspidoceras ... 55
 Dubordieu, G. ... 13, 50
 Dukul ... 67
 Durnovarites ... 29, 37, 100
 eborenensis, Solgerites ... 67
 Echi Aliki ... 97
 Egypt ... 101
 Elobiceras ... 10, 41, 101
 " sp. indet. ... 42 ; 7, 6
 " sp. nov. indet. 43, 97 ; 55
 Elobi Islands ... 100
 England ... 101
 Enugu Shales ... 12
 Eocene ... 10
 Epiaster sp. ... 73
 Esch ... 9
 eschii, Kamerunoceras ... 59, 98
 Euhystrichoceras ... 19, 101
 Euphyceras ... 83, 102
 " sp. ... 83, 99 ; 22, 5 ; text-fig. 42
 Eupachydiscus ... 16
 European Albian ... 101
 Euturritiles ... 13
 evolutum, Mortoniceras (*Mortoniceras*) ... 29, 97 ; 5, 2 ; text-fig. 11
 evolutum, Mortoniceras (*Mortoniceras*) subsp. amekaense 31, 97 ; 5, 4
 Eze-Aku Shales ... 11, 98
 Ezillo ... 11, 98
 Ezilloella ... 61, 63, 65
 ezilloensis, Ezilloella ... 65, 98 ; 11, 3
 ezoanum, Desmoceras
 (*Pseudouhligella*) ... 19
 Fagesia ... 61, 101, 102
 falcostatum, Hysterooceras ... 29
 Falconer, J. D. ... 9, 73
 False-bedded Sandstones ... 12
 ficheuri, Tissotia ... 87
 flicki, Forbesiceras ... 21
 Forbesiceras ... 21, 102
 forresteri, Forresteria (*Forresteria*) ... 69
 Forresteria ... 67, 69, 101
 fredericksburgense, Dipoloceras ... 27
 French Sudan ... 100
 Frontier Formation ... 59
 Folkestone ... 101
 footeanus, Ammonites ... 53
 Gabon ... 71, 100
 gagnieri, *Pseudotissotia*
 (*Wrightoceras*) ... 71, 72
 gallicum, Reesideoceras ... 69
 gaultina, *Pseudolimea* cf. ... 73
 gibbosulus, Hoplitoides 78, 81, 98 ; 17, 8 ; 18, 1 ; 21, 3 ; 22, 2 ; text-figs. 39, 40
 gibbosulus, Hoplitoides subsp. bipartitus 82, 98 ; 19, 1 ; text-fig. 39f
 gibbosulus, Hoplitoides subsp.
 makurdensis ... 78, 83 ; 19, 4 ; text-figs. 30c-e
 gignouxi, Nigericeras ... 62
 Glebosoceras ... 70, 75, 83
 " sp. ... 77
 glebosum, Glebosoceras ... 75, 98 ; text-fig. 35
 globosum, Pachyvascoceras ... 65, 98
 Gombe ... 12, 90, 99
 Gomeoceras ... 61, 63
 gongilense, Gomeoceras 62, 63, 98 ; 14, 5 ; 21, 4
 gourguechoni, Neptychites ... 67
 gracile, Prohysterooceras ... 45
 gracilis, Baculites cf. ... 15
 gregoryi, Mortoniceras (*Angolaites*) ... 37, 97, 98 ; 4, 13 ; 6, 3
 Gulf of Mexico ... 101
 Gyaloceras ... 15, 102
 Haas, O. ... 31, 39, 45
 haberfellneri, Ammonites ... 67
 harlei, Forresteria (Harleites) ... 99
 Harleites ... 67
 haugi, "Coilopoceras" ... 75
 Hoepen, E. C. N. van ... 31, 35, 95
 Hoplites ... 78, 101
 Hoplitoides ... 70, 75, 77, 101
 hornbyense, Didymoceras 13, 99, 101 ; 1, 3 ; text-fig. 2b
 Hourcq, V. ... 83, 102
 hugardianum, Neoharpoceras ... 43
 Hysterooceras ... 27, 29, 39, 97
 Hysterooceras ? sp. ... 29, 96
 " sp. nov. ... 4, 4, 27
 Ibenta ... 10, 31, 97
 ibo, Gyaloceras ... 15, 97 ; 2, 1, 2, 3 ; text-figs. 3, 4
 Icheri River ... 72, 83
 Igumale ... 11, 99
 ilarenai, *Pseudotissotia*
 (*Wrightoceras*) ... 71, 72
 Illo Group ... Table I
 Imo Clay Shales ... 10
 India ... 102
 Indo Pacific area ... 102
 Indoceras ... 89
 Inflaticeras ... 29
 ingens, Hoplitoides 77, 79, 98 ; 18, 4 ; 20, 1 ; text-figs. 38a-c
 " subsp. costata ... 81, 98 ; 20, 2 ; text-figs. 38e, g, i
 " subsp. laevis 81, 98 ; 18, 2 ; 19, 2 ; 20, 3 ; text-figs. 38f, h
 Neptychites ... 77
 Intermediate Beds ... 98
 intermedium, Elobiceras 41, 42, 97 ; 8, 7
 irregulare, Neoharpoceras ... 43
 Ishiagu ... 10, 37
 ishiaguense, Mortoniceras (*Durnovarites*) ... 38, 98, 7, 1
 ismaelis, Libycoceras ... 90, 100
 " subsp. soudanense ... 90
 jacobi, Eulophoceras ... 85
 Oxytropidoceras (*Manuaniceras*) ... 24
 jacobsoni, Kamerunoceras 59 ; 13, 5 ; text-fig. 26
 Japan ... 102
 japonicum, Desmoceras ... 18
 (*Pseudouhligella*) ... 18
 jugosum, Ophryoceras ... 31
 kamerunense, Pachydesmoceras 19, 98
 Kamerunoceras ... 49, 59
 Karrenberg, H. ... 50, 72
 Keana ... 11, 98
 kenehense, Choffaticeras (?) ... 72
 kiliani, Mortoniceras (*Mortoni-*
 ceras) ... 31, 33, 97, 101 ; 5, 3
 Kitson, A. ... 25
 Kler, M. ... 62
 Koenen, A. von ... 9, 78, 81
 koeneni, Choffaticeras
 (*Choffaticeras*) ... 73, 98
 koeneni, Choffaticeras
 (*Choffaticeras*) cf. ... 98
 koeneni, Hoplitoides 78, 98 ; 17, 7 ; 22, 4 ; text-fig. 37
 Komeceras ... 29
 Konshisha River ... 11, 62, 63, 71, 98
 Kossmat, F. ... 17
 koulabicum, Gomeoceras 62, 98, 102
 Kummel, B. ... 62, 70
 laevis, Solgerites (?) ... 67
 lamberti, Enchodus ... 12
 Pachydiscus ... 17
 lapparenti, Mammites ... 51
 largilliertianum, Forbesiceras ... 21
 latedorsatum, Desmoceras 17, 98, 102 ; 2, 6, 7 ; text-fig. 5
 latelobata, Tissotia ... 87, 99 ; 17, 6
 latelobatum, Peroniceras 90, 93, 99
 latesellatus, Hoplitoides ... 77
 Laube, G. ... 49
 Lebanon ... 101
 Lenticeras ... 70, 83
 Lenticeratinæ ... 69, 83
 lenticularis, Ammonites ... 87
 Leoniceras ... 70, 72, 75, 101, 102
 lesseli, Coilopoceras aff. ... 77, 98
 levecostatum, Mortoniceras (*Durnovarites*) ... 38, 98, 7, 2

INDEX—*continued*

- Libya ... 90, 101
 Libycoceras ... 89, 101, 102
 " sp. juv. 85, 90, 99; 19, 3; 20, 4
 linderi, Anapachydiscus ... 18, 19, 98
 Lisson, C. ... 87
 Lithological units, correlation of 10
 lobatus, Sphenodiscus aff. 87, 99; 22, 1; text-fig. 44
 Lobito ... 39, 100
 lobitoense, Elobiceras 41, 42, 97; 8, 1; text-fig. 16a
 Lokoja Series ... 10
 Lower Coal Measures ... 12
 Lower Limestones ... 10, 98
 Lower Turonian ... 11, 98
 luciae, Choffaticeras (*Leoniceras*) 73, 75
 Lyelliceratidae ... 45
 Lytoceratidae ... 101
- Madagascar 16, 50, 67, 77, 100
 Maestrichtian ... 12, 99
 Makurdi ... 11, 101
 Mammites ... 49, 58, 101, 102
 Mammitinae ... 49, 58
 Manteliceratinæ ... 47
 manuanense, Oxytropidoceras (Manuaniceras) ... 23, 24
 Manuaniceras ... 23, 24
 Masiaposa, Upper Turonian of ... 46
 massipanum, Choffaticeras (*Leoniceras*) cf. 75, 98
 matsumotoi, Onitshoceras 19, 99; 2, 9
 melleguensis, Paramammites ... 50
 meslei, Pseudotissotia ... 72
 Metasigaloceras ... 49
 Metoicoceras ... 47, 101
 sp. juv. 49, 98; 9, 5
 Metoicoceratinæ ... 47
 Mexico ... 62, 101
 michelobiensis, Mammites 50, 51
 Middle Albian ... 97
 Middle East ... 101
 Mineral Survey of Northern Nigeria ... 9
 mirabilis, Pseudotissotia (*Wrightoceras*) ... 71, 78
 Mojisovicinæ ... 22
 Mortoniceras 10, 29, 37, 39, 101
 Mortoniceras (*Mortoniceras*) sp. 35, 97; text-fig. 13
 Mortoniceratinæ ... 29
 moureti, Peroniceras ... 90
 multicostatum, Mortoniceras (*Mortoniceras*) aff. 35, 97
 multifalcatum, Hysteroferas aff. 29, 97; 2, 10
 Mundame ... 11, 98
 Mundock ... 11
 Mungo River ... 9, 11, 46, 78
 Mungo River Formation 11, 57, 98, 102
 munieri, Pseudotissotia (*Wrightoceras*) ... 70, 71, 78
 mutabilis, Mammites 51, 99; 10, 1
 " benueensis ... 53, 99; 10, 2; text-figs. 22, 23
 nanum, Mortoniceras ... 34
 natalense, Euphoceras ... 83
 Natal Senonian ... 100
 Ndi Ofia ... 97
 Neoharpoceras ... 43, 100
 Neokentroceras ... 38, 39, 100
 Neptychites ... 61, 65, 101, 102
 neubergicus, Ammonites ... 16
 New Kumberi ... 98
 newtoni, Elobiceras ... 43, 73, 97
 niceisei, Euhystrichoceras ... 21
 Nigerian Albian, zoning of 10, 97, 101
 Nigericeras ... 61, 62, 100, 102
 nigeriensis, Pseudotissotia (*Bauchioceras*) 71, 98; 15, 2; 22, 3
 nigeriene, Vascoceras ... 62, 98
 Niger Territory ... 100
 Nkporo Shales ... 12, 99
 Nkpugwu Onyikwo ... 29, 33, 97
 Nkpume ... 10, 97
 nodoso-costatum, Mortoniceras (*Mortoniceras*) cf. 35, 97; 6, 1
 nodosoides, Mammites ... 49, 51
 " " subsp. chivensis 53
 " " subsp. spinosa 53
 nodosum, Forbesiceras ... 21
 North Africa ... 16, 101
 Nostoceratidae ... 13
 notha, Stoliczkaia ... 45
 novimexicanum, Obilopoceras ... 77
 Numan Division ... 72
 Nupe Sandstones Table I; 10
 N. V. De Bataafsche Petroleum Maatschappij ... 12
 Nyeba ... 97
 Nwofe ... 97
- obtectum, Forbesiceras ... 21
 occidentale, Euhystrichoceras 19, 98; 2, 4, 5; text-fig. 8
 Odukpani Formation ... 11, 98
 Ogoja ... 97
 ogojaense, Nigericeras 62, 98; 13, 6; 14, 3; text-fig. 28
 Oil Exploration, Shell D'Arcy ... 9
 Okpauku River ... 11
 Oldest Beds ... 98
 onilahyense, Barroisiceras ... 67
 Onitsha Province ... 12
 Onitshoceras ... 19
 Ophryoceras ... 31
 orbignyi, Hysteroferas 27, 28, 29, 97, 101; 4, 1
 ornatissimum, Romaniceras ... 47
 ornatum, Metoicoceras aff. 47, 98; 9, 6, 7
 " Oxytropidoceras (*Manuaniceras*) aff. 23, 97; text-fig. 9c
 Otusco ... 78
 Owutu Edda ... 13, 99
 Oxytropidoceras ... 22, 100, 101
 Pachydesmoceras ... 19, 102
 Pachydiscus ... 16, 101
 pachys, Mortoniceras (*Mortoniceras*) cf. 31, 97; 6, 2; text-fig. 11a
 Pachyvascoceras 61, 63, 65, 101, 102
 paganus, Pseudaspidoceras 53, 98
 Paleocene ... 10
 Paleoglykian ... 18
 Paracanthoceras ... 63
 Paralenticeras ... 83
 Paramammites 50, 61, 63, 101, 102
 Parapachydiscus ... 16
 Paratexanites ... 93
 Paravascoceras ... 61, 63
 paucituberculatum, Oxytropidoceras (*Androiavitae*) 22, 23
 paucituberculatum, Oxytropidoceras (*Androiavitae*) aff. 22, 97; 3, 6, 7
 Pelecodiscus ... 83
 perarmata, Mortoniceras ... 35
 perarmatum, Anisoceras 12, 97, 101; 1, 1
 perinflata, Subschloenbachia ... 37
 Peroniceras ... 90, 101
 " sp. ... 93
 " ? sp. 91, 99; text-fig. 46c
 Peroniceratidae ... 90
 perovalis, Neptychites 65, 66, 98; 10, 4; text-fig. 29
 Peru ... 65, 87
 Pervinquière, L. 78, 100, 101
 Pervinqueria ... 29
 philippii, Choffaticeras (*Leoniceras*?) ... 73
 Phylloceras ... 12
 Phylloceratidae ... 12, 101
 Piveteauoceras ... 67
 Plesiotissotia ... 70
 Plesiovascoceras ... 61
 pleurisepta, Sphenodiscus ... 87
 " 89, 99; text-figs. 44b, c
 polygona, Tissotia ... 87, 99
 " cf. ... 87
 polymorphum, Vascoceras ... 62
 polymorphus, Paramammites ... 50
 ponsianum, " Desmoceras" ... 19
 Portugal ... 102
 Pre-Cambrian ... Table I; 11
 Prelibyoceras ... 83
 prenodosoides, " Mammites" ... 50
 pricei, Mortoniceras (*Mortoniceras*) ... 31, 97; 4, 10
 pricei, Mortoniceras (*Mortoniceras*) aff. 32, 97, 101; 4, 12
 Prohysteroferas ... 45, 101, 102
 " sp. juv. 45, 97; 8, 5
 propinquum, Hysteroferas ... 28
 proprium, Pachyvascoceras 65, 98
 " " subsp. plenum 65, 98
 Protacanthoceras ... 58, 59
 pseudoaon, Dipoloceras subsp. moniliformis ... 25
 Pseudaspidoceras 49, 53, 62, 101, 102
 Pseudophacoceras ... 23
 Pseudoschloenbachia ... 83
 Pseudotissotia ... 63, 70
 Pseudotissotiinae ... 69, 70
 Pseudouhligella ... 18, 102
 pseudovaricosum, Neokentroceras 39
 pyrenaicum, Desmoceras ... 19

INDEX—continued

- quadratum, Dipoloceras 25, 27, 97 ;
 3, 4, 5 ; text-fig. 10c
 quadratum, Mortoniceras (Durnovariites) 34, 38, 39, 98 ; 6, 4, 5 ;
 7, 3 ; text-fig. 15
 quadrinodosum, Mortoniceras (Mortoniceras) 31, 33, 34, 97, 101 ;
 text-figs. 11c, 12a, b
 quattuornodosus, Texanites cf.
 93, 99 ; 23, 3 ; text-fig. 46a
 Queensland ... 15, 102

 Reeside, J. B. ... 67
 reesideana, Tissotia ... 85
 reesidei, Watinoceras ... 55, 101
 aff. ... 55, 98 ; text-figs. 25b, c
 Reesideoceras ... 67, 69
 remolinense, Euhystrichoceras ... 21
 requieni, Coilopoceras ... 77
 rhamnonotus, Stoliczkaia ... 45
 Riedel, L. ... 17, 81, 90
 Rima Group ... 12
 robini, Tissotia ... 87
 Romaniceras ... 46, 77, 101, 102
 romeri, Mortoniceras (Mortoniceras) cf. ... 33, 97 ; text-fig. 11
 romieuxi, Solgerites (?) ... 67
 rotalinus, Pseudojacobites (?) ... 65
 rusticus, Ammonites ... 49

 Salmurian ... 9, 101
 Santonian ... 12, 85, 90, 99
 scheuchzerianus, Turrilites (Euturritiles) ... 13, 98, 101 ; 1, 2
 Schloenbachiidae ... 19
 Schloenbachiinae ... 19
 schlüteri, Pseudaspidoceras ... 55
 Schniegans, D. ... 62
 scitum, Hysterooceras ... 27
 sculptum, Forbesiceras 21, 98, 100 ;
 text-fig. 8b
 Selwynoceras ... 59
 semileve, Hysterooceras aff. 28, 97 ; 4, 2
 Senonian ... 12, 78, 99
 serrata, Forresteria (Forresteria) 69,
 99 ; 15, 3
 Lamna ... 12
 Sharpe, D. ... 49
 Shell D'Arcy ... 9
 simplex, Euhystrichoceras ... 21
 Mortoniceras (Angolaites) 37
 smithi, Gyaloceras ... 15, 16
 Sokoto ... 12, 99
 Solger, F. ... 9, 66, 69, 81, 82, 87, 90
 solgeri, Hoplitoides ... 81
 Solgerites ... 67
 South Africa ... 17, 100
 South America ... 101
 soutoni, Submortoniceras (?) aff.
 93, 95, 99 ; 23, 1 ; text-fig. 50b
 Spain ... 50, 102

 Spath, L. F. ... 9, 33, 34, 37, 38, 39,
 97, 101
 spathi, Choffaticeras (Choffaticeras)
 72, 97, 98 ; 16, 1 ; text-figs. 33, 34
 Spathites ... 62
 Spheniscoceras ... 83
 Sphenodiscidae ... 87
 Sphenodiscus ... 87, 101
 spinosus, Benueites 57, 58, 99 ; 13, 4 ;
 text-fig. 25
 stallauense, Pachydiscus cf.
 17, 99
 aff. ... 17, 99, text-figs. 5b, c
 stantoni, Forresteria (Forresteria) 69
 steinmanni, Tissotia ... 87
 Stoliczkaia ... 45, 101
 stoliczka, Mortoniceras ... 33
 strangulatum, Hysterooceras ... 28
 stromeri, Schizorhiza ... 12
 Styphloceras ... 35
 subelobiense, Elobiceras cf. 42, 43, 97 ;
 8, 6
 Submortoniceras ... 90, 95
 subnodosoides, "Mammites" ... 50
 subobtectum, Forbesiceras ... 21
 Subprionocyclus ... 67
 Subprionotropis ... 91
 subquadratum, Mortoniceras (Durnovariites) ... 38, 39
 subquadratum, Mortoniceras subsp. crassicostatum ... 38
 subrobustus, Pachydiscus ... 17
 subrotundum, Mortoniceras (Mortoniceras) ... 34, 97 ; text-fig. 11e
 Subschloenbachia ... 29, 37
 subtenue, Gombeoceras ... 62, 98
 subtuberculatum, Neokentroceras 39
 swallowi, Metoiceras ... 47, 49
 Syria ... 78, 101
 szajnochai, Elobiceras ... 42
 Tarrant County ... 29
 telinga, Neptychites ... 65
 telingaeformis, Neptychites 65, 66, 98 ;
 11, 4 ; 15, 1 ; text-fig. 30
 Temple, F. ... 9
 Tertiary ... 10
 Texanites ... 29, 90, 91, 93, 101
 Texas ... 29, 101
 Texasia ... 62, 67
 Thomasites ... 61, 65
 Tissotia ... 67, 72, 85, 101
 tissoti, Buchiceras ... 85
 Tissotia sp. juv. ... 87 ; 16, 4
 Tissotiidae ... 69
 Tissotiinae ... 69, 85
 Tiv Division ... 10, 97
 tricarinata, Pseudotissotia (Bauchioceras) ... 71, 72, 98
 tricostata, Neithaea ... 73
 tuberculatus, Solgerites ... 67 ; 17, 5
 Tunisia ... 78, 101
 Turbinites ... 13
 Turkestan ... 55, 63, 102
 Turonian ... 11, 46, 61, 70, 72, 78, 98

 Turrilites ... 13, 101
 Turrilitidae ... 13

 uchauxiense, Romaniceras 46, 99,
 100 ; 9, 2 ; text-fig. 18a
 United States ... 101
 Upper Albian ... 10, 97
 Upper Coal Measures ... 10, 12
 Upper Dutch Creek Marl ... 29
 Upper Limestones Table I ; 12
 Upper Turonian ... 11, 99

 varicosus, Ammonites ... 27
 Vascoceras ... 50, 61, 62, 101
 Vascoceratidac ... 61, 62, 63, 70
 velledae, Phylloceras aff. 12, 98
 Venezuela ... 101
 Venzo, S. ... 43, 91
 vespertinum, Mortoniceras ... 29
 vibreyanus, Neolobites ... 100
 vignesi, Pholadomya ... 73

 Wadatta ... 11
 wallsi, Pseudotissotia (Wrightoceras) 71, 98 ; 24, 1 ; text-figs. 32a, b
 Walsh River ... 15
 Warmminster ... 101
 Wase ... 98
 Washita Group ... 96
 Watinoceras ... 49, 55, 101
 Western Europe ... 101
 westphalicum, Peroniceras subsp.
 australe cf. 90, 91, 99 ; text-fig. 46e
 White, E. I. ... 12
 Whitehouse, F. ... 15, 102
 whitei, Metoiceras ... 49
 Wilson, R. C. ... 9
 wintoni, Mortoniceras (Mortoniceras) ... 29, 37
 wintoni, Mortoniceras (Mortoniceras) aff. ... 37, 97 ; 4, 11
 wohlmanni, Hoplitoidea cf. 78, 81,
 98 ; 18, 3 ; text-fig. 36
 woodsi, Cucullaea cf. ... 73
 woodsi, Mortoniceras ... 95
 woollgari, Colligonniceras ... 59
 wordiei, Prohysterooceras 45, 97 ; 8, 4 ;
 text-fig. 17
 wordiei, Prohysterooceras subsp.
 compressum ... 45
 Wright, C. W. 9, 21, 67, 69, 75, 83, 93
 Wright, C. W. & E. V. collection 29,
 37, 57
 Wrightoceras ... 62, 70, 71, 101, 102

 xetra, Neptychites ... 67

 Youngest Beds ... 99

 zeilleri, Texanites ... 93
 zones, Albian ... 97
 Coniacian ... 99
 " Turonian ... 11, 98

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