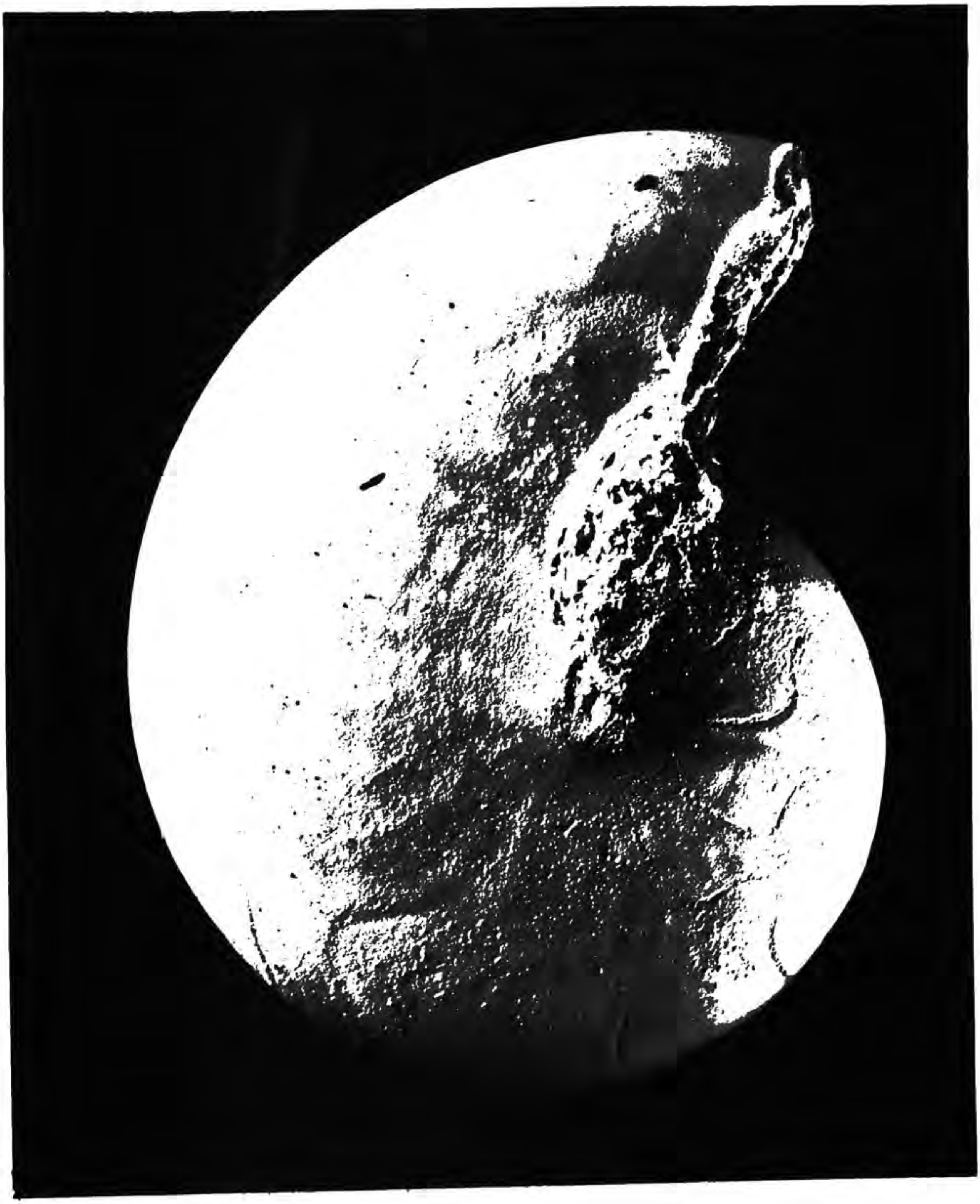
The devonian goniatites of Devon and Cornwall

House, M. R.

Frontispiece



THE DEVONIAN GONIATITES OF DEVON AND CORNWALL

By

M.R. HOUSE M.A.

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ABSTRACT

A description of the Devonian goniatites and their localities in Devon and Cornwall is given based upon museum material and new collecting. This enables correlation with the established continental successions and the following German ammonoid faunas have been recognized :

LOWER CARBONIFEROUS		Gattendorfia	X
UPPER DEVONIAN	FAMENNIAN	Wocklumeria	X
		Clymenia	X
		Platyclymenia	X
		Cheiloceras	-
	FRASNIAN	Manticoceras	X
MIDDLE	DEVONIAN	Maenioceras	X
		Anarcestes	X
LOWER	DEVONIAN	Mimosphinctes	-

The fauna of the Anarcestes Stufe has been recognized in South Devon and probably in Cornwall. Two faunal subdivisions of the Maenioceras Stufe have been recognized, the lowest only at Wolborough, South Devon, the uppermost at Lummaton and Barton, Devon and Trevone and Portquin, North Cornwall (the last two localities have previously been identified with the Cheiloceras Stufe). The three German zones of the Frasnian have been identified in South Devon but only the middle one with certainty in North Cornwall. The Famennian ammonoids have not been exhaustively examined. Only Maenioceras Stufe goniatites occur in the massive limestones of South Devon which appear to be wholly Givetian in age ; no Frasnian goniatites occur within them but they are found in the thin-bedded or rubbly limestones immediately above. The absence of evidence for the Cheiloceras Stufe emphasises the widespread development of ostracod-slate facies at that time. The recognition of the Gattendorfia and Wocklumeria Stufen (largely the work of others) tells against the large unconformity usually supposed to mark the base of the Carboniferous in South-West England.

Ontogenetical details are given for several species : the evidence from Maenioceras shows that it probably evolved direct from Anarcestes or early Werneroceras. Peculiar internal growths on specimens of Sobolewia shed light on the relation of the soft parts to the shell in goniatites.

CONTENTS

PREFACE AND ACKNOWLEDGEMENTS

The Devonian goniatites of Devon and Cornwall have received little attention by comparison with their continental equivalents. The important conclusion of this work is to show how useful they are for stratigraphical purposes. This thesis attempts to review existing material and is an interim report upon work and collecting still in progress. A little under half the material described, much from new localities, has been collected during field work in the period 1954-1958, the period of this research. The Famennian clymenids have not been studied since, in 1955, Mr. E.B. Selwood commenced research on the South Petherwin area, the richest region for English clymenids. The conclusions here found relate mainly to the Couvinian, Givetian and Frasnian and the Famennian goniatites have not been exhamined exhaustively.

The work has been under the supervision of Professor K.C. Dunham F.R.S., to whom the author expresses his thanks. The following gentlemen have kindly assisted in the collection of material or have loaned specimens for study : L.G. Anniss, G.F. Barter, N. Butcher, W. Dearman, D. Dineley, K. Joysey, D. McKie, the late P.J. Oliver, A. Pedder and J.E. Prentice. Thanks are due to the curators of the museums mentioned on page three and several continental museums for allowing access to the material under their charge and, in several cases, for allowing it to be loaned for study. Dr. W.H.C. Ramsbottom of the Geological Survey and Dr. M.K. Howarth of the British Museum have been most helpful in this respect. Others have contributed in answering queries on various matters, especially the late Dr. W. J. Arkell, Mr. W.S. Bisat, Dr. F. Hodson, Mdm. G. Petter, Mr. R. Phillips, Dr. H. Schmidt and Dr. H.B. Stenzel. The Durham Colleges' Research Fund have given financial assistance towards the cost of field and museum work in England, France, Belgium and Germany, and an award of the Daniel Pidgeon Fund of the Geological Society of London has helped work in North Cornwall. The Harkness Scholarship from Cambridge University has considerably aided the accumulation of a library of works on the Ammonoidea. A great debt must be expressed to Mr. G. McKenzie of the Durham Colleges' Science Library and his assistants for obtaining many works of reference. Mr. C. Chaplin, Mrs. J. Harker and Mr. M.S. Maconochie of the Durham Colleges' technical staff have given considerable help in the preparation of text figures and plates. The majority of photographs which accompany this thesis were taken by the author but they were all printed by Mr. Chaplin or Mr. Maconochie who also took several of the photographs appearing on the later plates.

Chapter 1 INTRODUCTION

Because of the thrust and contorted nature of the Devonian rocks of South-west England, and the relative paucity of well preserved fossils, exact determination of the succession in most areas is very difficult. In these circumstances any fossil which can be used to give an age determination becomes important, and each new determination becomes a step towards the elucidation of the many outstanding stratigraphical and palaeontological problems. In Germany, ammonoids excel all other fossils in their usefulness for correlating the Devonian. This study has been largely an attempt to see if goniatites in particular could be used to more advantage in dating the English Devonian rocks in which they occur.

Although they have never been the object of systematic study, numerous geologists and palaeontologists have described or recorded goniatites and clymenids in Devon and Cornwall. The first locality to attract attention was the Upper Famennian outcrop around South Petherwin, Cornwall. Ansted (1838) described some of the clymenids from there and later de la Beche, in his monumental report, described the locality (Beche 1839, p.60) and in the accompanying faunal description John Phillips (1841) described many of the ammonoids in more detail. Phillips also described specimens from Wolborough Quarry, Newton Abbot, now known to be Middle Devonian in age. After this initial spate, and partly as a result of the authoritative accounts of these writers and of Sedgwick and Murchison (1840), little progress occured for almost forty years, although McCoy (1851) did give some new names to South Petherwin ammonoids.

In 1877 J.E. Lee, an amateur geologist, announced the discovery of Upper Devonian goniatites at Saltern Cove and Clement Reid, in the same year, noted clymenids at Lower Dunscombe, Chudleigh. These discoveries apparently stimulated considerable interest among other geologists and over the next decades attention was drawn by many authors to localities yielding goniatites. Commencing in 1889 G.F. Whidborne began publishing the results of his faunal studies of the South Devon limestones and he described new goniatite species from Wolborough, Lummaton and Barton Quarries.

The year 1890 marks the first major contribution by W.A.E. Ussher of the Geological Survey. Over the next two decades Ussher discovered many new ammonoid localities whilst mapping the Torquay, Plymouth and Newton Abbot sheets. Ussher's contribution can scarcely be over-estimated ; not only did he become familiar with the Devonian geology of most of Devon, but also he travelled on the continent and was able to make shrewd comparisons between the Devonian of England and Germany and the Ardennes. At about the same time the Cornish amateur geologist Howard Fox began searching the North Cornish coast for fossils. Fox sent his finds to the leading palaeontologists of his day for determination and recorded his finds in a series of notes and papers (Fox 1894, 1900, 1905). In particular Fox noted the goniatite localities in Constantine Bay and at Trevone and near Cant Hill. His results were mostly quoted without modification in the later Survey Memoirs.

With the publication of the Padstow Memoir (1910) and the Tavistock and Launceston Memoir (1911), Clement Reid collated the work of several Officers of the Geological Survey and details were given of several new goniatite localities, such as that at Portquin, and redescriptions of others, such as those in the Launceston district.

The inter-war period is marked by the work of L.G. Anniss, who revised the geology of the Saltern Cove area and the Chudleigh area giving lists of the goniatites, the determinations in the former case being by L.F. Spath. Later Dr. Spath identified a new species among specimens sent to him for determination and it was subsequently described by D.T. Donovan (1943).

In 1955, Dr. R. Goldring announced his discovery of goniatites of the Gattendorfia Stufe in North Devon and his recognition of Wocklumeria Stufe trilobites. In 1956 the author was able to show that the faunas at Trevone and Portquin, North Cornwall, belonged to the Upper Givetian Maenioceras Stufe, and not to the Cheiloceras Stufe as had previously been supposed. The discovery of a specimen of Wocklumeria in the Penzance Museum from the Launceston area by the author was later substantiated by Mr. E.B. Selwood finding the Wocklumeria Stufe fauna *in situ* in that area (House and Selwood 1957).

Note on Abbreviations

Specimens in museum collections which are referred to are given the museum catalogue number with the following prefixes to indicate their location

BA.	Barnstaple Athenaeum, Devon.
BM.	British Museum (Natural History)
BU.	Bristol University (Department of Geology)
D.	Specimens at present in the collections of the Department of Geology in the Durham Colleges and collected by the author unless otherwise stated.
GS.	Geological Survey Museum, London.
KC.	King's College London (Department of Geology).
PM.	Penzance Museum, Cornwall.
SM.	Sedgwick Museum, Cambridge.
TM.	Torquay Museum, Devon.

Chapter 2 THE CONTINENTAL DEVONIAN AMMONOID ZONES

During the last century and a half the Devonian ammonoids of the continent have been assiduously collected and studied. As a result a scheme of zonation has been built up, chiefly by the efforts of Frech (1902, 1913), Wedekind (1908, 1913, 1914, 1917), Schmidt (1922, 1924b, 1926, 1927) and Schindewolf (1921, 1923a, 1924, 1926, 1937, 1952). The following table summarises the major divisions now recognised.

CARBONIFEROUS	Tournaisian	GATTENDORFIA	
UPPER DEVONIAN	Famennian	WOCKLUMERIA	6
		CLYMENIA	5
		PLATYCLYMENIA	3 & 4
		CHEILOCERAS	2
	Frasnian	MANTICOCERAS	1
MIDDLE DEVONIAN	Givetian	MAENIOCERAS	
	Couvinian	ANARCESTES	
LOWER DEVONIAN	Emsian Siegenian	MIMOSPHINCTES	
	Gedinnian	No Ammonoids known	

These ammonoid divisions are referred to as the Wocklumeria Stufe, Clymenia Stufe and so on. This usage does not correspond exactly with zones as conceived by their originator Albert Oppel (see Arkell 1956) but correspond to the genus zones of the Carboniferous. Most of the Devonian Stufen are subdivisible into true species zones and Wedekind was careful to distinguish between 'Stufen' and 'Zonen'.

i. Lower Devonian Ammonoid Zones

During the Lower Devonian Ammonoids first appeared but were particularly restricted in their distribution. The best known faunas are those from Czechoslovakia (Barrande 1865-67) and from the Harz Mts. (Eichenberg 1930, Erben 1953). Rare specimens occur at this horizon in the Eifel (Born 1915). Frech (1887b, 1887c, 1902) has recorded several ammonoids from the Lower Devonian of the Carnic Alps and the Montagne Noire but in both cases the stratigraphical horizon has proved to be Middle or Upper Devonian. These records led to some erroneous conclusions on ammonoid evolution. Recently Schindewolf (1958) has recorded Lower Devonian ammonoids from Spain. The evidence bearing on the stratigraphical distribution of the Lower Devonian ammonoids will be briefly given and the results synthesised to give the zonal pattern.

a. Czechoslovakia . The oldest Devonian rocks of the Prague basin occur in the south. There Svoboda and Prantl (1953) have recently shown that the Devonian/Silurian boundary should be drawn between the Upper and Lower Koněprusy Limestone. Gradually to the north the Upper Koněprusy Limestone and the lower parts of the succeeding Bránik or Mneniany Limestone are missing. The overlying Daleje Shales mark the base of the Eifelian.

The following records have been taken from a review of the Czechoslovakian goniatites by Prantl (1954) and incorporate the wider divisions of Svoboda and Prantl (1953).

MIDDLE DEVONIAN Daleje Shales above.

LOWER DEVONIAN
- Bránik Limestone
  - Zlíchov Lst. with *Mimagoniatites fecundus*.
  - Prokop Lst. with *Mimagoniatites fidelis*.
  - Drovec and Slivenic Limestones with *Anarcestes. praecursor* and *Mimagoniatites fidelis*.
- Upper Koněprusy Lst. with *Anarcestes praecursor* and ? *Goniatites verna*

The stage equivalents given by Prantl make the Bránik Limestone Coblencian (Emsian) and the Upper Koněprusy Limestone Siegenian. This emphasises the stratigraphical break at the base of the Devonian, the Gedinnian being for the most part absent.

b. Germany. The goniatites known from the Lower Devonian of the Harz Mts are from the Emsian alone. The fauna is interesting in that it shows some similarity with the Prague Basin but differs in the presence of Mimosphinctes and Lobobactrites. The following details are taken from Erben (1953) and Eichenberg (1930, 1931).

UPPER EMSIAN Limestone facies with Gyroceratites laevis, sandy facies with Sellanarcestes wenkenbachi.

LOWER EMSIAN

Dalmanites Horizon (two facies) with Sellanarcestes wenkenbachi, Anetoceras arduennense, Lobobactrites, Gyroceratites, Palaeogoniatites, Anarcestes aff. simulans.

Zorgensis Horizon (two facies) with Mimagoniatites zorgensis and var. tenuicostatus, Mimagoniatites aff. bohemicus, Anarcestes (Latanarcestes) latesellatus, Anarcestes simulans, Anarcestes lunatus, Anarcestes cf. lateseptatus plebeius, Gyroceratites laevis, Mimosphinctes spp.

Princeps Horizon. No goniatites known.

c. Synthesis.

When these records are critically examined it is clear that no faunal zonation of the Lower Devonian based on goniatites can be particularly well founded at present. The custom has been to consider all the Lower Devonian to lie within the Mimosphinctes Stufe. Eventually the Emsian may allow a division in that Mimosphinctes is restricted to the lower part and Sellanarcestes to the upper part. But Sellanarcestes continues on to the Eifelian. Anarcestes praecursor appears to be restricted to the Siegenian and the Gedinnian has not yielded goniatites so far.

ii. Middle Devonian Ammonoid Zones

The restricted goniatite faunas of the Lower Devonian give place in the Middle Devonian to a much richer fauna of world wide distribution. Middle Devonian goniatites have been described from Europe, the U.S.S.R., North Africa, North America and Australia. The stratigraphical evidence from Europe and North Africa will be briefly reviewed and the evidence for the proposed zonal schemes discussed.

a. Czechoslovakia. The classical Prague succession deteriorates upwards as far as the goniatites are concerned. No upper Givetian or Upper Devonian goniatites are known, but there are lower Givetian and Couvinian faunas which were figured by Barrande and have recently been reviewed by Prantl (1954) who makes the following records.

GIVETIAN

Roblinské Shale : no goniatites recorded.

Kačácké Shale with *Anarcestes lateseptatus lateseptatus*, *Werneroceras karpinskyi*, *Tornoceras simplex*.

COUVINIAN

Chotečské Lst. with *Anarcestes lateseptatus applanatus*, *A. lateseptatus plebeius*, *Pinacites jugleri*, *Palaeogoniatites ferronieri*, *Mimagoniatites bohemicus*, *Paraphyllites tabuloides*, *P. occultus*, *Gyroceratites gracilis*.

Třebotovské Shale with *Anarcestes lateseptatus plebeius*.

Dalejské Shale with *Mimagoniatites fecundus*.

It is singularly unfortunate that this faunal succession is not known in more detail since it is the source of many of the important species types.

c. *Germany*. The German Middle Devonian goniatites succession forms the type for the whole world. Not all districts are well favoured for determining the faunal succession and, as in England, tectonic disturbance complicates the problem. Numerous German stratigraphers have contributed to the building up of a zonal scheme. The most satisfactory plan is due to Wedekind who, in 1917, published the following table. Nomenclatorial changes have been made to accord with modern usage.

MAENIOCERAS STUFE = GIVETIAN

Zone of *Wedekindella brilonense*, also *Sobolewia nuciformis* and *Agoniatites fulguralis*.

Zone of *Agoniatites discoides*.

Zone of *Werneroceras rouvillei* and '*Foordites inversum*.'

ANARCESTES STUFE = COUVINIAN

Zone of *Pinacites jugleri*, also *Foordites ? occultus*

Zone of '*Anarcestes subnautilinus*' and *Anarcestes (A.) lateseptatus*.

Zone of *Sellanarcestes wenkenbachi*.

This succession was mainly built up for the Couvinian from the Wissenbach Slate succession of the Harz and Dill-Mulde areas. The Givetian sequence was obtained from the Stringocephalen Schichten and other developments found in the Schiefergebirge.

Schmidt (1926) later reviewed these Middle Devonian zones and made several modifications. This scheme is given below with nomenclatorial corrections.

UPPER MIDDLE DEVONIAN = MAENIOCERAS STUFE

Zone of Maeneceras terebratum	= Maenioceras terebratum
Zone of Maeneceras undulatum	= Maenioceras molarium

LOWER MIDDLE DEVONIAN = ANARCESTES STUFE

Zone of Anarcestes vittiger	= Werneroceras ruppachense
Zone of Anarcestes lateseptatus	= Anarcestes (A.) lateseptatus

UPPER LOWER DEVONIAN

Zone of Anarcestes wenkenbachi	= Sellanarcestes wenkenbachi

The modifications made by Schmidt to Wedekind's table deserve comment. First, the elimination of the 'Zone of Agoniatites discoides' was based on work by Schlüter (1927, Schmidt quoted his unpublished thesis) which showed that the Discoides Schichten of Wildungen and the Brilon Ironstone held facies-faunas only. Secondly, the lowermost of Wedekind's zones was relegated to the uppermost Emsian following the discovery by Dahmer (1921) of 'Anarcestes wenkenbachi' in the upper Coblencian of Mandeln. Such a position is supported by the recent discoveries of Erben quoted above. Thirdly, the recognition of a 'Zone of Maeneceras undulatum' depended on the observation that the maenioceratids of the Oderhäuser Kalk (= Lower Stringocephalen Schichten) have arounded lateral lobe whilst those from the Upper Stringocephalen Schichten have a pointed lateral lobe. Schmidt coined the nomen nudum 'undulatum' for the former. This is a junior synonym of Maenioceras molium which is also characterised by a more evolute shell (see systematic section for a more detailed discussion of this matter). The questionability of Schmidt's scheme will be discussed later.

c. North Africa. Since the early records of Devonian ammonoids from North Africa by Haug (1903, 1909) and Menchikoff (1932, 1933) much work and collecting has been done on the Devonian of Morocco and Algeria. An account of the geology of the region richest in Devonian ammonoids has been given by Mme Germaine Petter (in Alimen et al. 1952, p.62 et seq.). The succession given below is that along the valley of the Saoura between Marhouma and Aguedal which lie 390 miles south-east of Casablanca. The following records include more recent determinations by Mme Petter, many of which have been personally checked at Centre de Recherches Sahariennes.

The base of the EIFELIAN is marked, at Marhouma, by a limestone with Anarcestes (A.) lateseptatus lateseptatus. This is followed by shales and a limestone with Pinacites jugleri, Foordites numismalis, and F. djemeli together with anarcestids and agoniatitids.

The GIVETIAN consists of a lower series of shales followed by a limestone band with shales and intercalated sandstones above. Overlying this is the basal Frasnian. The base of the Givetian contains Werneroceras rouvillei, Subanarcestes macrocephalus, Agoniatites costulatus, Anarcestes (A.) lateseptatus plebeius and others. Higher in the succession come beds with Maenioceras terebratum, Wedekindella brilonense, Sobolewia nuciformis, Tornoceras (T.) simplex, Werneroceras sp. nov. and Agoniatites spp. Representatives of the evolute maenioceratids have not been found.

This sequence supports the zonal pattern proposed by Wedekind but the value of many records is marred by the fact that no systematic bed-by-bed collecting appears to have been done on the lines adopted by Buckman and Bisat in this country and the museum fossils are poorly labelled, if labelled at all. The quality of the material is such, however, that North Africa may come to replace Germany as a standard of reference for the Devonian ammonoid zones.

d. Synthesis. i. ANARCESTES STUFE

Schmidt's relegation of the Wenkenbachi Zone to the Upper Emsian is now well established. The lowest zone of the Couvinian then becomes the Lateseptatus Zone which may be recognised in Germany, Czechoslovakia and North Africa although the zone fossil, or its varieties, occur outside the zone. There seems no good reason to follow Schmidt in eliminating Pinacites jugleri as a zone fossil and replacing it by the somewhat problematical species Werneroceras ruppachense. Not only is Pinacites jugleri a highly distinctive fossil but it also has a wide distribution, occuring in Czechoslovakia, in the Schiefergebirge and the Eifel, and in North Africa. It therefore has two of the main qualifications of a zone fossil, and it also has priority. There seems every reason to retain the Jugleri Zone for the uppermost Couvinian.

ii. MAENIOCERAS STUFE

The recent evidence from Africa supports Wedekind's erection of the zone of Werneroceras rouvillei. The question then arises as to whether the Undulatum Zone of Schmidt is the same or younger. Since from a nomenclatorial viewpoint 'Maeneceras undulatum' is a synonym of Maenioceras molarium, the position of the Wolborough fauna is relevant. As will be shown in later pages this fauna is clearly distinguishable from that of the Terebratum Zone of the uppermost Givetian. Since there are no maenioceratids known from the W. rouvillei horizon of the Saoura it may be that the Wolborough fauna is intermediate between the Terebratum and Rouvillei Zones. On the other hand Wedekind (1917 p.118) did include 'Maeneceras' among the fauna of his Rouvillei Zone. Since Werneroceras rouvillei is not known in England the best solution for the purpose of English stratigraphy is to use the zone of <u>Maenioceras molarium</u> for the whole of the lower Givetian and leave it for subsequent research to discover whether it is possible to distinguish an upper subdivision from a lower subdivision with <u>Werneroceras rouvillei</u>.

The Terebratum Zone is readily separated from the Molarium Zone by the presence of involute and compressed species of <u>Maenioceras</u> and the distinctive <u>Wedekindella brilonense</u> which differs from the Molarium Zone species of <u>Wedekindella</u> in the possession of constrictions. The table of Middle Devonian zones adopted here is as follows.

MAENIOCERAS STUFE	Maenioceras terebratum Maenioceras molarium
ANARCESTES STUFE	Pinacites jugleri Anarcestes (A.) lateseptatus

iii. <u>Upper Devonian Ammonoid Zones</u>

The foundations of ammonoid zonation of the Upper Devonian were laid by Wedekind, first for the Frasnian, by his detailed collecting at Martenburg near Adorf, 30 miles west of Kassel (Wedekind 1913), and secondly for the Famennian as a result of monographing the clymenids of the Rhenisches Geberges (Wedekind 1914). In both of these works Wedekind collated the results of earlier workers but to him must go the credit for establishing an acceptable scheme which is still the most satisfactory today. His zonal plan was refined in 1917 but subsequently only minor modifications have been made by the work of Schindewolf, Schmidt, Matern and Lange. The sequences for the Frasnian and Famennian will now be briefly considered.

a. <u>Frasnian</u>

No single level in the Devonian is as readily recognised or as widely distributed as the Manticoceras Stufe which constitutes the Frasnian. The abundance of the genera Manticoceras, Beloceras and others at this level have enabled it to be identified in Germany, France, Belgium, England, North Africa, the U.S.S.R., China, Australia, Canada and the United States. The original zonal subdivision proposed by Wedekind (1913 p.25) was as follows, certain nomenclatorial corrections have been made.

Frasnian 1d+	Zone of Crickites holzapfeli
	Zone of Manticoceras adorfense
Frasnian 1c	Zone of Manticoceras cordatum and M. carinatum
Frasnian 1b	Zone of Ponticeras nodulosum
Frasnian 1a	Zone of Pharciceras lunulicosta

At first Wedekind did not include the zone of Pharciceras lunulicosta in the Manticoceras Stufe since Manticoceras does not appear until the zone above but it has been customary since 1913 to do so. Also Wedekind referred to Frasnian 1a as the Prolecanitenschichten (because of the abundance of Pharciceras) and the divisions 1b to 1d he termed the Belocerasschichten. This usage has never been followed and is best dropped.

Later Matern (1929 p.148) gave evidence to question the possibility of distinguishing Frasnian 1b from 1c. Since that time they have been united in the form 1(b)c.

It appears from the succession in Cornwall that a more detailed subdivision of the Frasnian may be possible there. That this has not been achieved on the continent is due to a facies problem. At Adorf, the type locality of Wedekind's zonation, a limestone facies is developed and, as is usual in such lithology, the goniatites attain a large size and the inner whorls can rarely be studied : such a development occurs at Chudleigh

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+ These suffixes were given the Greek equivalents in Devon. In the argillaceous facies the goniatites are usually small and pyritised : this facies occurs, for example, at the celebrated locality at Büdesheim, which has provided many types, and also Saltern Cove and the Padstow region in England. There is thus some difficulty in comparing specimens from different lithologies. Detailed subdivision should be possible at Büdesheim where, on the hill slopes south of the village church, Frasnian clays and thin limestone bands are exposed and many distinct goniatite bands visible. Unfortunately the sequence is much contorted owing to incompetent folding against the Middle Devonian limestones below during the formation of the Prüm syncline in which they lie. Detailed trenching might overcome this but it has still to be attempted. Similarly the succession in the Padstow area gives evidence of many distinct goniatites bands, many with clearly distinguishable faunas.

At the present stage it is best to follow the conclusions of Matern and recognise three primary divisions of the Frasnian. The lowest Lunulicosta Zone does not contain _Manticoceras_ but is characterised by Pharciceratids and other genera unknown outside the zone such as _Sandbergeroceras_, _Koenenites_, and _Timanites_. Longer ranging genera such as _Ponticeras_ and _Tornoceras_ are also common. For England at least it is advisable to take _Manticoceras cordatum_ as the zone fossil of the middle Frasnian, as Wedekind preferred for his Frasnian Ib. Glenister (1958 p.62) has proposed the _Beloceras sagittarium_ Subzone for the Middle Frasnian of Western Australia. This may be a useful local zone fossil in Australia, as it is in Europe, but it is common only in the Frasnian limestone facies in Germany and England whereas _M. cordatum_ can be identified in the two main facies types of Europe. In the Cordatum Zone _Beloceras_, _Ponticeras_, _Manticoceras_ and _Tornoceras_ (_Tornoceras_) and _T._ (_Aulatornoceras_) are common. The overlying Holzapfeli Zone contains _Manticoceras_, _Ponticeras_, _Archoceras_ and especially rotund species of the genus _Crickites_, a manticoceratid with convex growth lines.

b. <u>Famennian</u>

The subdivisions of the Famennian in Germany have been frequently described but there has been slight confusion over the terminology. The main usages are summarised in the table below.

<table>
<tr><th>Wedekind 1917</th><th>Schmidt 1924</th><th>Miller 1938</th><th>Schindewolf 1955</th></tr>
<tr><td>Glyphioceras-stufe (pars)</td><td>Hangenburg Schichten</td><td></td><td>Gattendorfia Stufe</td></tr>
<tr><td>Wocklumeria-stufe 6</td><td rowspan="2">Dasberg Schichten</td><td>Oberdevon 5</td><td>Wocklumeria Stufe</td></tr>
<tr><td>Laevigata-Gonio-clymeniastufe 5</td><td>Oberdevon 4</td><td>Clymenia Stufe</td></tr>
<tr><td>Postprolobites-Platyclymenia-stufe 4</td><td rowspan="2">Hemburg Schichten</td><td rowspan="2">Oberdevon 3</td><td rowspan="2">Platyclymenia Stufe</td></tr>
<tr><td>Prolobitesstufe 3</td></tr>
<tr><td>Cheilocerasstufe 2</td><td>Nehdener Schichten</td><td>Oberdevon 2</td><td>Cheiloceras Stufe</td></tr>
<tr><td>Manticoceras-stufe 1</td><td>Adorf Schichten</td><td>Oberdevon 1</td><td>Manticoceras Stufe</td></tr>
</table>

Wedekind in 1913 introduced the system of numbering the Upper Devonian stufen and by 1917 he had perfected this as shown above. In 1934 Schindewolf combined Wedekind's Prolobites and Postprolobites Stufen and since 1955 this combination has beem referred to as the Platyclymenia Stufe. In a letter to A.K. Miller in 1934 Schindewolf expressed his intention of re-lettering the Upper Devonian stufen to agree with this new combination (Miller 1938, p.3, footnote). Miller therefore followed this procedure in his monograph of the American Devonian Ammonoids. No one, not even Schindewolf, has followed him. The five Famennian stufen are now well established as given by Schindewolf in 1955. This system has been adopted in the Ammonoid section of the Treatise (Moore ed. 1957).

The Cheiloceras Stufe is characterised by Cheiloceras and the subgenera Torleyoceras and Dyscheiloceras . Dimeroceras and Tornoceras (Protornoceras) occur with early species of the genera Sporadoceras, Imitoceras and Pseudoclymenia. One species of Manticoceras is known. The fauna was well illustrated by the Sandberger brothers (1850-56) and again by Wedekind (1917), Schindewolf (1923) and Schmidt (1924).

The Platyclymenia Stufe is distinguished by the genera Platyclymenia, Piriclymenia and Falciclymenia which are not known to occur outside it. In some parts of Germany, Russia and North Africa a lower horizon occurs with abundant Prolobites. Other common genera include Sporadoceras and Imitoceras. The fauna has been described by Wedekind (1914), Schindewolf (1923) and others.

The rich fauna of the Clymenia Stufe was partly figured by Münster (1832-46) whose work was revised by Gumbel (1862). Wedekind illustrated representatives (1914, 1917) and the fauna has been re-examined by Schindewolf (1923), Lange (1929) and others. The fauna includes Clymenia, Gonioclymenia, Cymaclymenia, Protoxyclymenia together with common Imitoceras and Sporadoceras.

The bizarre Wocklumeria Stufe fauna has been exhaustively monographed by Schindewolf (1937). It includes many odd and diagnostic clymenids such as Wocklumeria, Parawocklumeria, Glatziella, Epiwocklumeria and others. Kosmoclymenia, Kalloclymenia and Kamptoclymenia occur together with Imitoceras and Sporadoceras.

The overlying Gattendorfia Stufe marks the base of the Carboniferous (Jongmans and Gothan 1937). Clymenids do not pass this boundary and the restricted goniatite fauna which remains includes Gattendorfia, Imitoceras, Kazakhstania and early prolecanitids.

Chapter 3. THE DEVONIAN GONIATITE LOCALITIES IN DEVON AND CORNWALL

Goniatites are not common in Devon and Cornwall except at certain localities although there can be little doubt that more detailed mapping will increase the number of localities considerably. This rarity is due partly to their limited original distribution and partly to the intense tectonic distortion and cleavage or, in the case of limestones, recrystallisation, which has removed all trace of them. In general goniatites are most common in the slates of Middle and Upper Devonian age, but unless cleavage approximately coincides with bedding there is little chance of them being well enough preserved for extraction and determination. Also they are not uncommon in the Knollen Kalk facies of the Upper Devonian, especially in South Devon, and there they may attain a large size. In the pure limestone and reef facies of the South Devon Middle Devonian they are rare except for a few places. Even at localities such as Lummaton goniatites are rare although other fossils are abundant.

It is possible, therefore, to list the localities in Devon and Cornwall at which goniatites have been discovered. Details of the localities and their goniatite faunas will be given below. For convenience the localities will be described regionally in the following order.

Devon east of Dartmoor
Devon west of Dartmoor
North Devon
South Cornwall
North Cornwall

In each division the more southerly localities will be given first.

In the faunal lists the museum or collection numbers will be given for determined specimens which are not subsequently described or mentioned, or which are of particular interest.

DEVON EAST OF DARTMOOR

1. Mudstone Sands, Brixham

The Mudstone Sands Anticline (Lloyd 1933, p.10) passes east west through Mudstone Bay, known also as St. Mary's Cove. Couvinian dark grey slate with limestone lenticles crop out in the anticline core along the beach. These slates contain a cephalopod fauna (Lloyd 1933, p.49, 62). The succeeding slates pass up into alternating slate and limestone above which follows the massive Givetian limestone of Berry Head.

The goniatites from here were not mentioned in the Torquay Memoir and the only reference to them in print appears to have been made, in passing, by Jukes-Browne and Newton (1914) who named them *Goniatites* (*Anarcestes*) *lateseptatus*. They noted they were "common in the bands of shaly limestone which occur in the lower part of the Calceola Shales of Mudstone Bay." The goniatites are set in an intractable mudstone and most museum specimens have been cut and polished. The finest collection is in the Torquay Museum. Specimens range up to at least 100 mm diameter. Determinable specimens are as follows.

? *Anarcestes* (*Anarcestes*) *lateseptatus plebeius*
Subanarcestes macrocephalus

The specimen determined as *S. macrocephalus* (BM.c1768), presented to the British Museum by J.E. Lee, has no locality label but agrees very closely with the lithology of other Mudstone Bay specimens.

This fauna is comparable with that of the Lateseptatus Zone but this correlation must be regarded as tentative.

2. Galmpton Point to Ivy Cove

The northern part of the east-west ridge of Middle Devonian limestone extending between Waddeton, Galmpton and Brixham forms part of a large recumbent anticline which closes to the north. The axial plane is almost horizontal and the lower limb may be replaced in part by a thrust. At the base of the high limestone cliffs between Elberry Cove and Silver Cove Upper Devonian purple slate with some intercalated limestone bands crop out. Poorly preserved fossils were first discovered here by Ussher (1890 p.508) who recorded "crushed Goniatites and Bactrites and very good examples of Cardiola retrostriata"(Ussher 1903, p.107).

A re-examination of the section has shown that the most fossiliferous localities are two-thirds the way between Elberry Cove and Silver Cove about 20 yards west of a large downfaulted mass of limestone. A thick limestone band rises low in the cliffs folded as a recumbent anticline overturned to the north with axis horizontal. Purple slate above and below the limestone band is fossiliferous and the following fossils have been found.

Manticoceras sp. D.1320,1322,1326,1328,1336
? Bactrites sp. D.1337
Orthocones indet. D.1321,1338
Buchiola sp. D.1335,1327

Farther to the west a new goniatite locality locality was discovered at Galmpton Point (whilst in the company of the late Mr. P. Oliver). The locality is due NNE of Warren House where red shales and interbedded limestones dip north beneath probably inverted massive limestone. The only specimen found, D.401, is a Manticoceras sp. indet.

These discoveries support Ussher's conclusion that the purple and red slate at these localities is Frasnian, but they do not support direct correlation with Saltern Cove where Archoceras and Tornoceras are the commonest goniatites. Their absence suggests that the localities near Silver Cove and at Galmpton Point belong to the Cordatum Zone, Frasnian 1b(c), since Manticoceras is not known from Frasnian 1a.

3. Saltern Cove and Waterside Cove

Saltern Cove is separated by a horn from a smaller cove to the north which is known in geological literature as Waterside Cove, a name coined by Anniss in 1927. The northern side of the horn is the locality where J.E. Lee discovered the first Upper Devonian goniatites ever found in South Devon. Lee (1877) figured several specimens and compared them with those known from the Frasnian at Büdesheim in the Eifel district. Ussher (1890) added a little during his survey of the area and gave a revised list of the fossils in the Torquay Memoir (Ussher 1903, p.106).

The coves were examined in detail by Anniss (1927) who gave detailed measurements of the succession together with a fresh list of the goniatites with determinations by Spath. He recorded the following goniatites : Manticoceras orbiculus (Beyrich), M. undulosum Wedekind, M. bickense Wedekind, M. cf. intumescens (Beyrich), M. cf. adorfense (Wedekind), M. cf. complanatum (Sandberger), M. serratum (Sandberger), M. cordatum, (Sandberger), M. affine (Stein.), Tornoceras cf. undulatum (Sandberger), T. auris (Quenstedt), T. simplex (L. von Buch), T. frechi Wedekind, T. acutum Frech, T. constrictum (Stein.), T. ausavevse (Stein.), Gephyroceras gerolsteinense (Stein.) (Anniss 1927, p.496). Anniss correlated this fauna with the Büdesheim fauna as Lee did.

Later the tectonics of the cove were revised by Lloyd (1933 p.486 et seq.) in the second edition of the Torquay Memoir and the goniatite records of Anniss were listed. A few years later Spath recognised a new species in collections sent to him for identification by D.T. Donovan who later described it as Archoceras angulatum. He also recognised that the specimens recorded by Anniss as M. bickense were partly this species and partly A. varicosum (Donovan 1942).

Through the courtesy of Mr. L.G. Anniss it has been possible to examine his private collection and the other specimens mentioned in the literature are in the British Museum or Geological Survey Museum. In some cases it has not been possible to justify previously quoted determinations for much of the named material is small and indeterminable. The following list revises the known specimens and includes determinations of specimens collected by the writer.

<u>Archoceras</u> <u>angulatum</u> Donovan
<u>Archoceras</u> <u>varicosum</u> (Drevermann)
<u>Archoceras</u> sp. nov. aff. <u>schlosseri</u> (Gallwitz)
<u>Manticoceras</u> cf. <u>cordatum</u> (G. & F. Sandberger)
<u>Manticoceras</u> aff. <u>serratum</u> (Steininger)
<u>Manticoceras</u> sp. nov. (aff. <u>unduloconstrictum</u> Miller)
<u>Manticoceras</u> cf. <u>adorfense</u> Wedekind
<u>Manticoceras</u> cf. <u>retrorsus</u> (von Buch)
<u>Crickites</u> <u>holzapfeli</u> Wedekind
<u>Tornoceras</u> (<u>Tornoceras</u>) <u>simplex</u> var. <u>ovata</u> Frech
<u>Tornoceras</u> (<u>T</u>.) <u>simplex</u> var. A
<u>Tornoceras</u> (<u>T</u>.) sp. nov. aff. <u>crassum</u> (Matern
<u>Tornoceras</u> (<u>Aulatornoceras</u>) <u>auris</u> var. <u>auris</u> (Quenstedt)
<u>Tornoceras</u> (<u>A</u>.) <u>auris</u> var. <u>bickense</u> Wedekind
<u>Tornoceras</u> (<u>A</u>.) sp. nov. aff. <u>auris</u> (Quenstedt)
<u>Tornoceras</u> (<u>A</u>.) <u>paucistriatum</u> (d'Arch. & de V.) var. nov.
<u>Tornoceras</u> (? <u>A</u>.) aff. <u>belgicum</u>(Matern)

This fauna has been compared in some detail with several hundred goniatites collected from the middle Frasnian locality at Büdesheim which is of Cordatum Zone age. In detail the resemblance is not close. The recognition of <u>Crickites</u> <u>holzapfeli</u>, which is unknown in the Cordatum Zone, as well as the abundance of <u>Archoceras</u>, shows that the fauna must belong to the Holzapfeli Zone. This correlation makes more reasonable the occurence of Famennian Cypridenenschiefer facies a little higher in the succession at Waterside Cove (Anniss 1927, p.497).

4. Staverton

A new Upper Devonian goniatite locality was discovered by Dr. G.V. Middleton during a survey of the country between Newton Abbot, Ashburton and Dartington. For structural and stratigraphical details reference should be made to his unpublished thesis (Middleton 1954). The locality is a quarry NW of St. John Baptist Chapel, Staverton, two miles NW of Totnes. The specimens found were presented to the Geological Survey Museum. The following re-determinations have been made.

Koenenites sp. nov.
Tornoceras (*Tornoceras*) aff. *simplex* (von Buch)
Ponticeras forcipiferum (G. & F. Sandberger)
Ponticeras cf. *forcipiferum* (G. & F. Sandberger)

This is undoubtably a Frasnian suite and *Koenenites* is restricted to the Lunulicosta Zone. *Ponticeras forcipiferum* also is common in that zone although, according to Matern (1929, p.150) it also occurs in the Cordatum Zone. The correlation is is therefore with the Lunulicosta Zone of the lowest Frasnian.

5. Torquay Museum Site

During excavations for the foundations of the 'Pengelly' Lecture Hall of the Torquay Natural History Museum in 1894 fossils were obtained from the spoil. These were described by Whidborne (1901 p.533) who referred them to the Lower Devonian. Subsequently Jukes-Browne and Newton (1914) re-examined the fauna and showed that it was Couvinian in age, a conclusion which had previously been reached by Ussher (1903 p.50) without giving reasons. These Couvinian slates dip north below the Givetian limestones which crop out just to the north of the museum.

"*Anarcestes lateseptatus*" was identified by Jukes Browne and

Newton (1914 p.314) and compared with specimens from Mudstone Sands. Despite search in the Torquay Museum and the British Museum (where Newton examined the fauna) these specimens have not been traced. The records seem reliable enough, however, to recognise tentatively from them the Lateseptatus Zone.

6. Petit Tor Combe, Torquay

Ussher (1890 p.405) was the first to find goniatites at Petit Tor Combe. Later he recorded "*Goniatites sagittarius* " in patches of "irregularly shaly, liver-coloured" limestone on the massive limestone boss which forms Petit Tor (1903 p.103). Lloyd subsequently compared the goniatite horizon with that at Chudleigh commenting on the presence of *Beloceras multilobatum* at both. Ussher's specimens are still extant and have been determined as follows.

Beloceras cf. *sagittarium* (G. & F. Sandberger) GS. Us1583 from the north side.

Manticoceras sp. GS.Us1585 frmm the south side of the Combe and GS.181 labelled Petit Tor Combe.

Lloyd was of the opinion that the goniatite bearing horizon was "higher in the sequence than the fossiliferous shales of Saltern Cove" (Lloyd 1933, p.83). But the presence of the alternative index fossil indicates the Cordatum Zone of the Frasnian.

7. Lummaton Quarry, Torquay

Lummaton quarry, near St. Mary Church, Torquay, has been the object of much attention by geologists. Whidborne figured fossils from here (1890) and Jukes-Browne (1906) has listed the fauna and added stratigraphical details and a geological sketch map. A description of the local geology together with a long list of fossils was given in the first edition of the Torquay Memoir (Ussher 1903, pp.65-68) and a revised account of the geology appeared in the second edition (Lloyd 1933, p.75). The following redeterminations of goniatites figured by Whidborne from here have been made.

Agoniatites fulguralis (Whidborne 1890, pl.5, fig.4,4a)
Tornoceras (*T.*) *simplex* var. *hughesii* (Whidborne 1890, pl.6, fig.1,1a, fig.2,2a)
Tornoceras (*T.*) *whidbornei* Foord and Crick (Whidborne 1890, pl.6, fig.3)

Several specimens belonging to *Tornoceras* have been found during this century. The most spectacular find was made by Dr. J.E. Prentice who collected over a dozen specimens from one fossiliferous block found at the foot of a quarry face at the western end of the quarry apparently from a horizon high on the face above the stromatoporoid limestone. Unfortunately the collection only includes examples referable to *T.* (*T.*) *simplex* var. *hughesii* or to *T.* *whidbornei*.

During 1957/8, however, a singularly important collection has been assembled by Mr. Vincent of the Geology Department, Exeter. The specimens apparently come from the same horizon as Dr. Prentice's specimens, but all were collected from fallen blocks. Dr. D.L. Dineley has kindly loaned them to me for study. They include the following.

Maenioceras terebratum (G. & F. Sandberger)
Maenioceras decheni (Kayser)
Tornoceras (*Tornoceras*) sp.
Agoniatites cf. *costulatus* (d'Archaic and de Verneuil)

This discovery gives proof that the upper part of the limestone mass at Lummaton is Middle Devonian, a fact only indicated previously by the single specimen of *Agoniatites fulguralis*. The presence of the index fossil of the Terebratum Zone shows that the horizon is upper Givetian. Further, since most of Whidborne's other fossils came from the same very fossiliferous horizon a more precise date is given for them as well.

8. Barton

Around the village of Barton, one mile NW of St. Mary Church, Torquay, Devonian rocks crop out as a small inlier, almost half a mile in width, completely surraunded by Permian rocks. Details of the geology and the fauna obtained from the Middle Devonian limestones are given in the Newton Abbot Memoir (Ussher *et al*. 1913, p.25). The following goniatites are known.

Wedekindella brilonense (Kayser) var, *aratum* Whidborne (1890 pl.6, fig.16,16a ; the locality is given in error on the plate as Lummaton).

? *Tornoceras* sp. (BM.73810 figured by Whidborne 1890 pl.6, fig. 17 as *Goniatites circumflexer* ? Sand.).

The specimen figured as *Goniatites pentangulatus* (Whidborne 1890, appears to be a planispiral gastropod as pointed out by Foord and Crick (1897 p.281).

The identification of *Wedekindella* here makes certain the correlation with The Terebratum zone to which *W. brilonense* is restricted. The Barton limestone must therefore be approximately the same age as that of the principal fossiliferous horizon at Lummaton. According to the Memoir (*supra cit*, p.25) the limestone is "bounded by Upper Devonian slates, which were probably banked up against it on the north and east". Ussher noted that "red shaly compact limestone is associated in one or two places with the red slates bounding it, and may represent the Goniatite-limestone", that is, the *Manticoceras* bearing horizon at Chudleigh.

9. Ransley

A quarry near East Ogwell, one mile SW of Newton Abbot, has been variously referred to in the literature as Ransley, Ransleigh or Ramsleigh quarry. Several fossils from here were listed by Whidborne (1895) and a summary of the fauna known was given by Ussher (*supra cit.* p.21).

Several goniatites were mentioned from here by Shannon (1921 p.3) and some figures were given. His identifications were as follows.

Tornoceras hughesii Whidborne (Shannon 1921, pl.1, fig.2)
Agoniatites inconstans Phill. (*idem* pl.1, fig.3)
Goniatites sp. (idem pl.1, fig.1)
Tornoceras molarius Whid. (recorded with some doubt as the specimen had been lost)

The specimen identified as *Tornoceras hughesii* is still extant (GS. 88673). It cetainly does not belong to *Tornoceras* as the readily visible suture testifies. It is a *Manticoceras* cf. *cordatum* (G. & F. Sandberger).

Shannon and Ussher noted that the massive limestone of the quarry was overlain by a red slaty limestone comparable with the Frasnian thin-bedded limestone of Lower Dunscombe Quarry, Chudleigh. Presumably the specimen of *Manticoceras* came from this level here and, if the determination of the *Agoniatites* is correct, that specimen probably came from the underlying Givetian limestones. The record of "*T. molarius*" is insufficient evidence to assume the presence of the Molarium Zone.

10. *Wolborough*

Goniatites from the celebrated Wolborough quarry on the east side of the Newton Abbot - Totnes road (A.381) west of Wolborough church, were first figured and described by Phillips in 1841. Later Whidborne (1890) described the fauna and Ussher (supra cit. p.22) has given a full faunal list.

The following list revises the goniatites figured by Phillips and Whidborne. Phillips gave the locality as Newton Bushel.

Agoniatites obliquus (Whidborne 1890, pl.5, f.3,3a, 1,1a, 2).
Agoniatites transitorius (Phillips 1841, pl.60, fig.227, Whidborne idem, pl.5, fig.7, 8, ? 9).
Agoniatites cf. costulatus (D'Archaic & de Verneuil) (Whidborne idem, pl.5, fig.5,5a, 6,6a,6b).
Agoniatites sp. indet. (Whidborne idem, pl.6, fig.8).
Maenioceras molarium molarium (Whidborne idem, pl.5, fig.11, 11a, ? pl.6, fig.4,4a. Phillips idem, pl.50, fig. 232a,b).
Maenioceras molarium apertum (Foord and Crick)(Whidborne idem, pl.5, fig.12, 12a,12b).
Maenioceras molarium intermedium (Foord and Crick)(Whidborne idem, pl.6, fig.5,5a).
Maenioceras aff. decheni (Kayser)(Whidborne idem, pl.6, fig. 15, 15a).
? Maenioceras sp. juv. (Whidborne idem, pl.6, fig.6,6a)
Sobolewia nuciformis (Whidborne idem, pl.6, fig.7,7a,7b, 1,1a)
Wedekindella psittacinum (Whidborne idem, pl.6, fig.9,9a, fig. 11, 12,12a,12b, 13, 13a,13b).
Wedekindella sp. nov.(Whidborne idem, pl.6, fig.14,14a,14b).
Tornoceras (T.) sp. (BM.c5670, an unfigured syntype of W. psittacinum).

This goniatite assemblage is clearly Givetian and belongs to the Maenioceras Stufe for the genera Maenioceras, Wedekindella and Sobolewia are restricted to that division in Germany and North Africa. Following Holzapfel's recognition of "Maeneceras excavatus" (= M. molarium) in the Lower Stringocephalenschichten at Wildungen (Holzapfel 1895, p.309) and supported by Schmidt's observation that the Oderhäuser Kalk maenioceratids have a more rounded lateral lobe than the younger maenioceratids it is clear that this assemblage belongs below that with M. terebratum. The fauna does not include Werneroceras rouvillei which may occur at a slightly older horizon in Germany. The fauna is placed here in the Molarium Zone, a nomenclatorial revision os Schmidt's Zone of M. undulatum and embracing all the lower Givetian.

11. Liverton

Records of poorly preserved goniatites and clymenids were made by Ussher (*et. al*.1913, p.39) around Liverton, five miles NW of Newton Abbot. The clymenids include *Clymenia* cf. *laevigata* and others. The only goniatite preserved is *Imitoceras* sp. (GS. Us1751) from "west of Liverton". The horizon is Famennian and, judging by the appearance of the clymenids, belongs to the Clymenia Stufe.

12. Teign Estuary

Opposite Combe Cellars on the Teign Estuary Ussher (*supra cit*., p.35) recorded "*Clymenia* ?" and "cf. *Beloceras multilobatum*" from friable nodules. The latter specimen (GS.Us1658) is a clymenid.

13. Whiteway Barton

Ussher records discovering goniatites "from a large block of shaly limestone covering a drain" in Whiteway farmyard (*supra cit*., p.38), and was assured by the farmer that they had been quarried on the farm and probably from a small quarry fifteen chains SW of the farm buildings. Of the determinable extant specimens one (GS.Us1654) is *Beloceras sagittarium* (G. & F. Sandberger) and is indicative of the Frasnian Cordatum Zone.

14. Chudleigh

a. Lower Dunscombe. Clement Reid (1877 p.454) was the first to record ammonoids from a quarry in the orchard just north of Lower Dunscombe Farm and he noted *Clymenia valida* and *Clymenia striata*. In August 1879, Dr. F. Roemer visited Lower Dunscombe Farm with J.E. Lee and he published a short account of the geology and fauna (Roemer 1880, p.145) noticing *Goniatites intumescens* and *Goniatites multilobatus* (two poor specimens of which were figured). He was able to state that "Without doubt this thin-bedded limestone of Chudleigh, rich in Goniatites, belongs to the same geognostic horizon as the Upper Devonian limestone in Nassau and in Waldeck" (Roemer 1880, p.146).

In response to this paper Clement Reid (1880 p.286) stated that the specimens of Clymenia recorded by him and determined by Etheridge, came from the field above the Lower Dunscombe quarry which, at the time of his visit in 1875, was under plough. Subsequently Kayser (1889) added Goniatites [Tornoceras] acutus and Goniatites [Tornoceras] simplex to the list and questioned the determination of Clement Reid's clymenids, as Champernowne (1880 p.381) had before him.

To these records Ussher (1913 p.36) was able to add few in in the Memoir, but be noted Beloceras multilobatum, cf. Manticoceras intumescens and a "very improbable" ? Clymenia.

In 1933, Anniss published the results of his survey of the Devonian rocks of the Chudleigh district and recorded the following goniatites from the thin-bedded limestone above the massive limestone of the Lower Dunscombe quarry.

Manticoceras intumescens (Beyrich)(Anniss 1933, pl.41, fig.4).
Manticoceras nodulosum Wedekind (idem, pl.41, fig.2).
Gephyroceras gerolsteinense (Steininger)(idem, p.437, text fig.2).
cf. Pharciceras clavilobus Steininger (idem p.437).
Gephyroceras pernai Wedekind (idem, pl.41, fig.3).
Tornoceras bilobatum Wedekind (idem p.437)

Anniss concluded that these goniatites indicated that there were at Lower Dunscombe representatives of all of Wedekind's zones from 1a to 2a of the Upper Devonian and that they were "condensed within a few feet of thinly bedded limestone in which no orderly succession has yet been established" (Anniss 1933, p.438). He also stated that he had found no specimens of *Clymenia* and concluded that "apparently no representative higher than zone IIa of Wedekind is exposed here".

Mr. L.G. Anniss has generously loaned his specimens for study and there are many others from this locality in the museums. Anniss developed his specimens to show the suture by filing down one side. This led to many of the sutures appearing less advanced than they were in reality and all his specimens recorded as "*Gephyroceras*" (=*Ponticeras*) are in fact *Manticoceras* with the median dorsal saddle and lateral saddle reduced in prominence by filing alone. Specimens are generally poorly preserved, are rarely testate, and are usually distorted. The only records which can be made with confidence are as follows.

Manticoceras cf. *cordatum* (G. & F. Sandberger)
Manticoceras cf. *intumescens* (Beyrich)
Beloceras sagittarium (G. & F. Sandberger)
Tornoceras (*T.*) cf. *simplex* (von Buch)

There is no reason, from these records, to suppose that there are representatives of any Frasnian zones other than the Cordatum Zone.

There is some suggestion of Famennian, however. In the Torquay Museum there is a specimen labelled 'Lower Dunscombe' (TM.34/12) which is a *Sporadoceras* cf. *contiguum* (Münster), a goniatite which Wedekind (1917 p.148) has recorded from Famennian 3b of Enkeberg. Also there is an excellent specimen of *Cymaclymenia striata* (Münster) in the British Museum (BM.c40185) labelled "*Gephyroceras*" and localised as Lower Dunscombe. These specimens indicate that there is probably more truth in Clement Reid's records than has been considered in the past. It would be most profitable to trench a section in the field above the quarry at Lower Dunscombe.

b. <u>Chudleigh Area</u> . Beginning at about 12 feet above the top of the massive middle Devonian limestone of Palace Quarry, Chudleigh, ammonoids occur in nodular limestone of Kramenzelstein type. The best exposures are along a track which passes up the hillside at the north-east end of the quarry. Dr. D.L. Dineley was the first to find ammonoids here. Collecting has so far yielded <u>Platyclymenia</u> sp. and <u>Imitoceras</u> sp. (D.1341-3). The clymenids show that the Platyclymenia Stufe is represented here. A complete succession has not been traced between the Middle Devonian limestones and the <u>Platyclymenia</u>-bearing horizon, so it is possible that a fault or thrust may separate them, but the dips accord and this is thought to be unlikely.

Ussher (<u>supra cit</u>., p.36) noted several clymenids near Lawell House, but no goniatites.

15. <u>Devonian Ammonoids Derived from the Trias</u>

Champernowne (1880 p.361) noted that at "Labrador Bay pebbles out of the Trias near Teignmouth contain undoubted <u>Clymeniae</u> as well as <u>Goniatites</u> ;... The matrix is an indurated red calcareous clay, not differing materially from the Lower Dunscombe top beds". From the Labrador Tea Gardens and Shaldon Beach come a large number of these derived fossils which are in the British Museum. The following have been determined.

<u>Manticoceras</u> sp. BM.c12705-6
<u>Beloceras sagittarium</u> (G. & F. Sandberger) BM.c12702
<u>Sporadoceras</u> sp. BM.c12703-4, c27442 (?).
<u>Imitoceras lineare</u> (Münster) BM.c12728, c12722, c12727 etc.
<u>Cymaclymenia</u> sp. BM.c12772.
? <u>Gonioclymenia</u> sp. BM.c12707-10.

This fauna clearly indicates that the Cordatum Zone of the Frasnian and probably the Clymenia Stufe were under erosion during the Trias, possible in the region of the southern Haldon Hills.

DEVON WEST OF DARTMOOR

16. Ince Castle and Earth

During his survey of the country immediately west of Plymouth Ussher discovered a fossil locality "by the Lynher estuary between Earth and Ince Castle, west of Ince Brake (about 770 yards from Ince Castle) in dark grey slates weathering buff and drab, which in places contain numerous soft brown nodules and nodular bands, of the German Knollen-kalk type." He recognised "*Bactrites* and small distorted *Goniatites*" (Ussher 1907, p.70). This locality was searched in August 1955 and poorly preserved lamellibranchs were found in addition to the following.

Bactrites sp. D.1304
Goniatites indet. D.1304

Ussher inferred that this horizon was Upper Devonian and it is so marked on the Plymouth Sheet. The probability is that the horizon is Frasnian but a final decision will have to await the finding of better material.

17. Warren Point

Near Warren Point on the Plymouth side of the Tamar, one mile north of Saltash Ferry, Ussher discovered "badly preserved but unmistakable traces of the Büdesheim fauna" (1907 p.73). On the shore 110 yards south of the Point he found "small *Goniatites* in greenish and grey slates associated with purple slates apparently containing *Styliola*"(Ussher 1907, p.79).

There are two chequered posts at Warren Point and a search of the green, grey and purple variegated slate exposed along the shore to the south yielded goniatites 35 yards (i) and 100 yards (ii) south of the posts. The cleavage dip of the beds is consistently southward, often at a very steep angle. The following specimens were found at these localities.

(i) Goniatites indet.

(ii) Manticoceras sp. indet. D.1306, 1308.
Orthocone indet.

The specimens D.1306 and 1308 show the dorsal and ventral suture complete so that there is no doubt concerning the generic assignment. The beds here are therefore Frasnian, and must belong to the Cordatum or Holzapfeli Zones. The abundance of Manticoceras and absence of other genera suggest the former rather than the latter.

18., Marytavy

A single specimen referred to as 'Brancoceras' was recorded by officers of the Geological Survey 680 yards north-west of Marytavy Church (Reid et al., 1911, p.19, 1912, p.8). The locality is on the west side of a Mine Leat. Searching this locality has yielded indeterminable goniatites. The original Survey specimen, GS.57362, has been photographed and Dr. H. Schmidt of Göttingen has determined it as Imitoceras sulcatum (Münster). This dates the locality as Famennian but I. sulcatum is long ranging although commonest in the Clymenia Stufe, so a more precise horizon is not possible.

19. Brentor

Two localities on the eastern slopes of Brentor have recently provided goniatites. Dr. W. Dearman and Mr. N. Butcher, at Easter 1956, found a small fossiliferous block in spoil from a quarry by the footpath 1000 feet north of South Brentor Quarry (Reid 1911, p.12). When developed the block was found to contain the following ammonoids which have been presented to the Geological Survey Museum.

GS.Zi8329,8330 Kosmoclymenia sp. cf. undulata (Münster)
GS.Zi8326-28 Clymenid indet

During the break-down of the block two very poorly preserved goniatites were noted one of which was thought to be a ? Sporadoceras. Another was thought to be a ? Wocklumeria. Both these records need confirmation. The evidence gives an Upper Famennian age for this quarry therefore, and it may belong to the Wocklumeria Stufe.

The South Brentor Quarry, which has a rich fauna of lamellbranchs, ostracods and trilobites, has provided a few ammonoids to Mr. N. Butcher and the writer. Again the best specimens have been presented to the Geological Survey.

Sporadoceras posthumm Wedekind GS.87113-5
Cymaclymenia sp. indet. GS.Zi8323
? Imitoceras sp. GS.Zi8324,5

This fauna is clearly Famennian. In Germany both Sporadoceras posthumm and Cymaclymenia are commonest in the Clymenia Stufe with which the beds here are best correlated.

20. Lydford Gorge

Several indeterminable goniatites have been collected from grey slate in a stream 280 feet NW of the 646 feet bench mark on the bridge beside Lydford Station. They are possibly all imitoceratids (GS.Zi8331-4). The lithology of the slate is unlike that of the local Culm so the horizon is probably Devonian.

NORTH DEVON

21. Barnstaple

Whidborne (1896) figured two goniatites from the Barnstaple area and others have recently been discovered by Dr. R. Goldring (1955a+; 1955 p.48) with determinations by Hermann Schmidt. The fauna from the upper part of the Pilton Beds was shown by Goldring to contain representatives of the Gattendorfia Stufe and on the basis of the trilobites he

+ Unpublished thesis not listed in references.

inferred the presence of the Wocklumeria Stufe in the lower part. The specimens described or figured by Whidborne are as follows.

Imitoceras ? *infracarbonica* (Paeck.)(Whidborne 1892, pl.4, fig.1,1a from 'Barnstaple'so determined by Schmidt 1924, p.533 but recorded by Hudson and Turner (1933 p.25) as *I. denckmanni*), SM.A6797.

Imitoceras sp. (mentioned Whidborne *idem* p.25 from Pilton Beds of Barnstaple), SM.A6798.

? *Cyrtoclymenia* sp. (Whidborne *idem* pl.4, fig.2 from Kingdon's, Shirwell, as *Agoniatites* sp.), BA.734.

The following were identified by Schmidt (in Goldring 1955b, p.48).

Gattendorfia crassa Schmidt (from Tutshill Farmyard).BU.7991.
Gattendorfia sp. (from Fremington S.),BU.7992.
Imitoceras sp. (from Tutshill Farmyard), BU.7993.
Imitoceras sp. (from Landkey Road),BU.7994.
Imitoceras sp. (from Fremington Dyke), BU.7995.

In addition Paul (1937 p.436) recorded ? *Clymenia* (TM.2190, 2191) from a well above Mt. Sandford which Goldring determined as ? *Nomismoceras*. However, Dr. F. Hodson, who has examined the specimen, informs me that it is not a *Nomismoceras*. It cannot be a clymenid as Paul suggested, since it has a ventral siphuncle.

Goldring's specimens provided the first certain evidence for the presence of the Gattendorfia Stufe in England. The presence of ammonoids of the Wocklumeria Stufe is indicated by the ? *Cyrtoclymenia* and Paul's"? *Clymenia*." may belong here.

SOUTH CORNWALL

22. St. Austell

There is a specimen in the Geological Survey (GS.33301) labelled "*Agoniatites* sp." from Rope Hawne, St. Austell. It is, unfortunately, indeterminable and may be a nautiloid.

NORTH CORNWALL

23. Booby's Bay

Howard Fox (1894) discovered goniatites on the northern side of Booby's Bay 400 yards SE of the Round Hole at Dinas Head. The locality was described in the Padstow Memoir (Reid et al., 1910 p.18). The only goniatite recorded was Goniatites (Anarcestes) noeggerathi (von Buch). This has been taken as evidence for a Middle Devonian age (House 1956, p.260). Searching at this locality has yielded poorly preserved and indeterminable goniatites and orthocones.

24. Polventon Bay

The dark grey calcareous slate between Long Cove and Merope Rocks on the east side of Trevose Head contain small pyritised orthocones and goniatites, but the specimens are too small for certain determination. The general appearance is, however, very like that at Pentonwarra Point, Trevone. Some suggestion of a Givetian age is also provided by a single goniatite found in Polventon Bay by G.C. Lamb (SM.H5214a) which has been referred to as ? Holzapfeloceras circumflexiferum. The dorsal suture cannot be seen so it could well be a Wedekindella.

During a search of this coast a large Agoniatites (D.465) was found in dark grey calcareous slate just NE of Little Cove, at the southern end of Polventon Bay. Six feet below was a bed which provided Agoniatites cf. costulatus (d'Archaic and de Verneuil) and several specimens of ? Wedekindella (D.466). This fauna is therefore Givetian.

25. Harlyn Bay

Dark grey calcareous slate at the northern end of Harlyn Bay, between Onjohn Cove and Big Guns Cove yields small pyritised orthocones and goniatites as at the northern end of Polventon Bay but they are too small for certain determination.

26. Trevone

The goniatite locality at Pentonwarra Point, Trevone was described by Howard Fox who discovered the locality (Fox 1894, p.636). The goniatites found by Fox were identified by G.C. Crick (in Fox 1894, p.637, 1901, p.541 *et seq*.). The details were copied in the Padstow Memoir (p.20). Crick supposed the horizon here represented the "Lower Beds of the Upper Devonian". Later Dewey claimed that the fauna here, and at some other places along the coast, was that characteristic of the "Chiloceras [*sic*] horizon of the Nehdener Schichten, near Brilon" (Dewey 1914, p.157).

An examination of the fauna here has shown that it is indisputably upper Middle Devonian in age (House 1956, p.259), the specimens identified with *Cheiloceras* by earlier authors being, for the most part, *Wedekindella* or other Givetian genera. Several bands in the calcareous dark slate on the southern side of the Porthmissen Beach at Trevone yield small pyritised goniatites but the best locality is immediately below the cliff at the Point itself and just above high-water level. Here quite large goniatites, up to two inches in diameter, occur in pyritic lenticles within the slate. From this locality the following fossils have been collected.

Agoniatites costulatus (d'Archaic and de Verneuil)
Holzapfeloceras aff. *circumflexiferum* (G. & F. Sandberger)
Wedekindella brilonense (Kayser)
Wedekindella aff. *brilonense* (Kayser)
Wedekindella sp. nov.
Werneroceras karpinskyi (Holzapfel)
Werneroceras cf. *ruppachense* (Kayser)
Maenioceras terebratum (G. & F. Sandberger)

<u>Sobolewia nuciformis</u> (Whidborne)
<u>Sobolewia</u> aff. <u>nuciformis</u> (Whidborne)
<u>Tornoceras</u> (<u>T</u>.) <u>simplex</u> (von Buch) var. B
<u>Tornoceras</u> (<u>Aulatornoceras</u>) aff. <u>sandbergeri</u> Foord & Crick
<u>Tornoceras</u> (<u>Protornoceras</u>) sp. nov.
<u>Bactrites</u> sp. PM.1034.
<u>Bactrites</u> cf. <u>obliqueseptatus</u> (G. & F. Sandberger)

This fauna is typical of the upper Middle Devonian of Germany. The genera <u>Maenioceras</u>, <u>Sobolewia</u> and <u>Wedekindella</u> are restricted to the Givetian, in which the genera <u>Werneroceras</u>, <u>Agoniatites</u>, <u>Tornoceras</u> and <u>Bactrites</u> are common. x The presence of <u>M</u>. <u>terebratum</u> and <u>Wedekindella</u> <u>brilonense</u> shows that the fauna belongs to the Terebratum Zone. The fauna is close to that known from Lummaton and Barton.

27. <u>Lower Merope Islands</u>

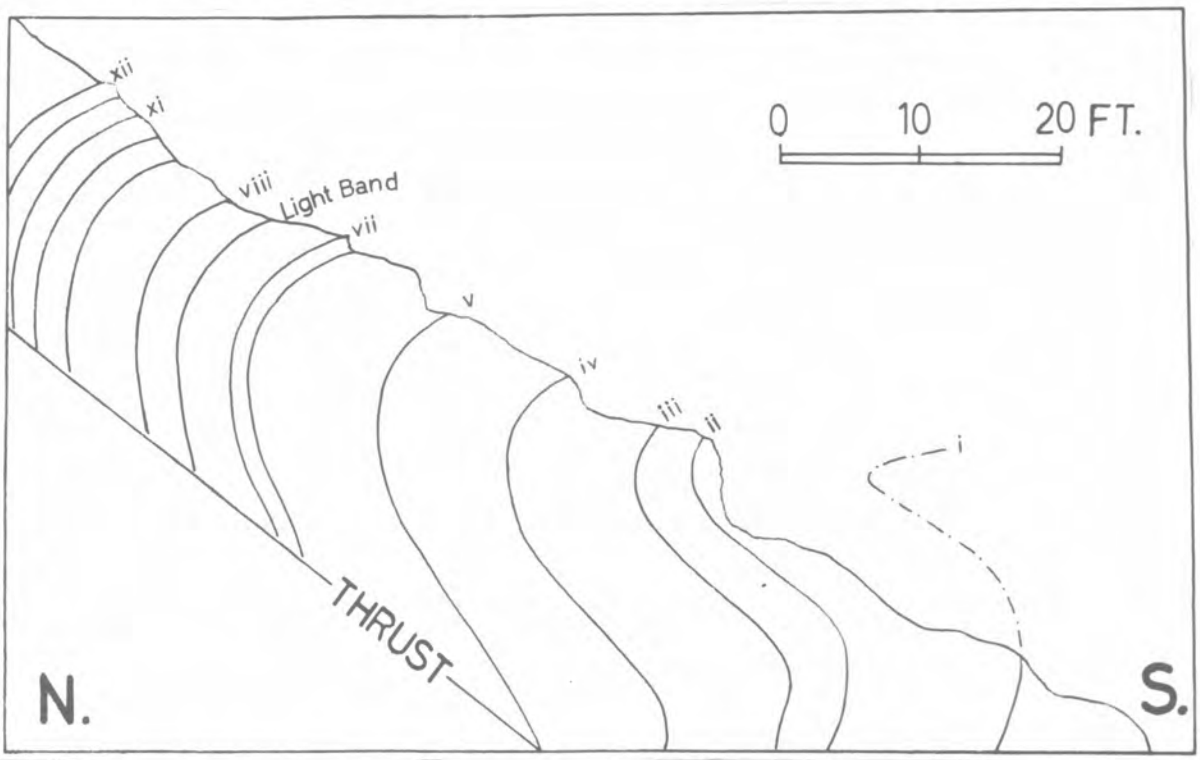
The goniatite localities on Lower Merope Island discovered during the examination of the coastal sections are likely to provide the key to the Frasnian goniatite succession met in the Padstow estuary. This is the first locality passing north along the North Cornish coast to provide an Upper Devonian fauna.

Lower Merope Island is cut off at ordinary tides from the coast by Tregudda Gorge (text fig.1) and the best sections are along the tricky and awkward western cliff face (text fig.2). At the northern end of the island Purple and Green slates dip north and in the southern part pale green or grey slate with dark bands immerge from beneath them ; below come darker grey slates. The succession may be summarised as follows.

Purple and Green Slate, seen for	300 feet
Grey slate with dark bands, about	120 feet
Dark grey slate (bed iii and below)	14 feet

The structure of the southern part of the island is shown on the accompanying text figure which also indicates the most

Text fig.1. Lower Merope Island and Tregudda Gorge from the south.



Text fig.2. Section of the southern part of Lower Merope Island showing the disposition of the Frasnian goniatite bands.

important fossil bands. The succession and fauna is as follows.

		feet	inches
xv	Dark grey slate	1	0
	Light grey slate	12	0
xiv	Dark grey slate with 1" light band		6
	Light grey slate	3	0
xiii	Dark grey slate	1	0
	Light grey slate with limestone lenticles	5	0
xii	Dark grey slate		6
	Light grey slate	1	3
xi	Dark grey slate		9
	Light grey slate	1	0
x	Banded dark grey slate with Goniatites indet. and ? *Manticoceras*, D.1223		3
	Light grey slate	1	7
ix	Dark grey slate with ? *Archoceras* sp., D.1188 and *Manticoceras* sp., D.1182, 1189, 1193, ?1192, ?1195.	1	6
	Light grey slate	1	6
	Limestone band weathering to 'ginger-bread'		1½
	Light grey/green slate	4	0
viii	Dark grey slate		8
	Light grey/green slate	2	0
	Prominent white band		2
vii	Finely banded dark grey slate with ? *Manticoceras* sp., D.1232	1	0
	Seam of pale slate		½
vi	Finely banded dark grey slate with ? *Tornoceras* sp., D.1231, *Manticoceras* sp., D.1231.	1	0
	Finely banded dark slate with limestone nodules especially in the lower part	8	0
v	Seam of light grey slate with ? *Manticoceras* sp., D.1233		½
iv	Light grey slate with dark bands especially below (iv)	9	0
	Light grey slate	3	0
iii	Dark grey slate with ½" light grey seam 3" from base. ? *Ponticeras* aff. *gerolsteinense*, D.1172, 1173, *Manticoceras retrorsum*, D.1177, ? *M.* cf. *cordatum*, D.1180, *Tornoceras* (*T.*) sp. juv., D.1179, *T.*(*Aulatornoceras*) *auris* var. *bickense*, D.1174	1	3
ii	Dark grey slate with ½" light seam in the middle. Goniatites indet.	1	0
i	Dark grey slate with ? *Archoceras* sp., D.1197, 1221, 1222, ? *Ponticeras* cf. *gerolsteinense*, D.1210, *Manticeras* sp., D.1213, 1215, 1220,		

	feet	inches
Tornoceras (*T.*) cf. *simplex*, D1199, 1212, 1218, *T.*(*T.*) aff. *simplex* towards *crassum*, D.1198, *Bactrites* sp., D.1209, ?1208, *Buchiola* sp., D.1200, 1206, Orthocones indet. D.1201, 1205. These fossils are restricted to the lower 4', the upper 8' is lighter in colour and has dark bands	c.12	0
Dark grey slate below		
Total	77	0

The sixty feet of beds above this succession up to the first purple band which marks the commencement of the Purple and Green Slate are not accessible. Dark bands can be seen, however, and they are probably fossiliferous. The fauna of the measured succession shows that this part of the sequence is of Frasnian age. In view of the poor nature of the material a more precise date is difficult. The fauna is certainly either of the Cordatum or Holzapfeli Zone.

28. Butter Cove

The succession from Butter Cove to the Crams (text fig. 3) shows the beds seen at Lower Merope Island again, here folded into a large recumbent syncline. The lowest darker grey slate is seen on the southern side of Butter Cove where goniatites occur but the sequence of grey slate with dark bands is disturbed by a crush zone. The Purple and Green Slate above can be seen to a thickness of some 600 feet and into it has been intruded the dolerite sill of Stepper Point.

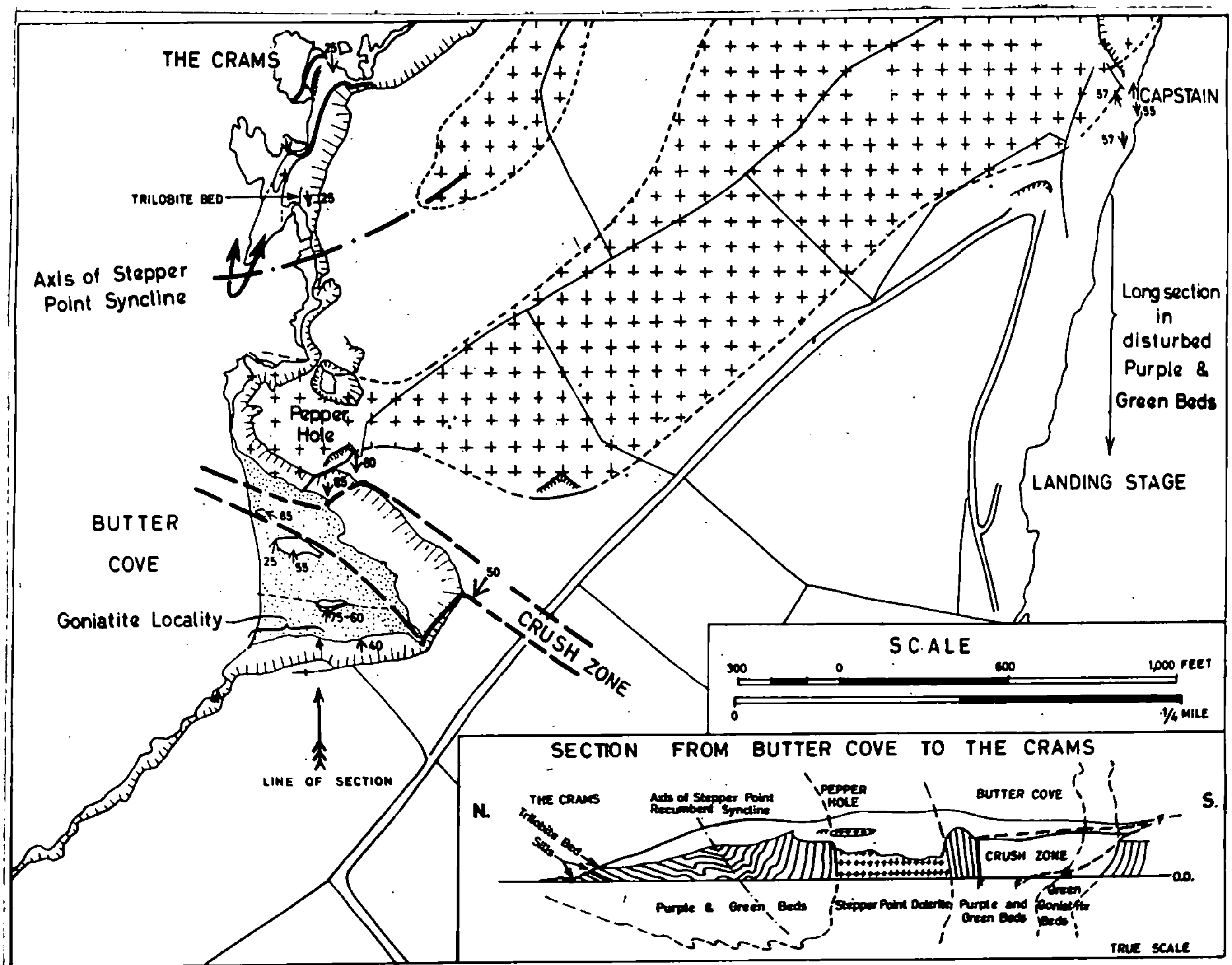
Ussher found specimens of "*Entomis*", *Styliola* and a small *Tentaculites* on the northern side of Butter Cove (in Fox 1905, p.130) but goniatites have only been noted in this survey. The southern part of Butter Cove has provided the following goniatites preserved in brassy appearing pyrite.

Ponticeras sp. D.633

? *Ponticeras* aff. *gerolsteinense* D.635

Manticoceras cf. cordatum D.646
Manticoceras sp. D.644, 647
Tornoceras (Aulatornoceras) paucistriatum var. nov., D.699

This fauna is clearly Frasnian in age and is quite close to that in beds i to iii at Merope Islands with which, on lithological characters it can be correlated. The presence of the same variety of T. (A.) paucistriatum as at Saltern Cove suggests that this fauna, and therefore that at Lower Merope Island, may be of Holzapfeli Zone age rather than Cordatum Zone, but the evidence from the Padstow Estuary tells against this (p.49).



Text fig.3. Geological map and section of Stepper Point showing the structural relations of the Butter Cove Frasnian goniatite locality.

The ostracods in the Purple and Green Slate on the northern side of Butter Cove are poorly preserved but comparable with Richterina (R.) striatula (R. Richter) which is common in the German Famennian. The trilobite bed at the Crams (text fig.3) has only yielded distorted thoracic segments.

29. The Padstow Estuary

The best localities for goniatites in the estuary are along the western cliffs north of Padstow. Goniatites were first noted hereabouts by Mr. A. Pedder. For the purpose of this work the coast has been re-examined and the numerous goniatite bands marked upon the twenty-five inch map. For convenience the localities have been numbered alphabetically according to their position along the coast north from Padstow. In most cases the goniatite bands can only be traced for a few feet and then are lost owing to shears, thrusts, crush zones or faults. The slate of the whole estuary is highly cleaved, the cleavage dip being about 20-25°S or SSW.

St. George's Cove

[A,B] The first goniatite locality passing north along the shore from Padstow is met just south-east of St. George's Cove (text fig.4). North of the main thrust, which separates slate of Middle Devonian appearance from Upper Devonian purple, green and grey slate, the following succession has been measured.

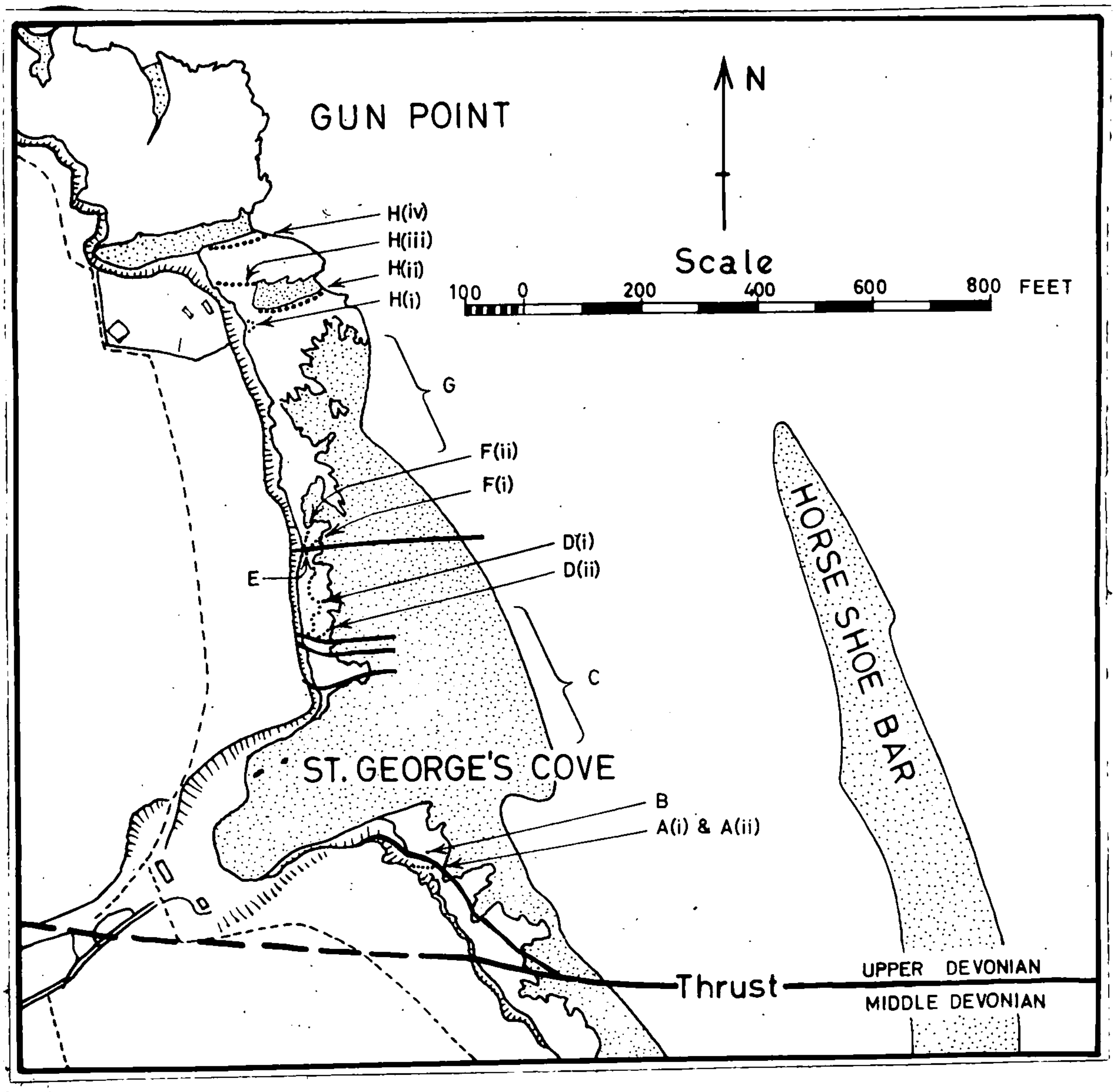
S. Major thrust plane separating Middle Devonian type grey slate from Upper Devonian slate.

	feet	inches
Grey/green slate with traces of purple bands, almost vertical, perhaps	20	0
Purple band in slate	c.6	0
Grey/green slate with goniatite bed A(iii) at the base	c.50	0
Purple band with fine mudstone seams, dipping 55° SSW	5	0
Grey slate with goniatite bed A(ii) 4' below the top	11	0
Grey slate with goniatites at the top, A(i)	5	0

Minor thrust plane

	feet	inches
Grey slate with goniatite band B(ii) 8' below the top	10	0
<u>Minor Thrust Plane</u>		
Grey slate	12	0
Purple band	c.4	0
N. Grey slate with goniatite band B(i) 9'below the top.		

These beds dip consistently towards the south. The cleavage/



Text fig.4. Sketch-map showing the Frasnian goniatite localities mentioned in the text along the Padstow Estuary between St. George's Cove and Gun Point.

/bedding relations (cl.19-25°S,bedd.55-58°SSW) suggest that this succession is inverted. The following fossils have been collected.

A(iii) Ponticeras sp.
Manticoceras sp. D.660
A(ii) Ponticeras aff. gerolsteinense (Steininger)
Orthocone indet.
A(i) Ponticeras aff. gerolsteinense (Stein.)
? Manticoceras sp. D.1021, 1016.
B(ii) Ponticeras aff. gerolsteinense (Stein.)
B(i) Ponticeras aff. gerolsteinense (Stein.)
Manticoceras sp. D.627
Orthocone indet.

These fossils are Frasnian. The true P. gerolsteinense comes from the Cordatum Zone.

[C] In St. George's Cove itself no determinable fossils have been found.

[D] Light grey slate with occasional purple patches is exposed for 50 yards north of the point at the north-east corner of St. George's Cove. Two thrusts then cut the slate and the finely banded grey slate which is seen next does yield goniatites. The first band, D(i), is traceable as a dark band parallel with the cliff at high-water level. The second band, D(ii), crosses the intertidal rocks just north of the two thrusts. The following have been collected.

D(ii) Ponticeras sp. D.667, 668.
Manticoceras sp. nov. D.669, 664.
? Manticoceras sp. D.672,674, 666.
D(i) Manticoceras cordatum (G. & F. Sandberger)
Manticoceras lamed (G. & F. Sandberger)
Orthocone indet., D.657.
Crinoid ossicles D.1293.

[E] A prominent sea-eroded cave marks the site of a thrust 108 yards north of the north-western corner of St. George's Cove. A few yards south of this cave, in finely banded light grey and quartz veined slate is another fossil band, E(i), in the lower part of the cliff. This has provided the following fauna.

E(i) Manticoceras sp. D.677, 680.
? Ponticeras sp. D.678.

At the southern side of the cave noted above, dark grey slate abuts against the thrust and from the slate goniatites weather out with a brassy appearance when fresh. This locality, E, has yielded.

E Manticoceras cordatum (G. & F. Sandberger)
Manticoceras sp. nov. D.1280, 1283.
Bactrites sp. D.651, Ponticeras prumiense (Steininger)

[F] At the top of the cliff face to the north of the cave a purple band is seen, dipping north. Just below is a disturbed band of grit lenticles six feet below which is a prominent dark band, one foot thick, of soft slate with poorly preserved goniatites, F(ii), mostly weathered to iron oxides. Another band, F(i), just above sand level on the north side of the thrust, also yields fossils.

F(i) Manticoceras cordatum (G. & F. Sandberger)
? Manticoceras sp.

[G] At various places in the slate between this locality and the localities at Gun Point a few indeterminable ponticeratids and/or manticoceratids have been collected.

[H] Fifteen yards south-east of the W.D. Bench Mark at Gun Point is a square platform of slate five by eight yards in area fringed with Fucus canaliculatus. Finely banded light grey slate hereabouts has fossils, H(ii). On the south side of a sandy inlet a little to the north-east goniatites occur again in dark grey banded slate, H(ii). A band which passes north-west from the landward side of this inlet also has poorly preserved fossils, H(iii), as does the slate on the southern side of a large sandy inlet a little to the north, H(iv). At these localities only the following determinable fossils have been found.

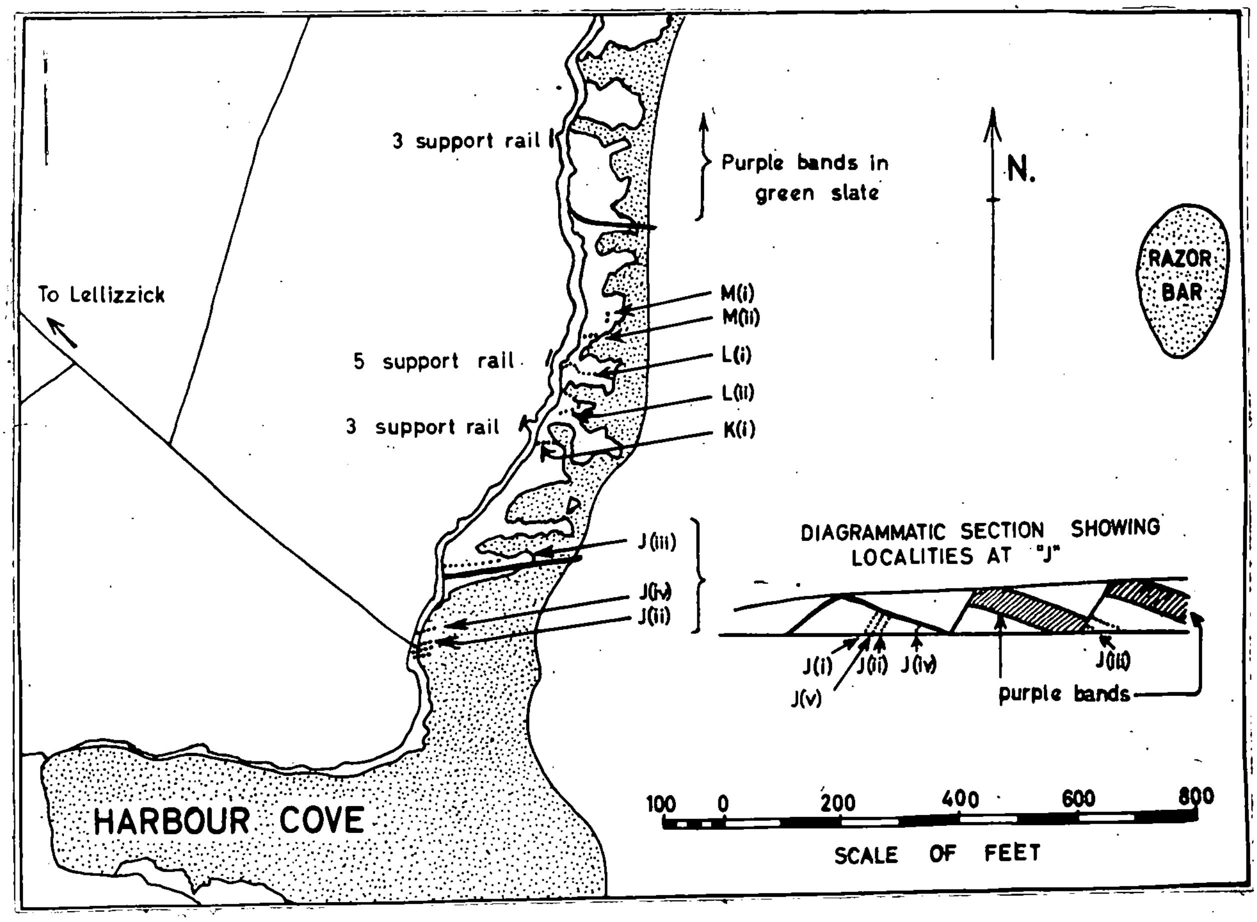
H(i)	? Ponticeras sp. D.980.
	? Manticoceras sp. D.979.
	Orthocones indet, D.972, 984.
H(ii)	? Manticoceras sp. D.987-990.

[I] Along the extensive cliffs on the south side of Harbour Cove no fossils have been found in the exposed purple and green banded slate.

[J] On the northern side of Harbour Cove, where a wall down from Lellizzick Farm reaches the cliff top, light grey-weathering finely banded slate with dark bands is exposed. These dark bands yield fossils (text fig.5). To the north purple bands appear. Below the wall and along the cliffs for 80 yards to the NNE, the following beds are seen. The succession between faults and thrusts is given in the order the beds are now seen with the top first. At least the first section is probably inverted.

		Feet
S.	Light grey slate with poorly preserved goniatites at the top. Dipping 50°-60°S, cleavage 22°SE	14
	Band of dark grey slate with goniatites, J(i)	1
	Light grey banded slate	5
	Band of dark grey slate, J(v)	1
	Light grey banded slate	3
	Band of dark grey slate immediately below the Lellizzick wall, with goniatites, J(ii)	3/4
N.	Light grey slate with goniatites, J(iv), seen to	c.6
	Fault and thrust beyond which beds dip north	
N.	Light grey/green slate	c.10
	Band of purple slate	5

		Feet
N.	Light grey/green slate with dark bands	c.8
	Fault, beyond which beds still dip north	
N.	Band of purple slate	c.5
	Grey/green slate	c.20
	Band of purple slate	c.5
	Light grey/green slate	5
	Dark grey slate	c.1
	Light grey/green slate	c.4
S.	Dark grey slate with goniatites, J(iii)	1



Text fig.5. Sketch-map showing the Frasnian goniatite localities along the Padstow Estuary north-east of Harbour Cove.

From these fossil bands at 'J' the following have been collected.

J(i) Ponticeras prumiense (Steininger)
Ponticeras cf. prumiense (Stein.), D.698.
Manticoceras cordatum (G. & F. Sandberger)
Manticoceras cf. affine (Stein.), D.601.

J(ii) Manticoceras cordatum (G. & F. Sandberger)
Manticoceras cf. cordatum (G. & F. Sandberger), D.549, 551, 611, 615.
Manticoceras cf. affine (Steininger)
Buchiola sp. D.553.

J(iii) Manticoceras cordatum (G. & F. Sandberger)
Manticoceras cf. cordatum (G. & F. Sandberger), D.688.

J(iv) Manticoceras sp. D.1000, 1001.
? Manticoceras cf. affine ISteininger)

The specimens from this locality agree very closely with the Büdesheim fauna andbtherefore with the Frasnian Cordatum Zone.

[K] Along the cliff top path north-east of Harbour Cove are three short railings, placed at three points where the cliff top dangerously approaches the path. These serve as useful guides to the fossil localities on the rocks below. The first railing, with three vertical supports, is 400 feet NNE of the end of the wall from Lellizzick mentioned above. Grey slate here dips 82°N and the cleavage is 25°S. A dark band on the south side of the inlet below the railing contains the following fossils, K(i).

K(i) Ponticeras prumiense (Steininger)
Ponticeras sp. juv. D.1289.
Manticoceras cf. cordatum (G. & F. Sandberger), D.649.
Tornoceras (T.) sp., simplex group, D.1288.

[L] Below a second railing, which has five vertical supports, 510 feet NNE of the end of the Lellizzick wall, is a small recess leading seaward to a small sandy embayment. In finely banded slate on the northern side of this recess is a two foot band of dark slate with goniatites, L(i). Above it is ten feet of pale grey/green slate with boudinaged limestone nodules. On the southern side of the recess is another dark band with goniatites, L(ii), which may be traced over the rocks towards, but not reaching, the three support railing to the south. These two bands contain the following fossils.

L(i) Ponticeras prumiense (Steininger)
Ponticeras sp. D.580, 583, 575, 523, 601, 602.
Manticoceras cordatum (G. & F. Sandberger)
Manticoceras sp. D.587, 592.
Tornoceras (T.) simplex group, D.573, 557, 584.
Tornoceras (Aulatornoceras) auris var., D.558.
Orthocone indet. D.586.
Gastropod D.557.
L(ii) Manticoceras sp. D.1004, 1010.

[M] On the rocks to the south of a small headland 46 yards north of the cliff guard rail with five supports, goniatites occur in disturbed grey slate. Two localities for goniatites are shown on the accompanying map (text fig.5), M(i) and M(ii). At M(i) the slate dips 15°N and the cleavage 21°S. The fossils are as follows.

M(i) Ponticeras sp. D.1290.
M(ii) Manticoceras sp. D.992.
Ponticeras sp. D.1290.
Tornoceras (T.) cf. simplex (von Buch) D.994.

This fauna is clearly Frasnian and, with that from localities at 'L' correlates with the Cordatum Zone.

To the north grey slate continues for 60 yards SE of the most northerly guard rail where a thrust introduces purple and green variegated slate which continues for one mile up to Stepper Point.

Synthesis on the Frasnian succession

The Frasnian localities A to M described between St. George's Cove and Stepper Point are all separated from each other by thrusts and faults so that their original order cannot be obtained from their field relations. No evidence has been found to suggest the presence of the Lunulicosta Zone and it is to be supposed that the localities must represent parts of the Cordatum and Holzapfeli Zones. However, concrete evidence for the presence of the Holzapfeli Zone has not been found.

Two localities, A,B and J(iii), at least, show goniatite bands closely associated with purple bands in the slate which, from the evidence at Lower Merope Island and Butter Cove, must be high in the Frasnian succession. The difference between the fauna at these localities, as well as the inference that the succession at A,B is inverted, show that Frasnian goniatite bands occur within the purple and green slate which is not therefore wholly Famennian in age. But whilst locality A,B may be of Holzapfeli Zone age, the presence of Manticoceras cordatum at J(iii) only 10 feet below a purple band would suggest that the Cordatum Zone might stretch up to at least the entry of purple bands. This also makes the tentative correlation of the Butter Cove Beds with the Holzapfeli Zone improbable.

Until the German successions for the Cordatum Zone are known in greater detail exact positioning of the other localities cannot be made, but the types of the majority of the species recognised come from the Cordatum Zone locality of Büdesheim. Whether any of the bands with a distinctive fauna occur high in the inaccessible cliff at Lower Merope Island must await a bed-by-bed collection there. The evidence does show that in this area the Cordatum Zone and possibly the Holzapfeli Zone is represented by grey slate, usually light in colour, with the goniatites practically limited to dark bands within the grey slate. At the top of the succession purple bands are intercalated.

Cant Hill

In 1905 Crick described several cephalopods from Cant Hill, on the eastern side of the Padstow Estuary, two miles south-east of Padstow. The specimens, collected by Fox, were identified as *Agoniatites* sp., *Orthoceras* cf. *commutatum*, *Cophinoceras* sp., and *Phragmoceras* (?). Crick concluded that the beds here must "certainly Devonian and most probably Eifelian or lower Middle Devonian age" (Crick 1905, p.160). Only the body chamber of the specimen identified as *Agoniatites* is extant (PM.1859) from 300 yards east of Gentle Jane Beach, Cant Hill. The specimen is an *Agoniatites* but is not specifically determinable. The age may be Eifelian as Crick suggested. *Agoniatites* only occurs in the Middle Devonian.

Brea

Mr. Alan Pedder found one specimen of *Manticoceras* at about 400 feet south of the minverite intrusion forming the southern point of Daymer Bay (House 1956, p.261). Search hereabouts has yielded no more specimens but the age must be Frasnian.

Daymer Bay

Disturbed purple and green slates crop out on the north side of Daymer Bay. About eight feet below the lowest band of purple slate seen is a goniatite band six inches thick which may be traced for about twenty five yards across the rocks on the foreshore. About fifty goniatites have been collected from this band but the majority can only be determined as *Manticoceras* sp., but crinoid ossicles and orthocones also occur. The horizon must be Frasnian in age. The specimens are much more poorly preserved than the specimens at J(iii) on the western side of the estuary so that a correlation cannot be made with certainty.

A specimen of *Tornoceras* cf, *auris* was recorded by the Officers of the Geological Survey at Trebetherick Point (Reid *et al*., 1910, p.25) and may have come from the same band described above. It does not help to give a more precise horizon, however.

Gravel Caverns

Mr. A. Pedder found goniatites at Pentire Haven two and a half miles north-north-east of Padstow. A determination has been quoted for one of them as Cheiloceras (House 1956, p.261) but an examination of the specimens, kindly sent from Canada by Mr. Pedder and presented to the Sedgwick Museum, has led to the following identifications.

Tornoceras (T.) simplex group, SM.H 7363 (Pedder Coll.101)
Manticoceras aff. calculiforme (Beyrich), SM.H 7364 (Pedder Coll.102)
Tornoceras (T.) aff. simplex towards crassum Matern, SM. H 7365 (Pedder Coll.103).

Presumably the specimens of Tornoceras were taken for Cheiloceras. The specimens show biconvex growth lines so there is no doubt as to the generic assignment. The specimen of T. (T.) aff. simplex towards crassum is very close to the specimen so identified (D.1198) from Bed i at Lower Merope Island. The true M. calculiforme comes from the Cordatum Zone in Germany so this fauna is best correlated with the middle Frasnian.

A peculiar bed of rather siliceous conglomerate occurs at the cliff top of a small promontory between the two small coves adjacent to Pentire Haven and called Gravel Caverns on the O.S. twenty-five inch maps. The bed is five feet thick on the promontory but appears again on the foreshore having been faulted down.

A description was given by Fox (1904 p.34) of this locality and he correctly noted the same conglomerate in the floor of 'Tar Cavern' trench which is just to the south. Ussher found a small Orthoceras at the latter locality but at Gravel Caverns found two specimens of 'Cardiola retrostriata' and a small goniatite referred by Crick to Tornoceras. The following fossils have been found in the conglomerateon the foreshore at

Gravel Caverns.

Manticoceras sp. D.1302.

Tornoceras (*T.*) *simplex* group , D.1304.

Tornoceras (*A.*) sp. juv. D.1303.

Orthocone indet. D.1013.

Buchiola sp. D.1013.

Also *in situ* from the conglomerate of the promontory :-

Tornoceras (*T.*) *simplex* group.

The single *Manticoceras* is sufficient to give a Frasnian age to the conglomerate since these fossils come from the matrix.

30. *Portquin*

The goniatite locality at Portquin was described in the Padstow Memoir (Reid *et al.*, 191o, p.26) and Clement Reid and his wife made a collection here which is now in the Survey Museum. Grey slate on the north and south sides of the small inlet at Portquin at about low-water mark of ordinary tides provides the best collecting.

Dr. Ivor Thomas identified the specimens from here and correlated them with the Cheiloceras Stufe of Germany (in Dewey 1914,p.157) and on the current Geological Survey one-inch map of Camelford the word "*Cheiloceras*" is engraved opposite Portquin. That the Middle Devonian genus *Wedekindella* was here mistaken for the Upper Devonian *Cheiloceras* has already been pointed out (House 1956, p.259). This locality has been visited annually for the past four years and the following list gives the specimens collected together with those in the Clement Reid collection at the Geological Survey Museum.

Agoniatites costulatus (d'Archaic and de Verneuil)

Wedekindella brilonense (Kayser)

Wedekindella sp. nov. D.739, as at Trevone.

Maenioceras terebratum (G. &. F. Sandberger)

Holzapfeloceras aff. circumflexiferum (G. & F. Sandberger)
Sobolewia nuciformis (Whidborne)
Tornoceras (T.) simplex var. B.
Tornoceras (Protornoceras) sp. nov.
Tornoceras (Aulatornoceras) sp. nov. aff. varicata Wedekind

The specimens at this locality are not as well preserved as those at Pentonwarra Point, Trevone and there are none of the pyritic lenticles which at Trevone yield the largest goniatites. The faunal resemblance with Trevone is clearly very close and there can be no doubt but that the horizon is the Terebratum Zone of the Givetian.

31. Launceston Area

This area, including the famous locality of South Petherwin, and also the known localities around Landlake and Yeolmbridge has not been examined in detail since Mr. E.B. Selwood is engaged here. The recognition of the Wocklumeria Stufe (House and Selwood 1957) in addition to the well known fauna of the Platyclymenia and Clymenia Stufen (figured by Phillips 1841 and Ansted 1838) shows that the Famennian succession is nearly complete, only the Cheiloceras Stufe has still to be recognised, but that may still be in Cypridenenscheifer facies. No detailed description of the goniatites from this region is included in the systematic section which follows.

Chapter 4. SYSTEMATIC PALAEONTOLOGY

Contents

(1) The Evolution of the Devonian Goniatites

In the last century views on the evolution of the goniatites suffered especially from inaccurate stratigraphical information. The general tectonic disturbance of Devonian rocks in Europe was largely the cause of this and as recently as 1887 Frech was recording Upper Devonian ammonoids from supposedly Lower Devonian rocks in the Carnic Alps and Montagne Noire unaware that at both localities the succession is generally inverted. It was therefore not until after the publication of Wedekind's careful work (1913, 1917) that any accurate synthesis became possible. In a long series of papers beginning in 1920 O.H. Schindewolf has introduced order into the problem of Devonian ammonoid evolution. In these studies the suture has always been regarded as of paramount importance. Indeed, in such respect are sutureshheld by Schindewolf that he has recently (1958) published a scathing attack on Arkell (1957) for questioning their reliability in Jurassic ammonoid systematics, where their usefulness is least attested. However much it might appear that the German views still bear the stamp of the nineteenth century schools of transcendental Natur-philosophie with the suture as the supreme morphological and systematic unit, yet, in the Devonian at least, they seem to work. But for the elucidation of detailed lineages other evidence must also be examined and there are cases were the suture alone gives a misleading picture.

The Origin of the Goniatites

There are three common hypotheses regarding the origin of Devonian goniatites. The first, favoured by Barrande (1867), Hyatt (1884, 1889), Schindewolf (1933, 1935, 1954), Miller (1938) and most Devonian goniatite specialists, considers them descended from straight nautiloids, probably michelinoceratids, via <u>Bactrites</u>, <u>Lobobactrites</u> and <u>Gyroceratites</u>. The second, championed especially by Spath (1933, 1936, 1937), would derive them direct from coiled Ordovician and Silurian nautiloids of <u>Barrandeoceras</u>, <u>Tarphyceras</u>

or <u>Palaeonautilus</u> type. The third view, tentatively suggested by Frech (1902), supposes that they are polyphyletic in origin, arising from several different nautiloid groups. Unfortunately there is no complete faunal succession rich in cephalopods spanning the Upper Silurian, Gedinnian and Siegenian so evidence is mainly inferred indirectly from morphological factors.

The evidence favouring the first hypothesis is formidable and the most important considerations are as follows.

(i) Bactritids show a ventral siphuncle which forms a ventral lobe : this is an invariable feature of goniatites. In this respect they show a step towards the goniatite from the nautiloid condition.

(ii) The protoconch of <u>Bactrites</u> and <u>Lobobactrites</u> is egg-shaped as it is in some michelinoceratids. The typical protoconch of coiled nautiloids is hemispherical.

(iii) Emsian goniatites such as <u>Gyroceratites</u> and <u>Mimagoniatites</u> have egg-shaped protoconchs. Most later goniatites have barrel-shaped protoconchs.

(iv) <u>Gyroceratites</u> and <u>Mimagoniatites</u> have loosely coiled whorls and a perforate umbilicus. Later goniatites are more tightly coiled and have an imperforate umbilicus.

(v) <u>Eobactrites</u> occurs in the Ordovician and <u>Lobobactrites</u> has recently been found in the Emsian (Erben 1953) and occurs either in the Couvinian or Emsian of Australia (Teichert 1948). Its stratigraphical position does not therefore support the view that it is a secondarily uncoiled goniatite as Spath claimed. However, the comment of Schindewolf (1954 p.222) that "<u>Anarcestes</u>, at least, is not known from beds older than those containing <u>Lobobactrites</u>, <u>Gyroceratites</u> and <u>Mimagoniatites</u> " is not substantiated by the record of a Siegenian <u>Anarcestes</u> by Prantl (1954).

The evolutionary sequence involved in this hypothesis commences with orthoconic nautiloids with a sub-central siphuncle. First the siphuncle migrates to the margin to give the ventral lobe of

Eobactrites and Bactrites. Bactrites, at least, develops a marked egg-shaped protoconch. Next bilateral symmetry appears and lateral lobes are formed as in Lobobactrites. Next coiling begins to give Gyroceratites with a perforate umbilicus. Coiling then tightens and one involute stock leads to Anarcestes and its allies, another to Agoniatites and from these others are produced mainly by diversification of shell and sutural form.

The evidence is not concrete enough to dogmatise on one hypothesis rather than another and it may be that the Mimosphinctes group, at least, do arise independently from coiled nautiloids in the manner proposed by Frech and Spath, but there is little direct evidence to support this. The subsequent evolution of the stock is better known and has given rise to little argument.

a. Mimoceratidae

The Emsian and Couvinian Gyroceratites is, according to the most commonly accepted hypothesis, supposed to have arisen from the Lower Devonian Lobobactrites , with which the suture agrees in possessing only lateral and ventral lobes. Erben (1953) has shown that the Couvinian species of Gyroceratites are more tightly coiled than the Emsian species although all have a perforate umbilicus. A separate group of mimoceratids including Mimosphinctes, Palaeogoniatites and Anetoceras show strong ribbing. Indeed, plaster casts of Mimosphinctes might be mistaken for Jurassic perisphinctids. Palaeogoniatites is very evolute and in Anetoceras the whorls cease to be in contact. This sequence probably represents a secondary uncoiling.

b. Agoniatitidae

Mimagoniatites, of the Emsian and Couvinian, probably evolved from Gyroceratites by the development of a median dorsal lobe ; it still has a perforate umbilicus and gives rise to Agoniatites, of the Couvinian and Givetian, by the closing of the umbilicus. Paraphyllites (Couvinian) is similar but forms small umbilical lobes.

c. Anarcestidae

Anarcestes (Siegenian to Givetian) is the first goniatite known and is perforate, with a dorsal and ventral lobe, and a lobe which is sub-umbilical in early stages but which may become lateral in position in the adult. The evolution of the genera Subanarcestes, (Couvinian to L. Givetian), Werneroceras (Couvinian to L. Famennian) and Sellanarcestes (Emsian and Couvinian) has been described by Schindewolf (1933). Archoceras, a Frasnian member, represents the ancestral type for the Gephuroceratidae and Schindewolf (1937a, 1949, 1955) would also derive the clymenids from it by a dorsal migration of the siphuncle.

A second group of anarcestids includes Pinacites and its allies all of which form an umbilical lobe before the adult and show a lateral migration of the primarily sub-umbilical lobe during ontogeny. Of these Foordites and Pinacites are laterally compressed and the suture of the former may make it homoeomorphic with Tornoceras (Petter 1955). Wedekindella is usually more rotund than Foordites and forms a median dorsal saddle ; upper Givetian specimens have prominent constrictions. The Givetian Maenioceras forms an adventitious lobe between the ventral and lateral lobes of the adult and also a pair of dorsal umbilical lobes. Schindewolf (1933) considered that this genus evolved from Foordites but evidence of the ontogeny of Cornish specimens of Maenioceras as well as evidence from the Wolborough fauna shows that they probably came direct from Anarcestes with which the lower Givetian specimens are intermediate.

d. Prolobitidae

Only one member of this family, Sobolewia (Givetian) occurs in England so that little can be added to the problem of the origin and evolution of the group (Wedekind 1913a, Schmidt 1952, Schindewolf 1954). If Schmidt's view is upheld that Prolobites is descended from Cheiloceras then Sobolewia may have given rise to Cheiloceras via the American Raymondiceras which it closely resembles. Sobolewia, suitably for this, shows the onset of convex growth lines.

The relationship of the subfamily Sandbergeroceratinae to typical prolobitids is less firmly established than Miller and Furnish (in Moore Ed., 1957) suggest in their classification. The multilobed genera Sandbergeroceras and Schindewolfoceras may, more reasonably be linked with the Pharciceratidae.

e. Gephuroceratidae

A morphological sequence may be traced from the anarcestid Archoceras through Ponticeras or Probeloceras to Manticoceras showing the systematic entry of umbilical lobes. All these are common in the Frasnian but Ponticeras appears first and Archoceras last so the series may not be evolutionary. But, unless Archoceras is degenerate, its presence does suggest that the simple sutured anarcestid stock continued unchanged into the Upper Devonian and was therefore available as an ancestral stock for the Gephuroceratidae. It has been claimed that the series continues from Manticoceras on through Koenenites and Timanites to Pharciceras along one line, and through Neomanticoceras and Eobeloceras to Beloceras in another (Schindewolf 1936, p.691). But, since Pharciceras appears stratigraphically before Manticoceras, it is at least possible that the multilobed condition arose independantly, and perhaps suddenly, in the Pharciceratidae. This could be associated with the more depressed whorl section of some pharciceratids.

f. Beloceratidae

It seems probable that Beloceras was derived in part as Schindewolf suggested. Recently a new genus, Mesobeloceras, has been intercalated in the series between Eobeloceras and Beloceras (Glenister 1958, p.82).

g. Tornoceratidae

In this family the lateral lobe of the adult arises adventitiously during ontogeny upon the arched lateral saddle of the early whorls. The group probably arose in the Emsian but the first authenticated recorde are Couvinian. There is the possibilty that many early records of the genus _Tornoceras_ are not _Tornoceras_ at all but homoeomorphic _Foordites_ or _Holzapfeloceras_ which could only be distinguished on the basis of sutural ontogeny. The family continues up into the Famennian. Differentiation of the stock took place mainly by variation in the shell form. _Tornoceras_ ss. is completely involute, with rounded outline ; _Protornoceras_ has an open umbilicus and _Aulatornoceras_ has paired external furrows. All possess biconvex growth lines. Sobolew contended that the clymenids arose from this group by a simplification of the suture and a dorsal migration of the siphuncle, but no one has subsequently supported this view which does not take account of the Frasnian _Acanthoclymenia_. The group may have given rise to the Cheiloceratidae by the development of convex growth lines.

g. _Cheiloceratidae_

Cheiloceras is very common in the lowest Famennian of Europe but it has not been found in England. The sutural development was held by Schindewolf to be of tornoceratid type but Schmidt (1952) considers it is prolobitid. The growth lines are invariably convex and constrictions are not uncommon. The genus is subdivided on the basis of the dorsal suture which may be of several types. By the formation of an adventitious lobe, this group gives rise to _Sporadoceras_ and the pattern has been worked out in detail by Schmidt (1921). By a farther development of another adventitious lobe _Discoclymenia_ is produced. Considerable dispute centres around the genera _Imitoceras_ and _Prionoceras_, which occur in the Famennian although the former may range on to the Permian. _Prionoceras_ was placed with _Gattendorfia_ in the Prolobitidae by Schindewolf (1924) who claimed that these genera showed true constrictions, rectilinear growth lines and a prolobitid ontogeny. _Imitoceras_ he referred to the Cheiloceratidae stating that it has false constrictions (not observable on the outside of the shell) and truly convex growth lines. But most authors, including Schmidt (1925), Librovitch (1940) and Miller and Furnish (in Moore Ed. 1957) place _Prionoceras_ and _Gattendorfia_ together with _Imitoceras_ in the Cheiloceratidae.

(2) Terminology

The descriptive terminology used for the Palaeozoic ammonoids has recently been reviewed by Miller and Furnish (in Moore Ed., 1957) so that no details need be given here except to justify any different procedure adopted.

a. Sutures. Von Buch (1832) used descriptive terms such as "upper lateral" or "first lower lateral" to designate sutural elements and McCoy (1854) proposed to number lobes from the "outer mid-lobe" [=ventral] dorsally. But these, and other systems took no account of the sutural ontogeny. True sutural formulae were introduced by Noetling (1905) as a result of studying the ontogeny of Pseudageceras multilobatum from the Trias of the Salt Range, but his system is complex and has never been adopted. Wedekind (1917) introduced a much simpler scheme for Devonian goniatites in which a lettering is used for the lobes and the saddles neglected. Various modifications of the letters used have been introduced by Matern (1931), Schmidt (1952) and Bogoslovski (1954). These systems all take account of the fact that the first suture of the typical Devonian goniatite has four lobes, a Ventral lobe (E or V), a Dorsal lobe (I, J or D) and one Lateral lobe on each side (L or P). In later development Adventitious lobes (A) may develop between the Ventral and Lateral lobes and Umbilical lobes (U) between the Lateral and Dorsal lobes. The letters used by various authors are shown below.

	Ventral	Adventitious	Lateral	Umbilical	Dorsal
Wedekind 1917	E	Ai,ii..	L	Ui,ii..	J
Matern 1931	E	A1,2..	L	U1,2..	I
Schindewolf 1933,1954	E	A1,2..	L	U1,2..	J
Schmidt 1952	E	A1,2..	P,L	U, K	J
Bogoslovski 1954	V	A	U	U1,2..	D

It has been thought best in the specific descriptions which follow to describe the sutural elements rather by their actual position around the whorl than by their alleged, or assumed, origin. However, when primary lobes are referred to the name will be capitalised. Thus, a "lateral lobe" is one laterally placed on the whorl flank whilst a "Lateral lobe" is the primary sub-umbilical lobe which, in the adult, may be umbilical, sub-umbilical or lateral in position.

b. Synonomies. The species synonymies are rarely complete but an asterisk (+) is given against references where more complete synonymies will be found.

c. Reference to Genera and Species. Since in the accompanying appendices, lists, as exhaustive as possible, are given of the generic and specific names which have been applied to Devonian goniatites, these details are, in general, not included in the text.

d. Measurements. All measurements are in millimetres. Ratios are given as percentages. The following abbreviations are used :

C - number of constrictions in the last whorl.

D - diameter.

S - number of septae in the last whorl.

SH - height between the base of a lateral lobe and a line joining the crests of the umbilico-lateral and the ventro-lateral saddles.

US - length of an umbilico-lateral saddle measured from the umbilicus to the point of inflexion at the dorsal side of the lateral lobe.

UW - umbilicus width.

WH - whorl height by lateral projection.

Wh - height between the venter and the bottom of the impressed area.

WW - maximum whorl width.

(3) Systematic Descriptions

Suborder ANARCESTINA Miller and Furnish 1954
Superfamily ANARCESTACEAE Steinmann 1890
Family AGONIATITIDAE Holzapfel 1899

Genus AGONIATITES Meek 1877

Type species : Goniatites vanuxemi Hall 1879

Diagnosis : Primitive ammonoids with ventral siphuncle. Shell involute to sub-evolute, usually somewhat discoidal. Protoconch large, subspherical. Umbilicus imperforate. Growth lines biconvex. Suture with a small V-shaped ventral lobe, a Lateral lobe laterally placed from the earliest stages and a single median dorsal lobe.

Remarks : The nomenclatorial history of Agoniatites has been given by Miller (1938 p.43) and the details of the ontogeny and probable phylogeny by Schindewolf (1933 p.83).

1. Agoniatites costulatus (d'Archaic and de Verneuil)

Plate 1, fig. 1 and 2.

1842 Goniatites costulatus d'Archaic and de Verneuil 1842, p.341, pl.26, fig.3,3a,3b.

1895 Agoniatites inconstans var. costulatus E. Holzapfel 1895, p.63, pl.6, fig.2, pl.8, fig.5.

+1897 Agoniatites costulatus A.H. Foord and G.C. Crick 1897, p.285, fig.140.

1917 Agoniatites costulâtus R. Wedekind 1917, p.113, pl.15, fig.13,14, text fig.21 i.

+1927 Agoniatites costulatus H. Schlüter 1927, p.210.

1933 Agoniatites costulatus O.H. Schindewolf 1933, p.83, pl.4, fig.15, 16.

1950 Agoniatites costulatus H. Schmidt 1950, p.92, text fig. 8.

1956 Agoniatites aff. costulatus M.R. House 1956, p.259.

This species is especially common in the continental Upper Givetian. In England it occurs at Trevone, Portquin and Lummaton.

Description (of Cornish specimens)

Dimensions	D	WH	WW
GS.95395 Trevone	c.4.8	1.4	1.6
D.875 Trevone	c.8.0	c.2.5	3.0
D.736 Portquin	?c.7.0	2.2	3.3

Shell form evolute in early whorls, compressed, all whorls visible. Protoconch large, reaching 1.7mm diameter and 1.6mm in breadth(text fig.6). Whorls rounded in section, slightly depressed with traces of paired ventro-lateral furrows. Slight impressed area.

Ornamented with strong periodic ribs, 4.2 per mm on the flanks at 5mm diameter, 5 in 3mm at c.7mm diameter. Ribs accord with growth lines which form a broad sinus on the lateral areas and a narrow linguiform salient on the ventro-lateral shoulders and a similar sinus on the venter.

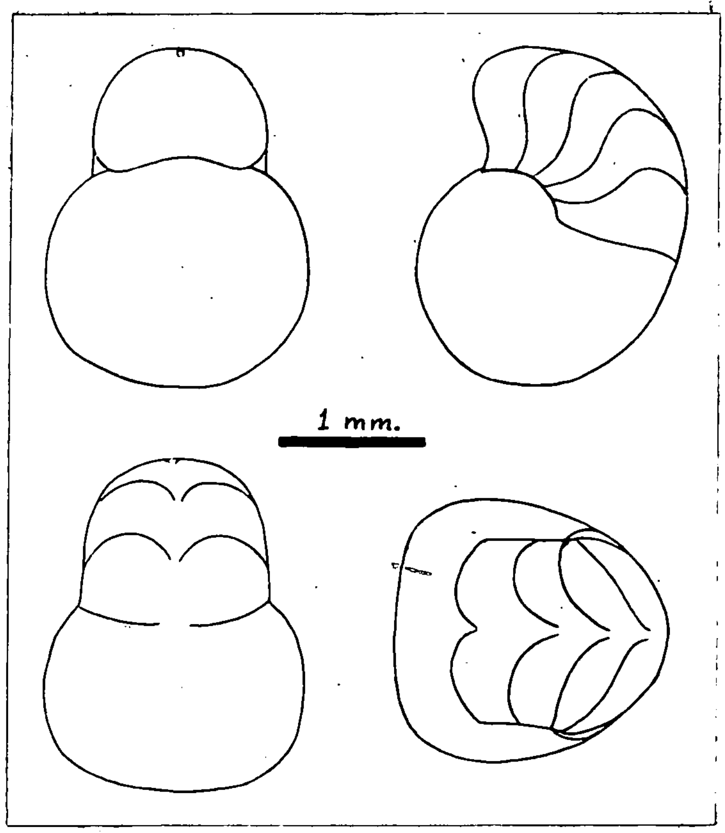
Suture with a V-shaped ventral lobe, a rounded ventro-lateral saddle and broad lateral lobe. Umbilical saddle centres on the seam. Rounded median dorsal lobe.

Remarks

Cornish specimens were referred to A. aff. costulatus on the basis of the tighter coiling shown on the early whorls of the holograph. Examination of the holotype in the l'Ecole des Mines shows that the holograph is in part a reconstruction ; the inner whorls are filled with matrix. Details of the holotype are as follows :-

	WH	WW	UW
At 24.3 mm dia.	8.7	9.2	9.5
At 19.0 mm dia.	8.4	7.0	7.5

In the last half whorl, which is mostly body chamber, there are 17 ribs. There are seven septae in the last quarter whorl of the septate portion. The specimen is more evolute than the type figure suggests, and only two complete whorls can be seen.



Text fig. 6. Protoconch and early chambers of Agoniatites costulatus (d'Archaic and de Verneuil) from Portquin, North Cornwall. Based on D.736, X 20.

According to the reconstruction of Schmidt (1950 text fig.8) this species becomes more compressed in the adult. If this is so then it becomes comparable with other species, such as A. holzapfeli and A. floweri, which have similar strong ribbing on the early whorls. According to the interpretation adopted here A. transitorius may be distinguished by much gentler ribbing.

Horizon

Both the specimens from North Cornwall and the single specimen from Lummaton can, on the evidence of associated goniatites, be dated as of Terebratum Zone age where this species is commonest in Germany.

Specimens

From Portquin, GS.1610, 1673, D.743, 742, 736. From Trevone, GS.95395, D.825, 875, 903. A single specimen from Lummaton is in the collections of the Exeter Geology Department.

2. Agoniatites fulguralis (Whidborne)

Plate 2, fig. 1, 2 and 3.

1890 Goniatites fulguralis G.F. Whidborne 1890, p.59, pl.5, fig. 4,4a.

1895 Agoniatites inconstans var. fulguralis E. Holzapfel 1895, p.64, pl.7, fig.1.

1917 Agoniatites fulguralis R.Wedekind 1917, p.112, pl.15, fig.12, text fig.21 g.

Only one specimen of this species is known in England. It comes from Lummaton Quarry, Torquay.

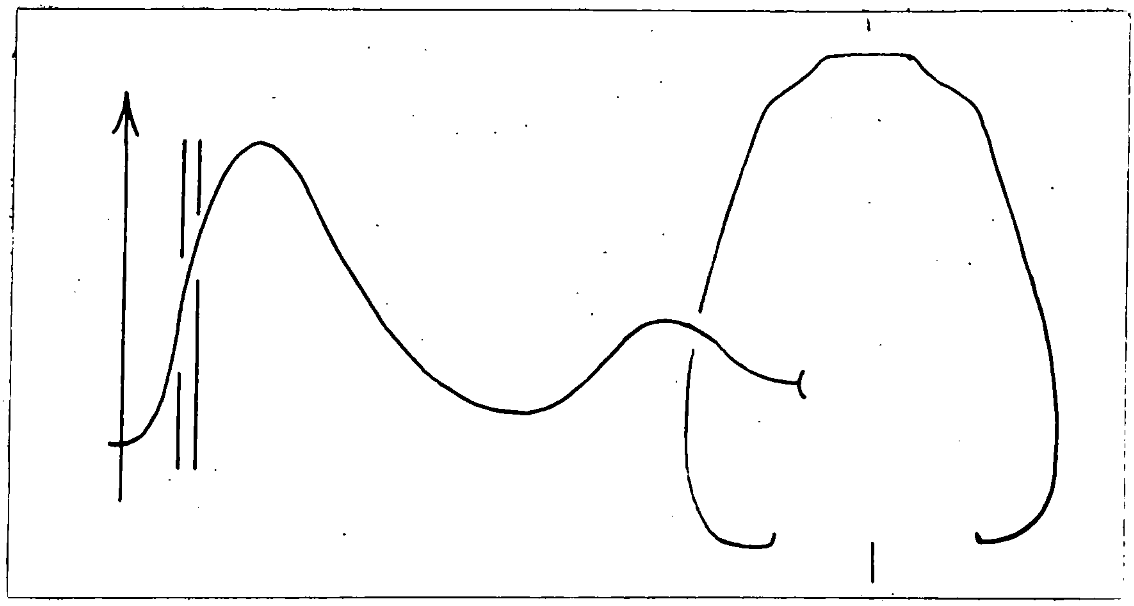
Description (of SM.H 4132, the Holotype)

Dimensions	D	WH	WW	UW
Maximum diameter	33.0			
	32.6	15.0	10.8	9.8 (internal mould)
	22.0	9.6	9.3	6.6 (testate)
	c.15.0	6.2.	6.3	4.8 (testate)

Shell sub-evolute and subdiscoidal, open umbilicate. Whorl section (text fig. 7) with flattened ventral band (2.6mm broad at 22mm diameter), bounded by slight ventro-lateral furrows. Lateral areas slope convexly out to maximum width near the umbilicus. Umbilical shoulder rounded and wall steep. Moderate impressed area. Whorl height exceeds width above 17mm diameter.

Growth lines form fine biconvex lirae 1mm apart at 25mm diameter. They pass forward from the umbilicus to form a salient just beyond the umbilical shoulder (text fig. 7) and back to a broad sinus on the lateral areas. They curve sharply forward to a marked projecting salient near the ventro-lateral shoulder and return to a very deep linguiform ventral sinus.

The septate portion of the holotype is testate and the course of the suture cannot be determined.



Text fig. 7. Agoniatites fulguralis (Whidborne). Left, growth lines at 27mm diameter, X 6. Right, whorl section at 28mm diameter, X 5. Both based on SM.H 4132, from Lummaton Quarry, Torquay.

Remarks

Only two specimens were known to Whidborne when he first described this species and none have since been found in Devon. The second specimen, BM.23707, is a poor polished specimen which cannot be referred to this species with certainty. The species has been recorded by Holzapfel (1895) from the Stringocephalenschichten and Wedekind has figured a specimen from the Givetian of Martenburg. Whidborne compared the species with several of Barrande's forms from Czechoslovakia (1890 p.60), especially with Goniatites Bohemicus, but the majority of those syntypes differ in not possessing a deep lateral sinus although one (Barrande 1865 pl.1, fig.1) does compare in this respect.

The determination of this specimen with Agoniatites until recently gave the only concrete evidence that the high fossiferous horizon at Lummaton was of Middle Devonian age. The Terebratum Zone fauna which has been found here by Mr. Vincent compares very closely in lithology and preservation with the specimen of A. fulguralis which probably came from the same bed.

Specimens

Holotype, SM.H 4132, from Middle Devonian Terebratum Zone, Lummaton Quarry, Torquay,

3. Agoniatites obliquus (Whidborne)

Plate 2, figs. 4 to 7.

1889 Goniatites obliquus G.F. Whidborne 1889, p.29.
1890 Goniatites obliquus G.F. Whidborne 1890, p.56, pl.5, figs.1-3.
1895 Agoniatites inconstans var. obliquus E. Holzapfel 1895, p.62, pl.5, figs.1,5, pl.7, fig.14, pl.8, fig.4.
1897 Agoniatites obliquus A.H. Foord and G.C. Crick 1897, p.56, text fig.57.
1913 Goniatites obliquus W.A.E. Ussher 1913, p.23.
1917 Agoniatites oxynotus var. obliquus R. Wedekind 1917, p.112, pl.15, fig.4, text fig.21d.

Description (of GS. 7114, the specimen best suited among the original syntypes for selection as lectotype).

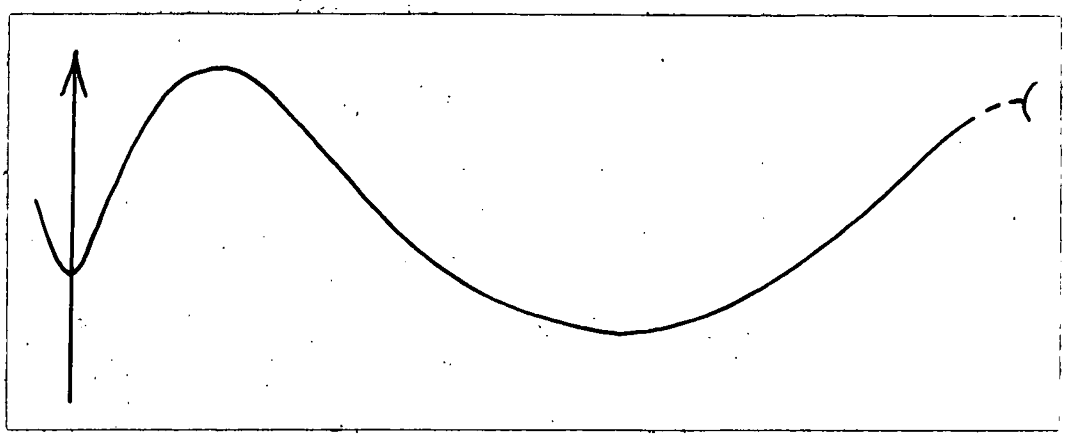
Dimensions	D	WH	WW	UW
At max. dia.	35.0	15.5	10.8	10.0
	28.0	12.2	c.7.8	8.7

The specimen is poorly preserved as an internal mould in coarse, crystalline limestone. It is fully septate to a diameter of 30mm. One side shows traces of the ornament, the other shows the septae, ten of which can be distinguished in the last half whorl of the septate portion.

Shell sub-evolute and discoidal. Whorl section with a flattened band on the venter (3.5mm broad at 32mm diameter) with furrows on either side. Impressed depth 29% at maximum diameter. Lateral areas diverge from ventro-lateral furrows to maximum width close to the umbilical shoulder. Inner whorls not clearly seen but more rotund in cross section.

Ornamentation takes the form of close-set, slightly backwardly projecting ribs over the umbilical shoulder in the early whorls. In the outer whorls there are tracse of growth lines which appear to slope forward on the outer flanks towards the ventro-lateral flanks ; elsewhere they cannot be traced.

The sutures (text fig. 8) show only a V-shaped ventral lobe, a narrowly rounded ventro-lateral saddle and a broad, shallow lateral lobe. The dorsal suture cannot be traced.

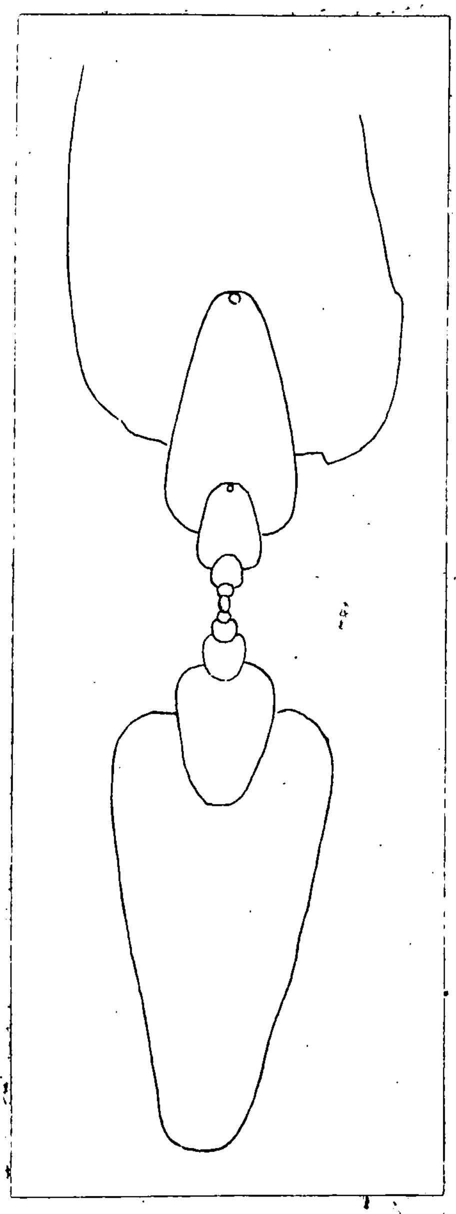


Text fig. 8. Agoniatites obliquus (Whidborne). Suture slightly reconstructed from GS.7114, Wolborough Quarry, Newton Abbot, South Devon, X 12.5 .

Remarks

This species is very close to A. fulguralis but it is significantly more compressed, has a deeper impressed area in the adult and is more evolute in the early stages. Apart from the large specimen figured by Whidborne (1890 pl.5, fig.2) and probably the specimen from Barton mentioned by Foord and Crick (1897 p.379) and illustrated here (text fig. 9) the other syntypes can only with the greatest reservations be placed in this species, they are either too small or too poorly preserved for certainty.

Holzapfel considered both A. fulguralis and A. obliquus recognizable in the German Middle Devonian but placed both as varieties of "Agoniatites inconstans". Goniatites inconstans Phillips is a Namurian Reticuloceras from near Exeter. Although Wedekind placed



Text fig. 9. Agoniatites cf. obliquus (Whidborne). Median section based on BM.c 3793 from the Middle Devonian limestones at Barton Quarry, Torquay, South Devon. Natural size.

both of these species as varieties of Agoniatites oxynotus, also an upper Middle Devonian species, it is best to regard them as distinct species. A. oxynotus becomes a true oxycone in the outer whorls where it has an obtusely angular venter. This does not appear to develop in A. obliquus, which is known to comparable diameters, nor does A. fulguralis give evidence that it will become so at diameters greater than that of the known English specimens.

Specimens, Horizon and Locality

Whidborne's figured syntypes came from Wolborough. They are : GS. 7114 (Whidborne pl.5, fig.3, 3a) and BM.c 1740 (Whidborne pl.5, fig.2). The horizon of both of these is Molarium Zone, on the basis of the associated maenioceratids. Whidborne also mentioned the polished specimen from Barton Quarry, Torquay, figured above (BM.c 3793, ex Torquay Museum) ; this specimen is thought to be comparable with the species and the horizon, on the basis of the presence at Barton of Wedekindella brilonense var. aratum, is Terebratum Zone. Also comparable is SM. 3405 labelled "Newton Bushel" and probably coming from Wolborough.

4. Agoniatites transitorius (Phillips)

Plate 1, figs. 4 to 10

1841 Goniatites transitorius J. Phillips 1841, p.140, pl.60, fig. 227+.

1890 Goniatites transitorius G.F. Whidborne 1890, p.61, pl.5, figs. 7-10, ? pl.6, fig.8, 8a.

+1897 Agoniatites transitorius A.H. Foord and G.C. Crick 1897, p.55, text fig. 20.

1913 Goniatites transitorius W.A.E. Ussher 1913, p.23.

Description (of the Holotype, GS.7115, from Wolborough Quarry, Newton Abbot, South Devon).

Dimensions (with estimated corrections for distortion)

D	WW	WH	UW
c.25.0	c.9.0	c.10.0	c.9.0

The Holotype is preserved as a distorted, fully septate internal mould of coarse crystalline limestone.

Shell form sub-evolute, laterally compressed. Whorl section rotund, with traces of a ventral band and ventro-lateral furrows. Maximum whorl width two-third way across flanks. Umbilical shoulder rounded and wall steep. Slight impressed area.

Suture with a very small V-shaped ventral lobe, a broad, rounded, lateral lobe on the flanks with an umbilical saddle centred on the seam. Only the commencement of median dorsal lobe visible.

No trace of surface ornament can be seen.

Remarks

In view of the poor state of the Holotype it is necessary to follow Whidborne in defining the species taking into account the form of similar topotypes. Some of these are illustrated afresh here (BM. 23707, pl.1, fig. 3,4, BM. 36279, pl.1, fig. 6,7,8). These show a shell form quite comparable with that of the Holotype but in addition give evidence of an ornament of slight ribbing in the early whorls which forms a slight lateral sinus. Another specimen from Wolborough (SM.A 6793, pl.1, fig. 3), which is comparable with A. transitorius shows ornamentation on the body chamber at 60mm diameter which suggests a broad, rounded ventro-lateral salient in the adult.

This species has less strong ornamentation than A. costulatus and differs from A. obliquus and A. fulguralis by being more rotund. A. dannenbergi has more evolute inner whorls and no evidence of surface ornament. This species belongs to Wedekind's group 3 of the agoniatitids and to subgroup 'b' (Wedekind 1917, p.112) but it differs from all species included therein although is nearest A. costulatus var. euryomphala but the ribbing in that species is stronger.

Horizon

All known English specimens come from Wolborough which, on the evidence of associated maenioceratids, belongs to the Molarium Zone of the Lower Givetian.

Specimens

Holotype, figured by Phillips 1841 and Whidborne 1890, GS. 7115. Other specimens include BM. 23707, 36279. The following specimens are comparable to the species : SM. H 3406, 3405, SM. A 6793. All specimens are from Wolborough Quarry, Newton Abbot, South Devon.

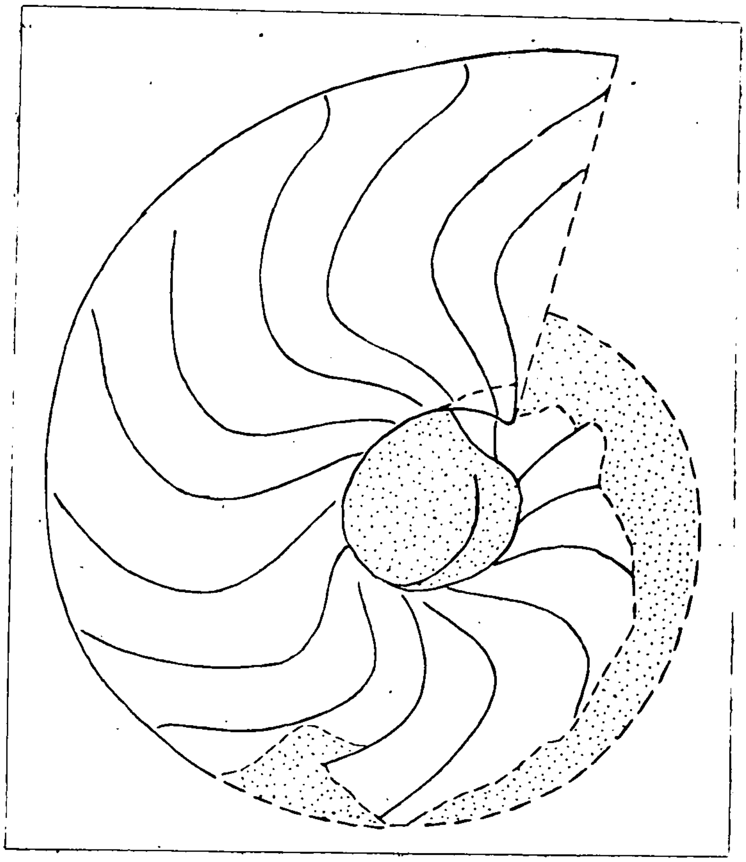
5. Agoniatites sp.

The largest goniatite so far discovered on the North Cornish coast comes from Mother Ivey's or Polventon Cove.

Description (of D.465)

Crushed goniatite 104mm in diameter with no trace of external ornament and still fully septate to the maximum diameter (text fig.10).

The sutures show a wide, well rounded lateral lobe with traces of a ventro-lateral saddle and ventral lobe.



Text fig. 10. Agoniatites sp. The largest goniatite known from the North Cornish coast. From 700 feet due east of Mother Ivey's Cottage, Polventon Bay. Drawing based on D. 465. Natural size.

Remarks

It is not possible to identify this specimen specifically although in size and apparent whorl form it agrees with A. roemeri, A. phillipsi or A. oxynotus. In the grey slate six feet below the locality which yielded this specimen were found A. cf. costulatus and several specimens of ? Wedekindella supporting a Givetian age for the grey slate here

Specimen, Horizon and Locality.

Only D.465 from grey slate at the southern end of Polventon Bay, north east of Little Cove and 700 feet due east of Mother Ivey's Cottage. Givetian.

6. Agoniatites sp.

1904 Agoniatites sp. H. Fox, p.42.
1904 Agoniatites sp. G.C. Crick 1904, pp.68-70, fig.2,2a.
1905 Agoniatites sp. G.C. Crick in Fox 1905, p.158, fig.2,2a.
1910 Agoniatites sp. C. Reid, 1910, p.
1956 Agoniatites sp. M.R. House 1956, p.260.

A specimen from near Gentle Jane Beach, Cant Hill, was discovered by Fox and described by Crick. The specimen originally consisted of part of a body chamber and two camerae, distorted and poorly preserved. It was deposited by Fox in the Penzance Museum. Searching in the museum has yielded only the body chamber (PM.1859) ; the two camerae are lost.

Description (of PM.1859)

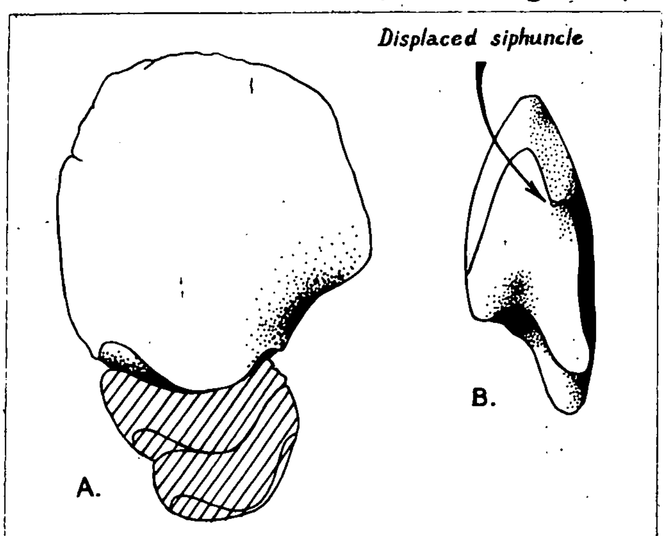
Dimensions (most approximate owing to distortion)

D	WH	WW	
? 85.0	40.0	-	
	29.0	17	Impressed depth 30%

The venter appears to have been rounded rather than angular and the flanks diverging convexly to a maximum whorl width close to the umbilical shoulder.

Ornament not seen except for close set striae on the ventro-lateral region of one side which are coincident with ventro-lateral parts of the suture and project strongly forward.

The suture shows a small ventral lobe, a wide and rounded lateral lobe, a rounded umbilical saddle centred on the seam and a narrow median dorsal lobe (text fig. 11).



Text fig.11. Agoniatites sp. Lateral and apertural views of a specimen from Cant Hill, St. Minver, North Cornwall. Partly based on PM.1859 and partly on a drawing by Crick 1904. Middle Devonian.

Remarks

As Crick noted, despite the considerable distortion of the specimen the suture shows clearly that it is an Agoniatės and not a Pinacites or Paraphyllites, the other genera which approach it. It is not possible to identify the specimen specifically but it appears to belong to Wedekind's group 1 of the agoniatitids (Wedekind 1917, p.110).

Specimen, Horizon and Locality

One specimen only, PM.1859, from 300 yards east of Gentle Jane Beach, Cant Hill, two miles ESE of Padstow, from "a dark, partially decomposed bed of slate" appearing among harder beds dipping east at a low angle (Fox 1904, p.42). Horizon, based in part on associated fauna "certainly Devonian and most probably Eifelian or lower Middle Devonian age" (Crick 1905, p.160).

Family ANARCESTIDAE Steinmann 1890
Subfamily ANARCESTINAE Steinmann 1890

Genus ANARCESTES Mojsisovics 1882

Type species : Goniatites plebeius Barrande 1865

Diagnosis : Primitive ammonoids with ventral siphuncle. Shell involute to sub-evolute, usually rotund. Protoconch small, nearly spherical. Umbilicus slightly perforate. Growth lines biconvex. Suture with small V-shaped ventral lobe. Lateral lobe sub-umbilical in early stages and may migrate ventrad during ontogeny (Latanarcestes). Median dorsal lobe.

Remarks : The evolution, phylogeny and subdivision into the subgenera Anarcestes and Latanarcestes is described by Schindewolf (1933 p.90, et seq.). Some details are also given by Miller (1938 p.56).

1. ? Anarcestes (Anarcestes) lateseptatus (Beyrich) var. plebeius (Barrande)

Plate 4, fig. 3.

1914 Anarcestes lateseptatus Jukes-Browne and R.B. Newton, 1914, p.311.

There are a large number of specimens in the Torquay Museum from Mudstone Bay, Brixham, mostly labelled as "Goniatites (Anarcestes) lateseptatus". The fossils are set in an intractable mudstone matrix and most specimens have been cut and polished to show the internal features. A selection of drawings of these, based on photographs, is shown on the accompanying illustration (text fig.12).

Description

Shell form rotund and subinvolute up to 40mm diameter, becoming involute and slightly compressed at larger diameters. Whorl section in early stages with wide, broadly rounded ventral areas and short radial and rounded flanks: impressed depth about 50% at 20mm diameter decreasing towards protoconch and towards aperture, at 100mm it is 35%. Body chamber seen to 1¼ whorls.

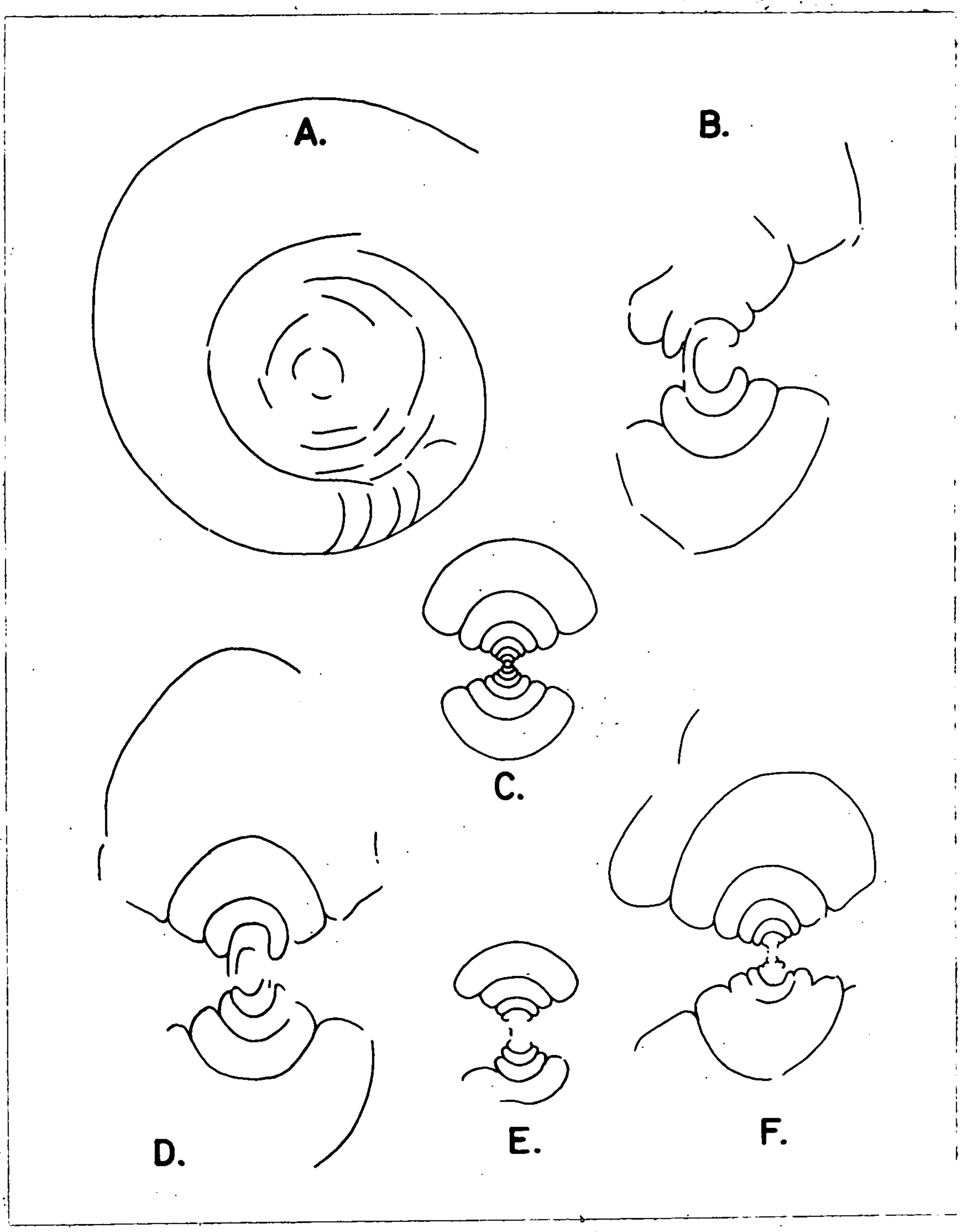
Ornament not seen. Sutures not traced. Septae with concave side directed forward.

Remarks

The shell form of these specimens is unlike that of the true A. (A.) lateseptatus but comes very close to some of the specimens figured by Barrande (1865, especially pl.5, fig.15) but those specimens have a slightly wider umbilical angle. Without knowledge of the suture it is not possible to give a certain determination.

Specimens, Horizon and Locality

TM.72/9, 74/9, 78/9, 68/9, 69/9 and BM.c 30396 from Mudstone Bay, Brixham. Probably from "the lower part of the Calceola Shales", (Jukes-Browne and Newton 1914, p.314), Couvinian, ? Lateseptatus Zone.



Text fig. 12. ? Anarcestes (Anarcestes) lateseptatus (Beyrich) var. plebeius (Barrande). A. TM.72/9, B. TM.68/9, C. BM.c 30396, D. TM.69/9, E. TM.78/9, F. 74/9. All from the lower part of the Calceola Shales at Mudstone Bay, Brixham, Devon. Couvinian, ? Lateseptatus Zone. All natural size.

Genus <u>SUBANARCESTES</u> Schindewolf 1933

Type species : <u>Subanarcestes</u> <u>macrocephalus</u> Schindewolf 1933 (Beyrich MS.)

Diagnosis : Primitive ammonoids with subglobular, involute shell and small, open umbilicus. Protoconch small. Umbilicus imperforate. Growth lines biconvex. Small V-shaped ventral lobe. Sub-umbilical lobe of early stages remains sub-umbilical throughout ontogeny. Broad and rounded median dorsal lobe. Possibly a small lobe forming in adult on ventro-lateral saddle.

Remarks : Schindewolf (1933 p.95) has given details of the ontogeny and relations of this genus.

1. <u>Subanarcestes</u> <u>macrocephalus</u> Schindewolf (Beyrich MS.)

Plate 4, figs. 4 and 5.

One unlocalised specimen in the British Museum is identical in lithology with specimens from Mudstone Bay, Brixham. Since it was presented to the museum by J.E. Lee it probably comes from that locality.

<u>Description</u> (of BM.c 1768)

Dimensions	D	WH	WW	UW
	47.2	22.3	31.5	10,1

Shell form involute with deep open umbilicus. Outline ovoid. Whorl section with broad and wide rounded ventral area, sharp umbilical shoulder and short, flat umbilical wall (6.5mm high at 47mm diameter). Impressed area at maximum diameter 52%.

Ornament not seen. Suture forms a deep and narrow V-shaped ventral lobe and a shallow, rather convex lateral saddle which passes to a shallow lobe on the umbilical wall. The sutural distance approximates towards the body chamber suggesting the specimen is full grown.

Remarks

The following dimensions are given for comparison . Details of the Holotype, determined from Schindewolf's figures are :

D	WW	UW
47.0	-	8.5.

The following measurements are based on specimens in the Laboratoire de Geologie at the Sorbonne from the Erg Djemel, Algeria. They all come from the "niveau à W. rouvillei".

51.8	29.0	12.7
28.0	20.0	6.0
34.6	21.8	7.5

The Holotype is of Couvinian age ; the North African specimens whose measurements are given above are from the lowest Givetian.

Specimens, Horizon and Locality

One specimen only, BM.c 1768, unlocalised, but thought to come from the Lower Calceola Shales at Mudstone Bay, Brixham, Devon. Couvinian, ? Lateseptatus Zone.

Genus WERNEROCERAS Wedekind 1917

Type species : Werneroceras subumbonale Wedekind (fide Schindewolf = Goniatites ruppachensis Kayser)

Diagnosis : Primitive ammonoids with ventral siphuncle. Rotund, open umbilicate. Small sub-spherical protoconch, imperforate umbilicus. Growth lines biconvex, possibly convex in juvenile. Suture with a V-shaped ventral lobe, a broad, rounded Lateral lobe migrating from a sub-umbilical position during ontogeny. Broad, rounded, median dorsal lobe.

Remarks : Details of the ontogeny and phylogeny of this genus have been given by Schindewolf (1933 p.96). Nomenclatorial details have been given by Miller (1938 p.57) together with information on the American species W. plebeiforme. More recent comments are made by Sincet and Miller (1956).

1. Werneroceras karpinskyi (Holzapfel)

Plate 4, figs. 1 and 2.

1895 Anarcestes karpinskyi E. Holzapfel 1895, p.77, pl.3, figs. 15-20, pl.5, fig.3.

? 1917 Anarcestes Rouvillei R. Wedekind 1917, p.109, pl.15, fig.2, text fig. 20c 1,2.

1933 Werneroceras karpinskyi O.H. Schindewolf 1933, p.98.

In the Penzance Museum there is a small goniatite collected by Howard Fox and labelled "Tornoceras globosum, Dev., Trevone" (PM. 1027). The specimen is rotund and has a widely open umbilicus. It cannot therefore belong either to Tornoceras or Torleyoceras (the subgenus to which Goniatites globosus Münster is now assigned). It is identical, however, with W. karpinskyi as figured from the German Middle Devonian.

Description (of PM.1027)

Dimensions	D	Wh	WW	UW
Maximum diameter	11.6			
	10.6	2.8	9.3	5.0

Shell form sub-evolute and rotund with a wide, regularly opening umbilicus. Whorl section very depressed, the broad venter marked by a slight flattened band 2.5mm wide at the maximum diameter. Section forms a broad, evenly rounded arch with umbilical walls low, and directed inwards.

The suture cannot be traced across the venter or ventro-lateral areas : cracks simulating sutures occur on the outer whorl. There is evidence of a small sub-umbilical lobe.

Poorly preserved ornament on the ventro-lateral area consists of close set lirae which pass out radially from the umbilical shoulder and swing forward to the ventral band where trace of them is lost.

Remarks

The close agreement in shell form of this specimen and the syntypes leads to confidence in the determination. The species is close to W. crispiforme in shell form, but the umbilical angle is lower and the ventral area is more arched in W. karpinskyi. The inner whorls are also rather similar to those of the Maenioceras molarium var. apertum group but the whorl section is wider in W. karpinskyi and is rounded rather than trapezoidal. A specimen of this species from the L. Givatian of Algeria shows, by a diameter of 11mm, the development of umbilical nodes which are common in the genus although not shown by the syntypes .

Specimen, Horizon and Locality

One specimen, PM. 1027, only. Labelled "Trevone" and probably from Pentonwarra Point. Givetian, Terebratum Zone. According to Holzapfel (1895) this species is found in the Upper and Lower Stringocephalenschichten of Germany.

2. Werneroceras cf. ruppachense (Kayser)

Plate 3, figs. 5 and 6.

One specimen comparable with this species is known from Pentonwarra Point, Trevone (D.902).

Description (of D.902)

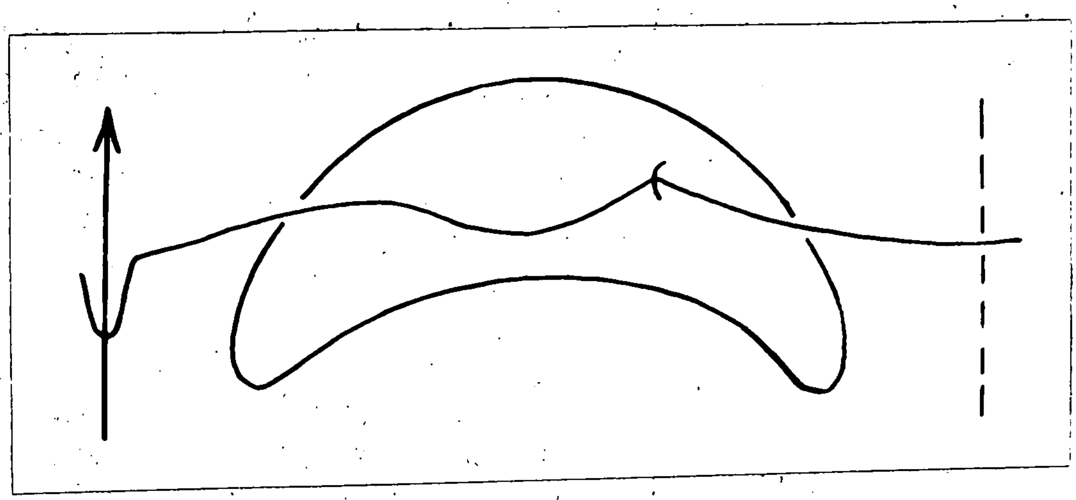
Dimensions (approximate owing to distortion)

D	WW	UW
c.13	7.0	3.3

Shell form sub-involute, outline rounded, laterally compressed. Whorl section half moon shaped (text fig. 13).

Growth lines pass backwards, occasionally as ribs, over the umbilical shoulder and become radial on the lateral areas. They form a slight salient on the ventro-lateral shoulder and a narrow, shallow sinus on the venter.

The suture (text fig. 13) shows a small V-shaped ventral lobe, a flat ventro-lateral saddle, a broad and shallow sub-umbilical lobe, a sharp umbilical saddle centred on the seam and a broad median dorsal lobe.



Text fig. 13. Werneroceras cf. ruppachense (Kayser). Suture and whorl section at a.9mm diameter. Based on a specimen from Pentonwarra Point, Trevone, D.902. Givatian, Terebratum Zone. Both X 12½.

Remarks

These characters agree with the syntypes figured by the Sandberger brothers except that the Cornish specimen is more compressed . This may be due, in part, to distortion. One other specimen may belong here, PM.1035, which is labelled "Goniatites (Anarcestes) noeggerathi -near to" : the locality was first given as Trevone but this has been deleted and "Constantine Bay" inserted.

Specimens, Horizon and Locality.

One specimen, D.902, from the Givetian Terebratum Zone of Pentonwarra Point, Trevone. Possibly another, PM.1035, subsequently labelled "Constantine Bay".

Genus ARCHOCERAS Schindewolf 1937a

Type species : Archoceras paeckelmanni Schindewolf 1933

Diagnosis : Primitive ammonoids with evolute shell, wide umbilicus and laterally compressed. Ventral siphuncle. Small barrel-shaped protoconch, umbilicus imperforate. Growth lines biconvex, occasionally with constrictions. Suture with a very broad and large V-shaped or bell-shaped ventral lobe. Subumbilical lobe from earliest stages. Median dorsal lobe.

Remarks : With the exception of the specimen figured by Schindewolf (1937a, pl.19, fig.8) as Werneroceras sp. nov., Archoceras is the youngest anarcestid. It ranges from the middle Manticoceras Stufe to the Cheiloceras Stufe. An anarcestid of Archoceras type is usually considered to be ancestral to the Manticoceras group via Ponticeras (Schindewolf 1937a, 1954), and also to the clymenids (Schindewolf 1937a, 1955).

1. Archoceras varicosum (Drevermann)

Plate 3, fig. 4.

1901 Euomphalus varicosum F. Drevermann 1901, p.140, pl. 14, fig. 10, 10a.

1913 Gephyroceras bickense R. Wedekind 1913, p.69, pl.6, fig. 6.

1917 Manticoceras bickense R. Wedekind 1917, p.124, pl.22, fig.6.

1927 Manticoceras bickense (pars) L.G. Anniss 1927, p.497.

1931 Manticoceras bickense H. Matern 1931, p.68, 69.

1933 Manticoceras bickense (pars) W. Lloyd 1933, p.88.

1937 Archoceras (?) varicosum O.H. Schindewolf 1938, p.249, 250, text fig.2, pl.19, fig.5.

1938 Archoceras varicosum H. Gallwitz 1938, p.377, text fig. 1a, 1b.

+1942 Archoceras varicosum D.T. Donovan 1942, p.578, pl. 13, figs. 8,9.

+1956 Archoceras varicosum K.J. Müller 1956, p.35.

This species is the commonest Archoceras found at Saltern Cove, South Devon. It is well represented in museum collections.

Description (all known English specimens come from Saltern Cove).

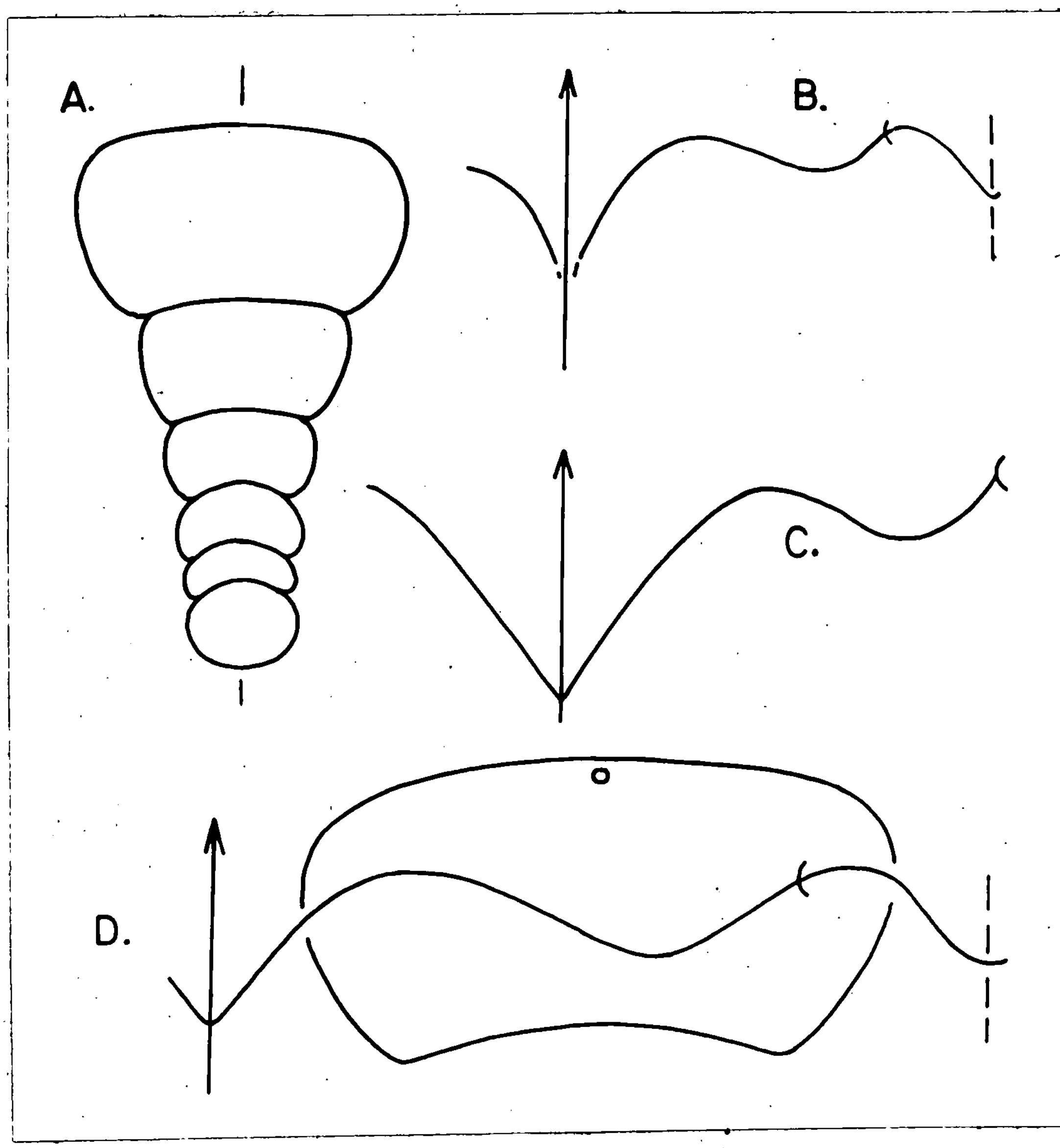
Dimensions	D	WH	WW	UW
GS. 63384	c.8.3	2.2	3.2	c.4.9
GS. 63383	10.0	2.5	3.9	5.4
D.208	11.8	3.3	c.4.7	6.7
SM.H 1532	12.0	c.2.8	c.4.2	7.0

All specimens are preserved as internal moulds of more or less oxidied pyrite. The available specimens enable some description of the development to be given.

Shell Form : The protoconch is small and sub-ellipsoidal, about 0.8mm in breadth and 0.5mm in maximum diameter. The first whorl is tightly coiled about it with a moderate impressed area which subsequently decreases relative to the whorl height (text fig. 14). The whorl section of the first and second volutions is well rounded and depressed with the ventral area strongly arched, but by the third volution the general whorl section of the adult is established. By a diameter of 6.0mm (fifth volution) the venter is noticeably flatter, although still slightly arched, and the lateral areas well rounded but also sloping inward to the umbilical seam. Up to 12mm diameter (the largest known from England) the outer parts become more rounded until all trace of the earlier ventral flattening is lost and the maximum whorl width draws nearer to the umbilical seam reaching 4/5 across the flanks.

Growth lines : It has not been possible to see the growth lines on the earliest whorls. By a diameter of 8mm the adult pattern is reached in which the growth lines swing markedly and concavely forward across the lateral areas to form rounded salients on the outer parts of the venter and a median ventral sinus. Constrictions first appear at about 4mm diameter and thenceforth occur regularly between three and four per whorl being more frequent in the outer whorls. Their course agrees with that of the growth lines.

Suture : The prosuture and earliest sutures have not been seen but by a diameter of 3.5mm (D.233) the adult sutural pattern is established with a wide V-shaped ventral lobe, 0.5mm deep, curving convexly outward to form a rounded saddle on the ventro-lateral shoulders : across the lateral slopes there is a shallow Lateral lobe 0.15mm deep. The umbilical seam lies slightly ventrad to the crest of the umbilical saddle and there is a V-shaped dorsal lobe. The adult suture retains the same general proportions (text fig. 14c) with a tendency for the ventral lobe to become rather flat sided in many specimens, but still convex in others.



Text fig. 14. Archoceras varicosum (Drevermann). A. reconstructed cross-section of the inner whorls based on D.233, X 20. B. Suture at 6mm diameter of D.233, X 20. C. Suture at 8mm diameter of D.208, X 20. D. Whorl section and suture of D.241 X 40.

The base of the Lateral lobe is sometimes acute, sometimes slightly rounded. As Donovan (1942 p.377) has pointed out the depth of the lateral lobe is much less than in A. angulatum.

Remarks

This species was first described by Drevermann as a gastropod. In 1937 Schindewolf tentatively referred the species to his new genus Archoceras and this assignment was later confirmed by Gallwitz (1938). The shell of the holotype shows peculiar thickenings associated with constrictions. All the Devon specimens are internal moulds but such thickenings could have formed in the shell of the outer whorls.

Some comparison can be made between the German and English specimens on the basis of details given by Gallwitz. The mean WH/WT ratio of the Saltern Cove specimens ranges between 64%-70% at diameters between 8mm and 12mm. This falls within the lower part of the range given by Gallwitz (1938 p.381, text fig.3) whose mean WH/WT ratio is 80%. One specimen only, SM.H 1532, approaches this with a ratio of about 70%. Similarly a comparison of the UW/D ratio shows a difference between the English and German specimens : the German mean is 53% : Devon specimens range between 54% and 58% with a mean at 56.4%.

The specific name varicosum is therefore used here in a wider sense than by Gallwitz. Gallwitz did not have specimens which were undistorted, so his figures must be approximate only. The largest specimen from Saltern Cove has a diameter of 12mm and none are known exceeding 13mm from Germany (Gallwitz 1938, p.378). One English specimen (D.208) has a body chamber one complete whorl in length.

Horizon

In Germany this species occurs in both the Cordatum and Holzapfeli Zones. The Saltern Cove locality is thought to belong to the Holzapfeli Zone.

Specimens and Locality

All English specimens come from Saltern Cove, Devon. They include : SM.H 1532, 1533, ? 1530, GS. 63383, 63384, D.233, 234, 225, 208.

2. Archoceras angulatum Donovan

Plate 3, figs. 1, 2 and 3.

1927 Manticoceras bickense (pars) L.G. Anniss 1927, p.496.
1933 Manticoceras bickense (pars) W.L. Lloyd 1933, p.88.
+1942 Archoceras angulatum Donovan 1942, p.377, pl.13, figs. 1-6.

This species was first recognised by L.G. Spath among specimens sent to him for determination. It was subsequently described by Donovan. It has only been recorded at Saltern Cove.

Description of Holotype (GS. 63381 from the southern end of Waterside Cove, Saltern Cove, Devon).

Dimensions	D	WH	WW	UW
Max. dia.	8.6	2.3	3.6	5.1
	6.6	1.7	2.5	3.7

The specimen is slightly distorted and preserved as an internal mould of oxidised pyrite. The body chamber is preserved for half a whorl.

The shell form is evolute, serpenticonic in inner whorls, coronate in outer whorls. Whorl section depressed at maximum diameter WH/WW = 64%, and the venter is broad and rather flat (text fig. 15), it curves over sharply to form a rounded lateral area which curves in to the umbilical seam. Impressed area slightly concave. At rather earlier diameters the lateral areas are flatter.

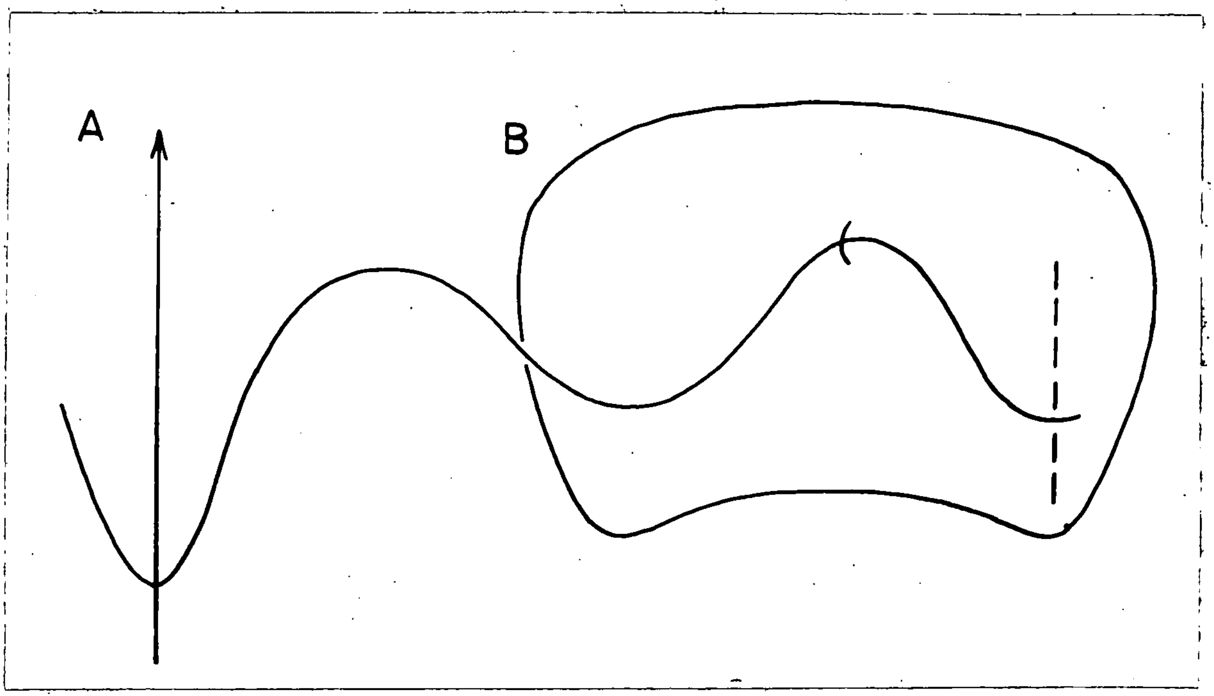
Suture forms a deep, bell-shaped ventral lobe with a rounded saddle on the outer part of the ventral area. Across the lateral area is a broad, rounded Lateral lobe extending to about half the depth of the ventral lobe. Umbilical saddle centres on the seam. Median dorsal lobe deep and bell shaped.

Growth lines on the body chamber sweep sharply and concavely forward across the lateral areas to form rounded salients on either side of a shallow median ventral sinus. One single constriction is visible on the outermost part of the body chamber which accords, over the lateral area and ventro-lateral shoulder at least, with the growth lines.

Details of other specimens (all from the same locality)

Dimensions	D	WH	WW	UW
BM.c40153(paratype)	7.9	1.8	3.1	4.4
GS. 92711	7.7	2.1	2.0	4.1
D.239	4.7	1.4	2.5	c.2.7

Whether the largest of these specimens are adult and the species micromorphic, as Donovan supposed, is solely attested by the slight orad approximation of the septae (as in the holotype) or the disturbed arrangement of them in the outer whorls (BM.c40153). The body chamber in one specimen (GS.92711) occupies a complete whorl.



Text fig. 15. Archoceras angulatum Donovan. Suture and whorl section at 6mm diameter. Based on the holotype, GS. 63381, from Saltern Cove, Devon. Holzapfeli Zone of Frasnian. X 40.

The relative proportions of the whorl section are somewhat variable but in general the WH/WW ratio decreases outwards. Also, as Donovan noted, the adult venter is flatter in some cases than in others. In the juvenile (e.g. GS. 63382) the venter is particularly flat and the ventro-lateral shoulder sharp.

Remarks

This species is clearly distinguished from others in the genus, except A. sp. nov., by the more angular and depressed whorl section and the form of the suture. The suture of A. sp. nov. differs from that of A. angulatum in being V-shaped and not bell-shaped (compare text fig. 15 and 16), and the shell differs by the late development of paired ventro-lateral furrows.

Horizon, Locality and Specimens

Only known from the Frasnian Holzapfeli Zone at the south end of Waterside Cove, Saltern Cove. Specimens include : GS. 63381 (holotype figured Donovan 1942, pl.13, figs. 4,5 and 6), GS.63382 (paratype figured Donovan pl.13, fig.3), BM.c40153 (paratype figured Donovan pl.13, figs.1 and 2), GS. 92711, D.239, 261. There is also a specimen in the collection of Mr. L.G. Anniaa.

3. Archoceras sp. nov. (aff. schlosseri Gallwitz)

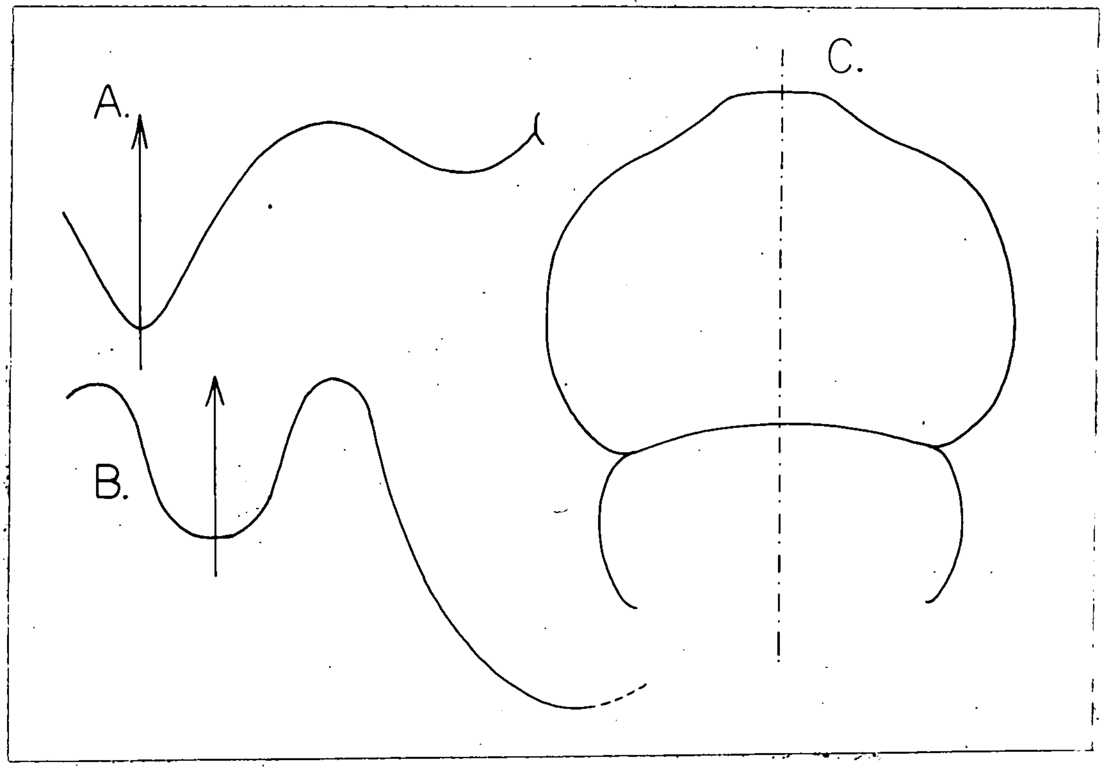
Plate 3, figs. 7 and 8

A single incomplete and distorted specimen from Saltern Cove is different from any other described Archoceras but comes near to A. schlosseri.

Description (of SM. H 1534 from Saltern Cove, Whidborne Collection)

Dimensions	D	WH	WW	UW
SM. H 1534	? 12	3.0	5.0	? 7

Shell form evolute and serpenticonic. At maximum diameter the whorl section is depressed with a prominent pair of furrows on each side of a flat-topped ventral ridge (text fig. 16). The lateral areas are well rounded. At earlier diameters the whorl section is completely different ; the venter is broad and flatly convex and the ventro-lateral shoulder is quite sharply rounded whilst the short, rounded flanks slope slightly inward to the umbilical seam.



Text fig. 16. Archoceras sp. nov. A. Suture at 8mm diameter. B. Growth lines on body chamber at c.12mm diameter. C. Diagrammatic cross section at 12mm diameter. All based on SM. H 1534 from Saltern Cove, South Devon. Holzapfeli Zone, Frasnian. All X 12½.

The growth lines (text fig. 16B) and the occasional shallow constrictions pass concavely forward across the lateral areas to form prominent, well rounded lappets in the ventral paired furrows and a linguiform sinus on the venter.

The suture forms a very deep, pointed ventral lobe with a shallow saddle on the ventro-lateral area and a shallow, rounded Lateral lobe, subumbilical in position. The dorsal suture is not seen.

Remarks

Gallwitz gave statistical details for his species A. schlosseri so that the Saltern Cove specimen may be compared with it quantitatively. The UW/D ratio was given for A. schlosseri as 46% with a range of 5% on each side of the mean. The Devon specimen reaches UW/D = 58% at maximum diameter. The WH/WW ratio of 60% is considerably less than the 90% mean of A. schlosseri. Also the impressed area of A. schlosseri is much deeper and the whorl section of the early whorls more rotund. The angularity of the early whorls shown by the Devon specimen shows that caution is necessary in determining specimens as A. angulatum on this character alone. Indeed nuclei are probably specifically indeterminable.

Horizon, Specimen and Locality

One specimen only, SM. H 1532, collected by G.F. Whidborne from the Frasnian Holzapfeli Zone slate at Saltern Cove, South Devon.

Subfamily PINACITINAE Schindewolf 1933

Genus HOLZAPFELOCERAS Miller 1932

Type species : Tornoceras convolutum Holzapfel 1895

Diagnosis : Primitive ammonoids with ventral siphuncle. Shell involute to subinvolute. Protoconch small, umbilicus imperforate. Growth lines biconvex. Suture with a ventral lobe, a Lateral lobe migrating ventrad from a subumbilical position in the early stages. Median dorsal lobe.

Remarks : Wedekind did not distinguish the species within his genus Parodiceras which developed a median dorsal saddle from those which did not, but he selected Goniatites brilonense as type species of Parodiceras. Schindewolf (1928) proposed Wedekindella to replace Parodiceras which was pre-occupied. Unaware of this Strand proposed Parodicerellum for the same purpose in 1929. Strand did not designate a type for his genus but since he intended it to replace Parodiceras Wedekind the type must be the same, that is, Goniatites brilonense. Unaware that two other names had been proposed to replace Parodiceras Wedekind, Miller in 1932, proposed Holzapfeloceras for it, but designated Tornoceras convolutum as type species. Later Schindewolf (1933) was able to show that the genotype of Holzapfeloceras differed from the genotype of Wedekindella (= Parodiceras Wedekind = Parodicerellum) in not possessing a median dorsal saddle. Miller has since proposed (1957 in Moore Ed.) to regard Holzapfeloceras as a junior synonym of Parodicerellum but this action only introduces farther confusion. Since the work of Schindewolf (1933) the name Holzapfeloceras has come to be widely used and since it has priority, if the genotype claimed here for Parodicerellum is accepted, there is no reason to abandon it.

The genus Holzapfeloceras is homoeomorphic in the adult with Tornoceras but the lateral lobe of the former arises by ventrad migration of a primary subumbilical lobe whereas in Tornoceras the adult lateral lobe arises adventitiously upon the ventro-lateral saddle during ontogeny.

1. Holzapfeloceras aff. circumflexiferum (G. & F. Sandberger)

Plate 4, figs. 6 to 8.

This form occurs in the Givetian grey slate at Portquin and Trevone, North Cornwall.

Description

Dimensions	D	WW	WH	UW
D.732(Portquin)	7.6	c.4.0	c.4.0	c.0.9
D.899(Trevone)	7.4	c.4.4	4.0	c.1.0
D.811(Trevone)	6.1	c.3.5	c.3.4	c.0.9

Shell form involute, with almost closed umbilicus, slightly compressed with well-rounded outline. Whorl section with maximum width close to the umbilicus. Flanks slope convexly to well rounded venter. Body chamber at least half a whorl in length.

Growth lines form a slight salient on the umbilical shoulder and pass backward to form a shallow sinus on the outer flanks and only slightly forward to a ventro-lateral salient where the growth lines become more obvious. Across the venter they form a narrow sinus.

Suture with a small median ventral lobe, a shallow ventro-lateral saddle and lateral lobe. Ventrad slope of umbilico-lateral saddle steep, but dorsal slope convex and sub-radial. Dorsal suture (seen in D.818) shows a single deep and rounded median dorsal lobe.

Remarks

The ontogeny of the suture has not been determined because of the shortage of suitable specimens but the characteristic overall backward deflection of the growth lines (pl.4, fig.8) is typical of the genus and very unlike Tornoceras (T.). The specific assignment is difficult and they may represent a new species since they are more compressed than either H. convolutum or H. circumflexiferum. The growth lines are, however, unlike those illustrated by the Sandberger brothers for the former species. The Cornish specimens are very much like Wedekindella inversum but both Wedekind and Schmidt (1952 p.210) have shown that W. inversum has a median dorsal lobe and therefore truly is a Wedekindella. Petter (1955 p.577), on the other hand, has referred the species to Holzapfeloceras.

Specimens, Horizon and Locality

Known only in England from the Givetian grey slate of North Cornwall at Trevone and Portquin where the fauna is known to be of Terebratum Zone age. Specimens include : from Portquin, D.732, 785, 747, ? 726 : from Trevone, D.933, 899, and 811.

Genus WEDEKINDELLA Schindewolf 1928

Type species : Goniatites retrorsus var. Brilonensis Kayser 1872

Diagnosis : Primitive ammonoids with ventral siphuncle. Shell involute or subinvolute. Protoconch small, umbilicus imperforate. Growth lines biconvex. Suture with a ventral lobe, a Lateral lobe migrating ventrad from a subumbilical position in the early stages. By the adult a median dorsal saddle forms within the dorsal lobe.

Remarks : The ontogeny and relations of this species were described by Schindewolf (1933 p.101). The nomenclatorial history has been described under Holzapfeloceras.

1. Wedekindella brilonense (Kayser)

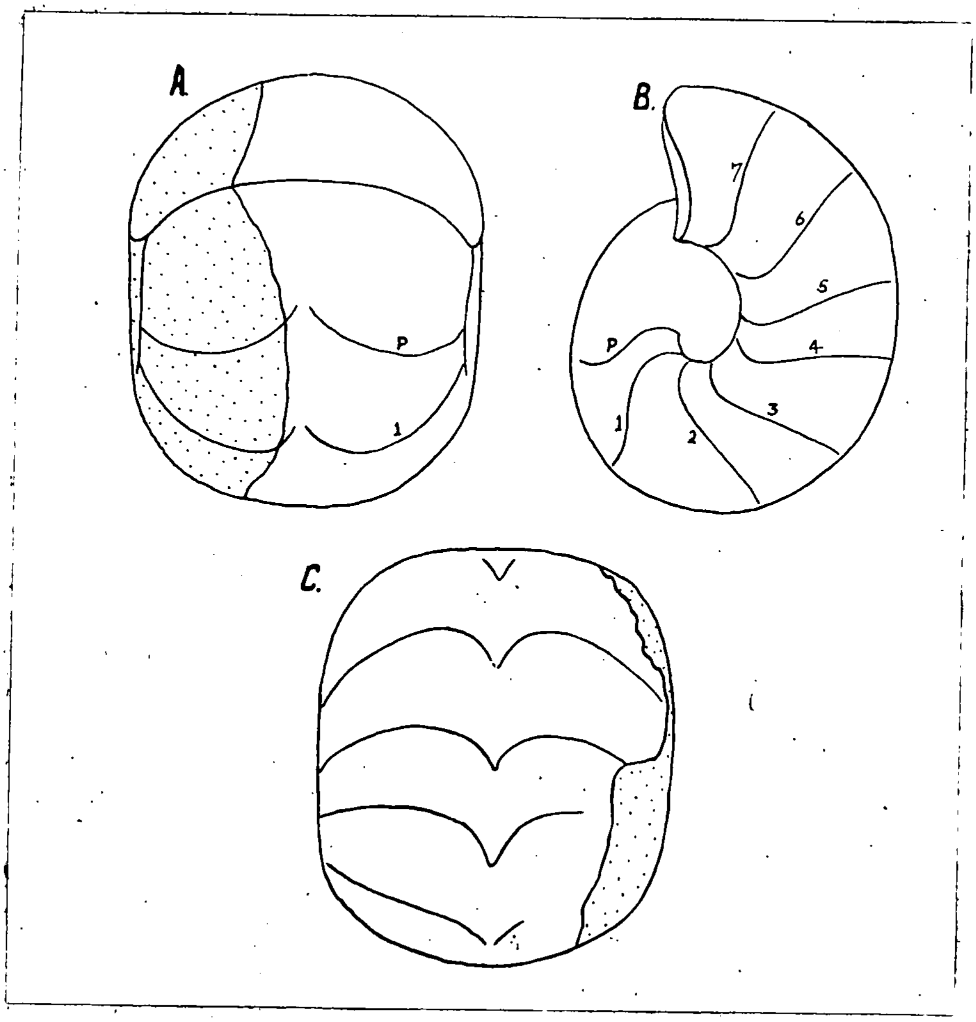
Plate 6, figs. 6 to 11.

1872 Goniatites retrorsus var. Brilonensis E. Kayser 1872, p.664, pl.25, fig. 2a-e.
1913 Tornoceras brilonense F. Frech 1913, p.16.
1917 Parodiceras brilonense R. Wedekind 1917, p.116,
1933 Wedekindella brilonensis O.H. Schindewolf 1933, p.101, text fig. 32.

This species occurs both in Devon and Cornwall. The Cornish specimens are preserved in pyrites and have been broken down to enable a description of the ontogeny to be given.

Description of Cornish specimens (from Trevone and Portquin)

Protoconch : The protoconch is 1.08-1.2mm in maximum diameter and about 0.7mm in width. It is depressed and barrel-shapeed (text fig. 17). The prosuture is simple, with a V-shaped, broad ventral lobe, a well-rounded lateral saddle and a subumbilical lobe. The first whorl is tightly coiled about the protoconch. No trace of surface ornament, if there is any, has been observed.



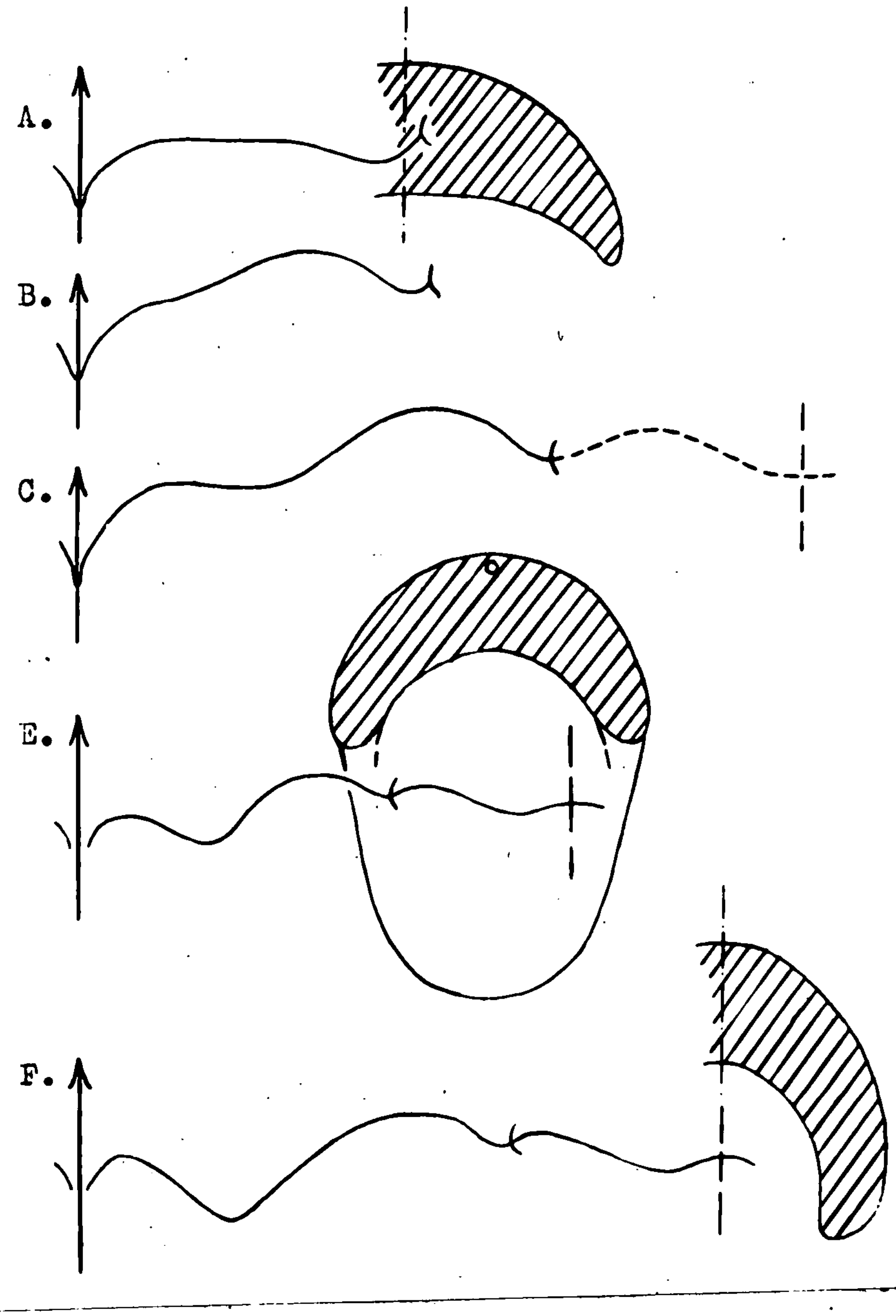
Text fig. 17. Wedekindella brilonense (Kayser). Protoconch and early chambers. Based on D.808 from the Terebratum Zone at Pentonwarra Point, Trevone, North Cornwall. All X 40.

Shell form : The first whorl has an open umbilicus but this increases very little in absolute size as growth proceeds. The whorl section of the first whorl is semilunar and distinctly depressed (text fig. 18A). At first the whorl height is noticeably less than the width and they are approximately equal between diameters of 6mm and 9mm above which the whorl height exceeds the width. Some relative proportions are given below.

	D	WH	WW
1. Kayser's specimen	30	16	14
2. Two specimens from the U. Givetian at Ouarourout, N. Africa. Sorbonne Coll.	27.8 29.4	- -	c.10.0 12.2

3. Specimens from Cornwall :

	D	WH	WW
GS.1606 (Portquin)	-	3.6	4.0
D.822 (Trevone)	c.7.0	3.4	3.5



Text fig. 18. Wedekindella brilonense (Kayser). A. 7th suture and whorl section at 1.4mm diameter based on D.808, from Trevone. B, C. Suture at 2.8mm and 3.8 mm diameter based on D.925 from Trevone. E. Suture and whorl form of GS.1574 from Portquin. F. Suture and whorl section of GS.1606 from Portquin. A. X 50. B,C X 25. E,F X 12½.

In the adult the whorl section is compressed and the umbilicus closed, or nearly so. The maximum whorl width is near to the umbilicus.

Suture : The form of the earliest sutures is shown on the accompanying diagrams (text fig. 17 and 18). The noticeable feature of the early sutures is the broad, well-rounded lateral saddle and adjacent subumbilical lobe. Later the ventro-lateral saddle becomes flatter and then the outer parts of the septae as a whole project apicad and the adult lateral lobe develops slowly on the ventro-lateral slope thus formed. By 4.5mm diameter a shallow dorsal saddle has formed on the original median dorsal lobe.

Growth lines : The growth lines at 3mm diameter pass backwards across the umbilical shoulder and then almost radially over the lateral areas where they form a broad and very shallow sinus. A ventro-lateral salient is formed and the growth lines then sweep sharply back to form a narrow, shallow sinus on the venter. The first constrictions appear between 3mm and 4mm diameter. They are sub-radiate and accord approximately with the course of the growth lines but the ventral sinus is shallower and wider. At first there are few constrictions per whorl, perhaps three or four, but the number increases to between four and six in the adult. With growth the course of the constrictions becomes more clear-cut and the ventro-lateral salient more projecting and narrower.

Devon Specimens

Apart from the specimens described below as *W. brilonense* var. *aratum*, only one specimen is known from South Devon (pl.6, figs. 10 and 11, GS. 86992). The locality recorded is "Newton Bushel" which may be Ransley or Ogwell or any of the many quarries around Newton Abbot.

Remarks

The specimens of this species from Trevone and Portquin have been referred by various authors to the Famennian *Cheiloceras*. Thus Crick (in Fox 1894) referred to specimens from Trevone as

"<u>Goniatites globosus</u>" and Dr. Ivor Thomas (in Dewey 1914 p.157) referred to similar forms at Portquin as <u>Chiloceras</u> (sic). These identifications are recorded on the current one-inch maps of the Geological Survey where, on the Camelford sheet (336) the word <u>Cheiloceras</u> is engraved opposite Portquin, and the words "Upper Devonian Goniatites" opposite Trevone. The details of the growth lines given above show that the specimens cannot be referred to <u>Cheiloceras</u>. Further, the sutural ontogeny of <u>Cheiloceras</u> shows the formation of a lateral lobe upon a well-rounded and arched lateral saddle in a manner different to that in <u>Wedekindella</u> .

<u>Specimens Horizon and Locality</u>

German examples of this species are confined to the Terebratum Zone and there is no reason to suppose the horizon of the English specimens is different. Specimens include ; from Trevone, GS.95404, D.808, 812, 822, 824, 825, 826, 828, 830, 838, 846, 863, 878, 925. From Portquin, GS.1573, 1574, 1576, 1577, 1606, 1652, ? 1596, 1592, ? 1882, D.709, 717, 725, 746. One single specimen, labelled Newton Bushel, GS. 86992.

2. <u>Wedekindella brilonense</u> (Kayser) var. <u>aratum</u> (Whidborne)

Plate 6, figs. 1 and 2.

1889 <u>Goniatites aratus</u> G.F. Whidborne 1889, p.29.
1890 <u>Goniatites aratus</u> G.F. Whidborne 1890, p.66, pl. 6, figs. 16,16a.
1895 <u>Tornoceras brilonense</u> (pars) E. Holzapfel 1895, p.102.
+1897 <u>Tornoceras</u> ? <u>aratum</u> A.H. Foord and G.C. Crick 1897, p.117.

<u>Description</u> (of the syntypes from Barton Quarry, Torquay).

Dimensions	D	WH	WW	UW
BM.c1802	25.3	12.7	?10.0	c.2.5
BM.c48908	15.2	9.0	8.0	c.1.0

Both specimens are preserved as internal moulds in a coarse crystalline limestone. No trace of the inner whorls, suture or original shell is preserved.

Shell form evolute, laterally compressed. Flanks flat and sub-parallel with maximum width close to the umbilicus. Venter well rounded. Umbilicus probably closed in the adult.

Constrictions number five per whorl (BM.c1802) and form a slight salient close to the umbilical shoulder, a shallow sinus on the flanks, a rather pointed ventro-lateral salient and a deep and rounded median ventral sinus.

Remarks

The validity of separating this variety from the true *W. brilonense* may be questioned. Whidborne compared his specimens with Kayser's figures and considered that species to differ "in the umbilicus being smaller and the sulci being less angulated, and being five instead of four " (Whidborne 1890, p.67). The umbilical shoulder of *W. brilonense*, as figured by Kayser, projects laterally much more than in the Devon specimens, but this may well be due to the fact that the original shell is preserved. As for the number of constrictions Kayser's figure shows five clearly but their separation suggests there are six in the outer whorl. But the Cornish specimens show that number of constrictions is variable. In view of the slight differences which separate the Barton specimens from Kayser's figures Whidborne's species *aratus* must be relegated to varietal status and it may, eventually, be shown to be a synonym of *W. brilonense*

Specimens, Horizon and Locality

Only two specimens, the syntypes, are known, BM.c1802 and BMc48908 (=BM.c1802b). Both specimens were collected by J.E. Lee from Barton Quarry, Torquay, South Devon. They show that the Barton limestone is in part of Terebratum Zone age.

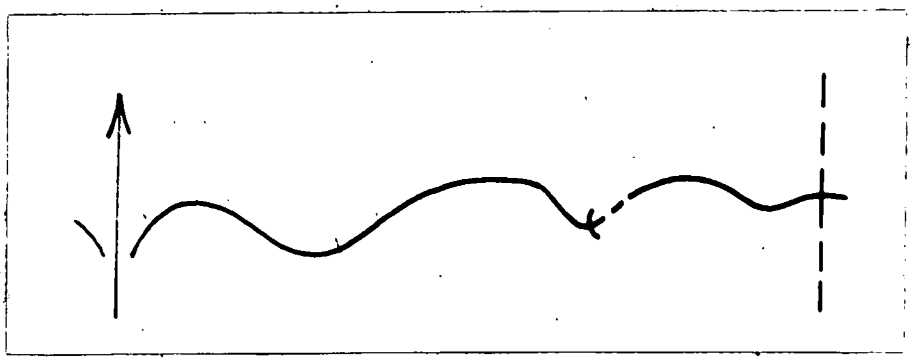
3. *Wedekindella brilonense* var. nov.

Certain specimens from Trevone and Portquin are close to *W. brilonense* but are significantly more rotund and globular.

Description

Dimensions	D	WH	WW	UW	S	C
D.853 (Trevone)	6.6	3.6	5.2	1.2	17	c.5
D.727 (Portquin)	7.4	c.4.7	5.8	?	-	5

Shell form similar to W. brilonense but more globular and rotund. Constrictions form a slight salient on the umbilical shoulder, a lateral sinus, a rounded ventro-lateral salient and a well-rounded ventral sinus. Growth lines similar but do not form such a wide ventral sinus as the constrictions. Suture (text fig. 19) similar to W. brilonense.



Text fig. 19. Wedekindella brilonense var. nov. Diagram of suture based on GS.1600 from Portquin, North Cornwall. Terebratum Zone, Givetian. X 12½.

Remarks

This variety reaches the same general proportions as Wedekindella clarkei but differs in having constrictions as in W. brilonense.

Specimens, Horizon and Locality

Only known from Trevone and Portquin, North Cornwall. Specimens include ; from Trevone, D.853 ; from Portquin, GS.1572, ? 1599, 1579, 1600, D.727. All from the Terebratum Zone, Givetian.

4. Wedekindella sp. nov.

Plate 6, figs. 3 to 5.

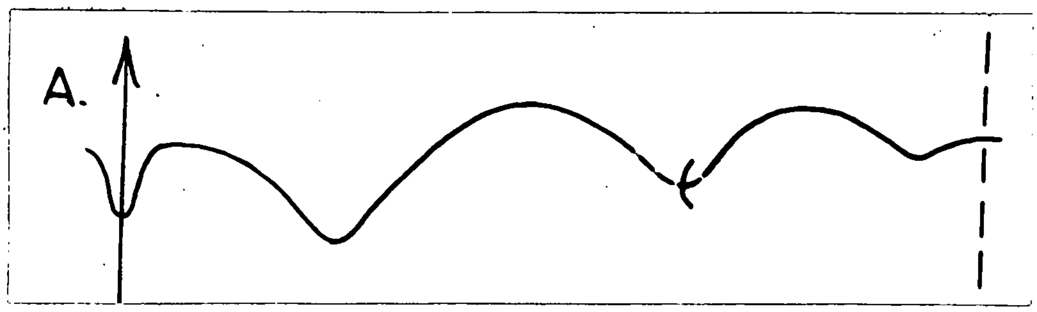
1956 Wedekindella spp. (pars) M.R. House 1956, p.259

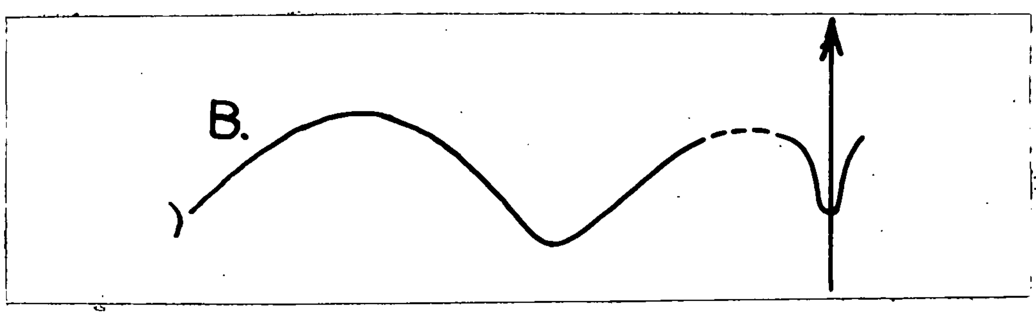
Description (of D.863 from Trevone)

Dimensions	D	WH	WW	UW	S
Max. dia.	13.5				
	10.0	5.3	4.9	? 0.7	18

Shell form involute, laterally compressed, with a well-rounded venter and only slightly convex lateral areas. Maximum whorl width near the umbilicus. Umbilicus open in internal mould.

Suture (text fig. 20) with a small ventral lobe, a rounded ventro-lateral saddle, a wide, V-shaped, subangular and almost symmetrical Lateral lobe. Shallow median dorsal saddle on dorsal lobe.





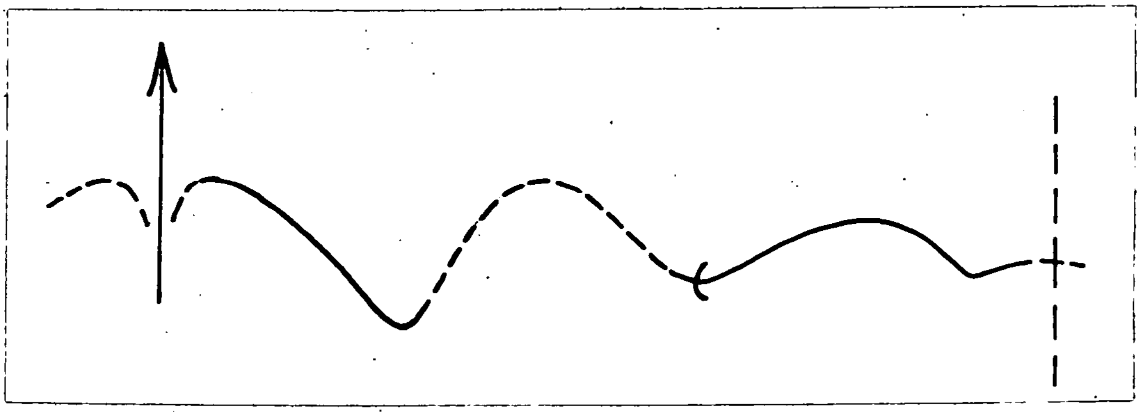
Text fig. 20. Wedekindella sp. nov. A. Suture of D.893 from immediately below the cliff at Pentonwarra Point, Trevone. B. Suture of D.739 from Portquin. Both from Terebratum Zone, Givetian. Both X 12½.

Remarks

This species differs from the other forms of Wedekindella found at Trevone and Portquin in the absence of constrictions, the more compressed form and the more angular Lateral lobe. The specimen figured by Whidborne (1890, pl.6, figs.14,14a,14b) as Goniatites sp. from Wolborough is thought to belong to this species and is refigured here (pl.5, figs 5 and 6, text fig.21). This specimen, GS.7118, has the following dimensions :

D	WH	WW	UW	Wh
15.8	9.0	c.8.7	c.L.0	4.1

The specimen shows a subacute Lateral lobe as in the Cornish specimens. The slight differences in the saddle proportions may be accounted for by the slightly larger size of the specimen.



Text fig. 21. Wedekindella sp. nov. Suture of GS.7118 from Wolborough, Devon. Molarium Zone, Givetian. X 6.

Specimens, Horizon and Locality.

From the Terebratum Zone at Pentonwarra Point, Trevone, D.893, 895, 936, ? 888. From the Terebratum Zone at Portquin, D.739. From the Molarium Zone of Wolborough Quarry, Newton Abbot, GS.7118.

5. Wedekindella psittacinus (Whidborne)

Plate 5, figs. 1, 2, 3, 4, 7 and 8.

1889 Goniatites psittacinus G.F. Whidborne 1889, p.29.

1890 Goniatites psittacinus G.F. Whidborne 1890, p.72, pl.6, figs.9-13.

1895 Tornoceras psittacinum E. Holzapfel 1895, p.101 (? pars.).

+1897 Tornoceras psittacinum A.H. Foord and G.C. Crick 1897, p.119, text fig. 55.

1917 Parodiceras psittacinum R. Wedekind 1917, p.116, text fig. 24d.

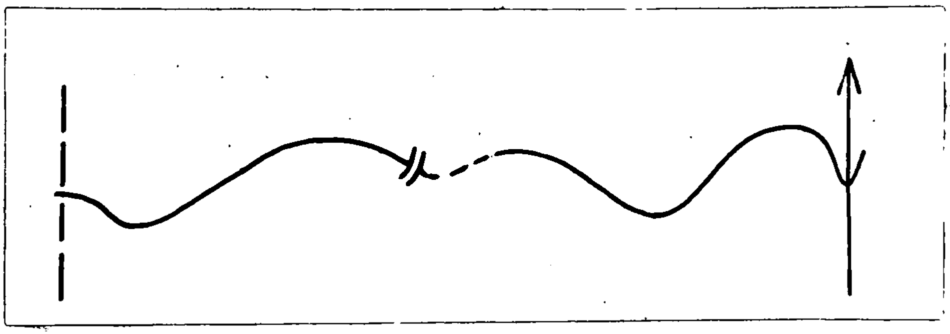
Description (of BM.c9010 from Wolborough, the specimen best suited among the syntypes for selection as lectotype).

Dimensions	D	WH	WW	UW	S
Max. dia.	20.0	8.8	10.3	1.5	15
	14.4	8.3	9.5	1.2	-

The specimen is preserved as an internal mould in coarse, crystalline limestone. Orad approximation of the septae suggest that the specimen is mature although the body chamber is not preserved.

Shell form involute, somewhat laterally compressed and ellipsiconic (therefore the dimensions given above are approximate).

No trace of growth lines is preserved. The suture (text fig. 22) shows a small V-shaped ventral lobe, a well rounded ventro-lateral saddle, a wide and rounded Lateral lobe, a shallow umbilico-lateral saddle and a median dorsal saddle within the wide dorsal lobe.



Text fig. 22. Wedekindella psittacinus (Whidborne) . Suture of the syntype BM.c9010 from Wolborough Quarry, South Devon at 20mm diameter. Molarium Zone, Givetian. c. X 6.

Remarks

There are numerous specimens from Wolborough which have been referred to Goniatites psittacinus but the syntype described above is one of the few which show the dorsal suture and enable the species to be referred without doubt to Wedekindella. The species is remarkable for the ellipsiconic form. Whidborne thought this shape was original and the lack of it in other species at Wolborough, as well as the absence of cracks or breaks on the ellipsiconic specimens supports this. The absence of constrictions is a feature shared with _Wedekindella_ sp. nov. which has a more angular Lateral lobe and a more arched umbilico-lateral saddle.

Specimens, Horizon and Locality

All known specimens are from Wolborough Quarry, Newton Abbot and come from the Molarium Zone according to the evidence of the accompanying maenioceratids. Specimens include GS.95338, 95427, 95426, 95337, BM.36623, c1741, c1804, c15476, c15473, c9010, c9012, c9013, c9013, c9014, c15474, c9011, c9015, c9016, c9019, c9020, c9021, c9022, c9017. These specimens are all syntypes but many of them are not generically determinable. At least one of the syntypes, BM.c5670, is a _Tornoceras_ (_Tornoceras_).

Genus _MAENIOCERAS_ Schindewolf 1933

Type species : _Goniatites terebratus_ G. & F. Sandberger.

Diagnosis : Anarcestids with subevolute to involute shell usually laterally flattened. Typically with paired ventro-lateral furrows. Growth lines biconvex. Suture in early stages with ventral, subumbilical and dorsal lobes. During ontogeny the subumbilical lobe migrates ventrad to become a Lateral and an adventitious lobe develops between it and the ventral. Also an umbilical lobe is formed and a pair of lobes on the outer slopes of the median dorsal lobe.

Remarks : The name _Maeneceras_ has been used for this group of Givetian goniatites but the type of that species, _Goniatites acutolaterale_, is a _Sporadoceras_. Hence Schindewolf proposed _Maenioceras_. Bogoslovski (1957 p.45) has recently erected _Sedgwickoceras_ with _G. acutolaterale_ as type, apparently unaware that it must automatically fall as a synonym of _Maeneceras_. The genus differs from _Sporadoceras_ in the possession of biconvex growth lines and in the sutural development. In Sporadoceras the lateral lobe of the adult arises adventitiously and the lobe between it and the ventral is the second adventitious lobe and not the first as it is in Maenioceras.

The genus includes two groups. The first group, typified by the genotype, has a closed umbilicus in the adult ; these are typical of the upper Maenioceras Stufe or Terebratum Zone. Other species here include M. tenue and M. decheni . The second group is known almost exclusively from the lower Givetian limestones at Wolborough Quarry, Devon; this group includes M. molarium and its varieties and is characterised by an open umbilicus in the adult.

The result of a study of the sutural ontogeny described below, as well as the earlier date for the Wolborough maenioceratids, shows that Schindewolf was not correct in deriving the genus from Foordites. The ancestor must lie among Eifelian Anarcestes or early Werneroceras.

1. Maenioceras terebratum (G. & F. Sandberger)

Plate 9, figs. 1 to 7, Plate 8, fig. 1.

1850 Goniatites terebratus G. & F. Sandberger 1850/56, p.99, pl.5, fig.3,3a-c.

? 1850 Goniatites retrorsus var. undulatus F.A. Roemer 1850, p.84, pl.13, fig.1a,b.

1860 Goniatites terebratus F.A. Roemer 1860, p.159, pl.24, fig. 4a-c.

1872 Goniatites terebratus E. Kayser 1872, p.665, pl.26, fig.1d-f.

1884 Maeneceras terebratum A. Hyatt 1884, p.321.

1895 Maeneceras terebratum E. Holzapfel 1895, p.107, pl.4, figs.14, ? 18, pl.6, figs.6,7,9.

+1897 Maeneceras terebratum A.H. Foord and G.C. Crick 1897,

1902 Maeneceras terebratum F. Frech 1902, p.54, text fig. 15.

+1913 Maeneceras terebratum F. Frech 1913, p.20.

1917 Maeneceras terebratum R. Wedekind 1917, p.114, text fig. 23 al,2, pl.16, fig. 7.

1933 Maenioceras terebratum O.H. Schindewolf 1933, p.104.

1950 Maenioceras terebratum G. & H. Termier 1950, p.50, pl.143, figs. 25-32.

1956 Maenioceras terebratum M.R. House 1956, p.259.

Large specimens of this species occur at Lummaton, Devon and smaller, pyritised specimens at Portquin and Trevone, North Cornwall. The former illustrate the adult, the latter enable a description of the ontogeny to be given.

Description of Devon Specimens (all from Lummaton Quarry, Torquay).

Dimensions	D	WH	Wh	WW	UW	
Specimens in the collections of the Exeter Geology Dept.	41	23.8	12.2	13.0	2.1	(i)
	22.5	12.4	6.0	8.0	1.7	(ii)
	20.5	10.0	-	8.7	2.8	(iii)
	25.0	-	-	9.7		(iv)

All specimens are preserved in crystalline limestone ; some show traces of the original shell.

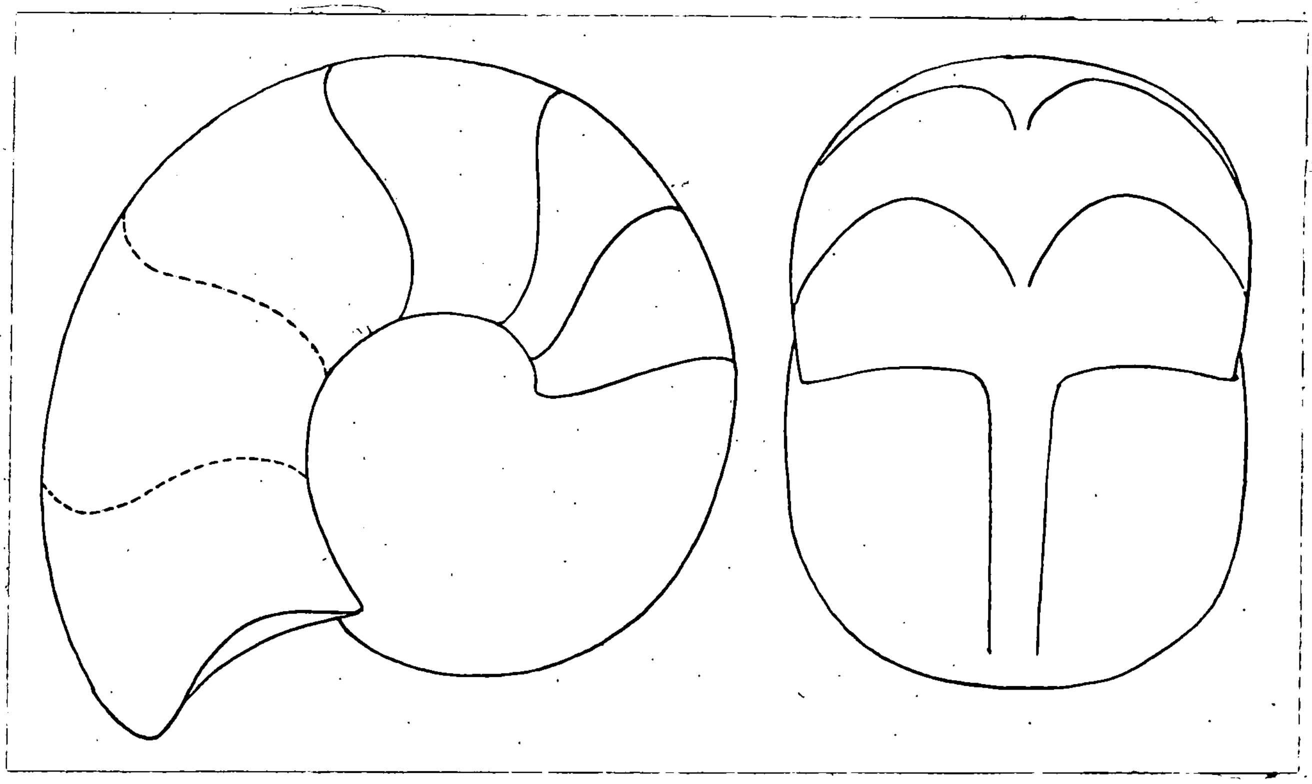
Shell form inolute, compressed, with flattened venter and parallel sides. Umbilicus just open. Whorl section shows flat raised ventral band, 6mm wide at 31mm diameter (i) with ventro-lateral furrows on each side.

Growth lines pass forward across the umbilical shoulder to form a salient on the inner flanks and an angular sinus two thirds the way across the flanks. They then sweep well forward to form a projecting salient in the ventro-lateral furrow. The course over the venter has not been observed. Sutures not seen.

<u>Description of Ontogeny</u> (based on specimens from Trevone and Portquin)

Dimensions	D	WH	WW	UW
GS. 1570	c.12.0	c.6.4	4.6	-
D.715	c.12.2	c.5.5	c.4.3	c.2.0
D.847	5.0	-	3.3	1.8

<u>Shell form</u> : The protoconch is small, sub-ellipsoidal to barrel shaped, transversely elongate, 0.62mm to 0.65mm in breadth. The first whorl is tightly coiled about the protoconch making an imperforate umbilicus. The impressed depth is very shallow at first. The early volutions are evolute and the whorl section is a curved trapezoid with steep umbilical walls which curve sharply over to form a broad, gently rounded ventro-lateral area (text fig. 24d). By a diameter of 4mm the angularity between the umbilical wall and the ventral area is lost and the section becomes more rounded and becomes semi-lunar by 7mm diameter. Later the form of the shell changes, becoming more discoidal and the umbilicus gets considerably smaller.

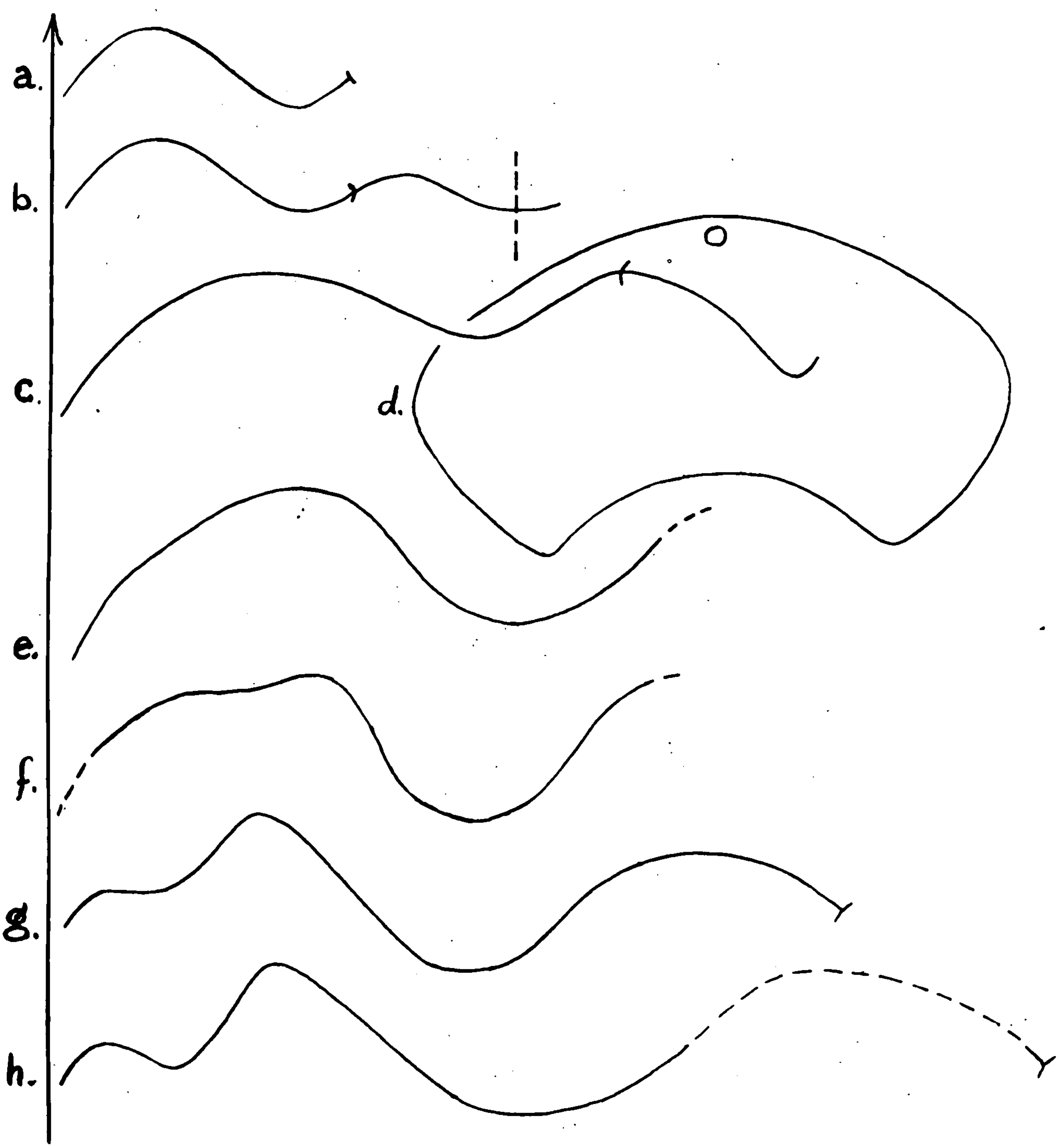


Text fig. 23. <u>Maenioceras terebratum</u> (G. & F. Sandberger). protoconch and early chambers based on GS.1595 from Portquin, North Cornwall. Terebratum Zone, Givetian. X 100.

The umbilicus is 2mm across in the largest Cornish specimens of around 12mm diameter. The body chamber is long, at least one whorl in length.

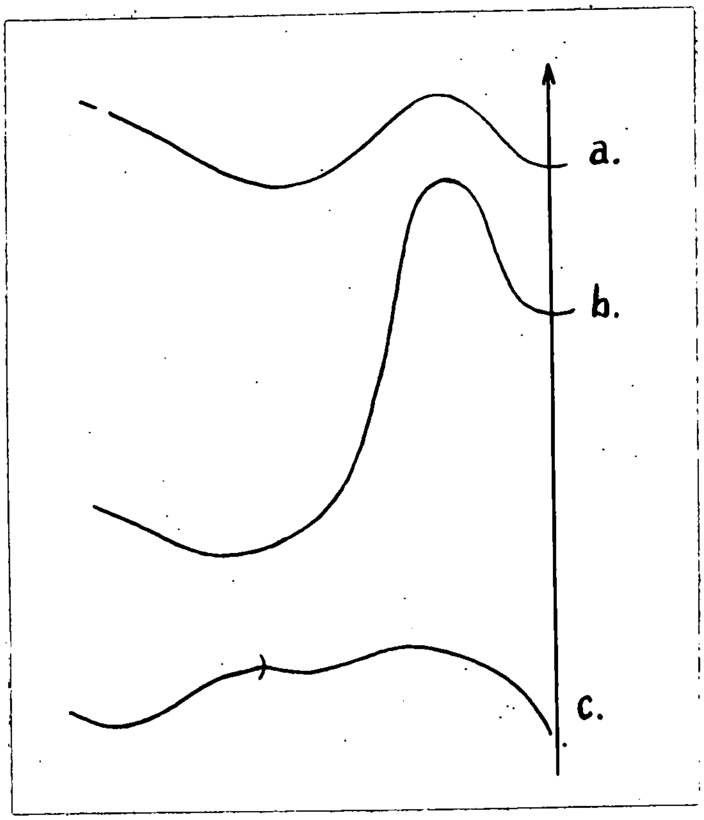
Growth lines : The growth lines are clearly marked in the earliest whorls and by 1mm diameter the adult elements occur but the indicated lappets are broad and short and the sinus on the venter is very shallow. By 7mm diameter the sigmoidal curvature of the growth lines has increased considerably (compare text figs. 25a and b). Thereafter the same relative proportions continue to the adult. Spiral lines above the siphuncle and on the outer border of the ventral sinus are seen in early whorls and are different from the incipient ventro-lateral grooves which are first seen at about 8mm diameter and become more prominent in later whorls.

Suture : The prosuture possesses a deep ventral lobe (text fig. 23), a very shallow ventro-lateral saddle and a very slight sub-umbilical lobe. In the first suture the ventral lobe is much deeper and V-shaped and the ventro-lateral saddle more arched. During the next few sutures the sub-umbilical lobe migrates slightly ventrad (text fig. 23, 24a). By the fourth suture the early sub-umbilical lobe centres well out on the umbilical wall : at this stage the dorsal suture has been observed to form a wide and shallow median dorsal lobe which passes outwards into an umbilical saddle which centres inside of the seam (text fig. 24b). In later sutures this dorsal saddle moves slightly ventrad until by 1.6mm diameter it centres at the umbilical seam and the lobe on the umbilical wall moves out with it (text fig. 24c). The ventral lobe during this time remains as a broad V-shape with wide, rounded saddles on each side. A good deal of variation has been noted at this stage, especially in the degree of arching of the ventro-lateral saddle, and the depth of the sub-umbilical lobe and narrowness of the median dorsal lobe. By 6mm diameter, when the whorl section is semi-lunar, the lobe which was at first sub-umbilical in position is laterally placed (text fig.24e). By this stage the ventro-lateral saddle begins to show a decided flattening on the ventral side and by about



Text fig. 24. Maenioceras terebratum (G. & F. Sandberger). Diagrams showing sutural ontogeny. a. The second suture, b. The fourth suture, c,d. The suture and whorl section at a diameter of 1.6mm. a-d based on D.862 from Trevone, X 100. e. Suture at 6.6mm diameter based on GS. 22077 from Trevone, X 25, f. Suture at 8.5mm diameter based on D.864, from Trevone, X 25, g. Suture at c.8mm diameter, h. at 12mm diameter, both based on GS.1570 from Portquin, X 25, both have been reversed for comparison. Terebratum Zone, Givatian.

8mm diameter, or in some cases later, the flattening becomes concave and an adventitious lobe is then formed (text fig. 24f-h). The lateral lobe of the adult usually, but not invariably, starts to become pointed at 12mm diameter. The development of additional lobes on the dorsal suture has not been observed.

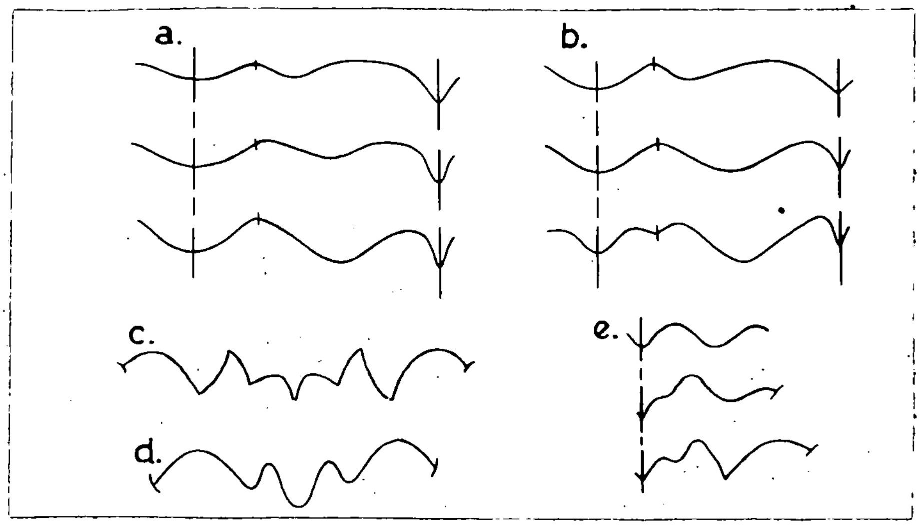


Text fig. 25. Maenioceras terebratum (G. & F. Sandberger). a. Growth lines at c.3mm diameter based on D.802 from Pentonwarra Point, Trevone. b. Growth lines at 6.8mm diameter based on GS.22077 from Trevone. c. Suture based on GS.1609 from Portquin. All Terebratum Zone, Givetian. All X 20.

Remarks

The ontogenetical details given here finally settle the question of the affinities of the genus. Various opinions have been expressed on this matter in the past. Foord and Crick (1897 p.121) following Holzapfel (1895 p.106) state of M. terebratum that "Young shells have the suture line of Agoniatites" and that "the development of the suture line points to a descent from Agoniatites". Schindewolf, on the other hand, without giving evidence, derives the genus from Anarcestes via Foordites (Schindewolf 1933, p.88). The most important distinction between the Agoniatitidae and the Anarcestidae, as elucidated by Schindewolf, is that in the former the lateral lobe of the adult is laterally placed in the earliest stages whereas in the Anarcestidae, whilst the Lateral lobe of the adult may be lateral or subumbilical in position in the adult, it is always sub-umbilical in the early stages. The preceding description has shown that the adult Lateral lobe in Maenioceras terebratum migrates from a sub-umbilical position during ontogeny. Maenioceras is therefore correctly related to the Anarcestidae.

The group of anarcestids, the Pinacitinae, which show such a migration of the primary subumbilical lobe and which do not develop a median dorsal saddle includes Holzapfeloceras, Pinacites, Foordites and Maenioceras. Schindewolf considered Foordites to be ancestral to Maenioceras because of the similarity in shell form between them and because Foordites in the adult forms a lobe



Text fig. 26. a. Ontogeny of the suture in Werneroceras ruppachense (Kayser), after Schindewolf 1933, b. Ontogeny of the suture in Foordites platypleura (Frech), after Schindewolf 1933. c,d. Ventral and dorsal sutures of Maenioceras terebratum (G. & F. Sandberger), from G.& F. Sandberger 1850/56. e. Suture development of Maenioceras terebratum (G. & F. Sandberger), from Holzapfel 1895.

centred on the umbilical seam (text fig. 26b) as does Maenioceras terebratum (text fig. 24g,h, 26c,d,e). But whilst the shell of Foordites is not dissimilar from Maenioceras terebratum it is very unlike Maenioceras molarium from which there can be little doubt that M. terebratum evolved following the new evidence from the Wolborough representatives. The resemblance between Foordites and M. terebratum is therefore misleading. Most probably Maenioceras evolved from Anarcestes via early Werneroceras and the early species in the Molarium Zone still possessed shells similar to Anarcestes but slightly more flattened laterally. Later species, typified by the genotype, became more discoidal and involute and the sutural elements became much more angular in the adult.

In 1956 certain Cornish specimens were referred to as Maenioceras aff. terebratum (House 1956, p.259) to distinguish specimens (such as GS. 1570) which do not develop angularity of the Lateral lobe before 12mm diameter. Most specimens show the angularity before that diameter. This difference is now considered a matter of variation only.

One specimen from Wolborough (BM.c15475) is closely comparable with M. terebratum (plate 8, figs. 4 and 5). Dimensions are given below with those of other Wolborough maenioceratids. This is the only specimen referable to M. terebratum known from the English Molarium Zone.

Specimens, Horizon and Locality

With the exception of BM.c15475 from Wolborough all specimens are thought to belong to the Terebratum Zone. All known Devon specimens are from Lummaton and are in the Exeter Geology Dept. collections. Specimens from Cornwall include the following from Portquin ; GS.1570, 1571, 1575, 1581, 1620, D.787, 715, 701, 702-5, 724, 728, 745 ; and from Pentonwarra Point, Trevone ; GS.95394, D.802, 806, 816, 820, 821, 831, 833, 836, 844, 847, 859, 867, 876, 879, 883, 888, 912, 914, 929. Many of these specimens are nuclei.

2. Maenioceras decheni (Kayser)

Plate 8, figs. 6 and 7.

1872 Goniatites decheni E. Kayser 1872, p.665, pl.26, figs. la-d.

1895 Maeneceras decheni E. Holzapfel 1895, p.114, pl.4, figs. 15, 16.

1913 Maeneceras decheni F. Frech 1913, p.20.

1917 Maeneceras decheni R. Wedekind 1917, p.114, text fig. 23 cl-3, also as M. terebratum var. decheni.

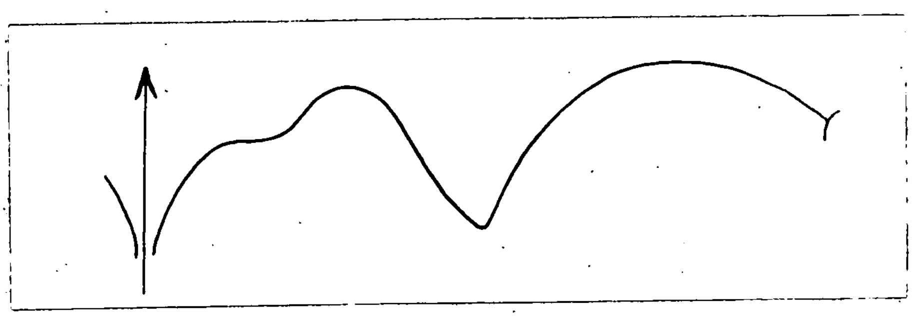
There are two specimens in the collections of the Exeter Geology Dept. collections from Lummaton which belong to this species.

Description

Dimensions	D	WH	WW	UW
(i)	c.19.0	9.5	8.2	? 1.0
(ii)	15.0	8.4	c.6.8	-

Shell form involute, laterally compressed, with well rounded venter, almost closed umbilicus and rather flat sides. Whorl section widest close to the umbilicus, flanks convexly converging towards the venter.

Growth lines cannot be traced. One specimen (i) shows traces of radial epidermids in the ventro-lateral region. Suture (text fig. 27) with V-shaped ventral lobe, adventitious lobe on the



Text fig. 27. Maenioceras decheni (Kayser). Diagram of suture based on a specimen from Lummaton Quarry, Torquay in the collections of the Exeter University Department of Geology. Terebratum Zone, Givetian. X 10.

ventral slope of the ventro-lateral saddle, angular Lateral lobe and arched umbilico-lateral saddle. Dorsal suture not seen.

Remarks

The specimen which most agrees with Kayser's figures (pl. 8, figs.6,7) has a well-rounded outline and almost closed umbilicus. Another specimen (pl.22, figs.7,8) shows an umbilicus with a depressed conical form and this specimen is compared to M. decheni only. This species is distinguished from M. terebratum by the well-rounded venter and absence of ventro-lateral furrows. This is also shown by a Wolborough specimen, described below, which has a more inflated form. Holzapfel (1895) recorded M. decheni from the Upper Stringocephalenschichten of Germany which belongs to the Terebratum Zone.

Specimens, Horizon and Locality

Two specimens only from Lummaton Quarry, Torquay in the collections of the Department of Geology, Exeter. Terebratum Zone, Givetian.

3. Maenioceras aff. decheni (Kayser)

Plate 8, figs. 8 and 9.

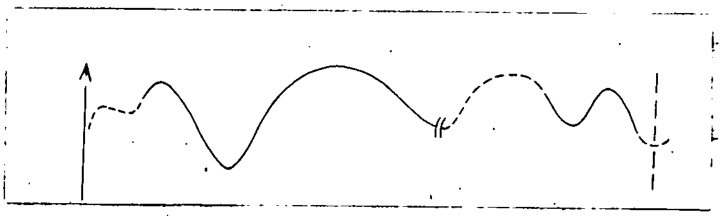
1890 Goniatites sp. G.F. Whidborne 1890, p.75, pl.6, figs. 15,15a.

Description (of GS.7117, from Wolborough, South Devon)

Dimensions	D	WH	WW	UW	Wh
	24.5	12.2	c.12.5	c.1.2	-
	-	10.3	c.10.5	-	4.9

Shell form involute, rotund and slightly compressed. Umbilicus probably closed in the shell (open in mould). Whorl section ovate, widest mid way across flanks. Impressed depth about 50%. Venter well-rounded with no trace of ventro-lateral grooves. Inner whorls almost globular.

Suture shows a trace of a V-shaped ventral lobe (text fig. 28)



Text fig. 28. Maenioceras aff. decheni (Kayser). Suture based on GS.7117 from Wolborough Quarry, South Devon. Molarium Zone, Givetian. X 3.

with an adventitious lobe formed on the ventral part of the ventro-lateral saddle. Lateral lobe spatulate, sub-angular. Latero-umbilical saddle arched. Dorsal suture with rounded sub-umbilical and median dorsal lobes.

Remarks

Whidborne was at a loss to name this specimen (1890 p.77), but the dorsal suture is identical with that figured by the Sandberger brothers among the syntypes of G. terebratus (text fig. 26d). The specimen differs from the holograph of M. decheni and from the Lummaton specimens of that species in having a more ovate whorl section and less angular Lateral lobe.

Specimen, Horizon and Locality

One specimen only, GS.7117, from Wolborough Quarry, South Devon. Molarium Zone, Givetian.

Maenioceras molarium (Whidborne)

The maenioceratids from Wolborough which have indications of ventro-lateral furrows form a variable suite ranging from some with a wide open umbilicus to others with an almost closed umbilicus. Phillips named some as Goniatites excavatus but it is clear that he did not consider them conspecific with the Carboniferous goniatite to which he had given the same name five years previously (Phillips 1836, p.235, pl.19, figs. 33, 25, a Bollandoceras Bisat). Whidborne therefore erected the name molarius for the group and referred to the specimen figured by Phillips (BM.c1803a) as the "type-specimen" (Whidborne 1890, p.65). Whidborne figured several related goniatites from the same locality and these formed the basis for the specific names apertum and intermedium (Foord and Crick 1897, p.125-7). Twenty four specimens of the group are preserved and details of these are recorded on the accompanying diagrams (text fig. 29). A study of the specimens has led to the conclusion that Foord and Crick's specific names should be relegated to varietal rank. The recognisable varieties will now be described.

4. Maenioceras molarium (Whidborne) molarium

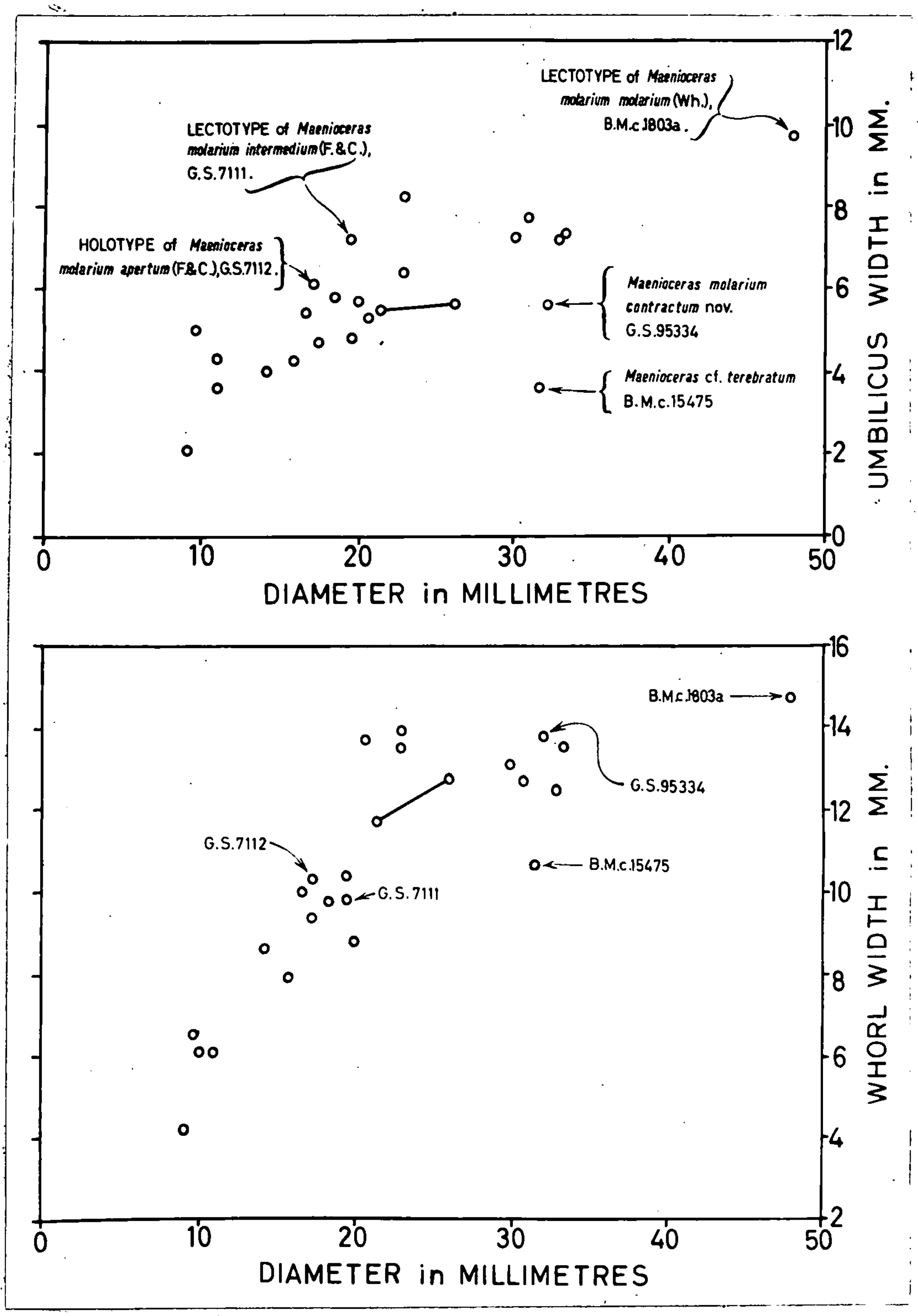
Plate 7, figs. 1 to 3, 7, 10, Plate 8, figs. 2 and 3.

1841 Goniatites excavatus J. Phillips 1841, p.121, pl.50, fig. 232a,b.
1888 Goniatites excavatus R. Etheridge 1888, p.167.
1890 Goniatites molarius G.F. Whidborne 1890, p.64, pl.5, figs. 11, 11a, pl.6, figs. 5, 5a (as Goniatites globosus Münster ?).
+1897 Maeneceras molarium A.H. Foord and G.C. Crick 1897, p.124, text fig. 58.
1907 Goniatites molarius A.J. Jukes-Browne and W.J. Else 1907, p.401.
+1913 Maeneceras excavatum F. Frech 1913, p.20.
1917 Maeneceras excavatum R. Wedekind 1917, p.115, ? text fig. 23d.
? non 1921 Tornoceras molarius W.G. Shannon 1921, p.248.
1923 Maeneceras excavatum C.W. Correns 1923, p.223.

Description of Lectotype (BM.c1803a, from Wolborough selected by Whidborne supra cit.).

Dimensions	D	WH	WW	UW
Max dia.	49.0			
	38.7	15.1	14.6	9.7

Shell form sub-involute and markedly flat sided and compressed. Umbilicus opening regularly. Whorl section almost quadrangular with parallel sides and a flattened band on the venter



Text fig. 29. Diagram showing the dimensions and variation in the Maenioceras molarium group. All specimens are from Wolborough Quarry. Against GS.7111 read "specimen best suited for selection as Lectotype". Against GS, 95334 read "var. nov." only.

(8.9mm wide at the maximum diameter) with shallow ventro-lateral furrows on either side. The maximum whorl width is reached mid way across the flanks and the sides then become parallel up to the low umbilical walls. Sutures and growth lines not seen.

Remarks

A sequence of specimens can be arranged between the varieties of M. molarium here distinguished. The Lectotype is the largest specimen of the group known from Wolborough and the relation between it and the smaller specimens is not always easy to determine. However, in var. molarium, the umbilicus opens regularly and the flanks are parallel for at least 50% of their height above 18mm diameter. In var. intermedium, the whorl section is more rounded and the umbilicus width tends to expand outwards. In var. apertum, the whorl section is very depressed and trapezoidal in outline. A morphological sequence can be traced showing the closure of the umbilicus in the adult from var. molarium through var. nov (e.g. GS.95334) to Maenioceras cf. terebratum (BM.c15475). At Wolborough only one specimen comparable with M. terebratum is known, but the sequence shows how the maenioceratids of the Molarium Zone gave rise to those of the Terebratum Zone by the closure of the umbilicus.

Specimens Horizon and Locality

Lectotype, BM.c1803a ; other specimens include GS.95330, 95333, BM.c40311. All from Wolborough Quarry, Newton Abbot, South Devon. Molarium Zone, Givetian.

5. Maenioceras molarium (Whidborne) var. apertum (Foord and Crick)

Plate 7, figs. 8 and 9.

1890 Goniatites globosus (pars) G.F. Whidborne 1890, p.67, pl.5, figs. 12, 12a,b.

1897 Maeneceras apertum A.H. Foord and G.C. Crick 1897, p.126, text fig. 59.

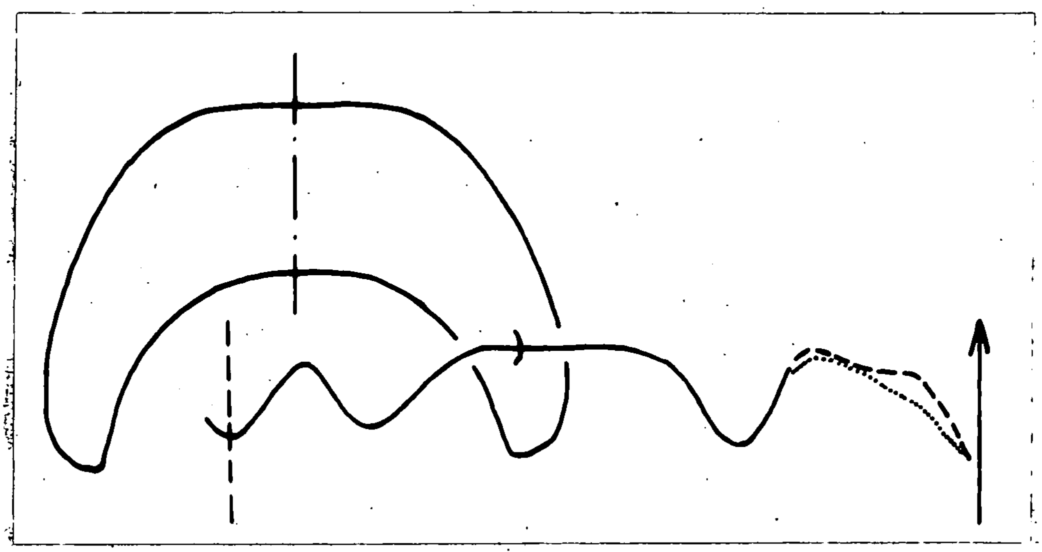
Description (of Holotype, GS.7112, from Wolborough)

Dimensions	D	WH	WW	UW	Wh
At max. dia.	c.17.2	6.0	10.3	6.0	3.3

Specimen preserved as an imperfect, fully septate internal mould in coarse crystalline limestone. There is no trace of the original shell or growth lines.

Shell form sub-evolute, trochoidal with wide, regularly opening umbilicus. Whorl section is a rounded trapezoid with a broad ventral band (5mm broad at the maximum diameter) , with a convex ventro-lateral area sloping out to a maximum whorl width close to the umbilicus (text fig. 30). Umbilical shoulder well rounded and umbilical wall very short.

Suture shows a poorly preserved ventral lobe with traces of a lobe on the ventral slopes of the ventro-lateral saddle (text fig. 30). Lateral lobe linguiform and sub-angular. Slight trace of an umbilical lobe. Dorsal elements reflect ventral with rounded sub-umbilical and median dorsal lobes.



Text fig. 30. Maenioceras molarium var. apertum (Foord and Crick). Suture and whorl section of the Holotype, GS. 7112, from Wolborough Quarry, South Devon. Dotted line shows actual and dashed line inferred course of the suture in the ventro-lateral area where the specimen is abraded. Molarium Zone, Givetian. X 6.25.

Specimen, Horizon and Locality.

Only the Holotype, GS. 7112, but others, such as GS.95339, approach it. Wolborough Quarry, Newton Abbot, South Devon. Molarium Zone, Givetian.

6. *Maenioceras molarium* (Whidborne) var. *intermedium* (Foord and Crick)

Plate 7, figs. 11 to 14.

1841 *Goniatites globosus* J. Phillips 1841, p.120, pl.50, fig. 231.

1890 *Goniatites globosus* (pars) G.F. Whidborne 1890, p.67, pl.6, figs. 5,5a.

1897 *Maeneceras intermedium* A.H. Foord and G.C. Crick 1897, p.125.

1917 *Maeneceras intermedium* R. Wedekind 1917, p.115.

Description (of syntypes from Wolborough Quarry)

Dimensions	D	WH	WW	UW
GS.7111	19.5	7.2	9.8	7.2
BM.c30306b	18.4	8.2	9.8	5.8
BM.c30306c	11.0	4.2	6.1	4.3

The syntypes are poorly preserved as internal moulds in coarse crystalline limestone and show no trace of the original shell or complete trace of the sutures.

Shell form sub-involute to sub-evolute, trochoidal with an open umbilicus expanding slightly outwards. Whorl section rounded in outer whorls with trace of a flattened ventral band (4.5mm broad at 19.5mm diameter in GS.7111). The ventro-lateral areas are convex and the flanks parallel towards the umbilical shoulder. The inner whorls are probably more depressed and reniform in section.

Specimens, Horizon and Locality

Syntypes are GS.7111 (the specimen best suited for selection as lectotype), BM.30306b,c. All from Wolborough Quarry, Newton Abbot, South Devon. Molarium Zone, Givetian.

7. Maenioceras molarium (Whidborne) var. nov.

Plate 7, fig.4.

This variety is distinguished by the umbilicus, which tends to be cylindrical or contracting in the later whorls rather than expanding as in the other varieties. Partly as a result of this the flanks are parallel for a wider distance on the sides. It is thought to represent a stage towards M. terebratum.

Description

Dimensions	D	WH	WW	UW
GS.95334	32.2	13.5	13.8	5.6
GS.95331	c.17.3	8.0	c.9.3	4.7

Specimens are poorly preserved as internal moulds in coarse crystalline limestone. None show growth lines or sutures.

Shell form involute, compressed laterally with parallel sides and flattened venter. Umbilicus open, expanding in early whorls, later either contractingrelatively or actually. Whorl section compressed, ventral band slightly convex, ventro-lateral shoulder convex sloping to maximum width of parallel flanks which continue to the sudden umbilical shoulder.

Specimens, Horizon and Locality

GS.95334 and 95331 from Wolborough Quarry, Newton Abbot, South Devon. Molarium Zone, Givetian.

Superfamily PROLOBITACEAE Wedekind 1913
Family PROLOBITIDAE Wedekind 1913
Subfamily PROLOBITINAE Wedekind 1913

Genus SOBOLEWIA Wedekind 1913a

Type species : Goniatites cancellatus d'Archaic and de Verneuil 1842.

Diagnosis : Primitive ammonoids with ventral siphuncle. Shell involute, usually globular or only slightly compressed. Growth lines convex in early stages, becoming biconvex in some species by the adult. Suture very simple, typically trilobed with a V-shaped ventral lobe, a broad, flat lateral lobe and a broad, shallow dorsal lobe. Some develop a small subumbilical lobe by the adult.

Remarks : Wedekind also included S. rotella and S. nuciformis in his genus and von Correns (1923 p.225) added Anarcestes denckmanni Holz. Schmidt (1950 p.92) has shown that Goniatites subnautilinus var. convolutus G. & F. Sandberger belongs here. The striking feature of the genus, apart from the simple suture, is the early convexity of the growth lines which places the genus in a unique position among Middle Devonian goniatites. The genoholotype still has convex growth lines at the maximum diameter known (23mm). In S. rotella biconvexity develops at diameters in excess of 22mm. On the other hand S. denckmanni only has convex growth lines below 12mm. diameter+.

1. Sobolewia nuciformis (Whidborne)

Plate 10, figs. 1 to 7, Plate 11, figs. 1, 2 and 5.

1889 Goniatites nuciformis G.F. Whidborne 1889, p.29.

1890 Goniatites nuciformis G.F. Whidborne 1890, p.77, pl.6, fig.7,7a,b, pl.7, fig.1,1a.

+1897 Anarcestes nuciformis A.H. Foord and G.C. Crick 1897, p.48, text fig. 13.

+1913 Anarcestes nuciformis F. Frech 1913, p.15.

1917 Sobolewia nuciformis R. Wedekind 1917, p.155,6, text fig. 50_2, pl. 19, fig.3.

+ These dimensions are based on the syntype figures in each case.

This species was first described from Wolborough Quarry, South Devon. It is here recorded also from North Cornwall.

Description of Devon Syntypes

Dimensions	D	WH	Wh	WW	UW	WW/D
BM.c9023	16.7	7.8	3.3	12.0	1.8	72
BM.c9024	15.6	7.6	3.1	11.8	1.4	75.5
BM.c9025	11.7	5.7	2.8	8.6	c.1.0	73.5
BM.c9026	c.19.5	c.8.8	c.4.0	c.14.9	c.1.2	-
BM.c9027	10.6	4.8	2.6	8.5	c.0.9	80
BM.c9028	25.5	11.8	c.4.0	13.8	2.3	54
BM.c9029	21.7	12.3	4.6	14.5	c.2.0	67
BM.36624	10.4	5.2	2.2	7.2	c.2.0	69

All syntypes are poorly preserved as internal moulds in crystalline limestone. Some show septae but none show traces of the original shell or growth lines. The description below applies to BM.c9023 which is the best preserved and most satisfactory for selection as lectotype.

Shell form involute, almost globular : narrow open umbilicus, possibly open in shell. Whorl section crescentic with a broad and rounded venter and ventro-lateral area. Whorl width widest close to the umbilicus. Body chamber not seen, septae concave.

Suture with perhaps a small ventral lobe (Whidborne thought there was none but his draughtsman thought otherwise). Suture then passes almost radially to the umbilicus where it crosses the umbilical seam to form a very broad, rounded dorsal lobe. Septae 3.5mm apart on the venter at 12.6mm diameter.

Description of Cornish Specimens

Dimensions	D	WW	UW	WW/D
D.892	13.5	8.9	c.2.4	66.5
D.896	10.5	8.6	c.2.0	82
D.897	14.7	6.8	-	46 (S. aff. nuciformis)
D.898	c.7.9	5.3	-	67

(All from Pentonwarra Point, Trevone)

Dimensions of specimens from the Givetian of the Redjel Imrad, North Africa, given for comparison

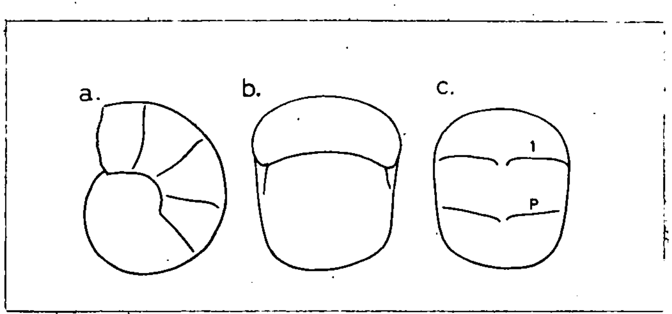
(i)	19.5	13.7	1.5	70
(ii)	16.6	11.9	1.5	72
(iii)	18.2	11.6	1.6	64
(iv)	15.7	11.6	c.1.6	74

The Cornish specimens are preserved as internal pyritic moulds with occasional pyritic casts of the original shell. Only one specimen (D.897) shows the close approximation of septae which may indicate true senescence.

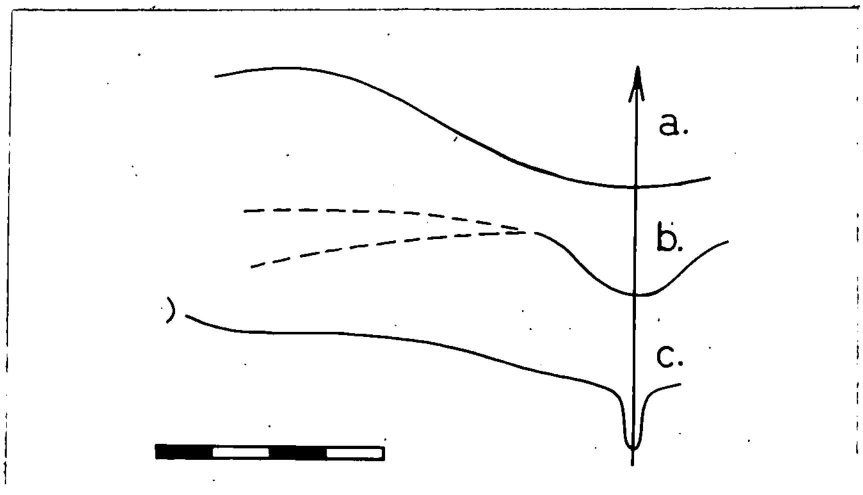
Shell form typically sub-globular, rather more laterally compressed than the Wolborough specimens, but there is a good amount of variation. The largest body chamber seen occupies one half whorl.

The prosuture (text fig. 31) is radial with a small ventral lobe. Subsequent early sutures form a slight umbilico-lateral lobe. By 5mm diameter the umbilico-lateral lobe is smaller and the suture passes rather convexly from it towards the ventral lobe and may form a slight lobe before reaching it (text fig. 32c). At larger diameters the umbilico-lateral lobe becomes smaller and may disappear.

Growth lines seen at all diameters up to 15mm are convex, forming a broad and shallow sinus across the venter and salients on the outer flanks (text fig. 32a). When seen on casts of the shell (pl. 11, fig. 2) the growth lines form close-set striae.



Text fig. 31. Sobolewia nuciformis (Whidborne). Protoconch and early chambers based on D.832 from Pentonwarra Point, Trevone. Terebratum Zone, Givetian. X 50.



Text fig. 32. Sobolewia nuciformis (Whidborne). a. The course of the growth lines. b. The course of the pit rows on the internal mould. c. The suture. All based on D.829 from Pentonwarra Point, Trevone. Terebratum Zone, Givetian. Scale of millimetres. X 7.5.

Remarks

The specimens here referred to S. nuciformis differ from the genoholotype only in not having a closed umbilicus. Perhaps when the genoholotype is found (it is not in the Verneuil collection at the l'Ecole des Mines in Paris where several of d'Archaic and de Verneuil's type specimens have been located) it will be discovered that the specimen has an open umbilicus since, as has been shown already, d'Archaic and de Verneuil's figures were to a large extent reconstructions. S. rotella and S. denckmanni from the Upper and Lower Stringocephalenshichten respectively develop biconvex growth lines which have not been seen on the Cornish specimens and the Wolborough specimens are too poor to preserve it. The North African S. inflata is probably a synonym of one of the already known species but details of the growth lines are lacking. The curious pitting on the internal moulds of many of the specimens of this species from North Cornwall warrants a special description of the phenomenon since certain deductions and inferences regarding the relation of the soft parts to the shell in Sobolewia can be made from them. Givetian specimens of S. nuciformis from the Givetian of North Africa show the same phenomenon.

<u>The pitting seen on the internal moulds of S. nuciformis</u>

A regular pitting has been observed on the internal moulds of some specimens of <u>S. nuciformis</u> from North Cornwall and Africa. Associated genera and species are unaffected. Pitting occurs on Cornish specimens between 8mm and 21mm diameter. Some specimens show only an occasional development of pits.

A. DESCRIPTION

(i) <u>Nature of the Pits</u>. The pits range between diameters of 0.3mm and 0.9mm and slope convexly inward to form a sub-conical depression which may reach as much as 0.5mm in depth. Where observable the pit bottom is rounded. The outer margins of the pits show no indication of discreteness (pl.11, fig.6). Pits have been dissected from beneath undisturbed portions of the pyritised shell (see also pl.11, fig. 2). Pits occur on the body chamber and septate areas. Pits formed on the mural portions of the septae show no difference from those formed elsewhere. Occasionally two or more pits may partly coalesce.

(ii) <u>Distribution of the Pitting</u>. In some specimens the pits appear rarely and it is not possible to distinguish any regular arrangement, but in several specimens the pits are seen to be arranged in rows which pass out from the umbilicus, cross the lateral areas either radially or with a slight forward projection, and ventro-laterally sweep back to form a shallow and narrow 'sinus' on the venter (text fig. 32b). In some specimens there are five to eight of these rows in half a whorl with about five pits between the umbilicus and the venter in each. Pits are developed more or less evenly on each side. The arrangement between successive does not show precise agreement. The distance between the rows agrees closely with the distance between the septae. The course of the growth lines does not agree with the course of the pit rows (text fig. 32b,c, pl.11, fig.2).

(iii) <u>North African Specimens</u>. Specimens of <u>S. nuciformis</u> in the Sorbonne collections from the Givetian of the Redjel Imrad collected by J. Follot show pitting on the internal moulds in a manner exactly comparable with the Cornish specimens. In no case is there any trace of the original shell. A single specimen from the Erg el Djemel (Ougarta) from the 'niveau à Pinacites jugleri' shows the pitting in a remarkable way (pl. 11, fig. 4). The specimen is unfortunately not even generically determinable, it might be a ? Foordites.

B. INTERPRETATION

(i) Interpretation of the Pit Rows. The growth lines of Sobolewia do not accord with the pit rows. Even when allowance is made that the pit rows may have formed some while after the growth lines and farther into the body chamber it remains true that the ventral sinus of the growth lines is much wider than the course followed by the pits : also the growth lines slope consistently backward from the umbilicus (pl.11, fig.2) whereas the pit rows either slope forward from the umbilicus or are radial in this region (text fig.32).

However, for Sobolewia there is evidence suggesting a structure in the shell which does agree with the pit rows. The genoholotype, S. cancellata, figured by d'Archaic and de Verneuil, showed on the surface an ornament which was described as follows. "From the central depression [umbilicus] radiate numerous striae, which are very fine, at unequal distances, and often bifurcated. They are directed forward near to the middle of the side, and then turn backward to form a broad and shallow sinus whose concavity is directed forward. At about two thirds of the side, where the inflexion of these striae commences, other striae, more delicate, but still regular and transverse, cross them obliquely forming a slight undulation, thus producing an elegant chequer-work over the entire dorsal [ventral] region of the shell" (d'Archaic and de Verneuil 1842, p.339). It would appear that the second type of striae represent the growth lines, and these agree with the Cornish specimens in their course over the venter. The coarser striae must then represent the course of the wrinkle layer lirae. The genoholograph shows both types of striae over most of the last whorl which is probably body chamber.

The periodic arrangement of the pit rows and their agreement in separation with the septae strongly suggest that the visceral mass moved forward in periodic jerks : after each forward movement, the septae, and in this case the structures which subsequently formed the pits, were formed.

(ii) Interpretation of the Pits. From the foregoing description and discussion the following deductions on the origin of the pits in Sobolewia and ? Foordites may be made.

a. The pits are the moulds of mounds which were developed on the inner surface of the shell with the outer surface of the shell unaffected.

b. The mounds were probably solid since the mural portions of septae reflect their shape and pyrites subsequently formed around them.

c. The mounds were formed in the body chamber and near to the aperture, but were not formed along the growth margin of the ostracum.

d. The mounds were formed periodically after forward movement of the visceral mass.

The several possible causes for the mounds will be discussed, for convenience, under four heads.

1. Pits formed subsequent to fossilisation.

The possibility that the pits are post fossilisation features is clearly ruled out in the case of Sobolewia by their relation to the shell and the mural portions of the septae : these show that the pits were formed during life. There is therefore no comparison with the pitting which has been described, for example, on the surface of the holotype of Perisphinctes (? P.) listeri (de Haan) from the Corallian Beds of Nunnington, Yorkshire which Dr. Vernon Wilson has suggested may be due to the subsequent action of rootlets and humic acid (in Arkell 1950, p.265). The Cornish specimens have been extracted from freshly eroded and unweathered intractable slate.

2. Functional mounds.

The evidence appears to tell against an advantageous purpose for the mounds such as, for example, the attachment of small muscles. The fact that all specimens of Sobolewia do not show the pits, and their lack of precise agreement between the successive rows is difficult to reconcile with such a view. On the other hand, if the interpretation given below on the relation of the soft parts to the shell in Sobolewia is true then increased shell formation along the anterior limit of soft part attachment could explain 'false' constrictions which are not visible on the outside of the shell and may bear little relation to the growth lines, Among Devonian genera Cheiloceras and Wedekindella commonly show constrictions of this type. The pit-like depressions on the lateral areas associated with such constrictions in Dunbarites rectilateralis (Miller, well figured in Miller and Furnish 1940, p.532, pl.63, fig. 1,4) may be formed in such a manner, but these are not directly comparable with the pits on the Middle Devonian specimens.

3. Alien organic growths.

Internal, discrete, alien organic growths might be expected to leave trace of a distinct boundary on the internal mould. This is not seen on the specimens described and in all cases the pits are in smooth continuity with the surrounding areas. The pits on the body chamber of Manticoceras oxy Clarke, figured by Miller (1938 pl.16) formed by orbiculoideans growing on the internal surface of the body chamber show a distinct boundary as would be expected from organic growths.

Borings through the shell from the outside by various organisms are common among recent Mollusca and may give rise to internal mounds. Dr F. Hodson informs me (in litt.) that borings are not uncommon on the shells of Namurian goniatites and they are well shown on the holotype of Hibernicoceras posthibernicus Hodson and Moore (1958 pl.4, fig.1). This cannot be the explanation in the case of Sobolewia because the shell above the pits is undisturbed. Whilst no trace of the shell is visible on the specimen of

? <u>Foordites</u>, the arrangement of the pits into periodic rows could only be interpreted as due to borings if some soft part structure extended fully one whorl beyond the aperture of the body chamber which is itself at least one whorl in length : it seems most unlikely that this could have been the case.

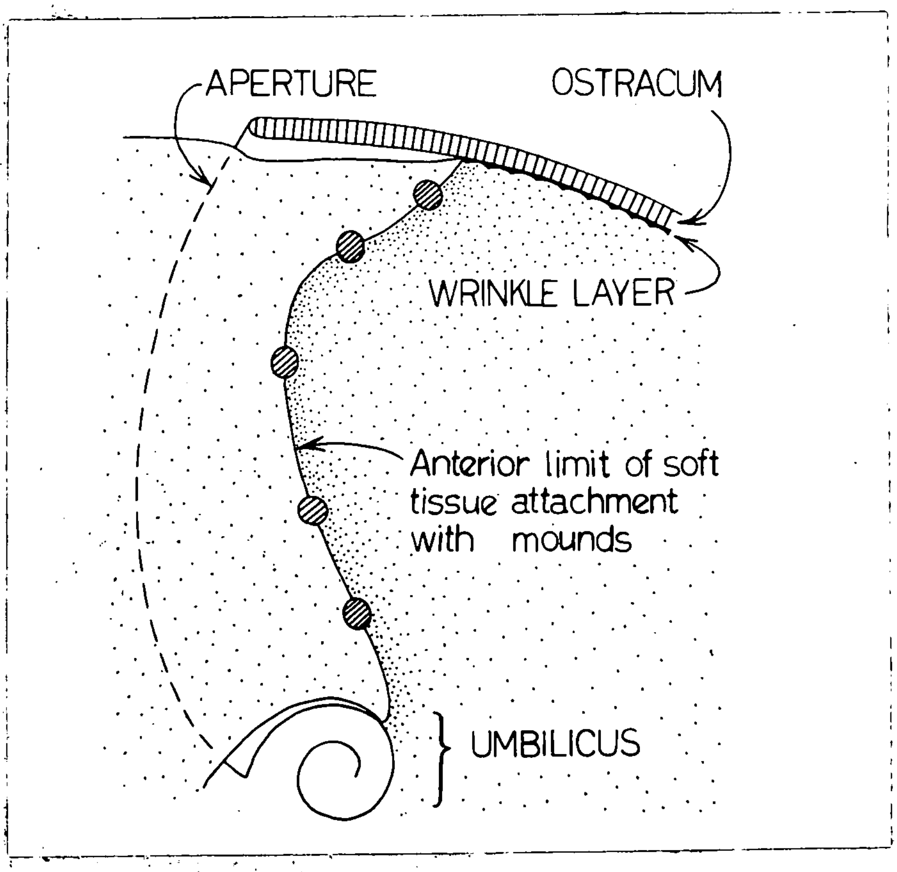
4. Localised shell thickenings.

The continuity between the pits and adjacent areas suggests that the mounds were tumerous accretions of actual shell material which formed after each advance of the body. Such tumerous growths might be due either to organic infection or might be inorganically caused by mechanical irritation leading to increased precipitation. In either case the resulting structures could be termed pathalogical (Moodie 1923, p.29). Were organic infection the cause it is surprising that the pits are so regular for, at times, the infection might be expected to seriously disrupt the soft parts. A mechanically caused irritation seems a more likely solution. Small particles, perhaps of small organisms, could conceivably enter between the shell and the body leading to structures analogous with pearl mounds in present day lamellibranchs. Since the exact cause of natural pearl mounds has been so disputed in modern Mollusca, attempts to deduce it for Devonian specimens are unlikely to be profitable. It should be noted that the small particles seen within the pits on ? <u>Foordites</u> (pl.11, fig.4) are probably due to subsequent limonitic concretion. Magraw (1956) has recently suggested that foreign particles might explain abnormal developments in <u>Gastrioceras</u>.

C. INFERENCES CONCERNING THE FORM OF THE SOFT PARTS

In the living <u>Nautilus</u> fine calcareous or conchiolin lirae are developed in the posterior part of the body chamber for the attachment of the ligament and muscles. These lirae are formed parallel with, and posterior to, the annulus. Lirae formed after subsequent forward movement of the visceral mass may show unconformable relations with earlier formed lirae. In <u>Nautilus</u> these lirae may, or may not, be well developed but they appear to form the means by which the body is attached (Owen 1832, Griffen 1900). That connection between the body and the shell in Nautilus is not considerable seems well attested by the interesting observations recorded by Smith (1887 p.226) and Dean (1901 p.832, see also the discussion in Foord 1888+, p.xi). As shown by Crick (1898) the annulus, when shown by ammonoids, is still in the posterior part of the body chamber as in the living Nautilus. The fact that the pits may cover a whole body chamber, as in the case of ? Foordites makes it seem unlikely that the soft part attachment area in the Devonian forms under discussion is comparable with the ligament and muscle attachment area of Nautilus.

The evidence indicating a relation between the mounds and the wrinkle layer in Sobolewia shows that the anterior limit of that layer has some significance in soft part anatomy. Whether the mounds are due to organic growths or to localised non-functional thickenings it seems reasonable to infer that the soft parts were



Text fig.33. Diagram showing the supposed relations between the mounds in Sobolewia to the ostracum and wrinkle layer according to the interpretation favoured.

+ Catalogue of Fossil Cephalopoda, B.M. (N.H.), Part 1.

firmly attached along the anterior linit of the wrinkle layer. Then, ex hypothesi, the line of mounds in Soboleia would correspond both to the posterior limit to which foreign particles, whether organic or inorganic, would be able to penetrate, and also that line would be one along which shell-secreting cells would be well developed (text fig. 33). If this is so then the situation would be directly comparable with that among lamellibranchs where the outer and inner portions of the mantle fold may secrete different parts of the shell.

Whatever interpretation of these abnormal growths is favoured it is peculiar that only some members of S. nuciformis in the Upper Givetian appear to have been affected and that some members of the same species living 1,200 miles away were similarly afflicted whilst other genera, apparently living side-by-side, were unaffected.

Specimens, Horizon and Localities

Devon specimens come from the Molarium Zone at Wolborough Quarry, Newton Abbot. The following syntypes were mentioned by Whidborne : Vicary Collection 7 specimens, now BM.c9023-9029 : Torquay Museum 2 specimens : Geological Survey 2 specimens, now GS.95336 and 95428. British Museum 1 specimen, BM.36624 (mentioned Foord and Crick 1897, p.49) : Champernowne Collection 1 specimen, now BM.c15476, here referred to S. cf. cancellata.

Cornish specimens come from the calcareous grey slate of the Terebratum Zone at Pentonwarra Point. Trevone, and Portquin. From Trevone there are the following, D.809, 814, 819, 829, 832, 845, 854, 861, 868, 872, 882, 892, 896, 897, 898. From Portquin only D.731.

2. Sobolewia cf. cancellata (d'Archaic and de Verneuil)

Plate 22, figs. 1 and 2.

1890 Goniatites nuciformis (pars) G.F. Whidborne 1890, p.77.

Only one specimen from Wolborough, a Sobolewia, resembles the genoholograph in being rather compressed and showing evidence of a closed umbilicus. It was described by Whidborne among the syntypes of S. nuciformis.

Description

Dimensions	D	WW	WH	Wh
BM.c15476	14.6	c.8.4	8.5	3.1

The specimen shows no sign of ornament and is preserved as an internal mould in coarse crystalline limestone.

Shell form involute, periphery well rounded, with umbilicus apparently closed. Specimen septate up to the last half whorl. Traces of the sutures indicate a small ventral lobe and a broad and flat, only slightly concave Lateral lobe. Growth lines not seen.

Remarks

The holotype comes from the Iron Mines of Brilon where it was stated by d'Archaic and de Verneuil to be "very rare". Search has been made for the figured specimen in the collections at the l'Ecole des Mines, where several types of these authors reside, but it was not located.

The shell form of the holotype was described as follows : "Shell globular, with rounded, inflated volutions, the last completely enveloping all the others ; umbilicus none, its corresponding place being occupied by a slight depression of the inner edge. Back simple, rounded, coalescing with the sides by a continuous curve."

The closed, concave umbilical area of this species serves to distinguish it from all other representatives of the genus. This species is one which apparently possesses concave growth lines up to the maximum diameter known.

Specimen, Horizon and Locality

One specimen only from the Molarium Zone at Wolborough Quarry, Newton Abbot, South Devon. BM.c15476, one of the syntypes of S. nuciformis.

Superfamily PHARCICERATACEAE Hyatt 1900
Family GEPHUROCERATIDAE Frech 1901

Genus PONTICERAS Matern 1929

Type species : *Ammonites aequabilis* Beyrich 1837.

Diagnosis : Ammonoids with ventral siphuncle, shell sub-involute to evolute, rotund to discoidal. Umbilicus imperforate. Growth lines biconvex. Suture with ventral saddle appearing within large ventral lobe during ontogeny, arched ventrö-lateral saddle, rounded sub-umbilical lobe, no umbilical lobes and a single median dorsal lobe.

Remarks : Wedekind (1913, 1917) standardised the use of *Gephyroceras* for manticoceratids with none and *Manticoceras* for manticeratids with one umbilical lobe. But the genotypes of both have one umbilical lobe. This led Matern (1929 p.151) to propose *Ponticeras* to replace *Gephyroceras* (= *Gephuroceras*). Matern gave a discussion of the matter as have Miller (1938 p.70) and Glenister (1958 p.63). Glenister gives a full discussion of the relation between *Ponticeras* and *Probeloceras*.

1. *Ponticeras forcipiferum* (G. & F. Sandberger)

Plate 12, figs. 8 and 9.

1850 *Goniatites forcipifer* G. & F. Sandberger 1850, p.81, pl.6, figs.3a-c.
1884 *Gephuroceras forcipifer* A. Hyatt 1884, p.317.
+1897 *Gephyroceras forcipifer* A.H. Foord and G.C. Crick 1897, p.61, text fig. 24.
1913 *Gephyroceras forcipiferum* R. Wedekind 1913, p.51.
1913 *Gephyroceras forcipiferum* F. Frech 1913, p.21.
1917 *Gephyroceras forcipiferum* R. Wedekind 1917, p.122 text fig. 28f.

Only one specimen of this species is known from England. It was collected by Dr. G.V. Middleton near Staverton, Devon.

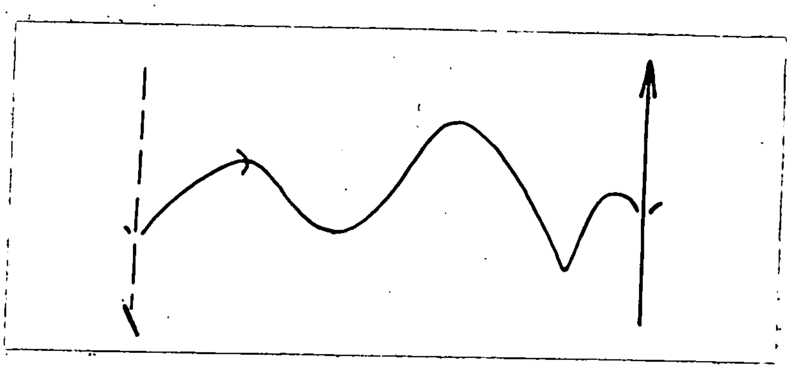
Description

Dimensions	D	WH	Wh	WW	UW
GS.95229	c.14.0	5.7	4.2	3.9	-
	c.8.5	c.3.0	-	2.5	-

The specimen shows the camerae displaced so the figures above are approximate. The last one third whorl is body chamber.

Shell form sub-evolute, discoidal. Whorl section with flat ventral band (1.9mm wide at 14.0mm diameter) curving sharply over to the flanks which slope gently and convexly out to a maximum width close to the umbilical shoulder which is well rounded.

Growth lines and wrinkle layer cannot be traced. The suture forms a large median saddle in the ventral lobe which is rather wider than the ventral band and reaches 50% of the height of the assymetric ventro-lateral saddle (text fig. 34). The Lateral lobe is rounded and passes to a saddle which centres on the umbilical seam. The dorsal suture is a very broad and wide V-shape. There are 19 septae in the last half whorl and they show orad approximation.



Text fig. 34. Ponticeras forcipiferum (G. & F. Sandberger). Suture based on GS.95229 from a quarry NW of St. John Baptist Chapel, Staverton Wood, South Devon collected by Dr. G.V. Middleton. X 12½.

Remarks

This species is very close to P. planorbis but at comparable diameters it is less evolute and wider. Both species are distinguished from other members of the genus in having tabular venters and a very compressed form. Until a lectotype is designated there will be the possibility of interpreting this species widely since among the syntypes there is another genus (G. & F. Sandberger 1850, pl.9, figs. 3g,f, a Koenenites) and another species (pl.9, fig. 3c, a P. cf. tschernyschewi). The most satisfactory to select as lectotype is the specimen figured on plate 9, figure 3e and d. Wedekind based his division between the species P. forcipiferum and P. planorbis on the width of the umbilicus (Wedekind 1917, p.122) but he introduced a confusion in that his text figure, labelled Gephyroceras forcipiferum, is referred to in the text as G. planorbis , but comparison with the Sandberger's figures shows that the error is in the text.

Specimen, Horizon and Locality

One specimen only, GS.95229, from a quarry NW. of St. John Baptist Chapel, Staverton Wood, South Devon. In Germany, according to Matern (1929 p.150) the species occurs in the Frasnian Cordatum Zone and the Lunulicosta Zone. It is commonest in the latter. At Staverton it was associated with Koenenites which is a Lunulicosta Zone genus.

2. Ponticeras aff. gerolsteinense (Steininger)

Plate 12, figs. 2 and 3.

This goniatite is characteristic of the Frasnian slate near the south-eastern corner of St. George's Cove, Padstow.

Description

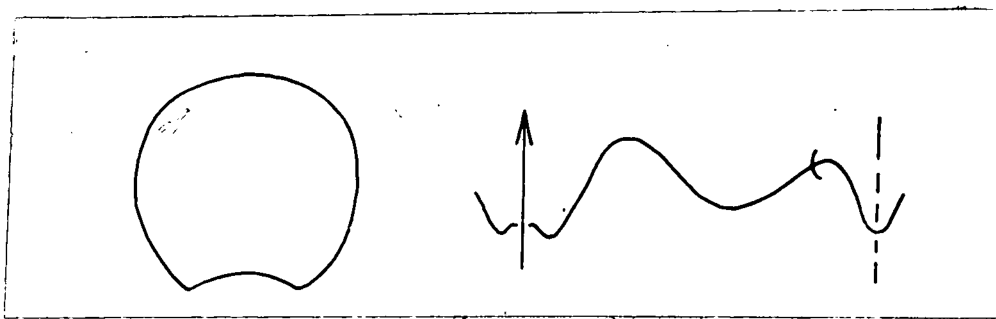
Dimensions	D	WH	WW	UW
D.621, B(i)	c.9.0	3.0	c.3.3	c.4.7
D.623, B(i)	c.13.0	-	-	c.6.0
D.653, B(ii)	c.11.5	c.3.2	c.3.4	c.5.9

The sixteen available specimens are mostly badly sheared and are preserved as internal moulds of partly oxidised pyrites with no trace of the original shell.

Shell form evolute, sub-serpenticonic, compressed. Whorl section with rather rounded- quadrilateral form (text fig. 35) and only slight impressed area. In early whorls, before 5mm diameter, the venter is flatter and broader than in the adult and the lateral areas slope inwards towards the umbilicus. At medium diameters there are faint traces on the venter of shallow, paired furrows. By 14mm diameter the flanks have become sub-parallel and the section is compressed.

Growth lines have not been observed. Impressions of the wrinkle layer are seen to form irregular close-set striae on the internal mould which may slope slightly backward from the umbilicus to become nearly radial on the flanks (D.623) or may slope markedly backward across the flanks (D.1017).

Suture with median ventral saddle within the V-shaped ventral lobe rarely reaching 15% of the height of the well-rounded ventro-lateral saddle. The Lateral lobe is broad and well-rounded, somewhat variable in depth, usually shallow. The umbilical seam usually lies just outside of the rounded umbilical saddle. Median dorsal lobe deep and V-shaped (text fig. 35).



Text fig. 35. Ponticeras aff. gerolsteinense (Steininger). Diagram of whorl section and suture at 7.5mm diameter based on D.621 from locality B(i) south-east of St. George's Cove, Padstow, North Cornwall. Frasnian.

Remarks

The better preserved of the specimens show quite close agreement in shell form with Steininger's rather poor figures. Comparison of them with the dozen topotypes collected by the writer from Büdesheim show that in the German forms the ventral lobe is narrower and deeper and the mid-ventral saddle at times scarcely visible : also the early whorls are slightly more compressed and serpenticonic as the following dimensions of two Büdesheim specimens show :

	D	WH	WW	UW
D.1058	8.3	2.3	2.7	4.3
D.1259	4.8	-	2.0	-

There is a tendency for the German specimens to show slight paired furrows on the venter as seen on some Cornish specimens (especially D.621).

It is apparent from Steininger's figures that the adult whorls increase rather rapidly in size and some specimens from St. Georges Cove show indications of this.

Anniss (1927 p.496, 1933 p.437) has recorded this species from both Saltern Cove and Chudleigh. An examination of his specimens shows that the Saltern Cove specimens belong either to Archoceras or are indeterminable and the specimen from Chudleigh is a Manticoceras cf. cordatum.

Specimens, Locality and Horizon.

All English specimens are from near St. George's Cove and from the following localities : A(i), D.1015, 1016, 1017, 1018, 1021 ; A(ii), D.1019, 1020 ; B(i). D.621, ? 622, 623, 625, 626 ; B(ii), D.653, 654, 655, 656. Steininger's holotype came from the Cordatum Zone, Frasnian, and these specimens may belong there or at the base of the Holzapfeli Zone.

3. Ponticeras prumiense (Steininger)

Plate 12, figs. 1, 5, 6 and 7

1853 Goniatites prumiensis J. Steininger 1853, p.43, pl. 1, fig. 5,5a.

1913 Manticoceras prumiense F. Frech 1913, p.22.
1917 ? = Manticoceras Koeneni R. Wedekind 1917, p.126.

In England this species has only been found in some of the Frasnian goniatite bands of the Padstow Estuary.

Description

Dimensions	D	WH	Wh	WW	UW
D.695,J(i)	-	4.7	-	3.3	-
D.578,L(i)	8.8	3.4	c.3.0	3.0	c.3.2
D.1278, E	8.8	c.3.5	-	c.3.0	3.8

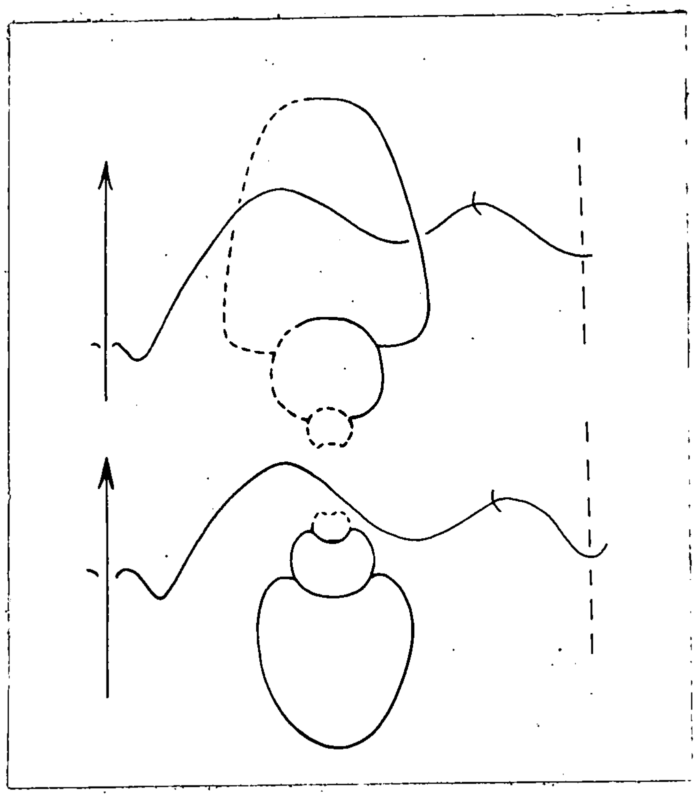
Shell form compressed, sub-evolute, with prominent ridges developing on the venter of the adult (above c.7mm diameter). Protoconch small, 0.4mm in breadth (D.695), early whorls serpenticonic with sub-circular cross section (text fig. 36). In adult, the flanks become flatter and only slightly contracting towards the venter ; the maximum whorl width at this stage is close to the umbilical shoulder. Ridges on the venter vary in frequency from 3 in 2.4mm at WH 4.7mm (D.695) to 3 in 3.1mm (D.569). The ridges only ocur over the venter and follow the course of the ventral sinus formed by the growth lines.

Growth lines are difficult to trace but apparently form a shallow sinus on the flanks and swing forward to a projecting rounded ventro-lateral salient and back to a linguiform ventral sinus. The wrinkle layer has not been seen.

The suture has a widely diverging ventral lobe with a median saddle within it scarcely reachin to 30% of the rounded ventro-lateral saddle at the largest diameters seen. Lateral lobe rounded and shallow. Umbilical seam centred slightly ventrad of the umbilical saddle in the adult. Adult median dorsal lobe deep and rounded (text fig. 36).

Remarks

This very distinctive species is on sutural evidence clearly referable to Ponticeras. The Cornish specimens agree



Text fig. 36. Ponticeras prumiense (Steininger). Whorl section and sutures based on D.648 from locality K, NE of Harbour Cove, Padstow. Above, suture at 3mm diameter, X 25. Below, suture at 7mm diameter, X 12½. Whorl section X 12½.

so well in shell form with Steininger's figures that this generic assignment is considered to be correct despite Wedekind's reference of the species to Manticoceras , in support of which he gave no evidence. Although the type locality is Büdesheim it must be very rare there since few authors have subsequently referred to it and no specimens were found among the many hundred goniatites collected at the Büdesheim locality by the writer. It is distinguished from Manticoceras serratum not only by the suture but also by the ventral ridges which are less sharply bounded than those in that species (compare pl.12, fig.7 with pl.15, fig.2).

Specimens, Horizon and Localities

All English specimens are from the Frasnian of the Padstow Estuary. Specimens include ; from J(i), ? D.698, 695, ? 696; from E, ? D.1278 ; from K(i), D.648; from L(i), cf. D.564, ? 563, ? 574, 578, 569, 570. All localities are of Frasnian age and probably belong to the Cordatum Zone.

Genus MANTICOCERAS Hyatt 1884

Type species : Goniatites simulator Hall 1874.

Diagnosis : Ammonoids with ventral siphuncle, shell sub-involute to sub-evolute, usually rather compressed. Umbilicus imperforate. Venter rounded, angular, grooved or serrated. Growth lines biconvex. Suture with a ventral saddle appearing during ontogeny within a large ventral lobe. Ventro-lateral saddle arched, rounded or acute Lateral lobe, subumbilical in position. One umbilical lobe, usually dorsal to the seam ; median dorsal lobe.

Remarks : Hyatt established the genus Gephuroceras in 1884 (p.316) and ,on the next page, the genus Manticoceras (p.317) and he designated Goniatites sinuosus and Goniatites simulator as their respective type species. The two genotypes were re-examined by Miller who concluded that "the sutures of G. sinuosus are distinctly advanced over those of G. simulator, but the differences between the two are of specific and not of generic or even subgeneric value" (Miller 1938, p.72). However, Wedekind and Holzapfel established a European usage in which Manticoceras was used for manticoceratids with one and Gephyroceras (sic, a "correction" introduced by Hyatt 1885) with no umbilical lobes. Matern established Ponticeras for the latter which may be a junior synonym of Probeloceras which has identical sutural characteristics. Gephuroceras has page priority over Manticoceras and for that reason was preferred by the writer (House 1956, p.261). But since then Miller and Furnish have used Manticoceras for the group (in Moore Ed., 1957).

Details of the ontogeny of several species were given by Miller (1938) and Glenister (1958) has recently reviewed the history of these genera.

1. Manticoceras aff. calculiforme (Beyrich)

Plate 15, fig. 6.

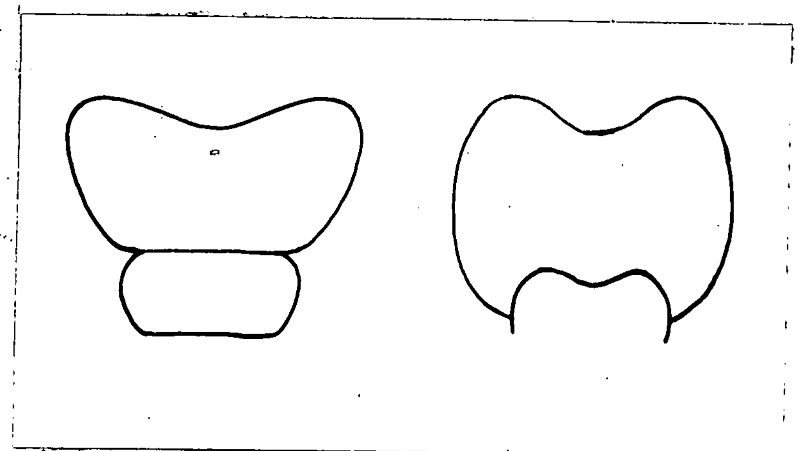
One specimen with the curious grooved venter of M. calculiforme has been collected by Mr. A. Pedder from Pentire Haven, North Cornwall.

Description (of SM.H 7364 = Pedder Collection, 102)

Dimensions	D	WW	WH	UW
	c.5.5	1.7	1.2	-
	2.7	1.1	0.7	c.1.5

Specimen fragmentary, preserved as an incomplete pyritic internal mould with no trace of the original shell. Sutures and growth lines not seen.

Shell form evolute, compressed, with wide open umbilicus. Venter with a deep and broad ventral groove (text fig. 37). Whorl section in early whorls, before 2mm diameter, depressed and subrectangular, perfectly flat dorsally and ventrally with short, rounded flanks. By 2.7mm diameter a deep groove has developed on the venter and the maximum whorl height and width is near the projecting ventro-lateral shoulder ; at this stage there is still no impressed area.



Text fig. 37. Left, Manticoceras aff. calculiforme (Beyrich), based on SM.H 7364 from Pentire Haven, North Cornwall, X 20. Right, Manticoceras calculiforme (Beyrich), based on Wedekind 1913, p.67, text fig. 12a1 from Martenberg, Germany.

Remarks

The only species with which this remarkable goniatite shows any resemblance is M. calculiforme, but that species has a maximum whorl width in the mid flanks whereas in the Cornish specimen it is at the projecting ventro-lateral shoulder (text fig. 37); also there is a deep impressed area in the true M. calculiforme which is lacking in the Cornish specimen. Since no other Devonian goniatite genus forms such a deep ventral groove the generic assignment is probably correct despite the absence of sutural evidence.

Specimen, Horizon and Locality

One specimen only, SM. H7364, collected by Mr. A. Pedder from a conglomerate at Pentire Haven, Padstow Estuary, North Cornwall. Horizon possibly Cordatum Zone, Frasnian, where the species with which it is compared occurs in Germany.

2. Manticoceras cordatum (G. & F. Sandberger)

Plate 13, figs. 1, 2, 3 and 7.

1851 Goniatites lamed var. cordatus G. & F. Sandberger 1851, p.90, pl.8, fig. 6,6a,b,d-g.

1897 Gephyroceras orbiculus A.H. Foord and G.C. Crick 1897, p.75.

1913 Manticoceras cordatum R. Wedekind 1913, p.57, pl.4, fig. 7, 8, pl.5, fig.7-11, pl.6, fig. 2, text fig. 8b1-2, 9b, 11a.

1917 Manticoceras cordatum R. Wedekind 1917, p.125, pl.22, fig. 10, text fig. 33b1,2.

non 1927 Manticoceras cordatum L.G. Anniss 1927, p.496.

+1931 Manticoceras cordatum Matern 1931, p.60.

+1956 Manticoceras cordatum K.J. Müller 1956, p.40, ? pl.1, fig,1, text fig. 5.

This is the zone fossil of the Middle Frasnian. In England it is not uncommon in the rocks of the Padstow Estuary, North Cornwall.

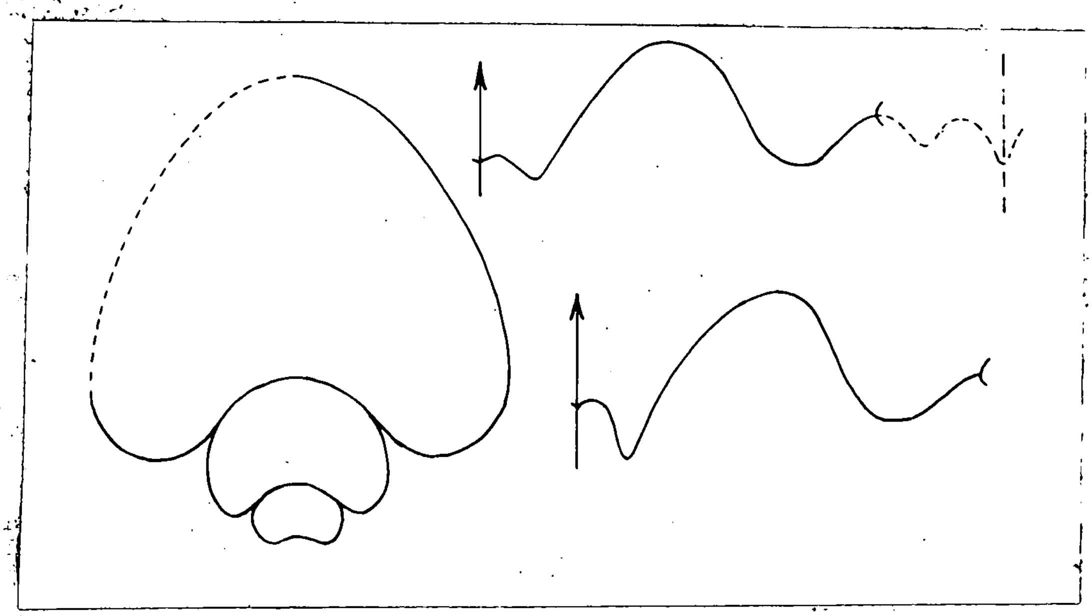
Description (the verbal description applies to specimens from the Padstow Estuary alone).

Dimensions	D	WH	Wh	WW	UW	WW/WH	WW/D
D.547, J(ii)	13.4	7.3	c.6.1	c.7.2	c.2.7	99	54
D.1022, J(ii)	c.15.3	-	-	c.7.4	-	-	49
D.616, J(ii)	9.0	c.4.5	-	4.1	-	91	46
D.619, J(ii)	8.5	-	-	4.2	-	-	48
D.552, J(ii)	5.5	2.8	-	2.8	1.7	100	56
Büdesheim topotypes :-							
D.1059	13.3	7.8	5.8	7.5	2.7	96	56
Sandberger's specimen, dimensions of lectotype of Wedekind 1913, p.58:							
	21.8	11.8	-	9.8	4.0	83	45

All the Cornish specimens are preserved as internal pyritic moulds and are commonly crushed and distorted.

Shell form sub-evolute in early stages, sub-involute in adult. Outline ovoid, slightly laterally compressed. Whorl section in adult with broad, well-rounded venter, with flanks diverging to a maximum width close to the umbilicus. Some specimens are more rotund in cross section than others (e.g. text fig. 38). Umbilical shoulder rounded, wall steep and incurved. Body chamber at least half a whorl in length. Some specimens show very slight traces of a ventro-lateral furrow in their early whorls.

Growth lines are not prominent. They form a slight salient on the umbilical shoulder, a shallow lateral sinus, a projecting ventro-lateral salient and a linguiform rounded sinus on the venter. Growth lines in the early whorls are in some cases prominent and give a ribbed appearance. The wrinkle layer is well shown in most specimens and forms on the internal moulds fine, close-set striae which pass irregularly and radially across the umbilical wall and pass gently back across the lateral areas becoming su-radial again across the venter. They number 8 per 0.4mm on the mid flanks and the frequency is the same at all diameters.



Text fig. 38. Manticoceras cordatum (G. & F. Sandberger). Left, whorl section at 14mm based on D.604 from locality J(i), Harbour Cove, Padstow, X 8. Top right, suture at 6mm diameter based on D.550 from locality J(ii), Harbour Cove, X 16. Bottom right, suture at 11mm diameter based on D.547 from locality J(ii), Harbour Cove, X 8. All from Cordatum Zone, Frasnian.

Suture with large V-shaped ventral lobe with a median saddle developing within it and reaching to 33% of the rounded ventro-lateral saddle by a diameter of 12mm. Ventro-lateral saddle assymetric, with a steep dorsal slope. Lateral lobe subumbilical in position, rounded. Umbilical saddle centred on the seam. Sub-umbilical lobe and median lobe on dorsal suture (text fig. 38).

Comparison

As the Cornish specimens are small they can be compared directly with Büdesheim topotypes (the lectotype, however, comes from Oberscheld). Agreement is very close, in shell form as in suture and wrinkle layer pattern. The frequency of the wrinkle layer striae is exactly the same as the Cornish specimens.

Remarks

There has been a little confusion over this common species. The Sandberger brothers (1851 p.90) named the following as varieties of their Goniatites lamed : rugosus, complanatus, cordatus, tripartitus, latidorsalis and calculiformis (Beyrich). Wedekind

(1913 p.52), who had the Sandberger's specimens before him as he wrote, considered that one specimen among the figured syntypes of var. cordatus (G. & F. Sandberger 1851, pl.8, fig.6c) was in fact the ventral view of a specimen figured among the syntypes of var. complanatus (pl.8, fig.5 only). He refigured that specimen as M. cordatum (Wedekind 1913, pl.6, fig.2 ; on the plate description he erroneously gave the plate number of Sandberger's figure as 7). With this interpretation he standardised the name M. cordatum and showed that it was characteristic of the Middle Frasnian. Later (1917), he used this species to typify his Group 3 of the manticoceratids, defining the group as follows, "Shell uniform, narrow umbilicate and deeply sunk. Flanks very flattened and incline towards each other", in the definition of the species he added, "outer side [ventral] rounded, form stout" (Wedekind 1917, p.125).

A.K. Miller in 1932 (p.331), apparently unaware of this history, proposed the name Manticoceras lamed Miller to replace Goniatites lamed var. complanatus and included among the types of the 'new' species the figure shown by Wedekind to be a M. cordatum. If that figure be excluded M. lamed becomes a name which can be applied to manticoceratids similar to, but more compressed than, M. cordatum.

Specimens, Horizon and Localities

All specimens referable without question to this species come from the Padstow Estuary. They include the following : from D(i), D.1022, 1023, 1024, 1025, 1029, 1034, 1266, 1271, 658; from E, D.1282, 1286, ? 1287; from F(i), D.686, ? 684; from J(i), D.604, 596, 999; from J(ii), D.550, 552, 615, 549, 547, 555, 616, 619; from J(iii), D.689.; from K, ? D.649; from L(i), D.556. All these are thought to belong to the Cordatum Zone of the Frasnian. In Germany this species has been recorded from the Holzapfeli Zone (Müller 1956, p.41) but the species is commonest in the Cordatum Zone of Germany and in Cornwall the genera Archoceras and Crickites, commonest in the Holzapfeli Zone, are not found at the localities yielding M. cordatum.

3. Manticoceras cf. cordatum (G. & F. Sandberger)

Plate 13, figs. 5 and 6.

Most manticoceratids from Lower Dunscombe, Chudleigh, are comparable with this species but are usually too poorly preserved for certain determination.

Description

Dimensions	D	WH	Wh	WW	UW
D.107	c.58.0	c.31.0	-	24.0	10.0
D.101	25.0	13.8	c.9.2	11.2	c.4.0

Shell form sub-involute, laterally compressed with open umbilicus. Whorl section with flatly rounded venter and rounded ventro-lateral shoulder passing to rather flat flanks which diverge to a maximum width close to the rounded umbilical shoulder. Umbilical wall vertical. Body chamber at least 3/4 whorls in length. Growth lines not seen.

Suture forms a median saddle reaching over 50% of the height of the laterally placed saddle by 35mm diameter. Lateral saddle only slightly assymetric, steeper dorsal slope. Latero-umbilical lobe pointed. Dorsal suture not seen.

Remarks

There are several hundred specimens in the British Museum, Sedgwick Museum and Torquay Museum which are possibly referable to this species, but most are badly distorted and the whorl form cannot be determined. None appear to show signs of the growth lines or wrinkle layer so that although the better preserved specimens can be directly compared with specimens of M. cordatum from the limestone facies of Germany (Wedekind 1913, pl.4, figs.7 & 8) they cannot be compared satisfactorally with the small syntypes.

As has already been pointed out, the specimens figured by Anniss (1933, pl.41) as Gephyroceras pernai and Gephyroceras gerolsteinense belong here.

Specimens, Horizon and Locality

The many specimens from Lower Dunscombe include, two specimens in the collection of Mr. L.G. Anniss (nos. 2 and 12), the following collected by the writer, D.101, 105, 107, ? 104, and others in the British Museum and Sedgwick Museum. The specimen figured by Shannon (1921 pl.1, fig.2) as Tornoceras hughesii from Ransley Quarry, South Devon belongs here (GS. 88673).

4. Manticoceras lamed (G. & F. Sandberger)

Plate 13, fig. 8. cf. fig. 4.

1850 Goniatites lamed var. complanatus G. & F. Sandberger 1850 (pars), p.90, pl.8, figs. 5b,c,d (only).

+1897 Gephyroceras complanatum (pars) A.H. Foord and G.C. Crick 1897, p.72.

1932 Manticoceras lamed (pars) A.K. Miller 1932, p.231.

Goniatites near to M. cordatum, but more compressed, are not uncommon in the Frasnian rocks of the Padstow Estuary.

Description

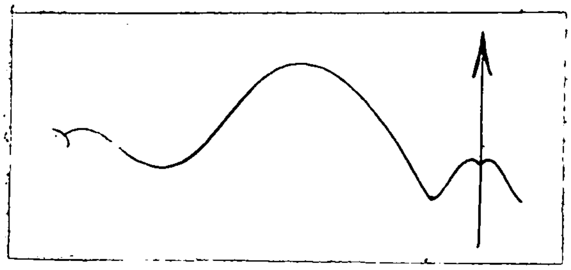
Dimensions	D	WH	WW	UW	WW/D	WW/WH
D.617, J(ii)	13.5	7.4	5.9	2.4	44	80
D.1284, E	8.3	3.4	3.4	-	42	100
D.613, J(ii)	c.9.3	4.6	3.8	-	41	83
D.1027, D(i)	11.8	6.2	5.0	c.2.1	41	81
D.1267, D(i)	c.10.5	c.5.3	c.4.6	c.1.9	c.44	-

All specimens are preserved as internal moulds with no trace of the original shell.

Shell form sub-involute to involute, laterally compressed, open umbilicus. Whorl section in early stages rotund with maximum width at the mid flanks. At larger diameters maximum width is nearer to the umbilical shoulder and the flanks slope convexly towards the broad, rounded venter. Body chamber at least one half whorl in length.

Growth lines not prominent, forming a shallow lateral sinus and swinging gradually forward across the outer flanks to form a prominent ventro-lateral salient and then back to a U-shaped ventral sinus. Wrinkle layer striae seen on the mould number about 5 per 0.4mm on the mid flanks at 14mm diameter. They pass slightly backward across the flanks, but convexly, and become sub-radial over the venter.

Suture forms a small median ventral saddle only slightly disrupted by the siphuncle. Ventral lobe widely diverging and passing to an almost symmetrical lateral saddle the crest of which is usually rounded but may be sharply rounded (D.1027). The latero-umbilical lobe is rounded and rather deep. Umbilical saddle centres just outside the seam (text fig. 39). Dorsal suture seen in juvenile to possess sub-umbilical and median lobes.



Text fig. 39. Manticoceras lamed (G. & F. Sandberger). Suture based on D.617 from locality J(ii) at Harbour Cove, Padstow, at 8mm diameter, X 10. Frasnian, Cordatum Zone.

Remarks

This species may be distinguished from M. cordatum by the more compressed form. The WW/D ratio is below 45% in M. lamed and above 45% in M. cordatum. In all other features there is quite close agreement, especially in the nature of the wrinkle layer. Indeed, this species may be the dimorphic equivalent of M. cordatum and slight difference in whorl width is one of the factors distinguishing the sexes in Nautilus pompilius. At Büdesheim even more compressed representatives of this group occur.

Specimens, Horizon and Locality.

All the English specimens are from the Padstow Estuary. They include ; from E, D.1284 ; from D(i), D.1027, 1267, 1269, 1272, ? 1033, 1031 ; from J(ii), D.613, 619, 617, ? 612, 614 ; from F(i), D.683 ; from M(ii), D.992 ; from L(i), D.571, 566. They occur with M. cordatum and belong to the Cordatum Zone, Frasnian.

5. <u>Manticoceras</u> aff. <u>serratum</u> (Steininger)

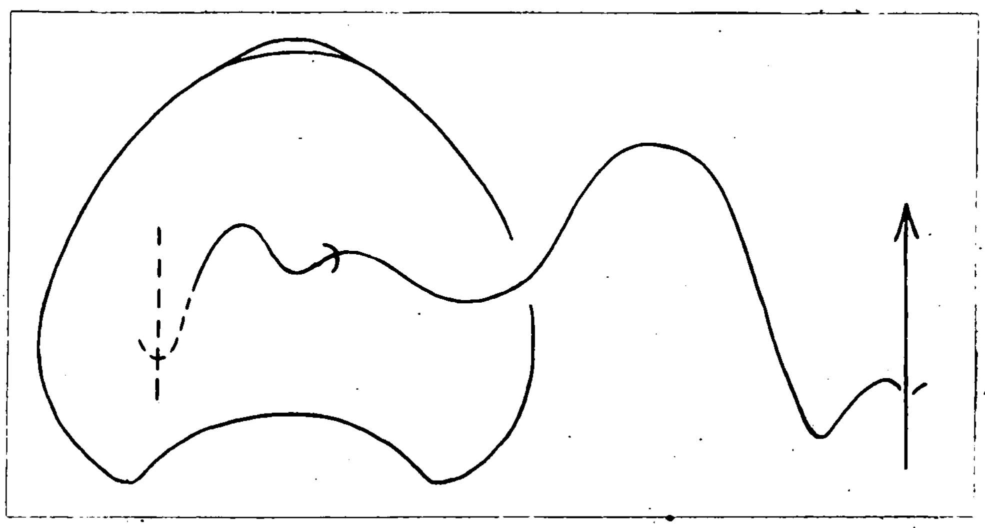
Plate 15, figs. 3, 9 and 10.

Specimens comparable with, but distinct from, <u>M</u>. <u>serratum</u> occur in England at Saltern Cove, Devon.

<u>Description</u>

Dimensions	D	WW	WH	UW
D.313	5.2	c.2.5	c.210	c.2.L
BM.c18433	10.7	c.3.2	c.5.0	2.8
(Measurements of topotypes from Büdesheim :-				
D. 1056	5.7	2.1	2.6	1.8
D. 1300	9.4	3.1	c.4.1	c.2.4

Shell form sub-involute, laterally compressed, with open umbilicus and serrated venter. Whorl section in juvenile rotund with slight impressed area (text fig. 40). Ventral serrations (D.312) number 19 per whorl at 5.2mm diameter but reduce in prominence in outer whorls and may disappear in the adult (BM.c18433).



Text fig. 40. <u>Manticoceras</u> aff. <u>serratum</u> (Steininger). Whorl section and suture based on D.312 from the southern part of Waterside Cove, Saltern Cove, South Devon, X 25. Holzapfeli Zone, Frasnian.

Growth lines biconvex, with shallow lateral sinus and prominent projecting and rounded ventro-lateral salient which passes back to a sinus over the venter with which the serration grooves are coincident. Wrinkle layer striae pass radially across the flanks and venter and number 6 to 7 in 0.4mm in the mid flanks at 5mm diameter (BM.c18433).

The median ventral saddle reaches 30% of the rounded assymetric ventro-lateral saddle by 7mm diameter and the steep slope of the ventro-lateral saddle passes to a well rounded Lateral lobe (text fig. 40). Dorsal suture with rounded sub-umbilical and median lobes.

Remarks

The holograph illustrates well the shell form of Büdesheim topotypes (two are illustrated here, pl.15, figs. 1 to 3) but the suture is obviously poorly drawn. Devon specimens differ from topotypes in several respects. One specimen (D.312) has a more rotund whorl section at comparable diameters and another (BM.c18433) shows a gradual decrease in the strength of the ventral serrations and their final loss. Büdesheim specimens show, in the adult, a rather tabular venter with the edges of the serrations well defined, especially orad, a feature well illustrated by the Sandberger brothers (1851, pl.9, fig.8). There is no sign of a tabular venter forming in the Devon specimens and the actual serrations are not as broad, nor as clearly limited, as in the topotypes.

Specimens, Horizon and Locality

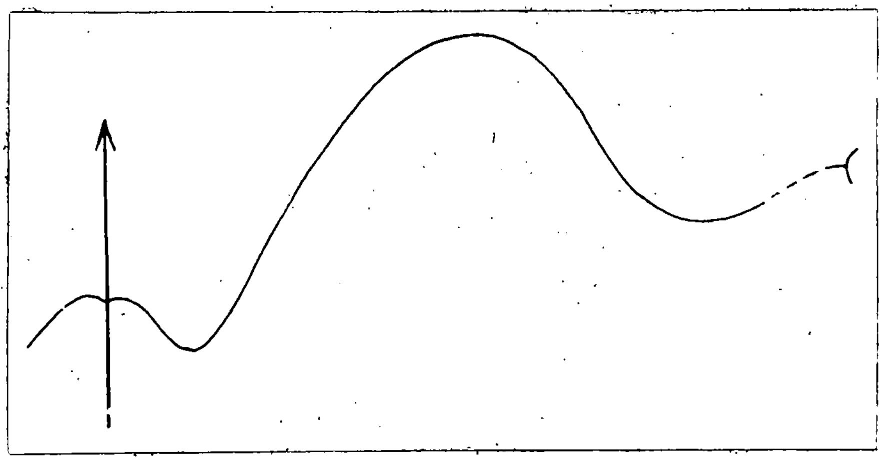
In England only occuring at Saltern Cove. Represented by BM.c18433 (mentioned Anniss 1927, p.496 as *M. serratum*), and D.312. Both from the Holzapfeli Zone, Frasnian.

6. *Manticoceras* cf. *affine* (Steininger)

Specimens referable to this species occur rarely in the Frasnian rocks of the Padstow Estuary.

Description (of D.554, J(ii))

Shell form sub-involute (WW=5.0mm when WH=3.5mm), depressed, with maximum width close to the well rounded umbilical wall. Flanks converge to a very broad, well rounded venter. Impressed depth c.20%.



Text fig. 41. Manticoceras cf. affine (Steininger). Suture at whorl height of 5mm, based on D.554 from locality J(ii), Harbour Cove, Padstow. X 20. Frasnian Cordatum Zone.

Suture (text fig. 41) with widely diverging ventral lobe with a small mid-ventral saddle within it. Crest of lateral saddle broadly rounded. Rounded umbilico-lateral lobe. Dorsal suture with evidence of sub-umbilical and median lobes.

Growth lines not traced. Wrinkle layer with close-set striae numbering 6 to 7 in 0.2mm at a whorl height of 3.8mm.

Remarks

Topotypes show the same close-set striae which characterise the wrinkle layer of the Cornish specimens, and the agreement in shell form is very close. This species was recorded by Anniss at Saltern Cove, but it has not been possible to confirm that determination. Foord and Crick (1897 p.84) also recorded it from Saltern Cove, but their specimens (BM.c1753b,c, c1960, c1961, c1961a, c1967a) are too small for determination and none show the characteristic wrinkle layer.

Specimens, Horizon and Locality

Occuring in the Padstow Estuary at locality J(ii), D.554, possibly J(iv), D.1003, more improbably K(i), D.1299. All supposed to be at the Cordatum Zone horizon on the basis of associated fauna. According to Matern (1929, p. 150) limited to the Cordatum Zone on the continent although recorded from the "Obere Manticoceras-stufe" of Bredelar by Wedekind (1917, pl.22, fig.12).

7. Manticoceras sp. nov.

Plate 15, figures 7 and 8.

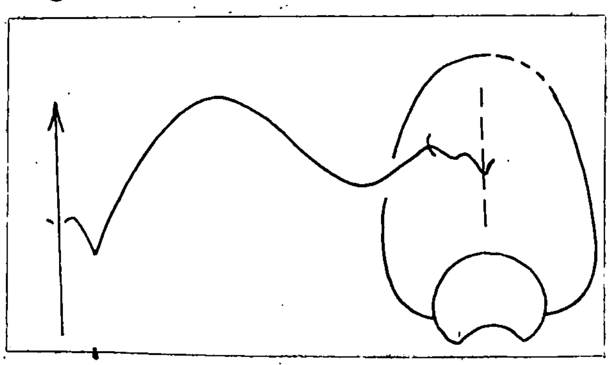
Certain specimens from the Padstow Estuary have a shell form like Ponticeras pernai but the suture of a Manticoceras.

Description

Dimensions	D	WH	WW	UW
D.669, D(ii)	10.2	4.5	3.5	2.9
D.664, D(ii)	8.4	3.4	2.8	c.2.2

All specimens are preserved as internal pyritic moulds with no trace of the original shell.

Shell form sub-evolute, compressed, with all whorls visible. Whorl section sub-circular below 4mm diameter, subsequently becoming more compressed with flanks sloping slightly to the rounded, slightly flattened venter (text fig. 42). Body chamber at least one third whorl in length.



Text fig. 42. Manticoceras sp. nov. Suture at 8mm diameter based on D.669, from locality L(i), Harbour Cove, Padstow, X 10. Whorl section based on D.667 from locality D(ii), St. George's Cove, Padstow, X 10. Both from the Frasnian Cordatum Zone.

Suture with short mid ventral saddle. Ventral lobe deep and widening out to a rounded symmetrical ventro-lateral saddle. Lateral lobe sub-umbilical in position, shallow. Dorsal suture with small umbilical lobe and rounded median lobe.

Remarks

In shell form and ventral suture this species is so close to Ponticeras pernai that it was so identified before specimens were broken down to expose the dorsal suture. Few species of Manticoceras have this shell form. Of the nearest M. drevermanni and M. adorfense can be easily distinguished by their sutures. The early whorls of M. guppyi Glenister (1958, p.74, text fig. 6A, D) are similar but there is no trace in the Cornish specimens of the sudden heightening of the median dorsal lobe or of the steep faced dorsal side to the ventro-lateral saddle.

Specimens, Horizon and Locality

Only known from the Padstow Estuary from localities as follows : from D(ii), D.669, 664, 667, 668, ? 671 ; from E, D.1280, 1283. Both localities probably represent the Cordatum Zone of the Frasnian.

8. Manticoceras sp. nov. (aff. unduloconstrictum Miller)

Plate 14, figures 1 and 2.

Two specimens in the Anniss Collection from Saltern Cove belong to a new species.

Description

Dimensions	D	WH	WW	UW
(i)	13.0	6.5	5.7	4.5
(ii)	8.0	c.1.6	3.7	c.3.5

Both specimens are preserved as internal moulds of oxidised pyrite with no trace of the original shell. Both are fully septate.

Shell form evolute, laterally compressed, with wide, open umbilicus. Below about 10mm diameter whorl width exceeds breadth and the section is depressed with well rounded flanks and less rounded venter. At greater diameters the section becomes sub-triangular with a slight impressed area, rounded umbilical wall and flanks roundly converging to a narrowly rounded venter.

Growth lines poorly seen ; they pass back from the umbilicus to form a rounded sinus on the lateral area. The presumed ventro-lateral salient cannot be traced but there is a tongue shaped ventral sinus. In both specimens there are four constrictions per whorl ; these are only prominent near to the venter where they form shallow depressions which accord with the growth lines. Both specimens show the wrinkle layer (text fig. 43) as fine, close-set striae which pass radially and slightly backward across the umbilical shoulder and lateral areas but rather irregularly across the venter, being especially disturbed at the constrictions.

Text fig. 43. Manticoceras sp. nov. (aff. unduloconstrictum Miller. Close-up photograph showing the wrinkle layer and suture and one ventral constriction of a specimen in the collection of Mr. L.G. Anniss from Saltern Cove, South Devon. Frasnian Holzapfeli Zone, about X 30.

Suture forms a wide and diverging mid ventral lobe, the median saddle within it reaching to 12% of the height of the rounded ventro-lateral saddle at 7.5mm diameter and increasing to 33% by 13mm diameter. The dorsal slope of the ventro-lateral saddle is slightly steeper than the ventral slope and passes to a rounded sub-umbilical lobe. The umbilical seam centres slightly ventrad of an umbilical lobes ; the median dorsal saddle is V-shaped.

Remarks

The larger of these two specimens was labelled in manuscript "Manticoceras orbiculus (Beyrich) Foord and Crick", and is the specimen recorded as such by Anniss (1927 p.496), but the holograph of that poorly known species shows a sub-involute shell with no trace of constrictions and with a pointed lateral lobe, all features not shown by the Saltern Cove specimens. In shell form M. affine is comparable and the species must belong to Wedekind's 'affine' group, but that species shows no constrictions. Absence of constrictions also distinguishes M. sororium and M. simulator. The species comes nearest to M. unduloconstrictum but in that species the constrictions pass right across the flanks and are not restricted to the venter.

Specimens, Horizon and Locality

Two specimens only in the collection of Mr. L.G. Anniss from Saltern Cove, South Devon. Both from the Frasnian Holzapfeli Zone.

9. Manticoceras cf. adorfense (Wedekind)

Plate 15, figure 5

Only one specimen is known referable to this species. It occurs at Saltern Cove.

Description (of D.299)

Dimensions	D	WW	WH	UW
	17.1	6.8	9.2	3.2

Shell form sub-involute, laterally compressed. Whorl section with rounded venter, flanks diverging convexly to a maximum width close to the rounded umbilical shoulder, moderate impressed depth.

Suture with a large median saddle in the ventral lobe reaching to 60% of the rounded laterally placed saddle. Lateral lobe sub-umbilical in position and acute in the outer whorls. Dorsal suture not seen.

Remarks

This specimen agrees quite well in shell form with the holotype except that the flanks are rather flatter. The suture is identical. According to Wedekind (1917 pl.22, fig. 9) and Matern (1929 p.150) the true M. adorfense comes from the upper part of the

Cordatum Zone.

Specimen Horizon and Locality

Only D.299, collected by Dr. K. Joysey from the southern horn at Waterside Cove, Saltern Cove, South Devon. From the Frasnian Holzapfeli Zone.

10. *Manticoceras* cf. *intumescens* (Beyrich)

Following the redescription of the type material by Holzapfel this species has been restricted to manticoceratids with a rotund whorl section and sub-evolute form (Holzapfel 1899, p.22, pl.1, fig.9). Wedekind (1917, p.125, fig.35a) has also refigured the whorl section of Beyrich's specimen. Although this name has been applied to specimens from Saltern Cove (Anniss 1927, p.496) those specimens (in his private collection) are too small for certain determination. Foord and Crick (1897, p.64) recorded a large number of specimens from Chudleigh, Devon, but many of those specimens are badly crushed so that the whorl section cannot be determined. Some Chudleigh specimens, such as D.101 to 107, do show sufficient of the section to enable reference to be made to this species, and it is a reasonable inference that it is the commonest species there, with *M. cordatum*.

Specimens Horizon and Locality

Only known indubitably from Lower Dunscombe Farm, Chudleigh, Devon. Specimens include D.101 to 107, and probably many of the large number whose catalogue numbers were given by Foord and Crick (1897, p.64). Cordatum Zone of Frasnian.

11. *Manticoceras* cf. *retrorsum* (von Buch)

Plate 14, fig. 4.

Description (of specimens from Saltern Cove)

Dimensions	D	WH	WW	UW
BM.c49454	6.5	2.7	c.2.4	2.0

Shell form sub-evolute, laterally compressed. Whorl section with narrowly rounded venter with slight traces of ventro-lateral furrows. Maximum width two thirds the way across flanks. Umbilical shoulder and wall well rounded.

Growth lines well marked forming slight ridges on the mould which form a slight salient on the umbilical shoulder, a very slight lateral sinus, a salient over the ventro-lateral furrows and a shallow, narrow sinus on the venter. Wrinkle layer striae on the mould number 6 in 0.4mm on the mid flanks at 6mm diameter and there slope slightly backward : elsewhere they cannot be traced.

Suture forms a mid ventral saddle reaching 25% of the assymetric lateral saddle. Ventral lobe widely diverging. Steep dorsal slope of the narrowly rounded lateral saddle passing to a rounded Lateral lobe. Dorsal suture (seen in D.399) with sub-umbilical and median lobes.

Remarks:

For a long while this species was thought to be a Tornoceras, according to modern usage, since the suture shown by the holograph has that appearance. But von Buch's textual description leaves no doubt as to the generic assignment. This species is almost unique among the species of the genus in the presence of ventro-lateral furrows. Glenister's M. cinctum may well be a synonym for the figures of that species are very close to the specimens in the l'Ecole des Mines figured by d'Archaic and de Verneuil (1842, pl.25, fig.2,2a,b,3) which have been taken to typify M. retrorsus.

Specimens, Horizon and Locality

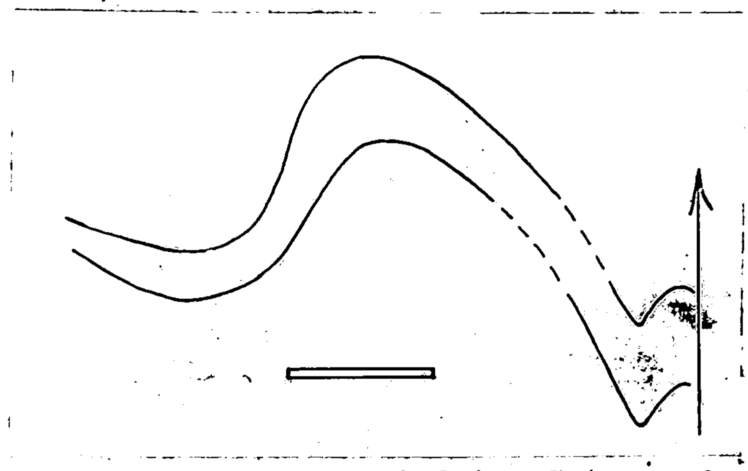
Occuring only at Saltern Cove in England. Specimens include ; BM.c49454, ? c1967, D.399. From the Holzapfeli Zone of the Frasnian.

12. Manticoceras spp.

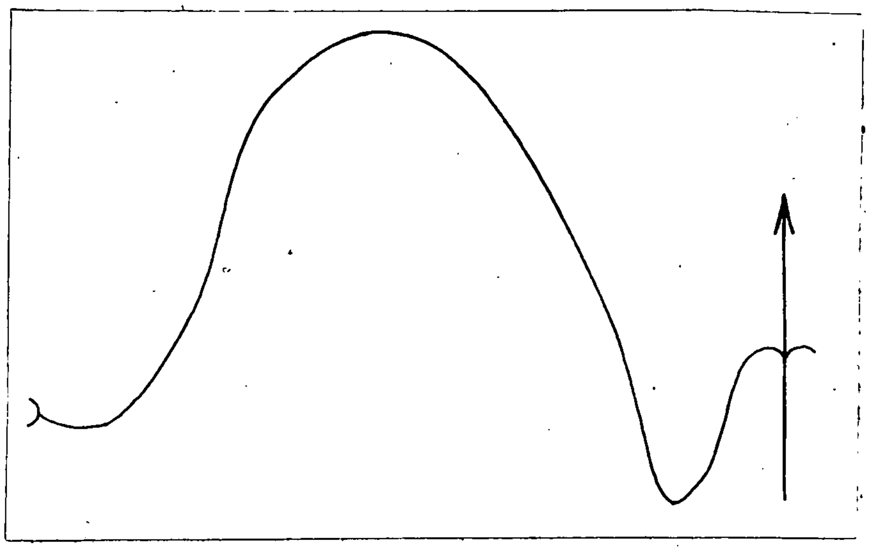
Plate 13, fig. 9, Plate 14, figs. 3, 5, 6 to 8

Several specimens which can be determined as Manticoceras but which cannot be assigned to species are figured here since they come from localities for which a Frasnian age deduced from them.

The sutures of two such specimens are illustrated in the accompanying text figures (44 and 45).



Text fig. 44. Manticoceras sp. indet. Suture of a specimen from Galmpton Point, due NNE of Warren House, four miles south of Paignton, South Devon. Frasnian, ? Cordatum Zone. Based on D.401, X 20.



Text fig. 45. Manticoceras sp. indet. Suture of a specimen from the northern part of Daymer Bay, Padstow Estuary, North Cornwall, from a goniatite band in the slate. Frasnian, ? Cordatum Zone. Based on D.512, X 20.

Genus CRICKITES Wedekind 1913

Type species : Crickites holzapfeli Wedekind 1913.

Diagnosis : Identical with Manticoceras except in the possession of convex growth lines.

Remarks

Miller and Furnish (in Moore Ed. 1957, p.33), and Glenister (1958 p.71) have regarded Crickites as a synonym of Manticoceras. Wedekind considered that the genus paralleled the evolution of Manticoceras and he even created the subfamily Crickitinae for them (Wedekind 1913, p.70). Since the genus Crickites does not occur in Australia or America it seems best to follow the conclusions of Wedekind, Schmidt (1921, p.543), Matern (1931 p.70) and Müller (1956 p.36) all of whom, from practical use find the genus acceptable.

1. Crickites holzapfeli Wedekind

Plate 16, figures 1 to 3.

1913 Crickites Holzapfeli R. Wedekind 1913, p.72, pl.7, fig. 5,6.
1917 Crickites Holzapfeli R. Wedekind 1917, p.131, text fig.39.
1931 Crickites koeneni H. Matern 1931b, p.162, text fig. 1,2.
+1956 Crickites holzapfeli K.J. Müller 1956, p.36, text fig.1.

English representatives of this Frasnian zone fossil have only been found at Saltern Cove, Devon.

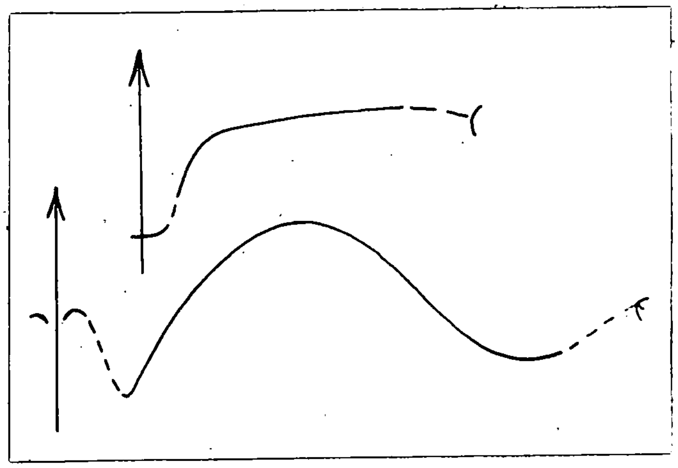
Description

Dimensions	D	WH	WW	UW
BM.c18436	11.0	4.9	6.5	2.4
D.202	c.9.0	c.3.5	c.4.5	c.2.0
BM.c49446	c.8.5	c.3.0	4.3	-

Shell form sub-evolute or sub-involute, slightly compressed laterally. In adult rather rotund. Whorl section below 10mm diameter rather depressed, with a flattened venter and flanks diverging convexly to a maximum width close to the umbilicus. Umbilical shoulder rounded, umbilical wall incurved. At larger diameters the whorl section becomes more rotund, but still depressed, and the venter becomes more rounded.

Growth lines convex and prominent forming prominent raised lirae on the mould. Growth lines sweep convexly across the flanks without forming a sinus (text fig. 46) and ventro-laterally turn back to form a ventral sinus. The growth line lirae occur with a frequency of 6 per 1.6mm on the ventro-lateral shoulder at 9mm diameter (D.202).

Suture shows only a small mid ventral saddle within the ventral lobe at the diameters seen. The sides of the lobe diverge to form a well rounded symmetrical saddle on the ventro-lateral area. The Lateral lobe is sub-umbilical in position and shallow, still rounded at the maximum diameter observed (text fig. 46). The dorsal suture has not been seen.



Text fig. 46. Crickites holzapfeli Wedekind. Above, growth lines at 7mm diameter. Below, suture at 11mm diameter. Both based on BM.c18436 from Saltern Cove, South Devon. Holzapfeli Zone, Frasnian. X 10.

Remarks

The form of the growth lines and the typical manticoceratid suture make certain the generic determination. Most species of Crickites have compressed shells, especially the Cordatum Zone species C. expectatus, sahlgrundensis and sheldensis , and C. acutus has a keeled venter. There only remains C. holzapfeli which is rotund in section (Wedekind 1913, p.72, text fig. 14a,b). The German specimens which have been described are larger than the Devon specimens. The slight differences which do appear, such as the shorter median ventral saddle in the Devon specimens, are probably only due to relative immaturity.

Specimens, Horizon and Locality

All English specimens are from Saltern Cove, South Devon, they include the following ; BM.c49446, c18436 and D.202. These give the main evidence for dating the Saltern Cove locality as Holzapfeli Zone, Frasnian.

Genus KOENENITES Wedekind 1913

Type species : Goniatites lamellosus G. & F. Sandberger

Diagnosis : Ammonoids with ventral siphuncle, sub-involute or sub-evolute, laterally compressed and usually discoidal. Growth lines biconvex. Suture with a median ventral saddle forming within the ventral lobe during ontogeny and two umbilical lobes forming between the Lateral and Dorsal lobes.

Remarks : This genus has been discussed in detail by Miller (1938 p.125) and Glenister (1958 p.76,77). Glenister separates Koenenites from Hoeninghausia on the basis of the form of the venter. Until the suture of the type species of Hoeninghausia it seems most inadvisable to use that genus. Search has been made for the type specimen in Paris without success, but as has been shown several times in this work, d'Archaic and de Verneuil's figures are not reliable.

1. Koenenites sp. nov. Plate 16, figure 5.

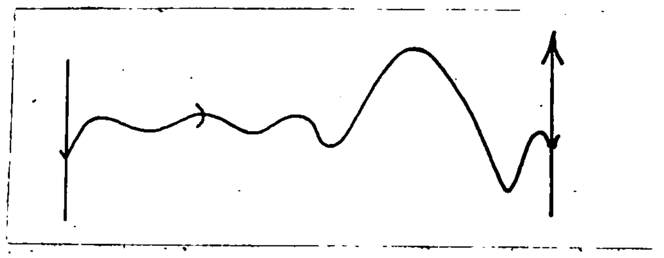
The only representative of this species was collected by Dr. G.V. Middleton from near Staverton, Devon.

Description

Dimensions	D	WH	WW	UW
GS.95230	8.2	4.2	2.8	c.1.0

Shell form sub-involute and discoidal. Whorl section with a flattened ventral band (1.0mm wide at 8.2mm diameter) which turns sharply over to the flanks which diverge to a maximum width two-thirds across the flanks. Close against the ventral band on the outer flanks are paired ventro-lateral furrows. The umbilical wall is rounded. At the maximum diameter the impressed depth is about 30%.

Growth lines are not traceable. The suture forms a deep ventral lobe within which the median saddle reaches 33% of the height of the rounded ventro-lateral saddle (text fig. 47). Lateral and sub-umbilical lobes well rounded. Dorsal suture with sub-umbilical and median lobe.



Text fig. 47. Koenenites sp. nov. Suture based on GS.95230 from a quarry NW of St. John Baptist Chapel, Staverton Wood, South Devon, collected by Dr. G.V. Middleton. Frasnian Lunulicosta Zone. X 10.

Remarks

This specimen shows a close resemblance to that figured among the syntypes of Ponticeras planorbis by the Sandberger brothers (1851, pl.9, fig.3g, f), but it is much more involute. The other members of the genus all have rounded venters except K. galeatum which has an acute venter (and therefore Glenister has referred it to Hoeninghausia (1958 p.77)).

Specimens, Horizon and Locality

One specimen only, GS.95230, from a quarry north-west of St. John Baptist Chapel, Staverton Wood, South Devon. Horizon, Lunulicosta Zone, Frasnian.

Family BELOCERATIDAE Frech 1902

Genus BELOCERAS Hyatt 1884

Type species : Goniatites sagittarius G. & F. Sandberger 1851
(= Ammonites multilobatus Beyrich 1837)

Diagnosis : Ammonoids with ventral siphuncle, shell form involute to subinvolute. Venter acute, rounded or grooved. Growth lines biconvex. Suture in early stages like Manticoceras but with 6 or 7 adventitious lobes arising centrifugally during ontogeny ventrad from the Lateral lobe and many umbilical lobes.

Remarks : The family has been discussed by Schindewolf (1936) and the genus in some detail by Glenister (1958 p.85).

1. Beloceras sagittarium (G. & F. Sandberger)

Plate 15, fig. 11, Plate 16, figs. 4, 6, 7, and 8.

++1958 Beloceras sagittarium B. Glenister 1958 p.55

Description

Dimensions	D	WH	Wh	WW	UW	Locality
BM.c49455	58	30	c.18	9.2	4.5	Chudleigh
BM.c1969	c.75	38	-	c.11.2	7.0	"
BM.c1852	c.70	-	-	c.10.0	-	"
TM.26/12	165	-	-	-	-	"
TM.25/12	c.145	c.75	-	30.0	20.0	"
BM.c12702	c.69	6	c.27	-	-	Shaldon Beach

All specimens are somewhat distorted and the figures above are therefore approximate. None show evidence of the shell.

Shell form oxyconic, very compressed and discoidal, involute with a small open umbilicus widening at large diameters. Whorl section with maximum width two-thirds the way across the flanks from the poorly seen, probably sub-acute, venter.

Suture with about 13 angular lobes at 28mm whorl height, but the number probably increases at larger diameters. When preserved the lobes have pointed apices and then widely diverge to become sub-parallel for a short distance befoe diverging again to form the more rounded saddles (pl.15, fig.11).

Remarks

Few Devonian species are as well known as this species and these specimens agree well with the descriptions although, since the shell is not preserved on them comparison of the growth lines is not possible.

Specimen TM.26/12 is of particular interest in being considerably larger than any member of the species on record. In England this spêcies was first described by Roemer (1880 p.145, pl.5) who figured two poorly preserved specimens from Lower Dunscombe. Foord and Crick (1897 p.276) give details of several specimens from that locality.

Specimens, Horizon and Locality

This species is only known from Devon in England. Most specimens are from the thin-bedded goniatite bearing limestone at Lower Dunscombe Farm Quarry, Chudleigh. Specimens from here include , BM.c49455, c1969, c1852, TM. 25/12, 26/12. From Petit Tor Combe, Torquay there is GS. Us1583, comparable with the species. From Whiteway Farm there is GS. Us1654. Specimens are also known in pebbles derived from the Trias at Shaldon Beach, for example BM. c12702.

In Germany this species is commonest in the middle Frasnian to which Matern (1929 p.150) has stated it is restricted although Wedekind (1913 p.48) gave it as occuring in the upper Frasnian as well. Müller (1956 p.46) has even suggested it may occur in the lower Frasnian, but this certainly needs substantiation. It is characteristic of the Cordatum Zone (= Sagittarium Subzone of Glenister 1958) to which the English localities are correlated.

Suborder GONIATITINA Hyatt 1884
Superfamily CHEILOCERATACEAE Frech 1897
Family TORNOCERATIDAE Arthaber 1911

Genus TORNOCERAS Hyatt 1884

Type species : Goniatites uniangularis Conrad 1842

Diagnosis : Ammonoids with ventral siphuncles, shell involute to sub-evolute, in some with paired ventro-lateral furrows. Growth lines biconvex. Suture with Ventral, Lateral and Dorsal lobes and an adventitious lobe arising during ontogeny on the arched ventro-lateral saddle.

Remarks : The subdivision of this genus into the subgenera Tornoceras, Protornoceras, Aulatornoceras, ~~Protornoceras~~ and Polonoceras has been discussed in detail by Miller (1938 p.140). The group as a whole is characterised by biconvex growth lines and a sutural development which is illustrated in the accompanying text figure (48) which shows the lobe which in the adult is lateral in position arising adventitiously upon the primitive ventro-lateral saddle.

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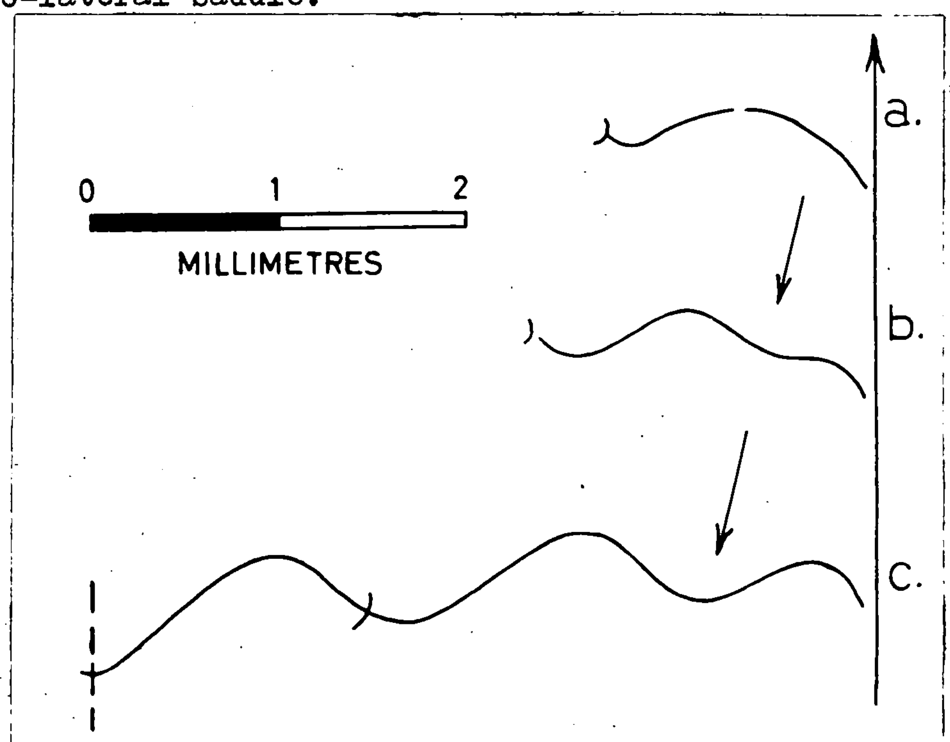


Text fig. 48. Tornoceras (Tornoceras) sp. Sutural development based on D.805 from Pentonwarra Point, Trevone. a, at 2.5, b, at 3.6, c, at 4.8mm diameter. Terebratum Zone, Givetian. All X 25.

Subgenus TORNOCERAS ss. Hyatt 1884

Tornoceras (Tornoceras) simplex (von Buch)

The holographs of this species consist only of two thumbnail sketches neither of which are particularly informative. Von Buch originally diagnosed his species as follows "the superior lateral [lobe] is linguiform, a little less deep than the dorsal [ventral] and almost as broad as deep ; approaching to a point." Von Buch's specimen came from Rammelsberg near Goslar. The interpretation which is generally adopted for the species is based on the figure of a specimen from Timan given by Wedekind (1917 pl.16, fig. 12). Until a redescription of von Buch's specimen is published, or a neotype chosen, there is likely to be some difference in interpretation of the species. However, several varietal names are available, or names considered here to be of varietal worth only, so that it is possible to distinguish the various forms which occur in England and enable more use to be made of the species stratigraphically.

1. Tornoceras (Tornoceras) simplex var. hughesii (Whidborne)

Plate 17, figure 6.

1889 Goniatites Hughesii (pars) G.F. Whidborne 1889, p.29.

1890 Goniatites Hughesii (pars) G.F. Whidborne 1890, p.69, pl. 6, figs. 2,2a, 1,1a.

1895 Goniatites simplex sp. mut. typus E. Holzapfel 1895, p.98, pl.6, fig.11,11a.

*1897 Tornoceras hughesii A.H. Foord and G.C. Crick 1897, p.118, text fig. 54.

1903 Goniatites Hughesii W.A.E. Ussher 1903, p.66.

non 1921 Tornoceras hughesi W.G. Shannon 1921, p.249, pl.1, fig.3.

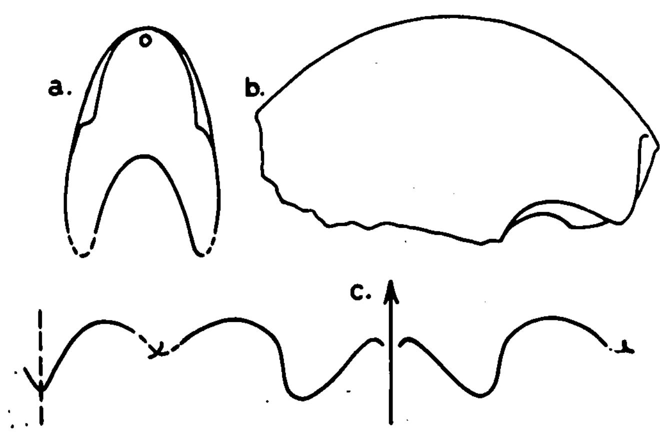
Description (all specimens are from Lummaton Quarry, Torquay).

Dimensions	D	WH	WW	UW	
BM.c1528a	55	c.35	c.18	0	Holotype
SM.H4133	86	53	c.32	0	
KC.r375	-	c.30.5	19.7	-	
KC.r377	63	37.5	-	-	
KC.r380	62	37.5	c.20	-	

Shell form completely involute, laterally compressed. Whorl section ovate (text fig. 49) with widest width close to the umbilicus. Lateral areas sloping convexly towards the well-rounded venter.

Growth lines poorly seen, apparently passing radially out from the umbilicus to the ventro-lateral area where they sweep forward to a slight salient and back to a sinus on the venter. Irregular epidermids commonly seen on the shell, as in T. whidbornei. They pass back from the umbilicus at a low angle.

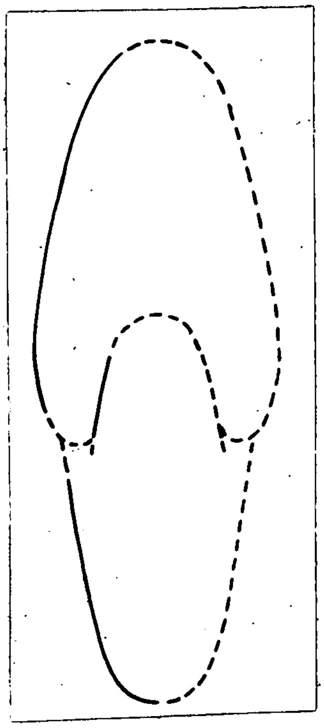
Suture forms a small V-shaped ventral lobe passing almost directly to a deep, rather narrow, well rounded lateral lobe (text fig 49c). Umbilico-lateral saddle highly arched, the ventrad slope almost concentric to the umbilicus. Dorsal suture with a median lobe. In the holotype there are seven chambers in the last half whorl.



Text fig. 49. Tornoceras (Tornoceras) simplex var. hughesii (Whidborne). a, whorl section. b, portion of body chamber, c, suture. All based on a specimen from a large block found at the foot of a quarry face at the western end of Lummaton Quarry apparently from a horizon high on the face above the stomatoporoid limestone, collected by Dr. J.E. Prentice. KC.r375. Natural size.

Remarks

When Whidborne described this species he included with it forms with less undulating sutures and more prominent epidermids which Foord and Crick later separated as the species T. whidbornei. They expressly excluded from their synonomy of T. hughesii a larger specimen figured by Whidborne (pl.6, fig. 1,1a, refigured here in



Text fig. 50. Tornoceras (Tornoceras) simplex var. hughesii (Whidborne). Outline based on a syntype from Lummaton Quarry, Torquay, Devon. SM.H1433. Slightly reduced.

text fig. 50), but an examination of that specimen (SM.H1433) shows that in shell form and, as far as can be discerned, in suture, the specimen is closely comparable with the lectotype (Foord and Crick limited the species to one specimen and referred to that specimen as the "type").

Specimens Horizon and Locality

All specimens are from Lummaton Quarry, Torquay. They include, BM.c1528a, the Lectotype, SM.H4133, a syntype, both figured by Whidborne. Dr. J.E. Prentice has also collected the following, KC.r375, ? r369, ? 371, r380, r381, r377. The associated maenioceratids show that the horizon is the Terebratum Zone, Givetian.

2. Tornoceras (Tornoceras) simplex var. ovata Frech

Plate 17, figures 3 and 4.

1902 Tornoceras simplex mut. ovata F. Frech 1902, p.47, pl. 3(2), fig.21a,b.

1913 Tornoceras simplex var. ovata F. Frech 1913, p.16.

Frech's specimen came from Büdesheim, in England closely comparable forms occur at Saltern Cove.

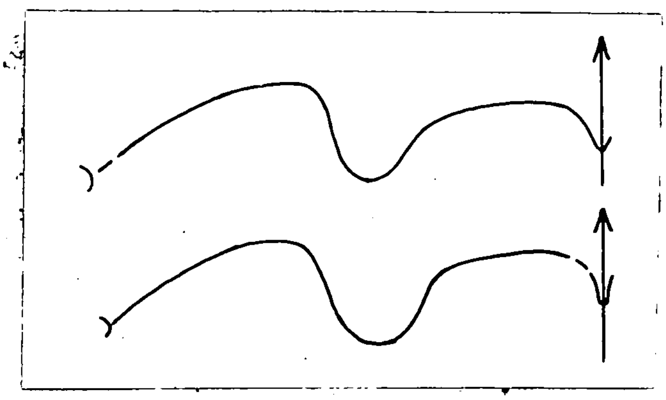
Description (the verbal description applies only to English specimens)

Dimensions	D	WH	Wh	WW	UW	WW/WH
D.308	5.8	c.3.3	-	c.3.6	0	108
D.249	c.7.2	-	-	c.4.7	0	-
BM.c18461	9.4	6.0	-	5.2	0	87
SM.H1526	11.2	6.4	-	6.0	0	94
The above specimens are from Saltern Cove, those below are from Büdesheim :						
D.1245	9.5	5.9	3.5	5.7	? .2	97
D.1257	c.18.0	10.7	-	8.5	0	95

Shell form above 7mm diameter involute, with closed umbilicus and slightly laterally compressed. Whorl section ovate, with maximum width close to the umbilicus, with convex flanks and rounded venter.

Growth lines cannot be traced. There are occasional traces of spiral striae over the venter.

Suture with small V-shaped ventral lobe, ventro-lateral saddle flat topped, sloping slightly dorsad. Lateral lobe linguiform. Ventrad face of the umbilico-lateral saddle moderately steep, dorsal slope gentle and convex. Dorsal suture with median lobe (text fig.51).



Text fig. 51. Tornoceras (Tornoceras) simplex var. ovata Frech. Above, suture based on SM.H1526, Below, suture based on BM.c18461. Both from Saltern Cove, Devon. Holzapfeli Zone, Frasnian. Both X 12½.

Remarks

The available specimens agree well in shell form with the much better preserved specimens from Büdesheim. Typically, however, the German specimens show a less deep lateral lobe and a more rounded ventro-lateral saddle at comparable diameters.

This varietal name is, in fact, invalid since both Holzapfel and Frech thought they were dealing with Münster's Goniatites ovatus which has since been shown to be a Cheiloceras (Staffites).

Specimens Horizon and Locality

In England known at Saltern Cove, Devon. Specimens include ; SM.H1526, BM.c18461, D.249, 308. Holzapfeli Zone, Frasnian.

3. Tornoceras (Tornoceras) simplex var. A.

Plate 17, figures 7, 8 and ? 9.

This variety is characterised by the almost complete absence in the adult of a ventral lobe.

Description (all the specimens are from Saltern Cove)

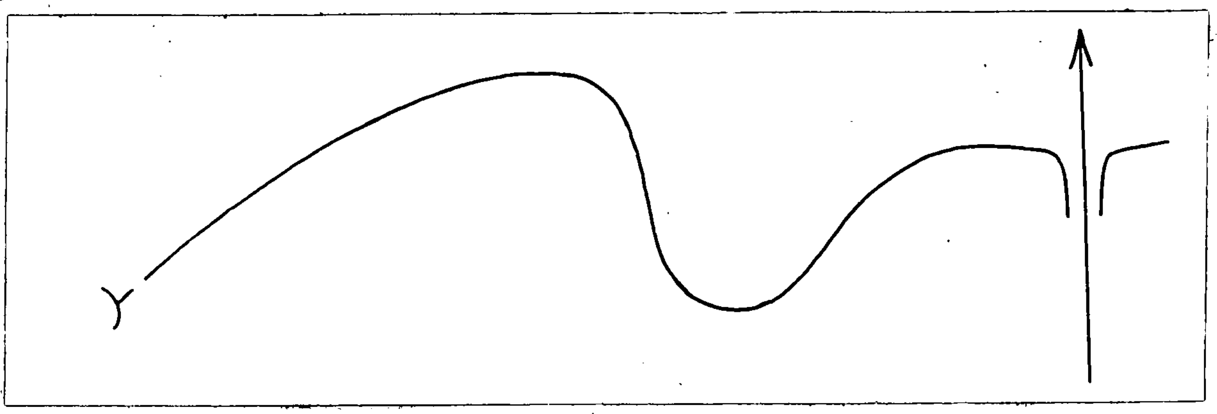
Dimensions	D	WH	WW	UW	US	SH	WW/WH
D.224	16.3	9.3	c.7.7	c.0.5	5.6	1.8	83
D.298	8.8	5.2	3.8	?	-	-	73
Anniss(12)	9.6	5.8	4.2	?0	-	-	72
BM.c49438	7.6	c.4.8	c.3.2	-	-	-	76

Shell form involute, laterally compressed with rounded venter and completely or almost completely closed umbilicus. Whorl section shows a maximum width near the umbilicus and the flanks slope convexly towards the venter which is broad and rounded.

Apart from traces of a ventro-lateral salient, growth lines are not seen. The suture shows a very small ventral lobe in the outer whorls which is little more than a slight deflection caused by the siphuncle. The ventro-lateral saddle is therefore very shallow but passes back to form a rounded, linguiform lateral lobe. The umbilico-lateral saddle is high and arched with a very steep ventrad face (text fig. 52).

Remarks

This variety is much more compressed than typical members of the T. simplex group. In this resect it comes near to T. frechi but that species is even flatter sided and has a less arched umbilico-lateral saddle (Wedekind 1917, p.136, text fig.41, pl.16, fig.9).



Text fig. 52. Tornoceras (Tornoceras) simplex var. A. Suture at 16mm diameter based on D.224 from Saltern Cove, Devon. Holzapfeli Zone, Frasnian. X 12½.

Specimens Horizon and Locality

All specimens are from Saltern Cove, Devon. They include ; D.224, 298, ? 201, ? 253, BM.c49438, and a specimen in the L.G. Anniss collection. On the basis of associated Crickites the horizon is determined as Holzapfeli Zone, Frasnian.

4. Tornoceras (Tornoceras) simplex var. B.

Plate 17, figures 1 and 2.

1956 Tornoceras (T.) simplex M.R. House 1956, p.259.

This variety occurs in the Terebratum Zone of North Cornwall.

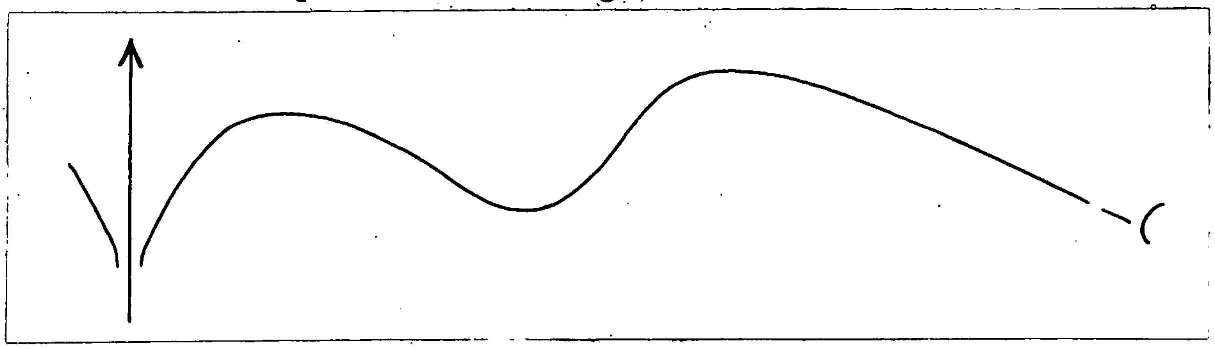
Description

Dimensions	D	WH	Wh	WW	UW	WW/WH
GS.95397	12.2	6.4	4.5	5.1	c.1.6	80
D.906	13.0	6.8	-	c.5.1	c.1.5	76

The specimens are preserved as internal pyritic mould with no trace of the original shell.

Shell form involute and laterally compressed, with rounded venter and nearly closed umbilicus. Whorl section has maximum width 3/4 way across flanks to umbilicus. From maximum width the flanks slope convexly both to the umbilicus and to the well rounded venter.

The course of the growth lines cannot be traced. The suture forms a broad V-shaped ventral lobe passing to a rounded ventro-lateral saddle which slopes convexly to the rounded lateral lobe (text fig. 53). The umbilico-lateral saddle is shallow and has only a short ventrad face and slopes almost straight to the umbilical seam.



Text fig. 53. Tornoceras (Tornoceras) simplex var. B. Suture based on GS.95397 from Trevone, North Cornwall. Terebratum Zone, Givetian. X 25.

Remarks

This variety is distinguished by the moderate sutural elements from the other varieties and by the true V-shape of the ventral lobe.

Specimens, Horizon and Locality

All specimens are from Portquin or Trevone, North Cornwall. From Trevone there are, GS.95397, D.906, 818, 837, 811 813, 852, 826, 804 etc. From Portquin, D.785, 729, 732, 737, 749 etc. These all belong to the Terebratum Zone, Givetian.

5. Tornoceras (Tornoceras) cf. simplex (von Buch)

Plate 18, figure 5.

One specimen from Chudleigh, Devon is figured here which probably belongs to this group. The specimen, which is in the collection of Mr. L.G. Anniss, was figured by Shannon (1921 p.6, pl.2, fig.6) as Manticoceras intumescens. The horizon is Frasnian Cordatum Zone.

6. Tornoceras (Tornoceras) aff. simplex (von Buch).

Plate 18, figures 1 and 2.

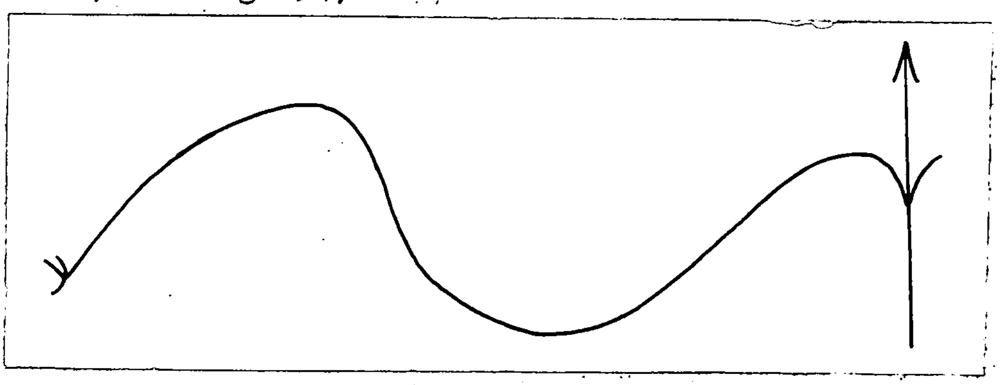
One specimen from Staverton has a shell form comparable with T. simplex but has a distinctly different suture with a short, highly arched umbilico-lateral saddle.

Description (of GS.95228)

Dimensions	D	WH	Wh	WW	US	SH	WW/WH
	13.1	8.0	4.3	6.2	3.7	2.2	77
	9.6	4.9	-	3.6			77

Shell form involute with closed umbilicus, laterally compressed with a rounded venter. Whorl section ovoid with maximum width close to the umbilicus with flanks sloping convexly to the venter. Impressed depth 54% at maximum diameter.

Growth lines not seen. The suture forms a very small V-shaped ventral lobe passing to a depressed ventro-lateral saddle and on to a very broad lateral lobe. The umbilico-lateral saddle is highly arched and very short. An umbilical lobe centres on the seam. The dorsal suture shows an arched umbilical saddle and a deep and rounded dorsal lobe (text fig. 54).



Text fig. 54. Tornoceras (Tornoceras) aff. simplex (von Buch). Suture based on GS.95228 from a quarry near St. John Baptist Chapel, Staverton Wood, Devon collected by Dr. G.V. Middleton. Frasnian Lunulicosta Zone. X 12½.

Remarks

So short an umbilico-lateral saddle is not common among members of this genus. The species which come near it in this respect are T. westfalicum, with an open umbilicus, and T.

subundulatum, which has an umbilico-lateral saddle even shorter than the Devon specimen.

Specimen, Horizon and Locality

Only GS.95228 from a quarry near St. John Baptist Chapel, Staverton Wood, South Devon collected by Dr. G.V. Middleton. Frasnian, Holzapfeli Zone.

7. Tornoceras (Tornoceras) whidbornei Foord and Crick

Plate 17, fig. 5, Plate 22, fig.3.

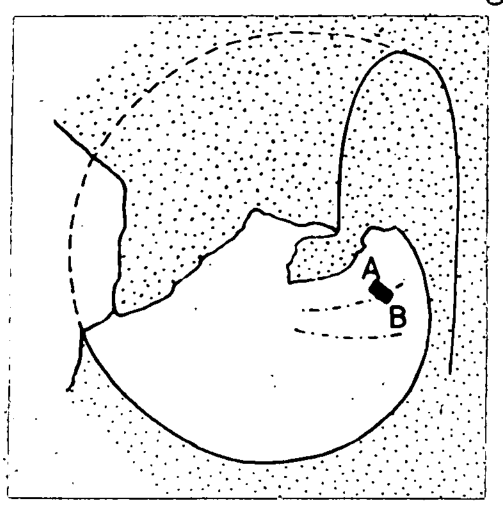
1889 Goniatites Hughesii (pars) G.F. Whidborne 1889, p.29.
1890 Goniatites Hughesii (pars) G.F. Whidborne 1890, p.69, pl.6, fig. 3,3a (only).
+1897 Tornoceras whidbornei A.H. Foord and G.C. Crick 1897, p.120, text fig. 56.

Description (of Holotype, BM.c1528b, and topotypes from Lummaton Quarry, Torquay).

Dimensions		D	WH	WW	UW
BM.c1528b	max.	53			
		45	26	c.17	0
KC.r368		60	35	c.20	0

Shell form involute, with closed umbilicus, laterally compressed. Whorl section ovate, widest close to the umbilicus, with flanks converging to the well rounded venter.

Growth lines cross the lateral areas almost radially with a very shallow lateral sinus, and form a very slight ventro-lateral salient before passing sharply back into a deep ventral sinus. Microscopic striae on the surface of the shell (pl.22, fig.3) sweep back from the umbilicus at a low angle (text fig. 55).



Text figure 55.
Tornoceras (Tornoceras) whidbornei Foord and Crick. Diagram showing the course of the surface microscopic striae. The black rectangle marks the area shown on plate 22, fig.3. Based on KC.r368 from Lummaton Quarry. X 1.

The suture forms a deep V-shaped ventral lobe, a narrow, rounded ventro-lateral saddle, a moderately deep lateral lobe which passes by a broad, arched saddle to a lobe centred approximately on the umbilical seam. Dorsal suture not seen. The septae are 6.5mm apart on the ventro-lateral shoulder at 45mm diameter.

Remarks

This species was separated from T. hughesii by Foord and Crick who stressed that the lateral lobe was less deep and the umbilical-lateral saddle less arched than in the specimen selected by them as the lectotype of T. hughesii. Both species show well the interesting surface striae to which Whidborne (1890 pl.6, fig.3c) drew attention.

Specimens, Horizon and Locality

Only known from Lummaton Quarry, Torquay. Specimens include the Holotype, BM.c1528b, and the following collected by Dr. J.E. Prentice which were extracted from "a large block at the foot of a quarry face at the western end of Lummaton Quarries" which apparently came from "high on the face above the stromatoporoid limestone ", KC.r368, r373, r373, r381. The associated fauna of maenioceratids shows the horizon to be the Terebratum Zone of the Givetian.

8. Tornoceras (Tornoceras) sp. nov. aff. crassum (Matern)

Plate 19, figures 2 and 3.

Description (of SM.H1541 from Saltern Cove, Devon).

Dimensions	D	WW	WH	UW
	8.0	c.5.1	4.5	c.0.8

The specimen is preserved as an internal mould with no trace of the shell.

Shell form involute, well rounded and slightly compressed and with an open umbilicus. Whorl section shows a well rounded venter with convex flanks reaching a maximum whorl width close to the umbilicus. The umbilical shoulder is sharply rounded and the wall vertical.

Growth lines pass gently back from the umbilicus forming a very shallow lateral sinus and a shallow ventro-lateral salient. The course of the growth lines cannot be traced over the venter. There are eight shallow constrictions in the last complete whorl which apparently accord exactly with the growth lines. On the venter the constrictions are deeper and project back to form a rounded ventral sinus.

The suture has a V-shaped ventral lobe, a well rounded ventro-lateral saddle and a small, rounded lateral lobe passing to a large umbilico-lateral saddle with a steep ventrad face.

Remarks

This distinctive Tornoceras is nearest T. ausavense crassum Matern which comes from Büdesheim. Since the species T. ausavense has been made genotype of Lobotornoceras because it forms an umbilical lobe (visible on a topotype figured here, pl.21, fig.3), and there is no evidence that the variety crassum does, it seems best to regard that species as distinct. There are noticeable differences between Büdesheim specimens of T. crassum and the Devon specimen. The most important distinction is that German specimens never have as many as eight constrictions, and the Holotype described by Matern (1931 p.27) has only four. The Devon specimen is also rather more rotund, as comparison with the following dimensions of Büdesheim specimens show.

	D	WH	WW	UW	Constrictions in last whorl
Matern's Holotype	7.2	-	3.3	-	4
D.1239	8.0	3.7	4.5	1.3	3 +
D.1240	5.9	3.1	3.6	0.6	5
D.1241	6.4	3.5	4.2	1.0	3
D.1242	6.6	3.7	4.2	0.5	4

Perhaps as significant as the greater number of constrictions is the fact that the growth lines on the Devon specimen pass backwards from the umbilicus whereas in the Büdesheim specimens they pass forwards. In addition the ventro-lateral salient of the Devon specimen is shallower than in the German topotypes.

Specimen, Horizon and Locality

The sole English specimen, SM.H1541, comes from Saltern Cove. The true *T. crassum* comes from the Cordatum Zone but the horizon of the Devon specimen is shown by the accompanying *Crickites* to be of Holzapfeli Zone age.

Subgenus *PROTORNOCERAS* Dybczynski 1913

Type species : *Protornoceras polonicum* Dybczynski 1913

Diagnosis : The characters of *Tornoceras* ss. but with a wide open umbilicus and usually more compressed laterally.

Remarks : This genus was founded by Dybczynski to include eight new species which he had collected from the eastern end of the town of Kielce in southern Poland. Subsequently Schindewolf (1922 p.188) proposed the name *Pernoceras* for this group claiming that the name *Protornoceras* was not appropriate. *Pernoceras* falls as a subjective junior synonym of *Protornoceras*.

1. *Tornoceras* (*Protornoceras*) sp. nov.

Plate 19, figures 4 to 8.

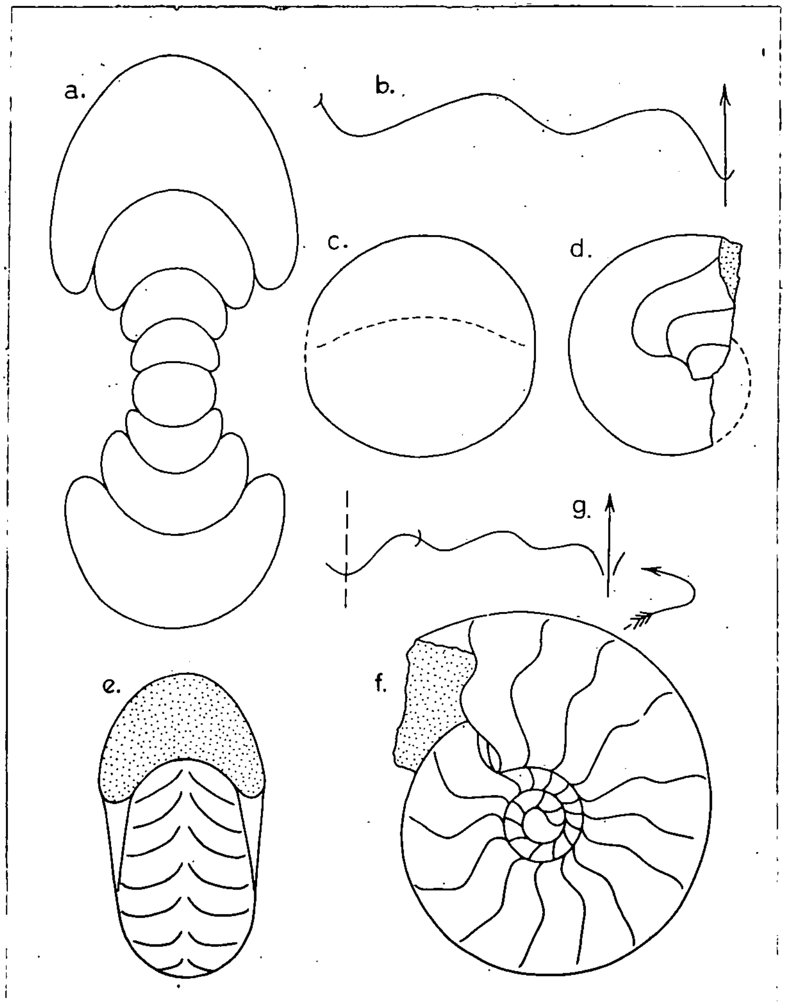
Descriptions (all specimens come from Trevone or Portquin, Cornwall).

Dimensions	D	WH	WW	UW	WW/WH
D.786	c.10.3	4.7	c.3.5	3.2	76
	7.6	3.2	2.9	2.3	94
D.810	-	3.4	3.4	-	100
D.916	-	4.1	4.0	-	98
D.716	c.14.0	c.5.0	c.4.5	c.4.7	c.91

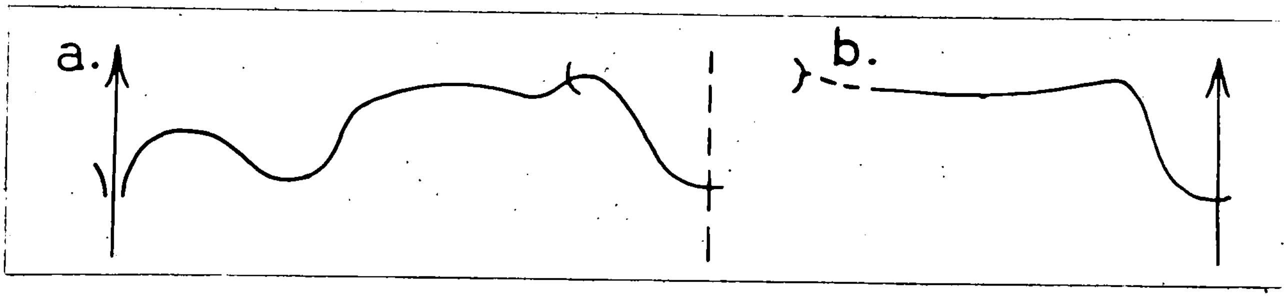
Shell form sub-evolute, laterally compressed. Whorl section slightly compressed in the adult with a sub-triangular outline ;

the venter is well rounded and the flanks slope convexly out to a maximum width near to the umbilical shoulder (text fig. 56a). The protoconch is sub-ellipsoidal, 1.3mm in breadth, 1.2mm in diameter. The whorl section of the early volutions are illustrated in the accompanying diagrams (text fig. 56) and photographs (pl.19, figs. 5 and 6).

Growth lines pass almost radially out across the umbilical shoulder and on the lateral areas form a very shallow sinus (text fig. 57b). As they sweep forward to form a slight ventro-lateral salient they become more prominent. Over the venter they pass back to form a rather deep ventral sinus.



Text fig. 56. Tornoceras (Protornoceras) sp. nov. a, median section X 10. b, suture at 5mm diameter X 25. c,d, protoconch and early chambers X 25. a-d based on D.849 from Pentonwarra Point, Trevone. e,f, lateral and ventral views showing the adventitious development of the adult lateral lobe. g, suture. e-f all X 10 and based on D.805 from Trevone.



Text fig. 57. Tornoceras (Protornoceras) sp. nov. a, Suture and b, growth lines. Both based on D.810 from Pentonwarra Point, Trevone, North Cornwall, X 12½. Terebratum Zone, Givetian.

The early sutural development is shown on the accompanying diagrams (text fig. 56b-g). The adult suture (text fig. 57a) consists of a V-shaped ventral lobe which widens out to a shallow, rounded ventro-lateral saddle. The lateral lobe is broad and rounded passing to the steep ventrad face of the umbilico-lateral saddle. The umbilical seam lies dorsal to the base of the Lateral lobe. The median dorsal lobe is deep, broad, and well rounded.

Remarks

This genus is more characteristic of the Frasnian and Famennian than the Givetian. Wedekind's three species euryomphala, kochi and weissi all have parallel sides and rather tabular venters. The numerous species erected by Sobolew under various of his elaborate generic names include many which should be referred to Protornoceras . Whilst many agree in shell form with the Cornish specimens the lateral lobe is rarely as deep or as rounded and the umbilico-lateral saddle less prominent. Both Sobolew's and Dybczynski's species are Upper Frasnian or Lower Famennian in age.

Specimens, Horizon and Locality

Only occuring in England at Portquin and Pentonwarra Point, North Cornwall. Specimens include ; from Pentonwarra Point, Trevone, GS.95399, 95402, D.805, 813, 835, 839, 840, 841, 851, 849, 810, 916. From Portquin, D.716, 726, 729, 786. Both these localities are shown by their associated fauna to belong to the Givetian Terebratum Zone.

Subgenus AULATORNOCERAS Schindewolf 1922

Type species : *Goniatites auris* Quenstedt 1846

Diagnosis : The characters of *Tornoceras* ss. except for the presence of prominent ventro-lateral furrows. Shell form may be involute or sub-involute. Growth lines commonly strong giving a ribbed appearance.

Remarks : Schindewolf (1954 p.131) has recently given the details of ontogeny for this subgenus and shown that the lobe development is similar to *Tornoceras* ss.

1. *Tornoceras* (*Aulatornoceras*) *auris auris* (Quenstedt)

Plate 20, figs. 1, 2, 4, 6 to 8, Plate 22, fig. 4.

1846 *Goniatites auris* F.A. Quenstedt 1846, p.64, pl.3, fig.7a-c.
1877 *Goniatites auris* J.E. Lee 1877, p.101, pl.5, fig.1.
+1897 *Tornoceras auris* A.H.Foord and G.C. Crick 1897, p.103,
+1913 *Tornoceras auris* F. Frech 1913, p.17.
1917 *Tornoceras auris* R. Wedekind 1917, p.137, text fig.42b, pl.16, fig.13.
+1931 *Tornoceras auris auris* H. Matern 1931, p.30.
+1956 *Tornoceras* (*Aulatornoceras*) *auris* K.J. Müller 1956, p.48, ? pl.1, fig.5.

When the museum specimens labelled "*Tornoceras auris*" from Saltern Cove are compared with topotypes of the species from Büdesheim it is clear that only a few are comparable with the true *auris auris* ; and some which have to be so referred are stouter than typical topotypes.

Description (of specimens from Saltern Cove).

Dimensions	D	WH	WW	UW
BM.c49451	10.6	4.1	c.5.0	c.1.5
BM.c18445	c.9.8	4.8	5.0	1.6
D.203	c.7.7	4.0	c.5.5	? 1.0
D.267	6.7	3.4	3.3	1.2

(Dimensions of Büdesheim Topotypes	D	WH	WW	UW	
D.1078	9.7	4.1	c.4.7	2.0	
D.1079	9.2	4.2	4.7	1.7	(pl.20,fig.1,2)
D.1080	c.16.0	9.3	7.3	c.2.4	(pl.20,fig.8)
D.1081	6.8	3.5	4.2	0.8	)

All the Devon specimens are preserved as internal moulds with no trace of the original shell. The description below applies to Devon specimens only.

Shell form involute, somewhat laterally compressed, with a small open umbilicus. Whorl section shows a tabular venter with well marked ventro-lateral furrows on each side. From the furrows the flanks slope out to a maximum whorl width close to the umbilical shoulder.

Growth lines pass forward from the umbilicus forming a slight ventro-lateral salient and on to a shallow lateral sinus. They then swing markedly forward, forming a prominent and elongate lappet in the ventro-lateral grooves and then sharply back to a deep ventral sinus. Some specimens (BM.c18445 and D.267) show raised bands between the growth line grooves (characteristic of Büdesheim specimens). No deep and continuous constrictions are formed.

The sutures show a V-shaped ventral lobe, a rounded ventro-lateral saddle (except around 4 and 6mm diameter when it is rather flat topped), a deep lateral lobe and an arched umbilico-lateral saddle with a steep ventral face. From the crest the lateral saddle slopes almost straight to the umbilicus (text fig. 58).

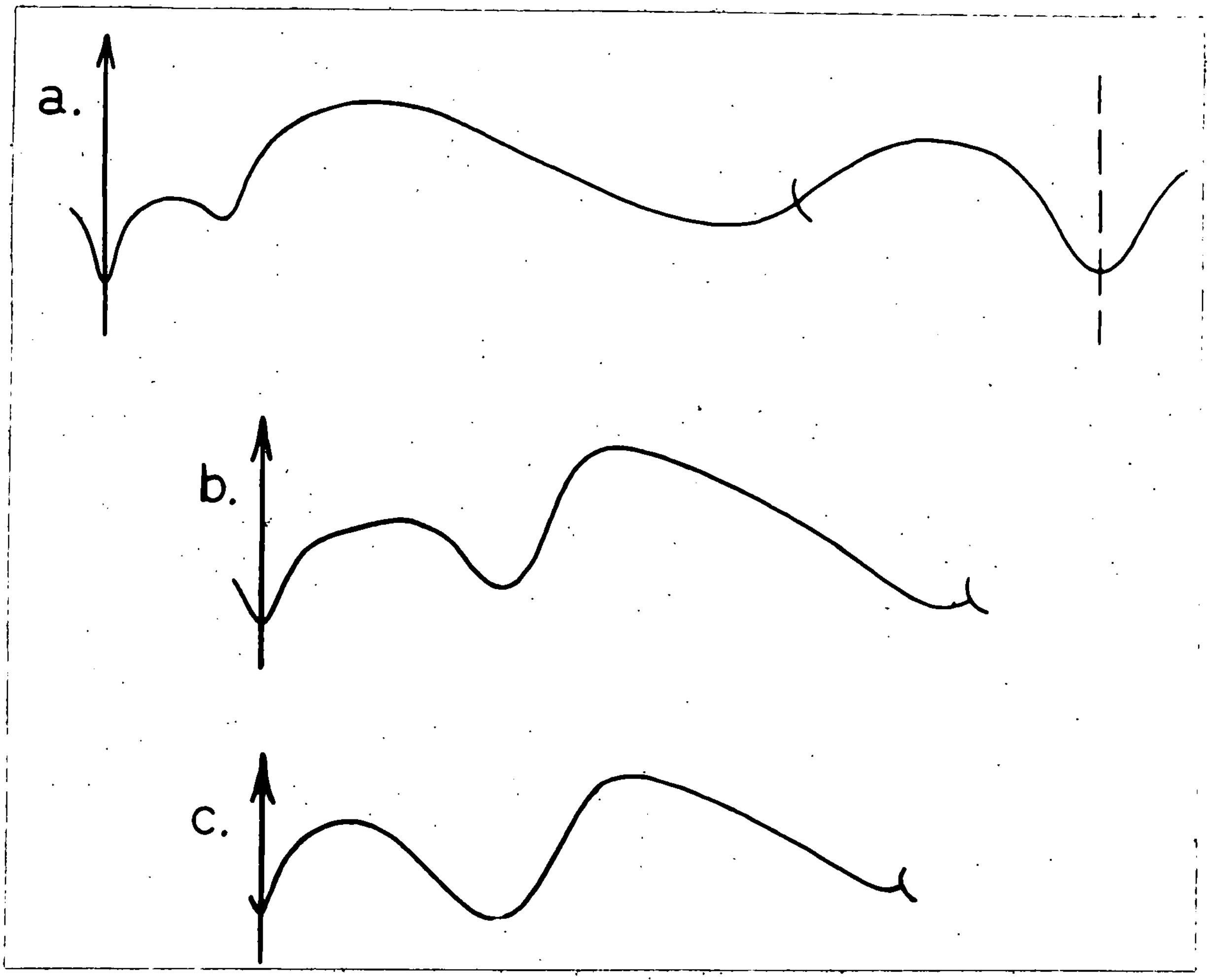
Remarks

The Devon specimens are slightly more rotund than typical Büdesheim specimens; also the growth line bands shown well on the German specimens (pl.20, fig.2) are rare on Devon specimens (cf. pl.20, figs.4,6 and pl.22, fig.4). The sutural form agrees and the Devon specimens even show the same flat-topped ventro-lateral saddle at intermediate diameters. The total development is identical with that figured by Schindewolf (1954 p.131, text fig.4) for T. (A.)

paucistriatum from Büdesheim : that is, the lateral lobe of the adult develops adventitiously well down the ventral slope of the ventro-lateral saddle and not near the crest as in T. (T.) simplex.

Specimens, Horizon and Locality

All English specimens are from Saltern Cove. They include; BM.c18445, c49451 (figured Lee 1877 pl.5, fig.1), D.203, 267, 244, 206, ? 231. In Germany this species occurs in the Cordatum Zone (type horizon) and Holzapfeli Zone. The associated Crickites show the Devon horizon is Holzapfeli Zone.



Text fig. 58. Tornoceras (Aulatornoceras) auris auris (Quenstedt). a. Suture at 1.9mm diameter based on D.1107 from Büdesheim, X 50. b, Suture at 6mm diameter based on BM.c18445 from Saltern Cove, X 25. c. Suture at 12mm diameter based on D.1080 from Büdesheim, X 12½.

2. Tornoceras (Aulatornoceras) auris var. bickense Wedekind

Plate 20, figure 5.

1917 Tornoceras auris var. bickensis R. Wedekind 1917, p.137.

This variety was proposed, but not figured, by Wedekind for specimens of T. auris with 3-4 constrictions.

Description (English specimens are from Saltern Cove)

Dimensions	D	WW	WH	UW	Constrictions per whorl
D.247	4.0	2.5	1.8	c.0.4	c.3
D.263	4.3	3.0	2.0	c.0.6	4
BM.c49439	3.2	2.2	1.7	c.0.3	2 in last ½ whorl
Büdesheim specimen :	4.8	2.4	2.0	0.6	c.4

Shell form rotund and involute with a very small umbilicus. Whorl section well rounded with a maximum width close to the umbilical shoulder. Impressed depth about 45%.

Growth lines swing gently forward across the lateral areas and ventro-laterally sweep sharply forward to form a prominent salient which passes back to form a sinus on the venter. The constrictions number 3-5 per whorl and apparently follow the course of the growth lines.

The sutural elements of the adult are established even by 2.4mm diameter and consist of a small V-shaped ventral lobe, a rounded ventro-lateral saddle and a lateral lobe passing to a well arched latero-umbilical saddle whose ventral face is particularly steep.

Remarks

Despite the general small size of the specimens they fit well the brief original description of Wedekind and the fuller description of Matern (1931 p.31).

Specimens, Horizon and Locality

English specimens come from Saltern Cove, Devon from the Holzapfeli Zone. Specimens include ; GS.86993, ? 86994, BM.c49439, D.247, 263, and a large specimen in the collection of Mr.L.G. Anniss.

3. Tornoceras (Aulatornoceras) sp. nov. aff. auris (Quenstedt)

Plate 18, figures 3 and 4, Plate 22, figures 5 and 6.

Some specimens from Saltern Cove are near to T. auris but are much more rotund.

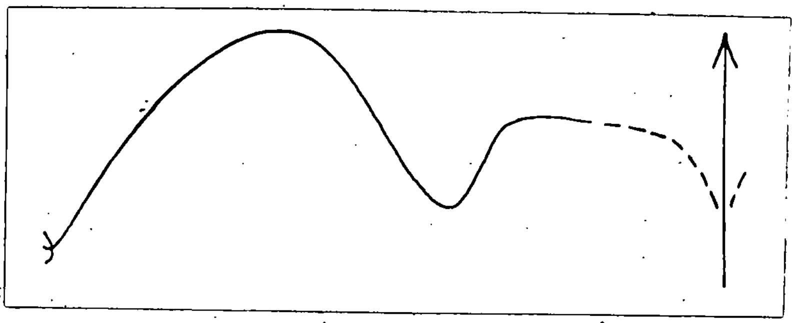
Description

Dimensions	D	WH	WW	UW
BM.c18440	8.9	5.5	6.5	0
BM.c49448	5.3	3.5	3.8	0

Shell form involute, rotund, with well rounded outline and closed umbilicus. Whorl section sub-circular, depressed, widest near to umbilicus. Venter rather flat, traces of ventro-lateral furrows.

Growth lines pass slightly forward from the umbulicus and then sweep back to form a wide, shallow lateral sinus; in juvenile they may be radial in the lateral area. Ventro-laterally they project forward in the furrows to form a long lappet and return to a ventral sinus whose base is slightly anterior to the radius of the lateral sinus.

Suture forms a small V-shaped ventral lobe, a flat topped, ventrally sloping ventro-lateral saddle, a U-shaped lateral lobe and a very highly arched umbilico-lateral saddle (text fig. 59).



Text fig. 59. Tornoceras (Aulatornoceras) sp. nov. aff. auris (Quenstedt). Suture based on BM.c49448, X 40, from Saltern Cove, South Devon. Holzapfeli Zone.

Remarks

The tumid and rounded form of this species readily separates it from related forms. It is close in shell form to T. (T.) sp. nov.

aff. crassum but the long growth line lappet, the ventro-lateral furrows and the flat topped ventro-lateral saddle easily distinguishes it. This form is not represented in the Büdesheim fauna.

Specimens, Horizon and Locality

All English specimens are from Saltern Cove, Devon. They include BM.c18440, c49448 (formerly c1961f) and a large specimen in the collection of Mr. L.G. Anniss. Horizon, Holzapfeli Zone of Frasnian.

4. Tornoceras (Aulatornoceras) paucistriatum (d'A. and de V.) var. nov.

Plate 21, figures 1, 2, 9, and 10.

Varieties of T. (A.) paucistriatum which have 3-4 constrictions are not uncommon at Saltern Cove. They stand in the same relation to the true species as T. auris var. bickense does to T. auris var. auris.

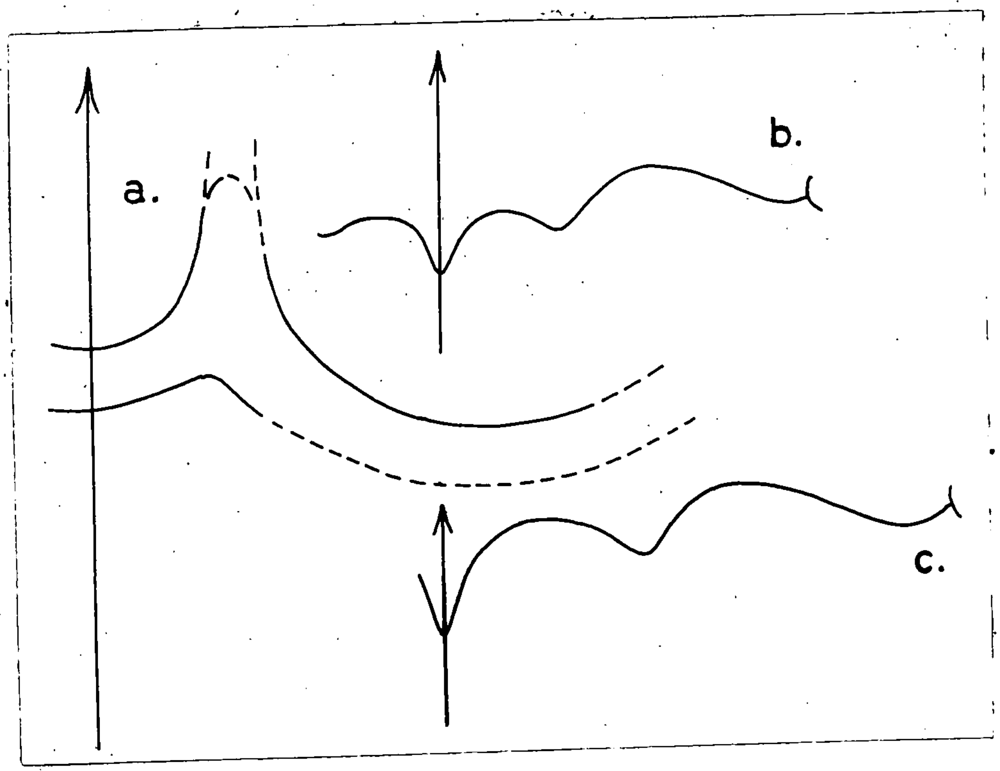
Description

Dimensions	D	WH	WW	UW
SM. H1528	8.7	3.5	4.6	c.2.5
D.241	6.8	2.8	4.0	1.9

Shell form sub-involute, laterally compressed. Whorl section well rounded, with ventro-lateral furrows above 6mm diameter. The lateral areas are well rounded, maximum width slightly dorsal of mid flanks. Impressed depth 34% at 8.7mm diameter. Body chamber seen for 3/4 whorls.

Growth lines pass radially and rather flexuously out from the umbilicus and sweep forward to the ventro-lateral furrows where they form a prominent projecting salient. There are three or four constrictions per whorl which coincide approximately with the growth lines (text fig. 60a) : above 6mm diameter they are confluent with the ventro-lateral furrows.

The suture (text fig. 60b,c) forms a small V-shaped ventral lobe



Text fig. 60. Tornoceras (Aulatornoceras) paucistriatum var. nov. a, Constriction at 6mm diameter. b, Suture at 4mm diameter, both based on D.246 from Saltern Cove. c, Suture based on SM. H1525 from Saltern Cove. All X 20. Holzapfeli Zone, Frasnian.

with a well rounded ventro-lateral saddle and shallow, sub-acute lateral lobe. The umbilico-lateral saddle is wide and gently arched, steeper ventrally. The Lateral lobe is subumbilical in position. Dorsal suture not seen.

Remarks

This variety may be distinguished from T. (A.) auris var. bickense by the wider umbilicus and from early whorls of T. (A.) auris var. auris by the less evolute form, the presence of regular deep constrictions and the absence of occasionally strong growth lines. This variety may be close to the poorly known species, T. constrictum, and a specimen comparable with the holograph from the type locality is here figured (pl.21, fig.8), the sutural elements of which are more arched and the umbilicus less wide than in the Devon specimens under discussion.

Specimens, Horizon and Locality.

Known best from Saltern Cove, Devon from the Holzapfeli Zone ; specimens include SM. H1525, D.241, 246, 311. Also from Butter Cove, North Cornwall, D.699. Frasnian.

5. <u>Tornoceras</u> (<u>Aulatornoceras</u>) aff. <u>sandbergeri</u> Foord and Crick

Plate 18, figures 6 and 7.

<u>Description</u> (of two specimens from Trevone, North Cornwall)

Dimensions	D	WH	WW	UW	UW/D
D.935	17.1	8.4	6.8	3.2	c. 19
D.891	18.4	8.8	7.4	2.5	c. 14

Shell form involue, with open umbilicus, laterally compressed and parallel sided. Venter rounded, with two shallow ventro-lateral furrows. Whorl section compressed (WW/WH=81% at 17.1mm diameter in D.935), flanks parallel but slightly convex. Impressed depth 46 % at 17mm diameter.

Growth lines pass forward across the umbilical shoulder and then sweep slightly back to form a broad, rounded sinus on the outer part of the lateral areas. They then pass sharply forward to make a narrowly rounded salient in the shallow ventro-lateral furrows and back to form a sinus on the venter.

The suture has a V-shaped small ventral lobe, a rounded ventro-lateral saddle, a deep and sub-acute lateral lobe and a rather short umbilico-lateral saddle with a steep ventral face. The Lateral lobe centres on the seam ; there is a deep median dorsal lobe.

<u>Remarks</u>

Although very near to the form distinguished by the Sandberger brothers as <u>Goniatites</u> <u>retrorsus</u> <u>undulatus</u> the umbilico-lateral saddle of the Cornish specimens is shorter and less arched and the sides are flatter. Foord and Crick (1897 p.112) proposed the name <u>T</u>. <u>sandbergeri</u> for this group, selecting a holotype among the Sandberger's figures (pl.10, fig.17,17a), pointing out that <u>Goniatites</u> <u>undulatus</u> is pre-occupied (by Brown 1841). Several subsequent authors have used the invalid name (Wedekind 1917 p.136).

<u>Specimens, Horizon and Locality</u>

Only known in England from Pentonwarra Point, Trevone from the Terebratum Zone , Givetian. The type horizon is Cordatum Zone. Specimens include only D.891, 935. Foord and Crick's records from Saltern Cove have not been substantiated.

6. Tornoceras (Aulatornoceras) sp. nov. aff. varicata Wedekind.

Plate 21, figures 4 and 5.

One specimen of Aulatornoceras from Portquin has a peculiar beaded venter and compressed form which does not agree with any previously named species.

Description (of D.707 from Portquin, North Cornwall)

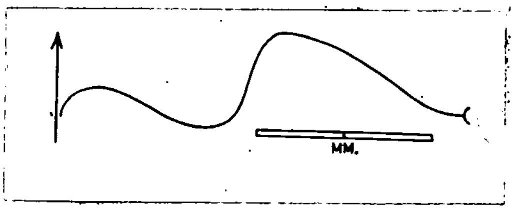
Dimensions	D	WH	WW	UW
D.707	7.0	4.2	c.3.4	0

The specimen is preserved as an internal pyritic mould : it is still septate at the maximum diameter.

Shell form involute, laterally compressed and with closed umbilicus. Venter with a narrow raised ridge (0.8mm wide at 6mm diameter) with furrows on each side periodically emphasised by constrictions. Lateral areas convex, sloping gently out to a maximum whorl width near the umbilical shoulder.

Growth lines pass almost radially across the flanks forming only a slight sinus. They swing forward to form a narrow ventro-lateral salient and back to a narrow, rounded sinus on the venter. At regular intervals small constrictions are formed across the venter which accord with the growth lines. There are seven of these in the last half whorl which give the venter a beaded form.

Suture consists of a small V-shaped ventral lobe, a shallow lateral lobe and a very arched latero-umbilical saddle with a steep ventral face (text fig. 61). There are nine septae in the last half whorl.



Text fig. 61. Tornoceras (Aulatornoceras) sp. nov. aff. varicata Wedekind. Suture at 6.8mm diameter based on D.707 from Portquin, North Cornwall, X 12. Terebratum Zone, Givetian.

Remarks

The nearest figured species to this specimen is T. frechi var. varicata from the Upper Frasnian of Martenberg, but this, according to the brief description given by Wedekind for the frechi group of tornoceratids has parallel sided lateral areas and no ventro-lateral furrows (Wedekind 1917, p.136). The restriction of constrictions to the ventral area and the more compressed form distinguishes it from the T. (A.) auris group.

Specimen, Horizon and Locality

One specimen only, D.707, from Portquin, North Cornwall. Terebratum Zone, Givetian.

7. Tornoceras (? Aulatornoceras) aff. belgicum Matern.

Plate 21, figures 6, 7 and 11.

aff. 1931 Tornoceras belgicum H. Matern 1931a, p.9, text fig.2.

Certain specimens from Saltern Cove are comparable with T. belgicum in shell form but have very simple sutures. They are thought to be immature, showing delayed formation of the adventitious lateral lobe.

Description

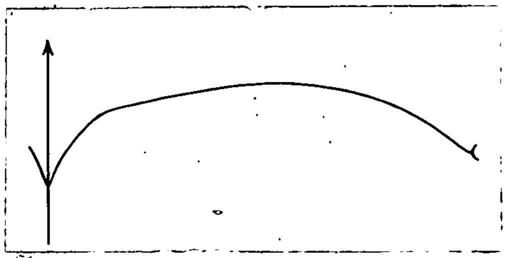
Dimensions	D	WH	WW	UW	
BM.c18448	7.3	3.8	3.5	c.1.1	
BM.c18452	6.0	3.6	2.9	0.9	figures approx.
(dimensions of Matern's Holotype					
	4.5	-	2.4	1.2)	

Shell form involute, laterally compressed with well rounded venter. Around 4,5mm diameter the whorl width equals the height. Subsequently the relative whorl height increases and the lateral slopes become flatter but the venter remains broad and well rounded. The body chamber is seen to occupy rather less than one complete whorl.

The growth lines cannot be traced. There are 4-5 constrictions per whorl which curve slightly back from the umbilical shoulder and then project markedly and concavely forward across the flanks to form small, rounded lappets on the ventro-lateral area, and back to a shallow, rounded sinus on the venter.

The suture shows a very simple form (text fig. 62). A pointed, V-shaped ventral lobe passes out laterally into a very broad lateral saddle whose crest lies 2/3 way towards the umbilicus, or may be nearer the venter (BM.c18451). From the crest the suture curves down to a lobe on the umbilical seam, possibly with a slight concavity.

Text fig. 62. Tornoceras (? A.) aff. belgicum Matern. Suture at 4.2mm diameter based on BM. c18448 from Saltern Cove, Devon. X 24. Holzapfeli Zone, Frasnian.



Remarks

The shell form of this species from Boussu-en-Fagne, Belgium, was described by Matern and it agrees well with the Saltern Cove specimens. Matern did not, however, describe the suture. In most species of Tornoceras the adventitious lateral lobe of the adult has developed long before 4mm diameter; in T. simplex it is formed by 1.4mm diameter+ (Schindewolf 1929, p.31) and it is formed at least by 2mm diameter in T. (A.) paucistriatum. The British Museum specimens were labelled T. ausavense , with which it is not related (cf. pl.21, fig.3), and that species forms the lateral lobe before 2mm diameter. The Belgium specimen comes from the Schistes de Matagne which, according to Matern (1931a p.7) belongs in part to the Cordatum and Holzapfeli Zones. Matern gave the horizon of the Holotype as Frasnian (b)c, or Cordatum Zone.

Specimens, Horizon and Locality

English specimens are from Saltern Cove, Devon which on other evidence is correlated with the Holzapfeli Zone. Specimens include , BM.c18448, c18452, c18451, ? c49437 and a specimen in the collection of Mr. L.G. Anniss.

+ In D.805, illustrated in text fig. 48, it arises at about 3mm diameter.

Family CHEILOCERATIDAE Frech 1897
Subfamily SPORADOCERATINAE Miller & Furnish 1957

Genus SPORADOCERAS Hyatt 1884

Type species : Goniatites bidens G. & F. Sandberger 1850

Diagnosis : Ammonoids with dorsal siphuncle and rotund to discoidal shell form, involute with closed umbilicus. Suture with a ventral lobe, a second adventitious lobe on the ventro-lateral area and a first adventitious lobe lateral in position. The Lateral lobe centres approximately on the umbilical seam. Dorsal suture with sub-umbilical and median lobes. Growth lines convex.

Remarks : The sutural ontogeny of this genus was described by Perna (1914 p.33). Nomenclatorial details have been given by Miller (1938 p.174) and more recently discussed by Müller (1956 p.56). Schindewolf (1923) worked out the evolution of the genus from Cheiloceras, and Schmidt (1952 p.213) has recently stated that the genus may arise monophyletically from the subgenus Torleyoceras.

1. Sporadoceras biferum (Phillips)

Plate 23, figure 5.

1841 Goniatites biferus J. Phillips 1841, p.120, pl.49, fig. 230a, b.
\+ 1908 Sporadoceras biferum R. Wedekind 1908, p.593, pl.39, fig. 20, 22, pl.40, fig.2.
1913 Sporadoceras biferum F. Frech 1913, p.31.
1917 Sporadoceras biferum R. Wedekind 1917, p.149, pl. 18, fig.15.
1921a Sporadoceras biferum H. Schmidt 1921a, p.328, text fig. 6b.
\+1923 Sporadoceras biferum O.H. Schindewolf 1923a, p.341, text fig. 5b.
? 1950 Sporadoceras biferum G. and H. Termier 1950, p.58, pl.153, figs. 26-28.

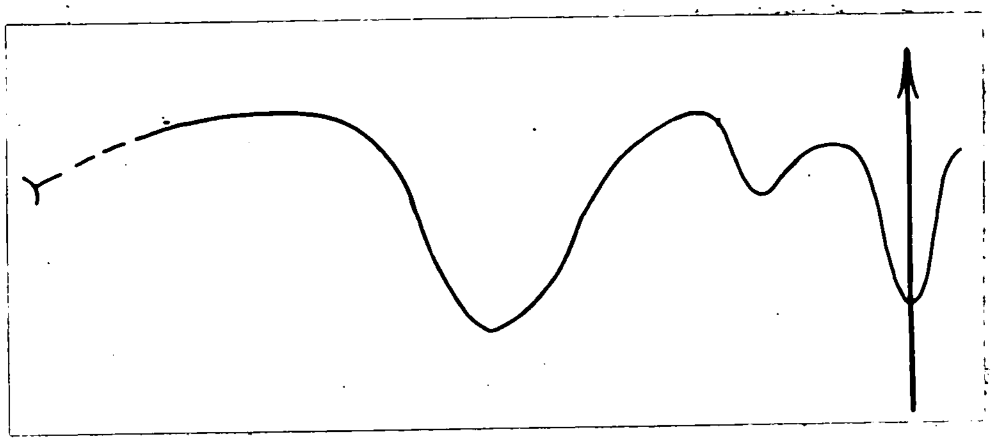
This species has not been studied in detail. The following description is based on GS.57301, from South Petherwin, Cornwall.

Description

Dimensions	D	WW	UW
GS.57301	c.15.0	9.0	0

Shell form involute, with closed umbilicus, laterally compressed. Whorl section with rounded venter from which flanks diverge convexly to a maximum width close to the umbilicus.

Growth lines convex (fide Phillips 1841 p.120). Suture forms a deep and narrowly V-shaped ventral lobe, a small, rounded 2nd adventitious lobe on the ventro-lateral saddle. A ~~spatulate~~ linguiform 1st adventitious lobe, lateral in position, and an arched and well rounded umbilico-lateral saddle. (text fig. 63).



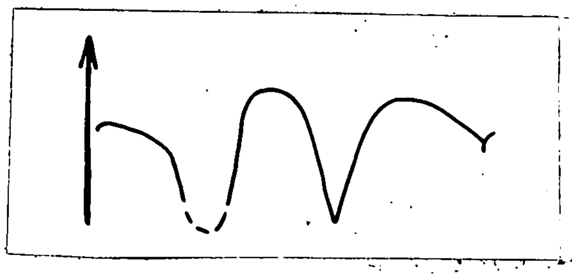
Text fig. 63. Sporadoceras biferum (Phillips). Suture at 15mm diameter based on GS.57301 from South Petherwin, North Cornwall. Famennian, Platyclymenia Stufe. X 12½.

Remarks

This Sporadoceras species is characteristic of the Platyclymenia Stufe in Germany (Schindewolf 1923 p.342) but has also been recorded from the Upper Cheiloceras Sufe. The South Petherwin localities have not provided evidence so far of the Cheiloceras Stufe.

2.. Sporadoceras cf. contiguum (Münster)

A single specimen in the Torquay Museum labelled Goniatites (Gephyroceras) intumescens (TM.34/12) from Lower Dunscombe, Chudleigh shows the suture of S. contiguum. The specimen is poorly preserved but clearly involute and with a closed umbilicus ; it is not worthy of description but the suture is figured here (text fig. 64).



Text fig. 64. Sporadoceras cf. contiguum (Münster). Suture based on TM.34/12 from Lower Dunscombe, Chudleigh. Famennian, ? Platyclymenia Stufe. X 2.

This specimen, together with a specimen of Cymaclymenia striata from the same locality in the British Museum, gives evidence for the presence of Famennian above the Frasnian thin-bedded limestones of Lower Dunscombe Quarry.

3. Sporadoceras posthumum (Wedekind).

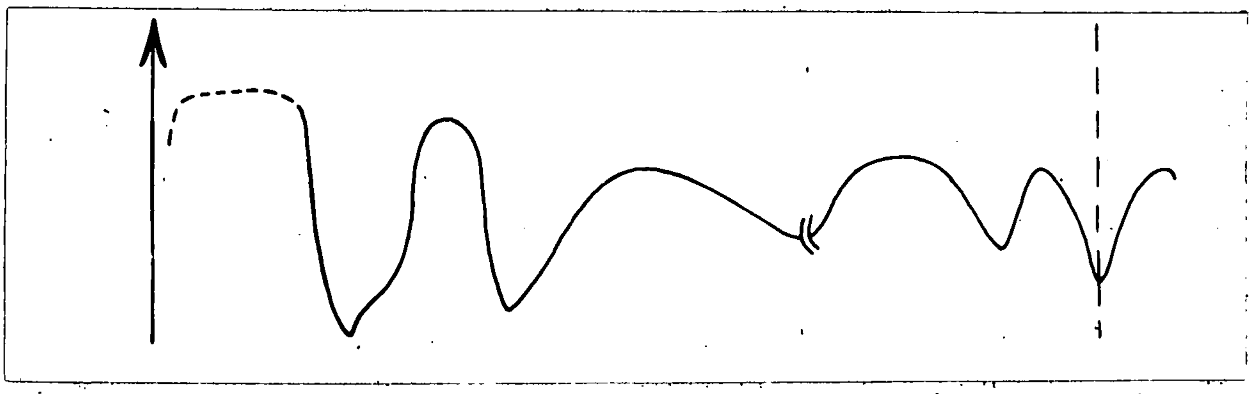
1917 Sporadoceras contiguum var. posthuma R. Wedekind 1917, p.149, pl.18, fig.13, text fig.47k.
+1924 Sporadoceras contiguum var. posthuma H. Scmidt 1924, p.123.

One poorly preserved specimen of this species was found by the writer at Brentor.

Description

Dimensions	D	WW	WH	Wh	
GS.87113-5	c.56	28	c.34	c.19	figures approx.

Shell form involute, rounded, with umbilicus probably closed. Deep impressed depth. Growth lines not seen. Suture (text fig. 65) shows a very small ventral lobe, a pointed 2nd adventitious lobe with parallel sides, the saddle between it and the venter is flat topped or forming a very slight lobe if at all. 1st adventitious lobe V-shaped, assymetric ; moderately arched umbilico-lateral saddle. Dorsal suture with umbilical and median lobe.



Text fig. 65. Sporadoceras posthuma (Wedekind). Suture based on GS.87113-5 collected by the writer from a spoil heap at South Brentor Quarry. Famennian, ? Clymenia Stufe. X 2.

Remarks

The suture of this specimen is quite close both to those figured by Schmidt and by Wedekind. The saddle adjacent to the venter does not seem to develop a 3rd adventitious lobe and the specimen is therefore not a Discoclymenia, the genus which is derived from this species.

Specimen, Horizon and Locality

Only GS.87113-5, a single fragmentary specimen collected by the writer, from a spoil heap at South Brentor Quarry, Devon. Probably Clymenia Stufe.

Subfamily IMITOCERATINAE Rhuzhencev 1950

Genus IMITOCERAS Schindewolf 1923

Type species : Ammonites rotatorius de Koninck 1844.

Diagnosis : Ammonoids with ventral siphuncle, involute shell, usually globular or slightly laterally compressed, umbilicus closed. Growth lines convex. False constrictions. Suture with a parallel sided median ventral lobe, a lateral lobe adventitious in origin, a Lateral lobe centred on or near the umbilical seam, dorsal suture with an umbilical and a median lobe.

Remarks : Schindewolf (1952 p.287) has recently re-discussed his genus Imitoceras and given farther details of its ontogeny. A detailed account of the nomenclatorial relations of the genera Imitoceras, Prionoceras, Brancoceras, Aganides, Postprolobites and Gattendorfia has been given by Miller and Collinson (1951 p.458). Librovitch (1940 p.226) has critically discussed the evidence bearing on Imitoceras and its relation to Prionoceras and Gattendorfia.

1. Imitoceras lineare (Münster)

Plate 23, figures 6 and 7.

1832 Goniatites linearis G. Münster 1832, p.17, pl.5, figs.1a-d.
+1897 Tornoceras lineare A.H. Foord and G.C. Crick 1897, p.96, text fig.97.
1913 Aganides sulcatus (pars) F. Frech 1913, p.30.
1917 Brancoceras stillei R. Wedekind 1917, p.147, 170, pl.18, fig.14, text fig. 54.
1923 Imitoceras stillei O.H. Schindewolf 1923, p.335, text fig. 4g 1,2.
++1952 Imitoceras lineare O.H. Schindewolf 1952, p.292, text fig. 8 (Holotype), 9-11, pl.2, figs. 1,2.

This species occurs at South Petherwin and also, derived from the Trias, near Teignmouth, Devon.

Description

Dimensions	D	WH	Wh	WW	UW
BM.c12728 (from Shaldon Beach)	42.0	c.23.5	c.9.0	23.6	0
Specimen in Exeter Museum from South Petherwin	21.8	c.11.2	-	c.13.7	0

Shell form rotund, laterally compressed, with closed umbilicus. Whorl section widest near to umbilicus, flanks slope convexly to the broadly-rounded venter.

Growth lines slope slightly backward and convexly across the flanks to form a rounded sinus on the venter. Constrictions false, following growth lines and reducing in prominence in later whorls, numbering about three per whorl.

Suture with a ventral lobe, not well seen, a rounded ventro-lateral saddle, sloping into a sharp V-shaped lateral lobe. Arched umbilico-lateral saddle, steep on ventral side and sloping gently to the umbilicus (BM.c12728).

Remarks

Schindewolf (1952) has re-figured the Holotype of this species and the shell form agrees well with the English specimens here included, but few of them show the suture. The lateral lobe of one Shaldon specimen (BM.c12728) is much narrower than that of the Holotype of B. stillei with which Schindewolf considers I. lineare to be conspecific (1952 p.293, text fig.10b), but the lateral lobe is like that of a specimen figured as I. stillei by Schindewolf in 1923 (p.330, fig. 4g2)

Specimens, Horizon and Locality

This species occurs at South Petherwin (specimen in Exeter Museum) and is common in pebbles from the Trias at Shaldon Beach, Teignmouth, Devon and specimens include, BM.c12728,c12722, c12727, c12753, c12755. In Germany this species occurs in the Clymenia and Wocklumeria Stufen and a specimen has been recorded from the Gattendorfia Stufe (Schindewolf 1952 p.294). Clymenids occur with the Shaldon material which suggests that these specimens were derived from the upper Famennian, possibly the Clymenia Stufe.

2. Imitoceras sulcatum (Münster)

Plate 23, figures 3 and 4

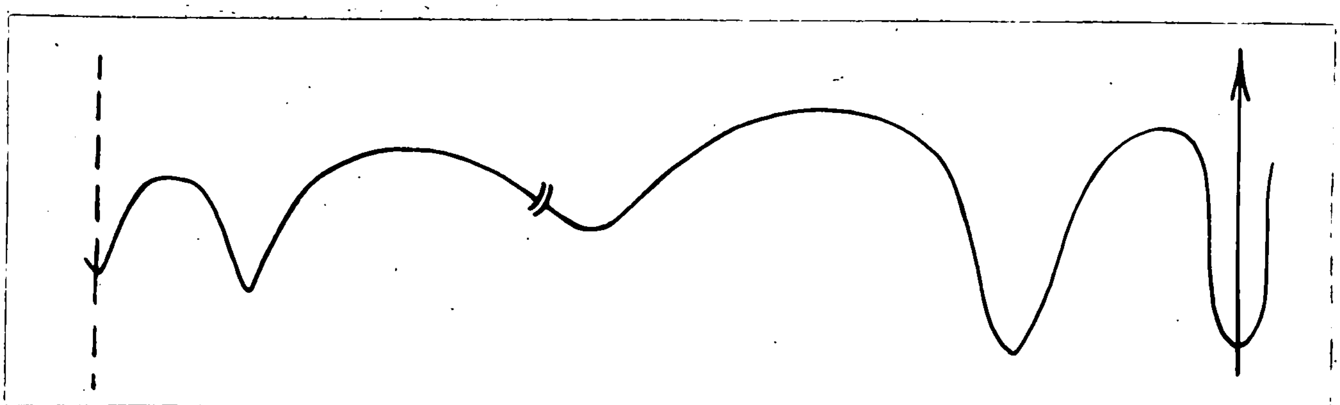
? 1832 Goniatites sulcatus G. Münster 1832, p.23, pl.3, figs. 7a-c.

1848 Goniatites sulcatus Rh. Richter 1848, p.32, pl.4, figs. 100-112.

1884 Brancoceras sulcatum A. Hyatt 1884, p.326.

1917 Brancoceras sulcatum R. Wedekind 1917, p.147, pl. 14, fig. 3.
+1931 Prionoceras sulcatum H. Matern 1931, p.53.
+1956 Prionoceras sulcatum K.J. Müller 1956, p.65, pl.2, fig. 17a,b.

A specimen collected by Officers of the Geological Survey 680 yards north-west of Marytavy Church, Devon has been determined by Dr. H. Schmidt of Göttingen, by means of a cast and photographs, as this species. Photographs are given here of the specimen and the suture is illustrated (text fig. 66). The specimen is too poorly preserved to warrant detailed description. The horizon is probably Clymenia Stufe where this species is commonest in Germany.



Text fig. 66. Imitoceras sulcatum (Münster). Suture at 14.5mm diameter based on GS.57362, dorsal suture from four septae previous. Specimen from a mine leat 680 yards north-west of Marytavy Church, Devon. X 8.

It may be noted that this specimen, and others commonly referred here, are closer the figures given by Richter (1848) than the holographs.

Chapter 5. SUMMARY OF ZONAL, STRATIGRAPHICAL AND PALAEOGEOGRAPHICAL CONCLUSIONS

The results embodied in the foregoing pages shed some light on certain stratigraphical and palaeogeographical problems through the more certain age determinations they give for the various localities. The occurence of the faunal divisions distinguished are summarised in the following table.

STUFE	ZONE	North Devon	South Devon	North Cornwall
GATTENDORFIA = L. Carb.		X	-	X
WOCKLUMERIA		X	?	X
CLYMENIA		-	X	X
PLATYCLYMENIA		-	X	X
CHEILOCERAS		-	-	-
MANTICOCERAS = Frasnian	Holzapfeli	-	X	?
	Cordatum	-	X	X
	Lunulicosta	-	X	-
MAENIOCERAS = Givetian	Terebratum	-	X	X
	Molarium	-	X	-
ANARCESTES = Couvinian	Jugleri	-	-	X
	Lateseptatus	-	X	
MIMOSPHINCTES		-	-	-

Mimosphinctes Stufe

No conclusive evidence indicating the presence of this fauna has been found. One poorly preserved specimen from East Looe, PM.1320, was thought to be a *Mimosphinctes*, but it may equally be a crushed brachiopod.

Anarcestes Stufe

A Couvinian age has already been given to the Calceola Shales yielding Anarcestes at Mudstone Bay (p.17) and Torquay (p.21). There is, in South Devon, no evidence for the Jugleri Zone. This suggests that the "Passage Beds" above the Calceola Shales may be in part upper Couvinian rather than lower Givetian. The occurence of supposed Couvinian slate at Cant Hill, Padstow (p.50), indicates that the lower part of the succession mapped by the Geological Survey as "Grey Slate" is possibly Couvinian.

Maenioceras Stufe

The recognition of two distinct faunas in the Givetian of South Devon constitutes one of the more important conclusions of this work. However, the Molarium fauna is, as yet, only known at Wolborough (p.25). The evidence shows that both the Molarium and Terebratum Zones in South Devon are represented by massive limestones, but these may pass locally into shale as several authors have suggested. The correlation of the fauna at Trevone (p.36) and Portquin (p.52), North Cornwall, with the Terebratum Zone shows that dark grey calcareous shales were laid down in North Cornwall whilst the limestones at Ransley (p.24), Lummaton (p.22) and Barton (p.24) were formed. The demonstration herein that goniatites can be used to correlate between the limestone facies and the slate facies of the Middle Devonian is likely to be of great stratigraphical value when more localities are known.

Manticoceras Stufe

South Devon. The goniatites appear to solve the problem of where the boundary between the Givetian and Frasnian should be drawn in South Devon. Lloyd (1933 p.69) has written "The difficulties of an attempt to subdivide the limestones between the Couvinian and Upper Devonian shales have already been stated. In the massive limestones forming the upper part of this series there is little doubt that the Upper Devonian is in part represented..." The recent discovery by Mr. Vincent of Terebratum Zone goniatites at Lummaton (p.22) shows that the principal fossiliferous horizon there is Givetian and the old records of "Rhynchonella cuboides" as indicative of the Frasnian are misleading. This conclusion is supported at Barton (p.24) where the upper part of the massive limestone also gives evidence of the Terebratum Zone.

At several localities in South Devon Frasnian goniatites occur in alternating limestones and shales, or rubbly limestones, immediately above massive limestone : they have not been found within the massive limestone. At Staverton (p.21) the Lunulicosta Zone has been recognized, but elsewhere the earliest date for these basal beds is Cordatum Zone, as at Elberry Cove (p.17), Galmpton Point (p.18), Chudleigh (p.27) and elsewhere. Accepting the measurements of Anniss (1927 p.495), the Saltern Cove succession may be modified as follows:

Purplish-red shales with Entomis [Famennian]	35feet +
Goniatite Band [Holzapfeli Zone]	5feet
Shale with thin limestones and ash and basalt intrusion. Alternating shale and limestone at the base	c360feet ? +
[Cordatum Zone at base indicated at Galmpton Point]	
Massive Limestone [Givetian] below	

The occurence of volcanic rocks in this succession suggest that the Ashprington Volcanic Series belongs to the age of the Cordatum Zone.

When this succession is traced north to Torquay there is evidence at Petit Tor Combe (p.22) that the Cordatum Zone is represented by shaly limestone which rests on massive Middle Devonian limestone. The Holzapfeli Zone has not been recognised but the Famennian occurs as ostracod shales and at Anstey's Cove contains Richterina (R.) sp. and R. (Maternella)sp. At Lower Dunscombe (p.27) Cordatum Zone thin-bedded and rubbly limestone rests directly on massive limestone. There is no evidence here of the other Frasnian zones which Anniss thought to be present. On the south-west side of Dartmoor, at Warren Point (p.31) the Frasnian is represented by variegated green and purple slate.

North Cornwall. In this region the Lunulicosta Zone has not been identified. On the south side of the St. Minver synclinorium, the lowest dated Frasnian, probably of Cordatum Zone age, occurs at Lower Merope Island (p.37). Tuff beds in Longcarrow Cove, between this locality and the Terebratum Zone locality at Trevone, may therefore be tentatively taken as marking the

Frasnian/Givetian boundary. On the north side of the St. Minver synclinorium the pillow lavas which stretch between Pentire Point and St. Kew intervene between the Terebratum Zone locality at Portquin and the many Cordatum Zone localities within the area mapped by the Survey as "Purple and Green Slate". This suggests a correlation between the tuff beds of Longcarrow Cove and the pillow lavas. The Gravel Caverns Conglomerate (p.51), probably of Cordatum Zone age, appears to represent the lowest Frasnian goniatite locality above the pillow lavas. Evidence at Butter Cove (p.39) shows that the Frasnian is represented around the Padstow Estuary by at least 150feet of grey slate, usually pale, with dark bands yielding goniatites, and that this series is exposed in the Estuary between St. George's Cove and around Harbour Cove (p.41, et seq.). The overlying purple and green variegated slate, seen to at least 600feet (p.39), must include some Frasnian at the base (p.49) and is not wholly Famennian. Only the Cordatum Zone of the Frasnian has been recognised with certainty in this area.

Cheiloceras Stufe

Although the Cheiloceras Stufe has been recorded at Lower Dunscombe (Anniss 1933, p.438) and in North Cornwall (Dewey 1914, p.157) the present work has shown these records to be due to misidentifications. Certainly around Saltern Cove, Anstey's Cove and in the Padstow area the lowest Famennian, at least, is represented by Cypridenenschiefer facies. North from this latitude the presence of the Platyclymenia Stufe at South Petherwin (p.53) in limestone facies, and at Chudleigh (p.30) in Kramenzelstein facies shows that either the Cypridenenschiefer facies changes northwards or that throughout it represents only the Cheiloceras Stufe and possibly the lower Platyclymenia Stufe (the horizon with Prolobites has not been found in England). A study of the exquisite ostracods of the Cypridenenschiefer facies and the correlation of them with the German succession established by Rabien (1954) and others would probably settle this matter. Trenching above Palace Quarry, Chudleigh (p.30) and Lower Dunscombe Quarry (p.29) might also help.

Platyclymenia, Clymenia and Wocklumeria Stufen

Since clymenids become the most valuable zonal fossils in the middle and upper Famennian this work has contributed nothing of significance towards knowledge of these levels. The dating of the Marytavy locality (p.32) and those at Brentor (p.32) does show that the succession around north-west Dartmoor has affinities with South Petherwin. In view of this, and the derived Trias records (p.30), the localities at Rora and Liverton (p.27) would warrant attention.

The recognition of the Gattendorfia Stufe and Wocklumeria Stufe in North Devon (Goldring 1955) and the latter in North Cornwall (House and Selwood 1956, Mr. E.B. Selwood has since found evidence for the Gattendorfia Stufe) tells against the large unconformity hitherto supposed to lie at the base of the Carboniferous in South-west England.

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PLATE 1

FIGURE 1. *Agoniatites costulatus* (d'Archaic and de Verneuil) sp. juv. Lateral view of a specimen from Trevone, North Cornwall. Givetian, Terebratum Zone. GS.95395, X 10.

FIGURE 2. *Agoniatites costulatus* (d'Archaic and de Verneuil). Lateral view of a specimen from Pentonwarra Point, Trevone. Givetian, Terebratum Zone. D.829, X 9.

FIGURE 3 *Agoniatites* cf. *transitorius* (Phillips). Lateral view of a specimen from Wolborough Quarry, Newton Abbot, South Devon. Givetian, Molarium Zone. SM.A6793, X 1.

FIGURES 4 & 5. *Agoniatites transitorius* (Phillips). Lateral and ventral views of a topotype from Wolborough Quarry, Newton Abbot, South Devon. Givetian, Molarium Zone. BM.c23707, X 2.

FIGURES 6, 7 & 8. *Agoniatites transitorius* (Phillips). Ventral and lateral views of a topotype from Wolborough Quarry, Newton Abbot, South Devon. Givetian, Molarium Zone. BM.36279, X 2.

FIGURES 9 & 10. *Agoniatites transitorius* (Phillips). Ventral and lateral views of the Holotype from Wolborough Quarry, Newton Abbot. Figured by J. Phillips in 1841. Givetian, Molarium Zone. GS.7115, X 2.


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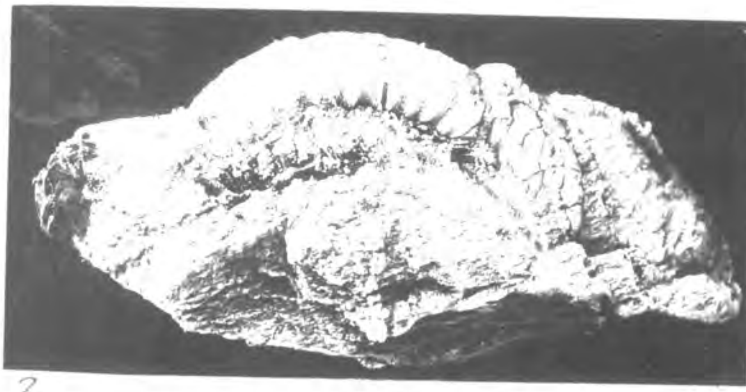
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PLATE 2

FIGURES 1, 2 & 3. Agoniatites fulguralis (Whidborne). Ventral and lateral views of the Holotype figured by Whidborne in 1890. From Lummaton Quarry, Torquay. Givetian, Terebratum Zone. SM.H4132, X 2.

FIGURES 4, 5 & 6. Agoniatites obliquus (Whidborne). Ventral and lateral views of a syntype from Wolborough Quarry, Newton Abbot. Givetian, Molarium Zone. GS.7114, X 2.

FIGURE 7. Agoniatites obliquus (Whidborne). Lateral view of a topotype from Wolborough Quarry, Newton Abbot. Givetian, Molarium Zone. BM.c1740, X 1.


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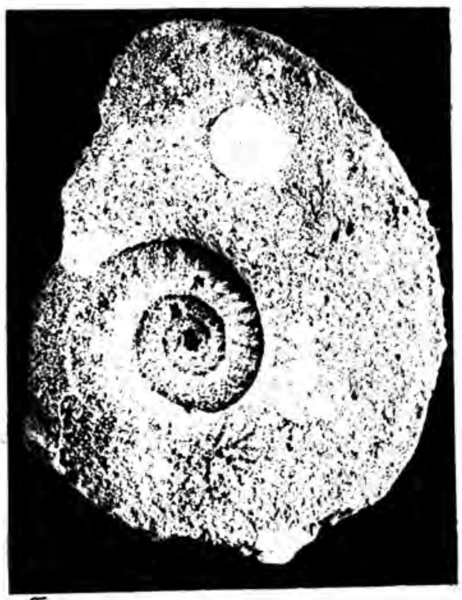
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PLATE 3.

FIGURES 1 & 2. Archoceras angulatum Donovan. Lateral and ventral views of the Holotype from Saltern Cove, South Devon. Frasnian, Holzapfeli Zone. GS.63381, X 6.

FIGURE 3. Archoceras angulatum Donovan. Lateral view of a paratype from Saltern Cove, South Devon. Frasnian, Holzapfeli Zone. BM.c40153, X 6.

FIGURE 4. Archoceras varicosum (Drevermann). Lateral view of a specimen from Waterside Cove, Saltern Cove, South Devon. Frasnian, Holzapfeli Zone. D.208, X 4.

FIGURES 5 & 6 Werneroceras cf. ruppachense (Kayser). Ventral and lateral views of a specimen from Pentonwarra Point, Trevone. Givetian, Terebratum Zone. D.902, X 4.

FIGURES 6, 7 & 8. Archoceras sp. nov. (aff. schlosseri Gallwitz). Lateral and ventral views of a specimen from Saltern Cove, South Devon. Frasnian, Holzapfeli Zone. SM.H1534, X 6.

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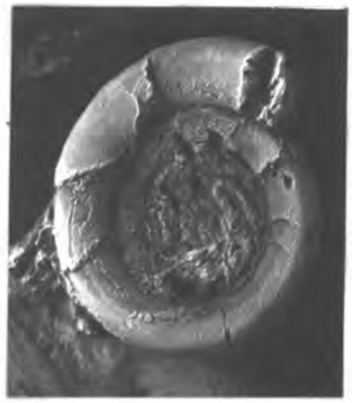

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PLATE 4

FIGURES 1 & 2. Werneroceras karpinskyi (Holzapfel). Ventral and lateral views of a specimen from Trevone, North Cornwall. Givetian, Terebratum Zone. PM.1027, X 6.

FIGURE 3. ? Anarcestes (Anarcestes) lateseptatus (Beyrich) var. plebeius (Barrande). Polished section of a specimen from Mudstone Bay, Brixham, South Devon. Couvinian, ? Lateseptatus Zone. BM.c30396.

FIGURES 4 & 5. Subanarcestes macrocephalus Schindewolf. Ventral and lateral views of an unlocalised specimen thought to come from Mudstone Bay, Brixham. ? Couvinian, Lateseptatus Zone. BM.c1768, X 1.

FIGURE 6. Holzapfeloceras aff. circumflexiferum (G. & F. Sandberger). Lateral view of a specimen from Portquin, North Cornwall. Givetian, Terebratum Zone. D.785, X 5.

FIGURES 7 & 8. Holzapfeloceras aff. circumflexiferum (G. & F. Sandberger). Ventral and lateral views of a specimen from Pentonwarra Point, Trevone. Givetian, Terebratum Zone. D.899, X 4.


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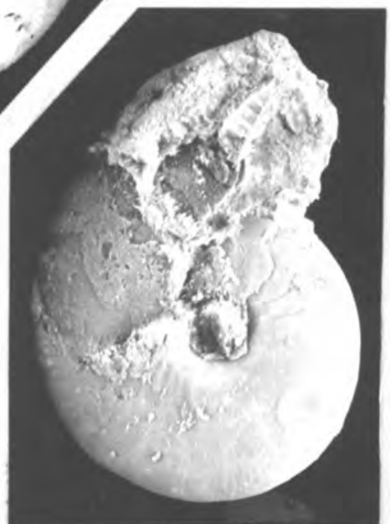
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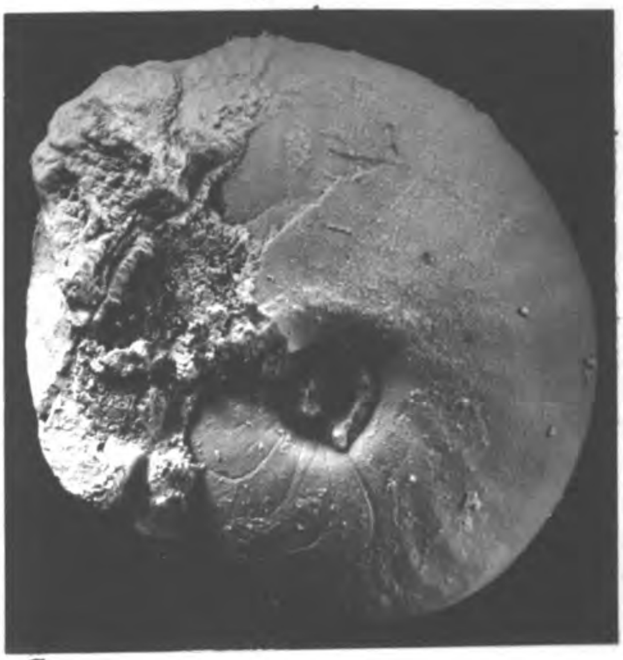
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PLATE 5

FIGURES 1 & 2. Wedekindella psittacinus (Whidborne). Ventral and lateral views of a syntype from Wolborough Quarry, Newton Abbot, South Devon. Givetian, Molarium Zone. GS.95338, X 1.

FIGURES 3 & 4. Wedekindella psittacinus (Whidborne). Ventral lateral views of a syntype from Wolborough Quarry, Newton Abbot, South Devon. Givetian, Molarium Zone. GS.95427, X 2.

FIGURES 5 & 6. Wedekindella sp. nov. Lateral and ventral views of a specimen from Wolborough Quarry, Newton Abbot. Givetian, Molarium Zone, GS.7118, X 4.

FIGURES 7 & 8, Wedekindella psittacinus (Whidborne). Ventral and lateral views of a syntype from Wolborough Quarry, Newton Abbot. Givetian, Molarium Zone. GS. 95426, X 1.1.

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PLATE 6

FIGURES 1 & 2. Wedekindella brilonense (Kayser) var. aratum (Whidborne). Ventral and lateral views of a syntype from Barton Quarry, Torquay, South Devon. Givetian, Terebratum Zone. BM.c1802, X 1.

FIGURES 3, 4, & 5. Wedekindella sp. nov. Ventral and lateral views of a specimen from Pentonwarra Point, Trevone, North Cornwall. Givetian, Terebratum Zone. D.829, X 4.

FIGURES 6 & 7. Wedekindella brilonense (Kayser). Ventral and lateral views of a specimen from Portquin, North Cornwall. Givetian, Terebratum Zone. GS.1592, X 5.4.

FIGURES 8 & 9. Wedekindella brilonense (Kayser). Ventral and lateral views of a specimen from Trevone, North Cornwall. Givetian, Terebratum Zone. GS.95404, X 7.

FIGURES 10 & 11. Wedekindella brilonense (Kayser). Lateral and ventral views of a specimen from "Newton Bushel", South Devon. Givetian, Terebratum Zone. GS.86992, X 2.


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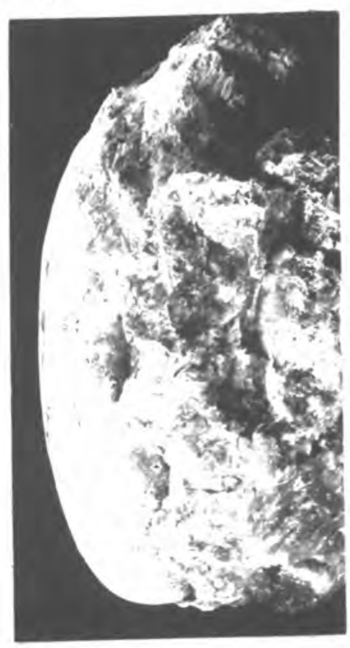
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PLATE 7

FIGURES 1, 2 & 3. <u>Maenioceras</u> <u>molarium</u> <u>molarium</u> (Whidborne). Lateral view of a syntype figured by J. Phillips in 1841. BM.c1803, X 1.

FIGURE 4. <u>Maenioceras</u> <u>molarium</u> (Whidborne) var. nov. Lateral view. GS.95332, X 1.

FIGURE 5. <u>Maenioceras</u> <u>molarium</u> (Whidborne) sp. juv. Lateral view. GS. 95341, X 1.9.

FIGURE 6. <u>Maenioceras</u> <u>molarium</u> (Whidborne) var. nov. Lateral view. GS.95334, X 1.

FIGURE 7. <u>Maenioceras</u> <u>molarium</u> <u>molarium</u> (Whidborne) Lateral view. GS.95330, X 1.05.

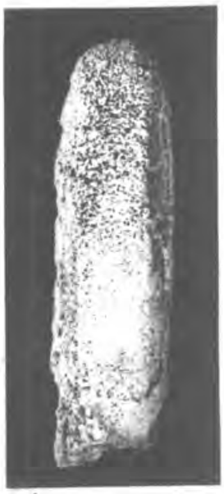
FIGURES 8 & 9. <u>Maenioceras</u> <u>molarium</u> (Whidborne) var. <u>apertum</u> (Foord and Crick). Ventral and Lateral views of the Holotype. GS.7112, X 2.

FIGURE 10. <u>Maenioceras</u> <u>molarium</u> <u>molarium</u> (Whidborne). Lateral view of syntype. BM.c40311, X 1.

FIGURES 11 & 12. <u>Maenioceras</u> <u>molarium</u> (Whidborne) var. <u>intermedium</u> (Foord and Crick). Lateral and ventral views of a syntype. BM.c30306b, X 1.

FIGURES 13 & 14. <u>Maenioceras</u> <u>molarium</u> (Whidborne) var. <u>intermedium</u> (Foord and Crick). Front and Lateral views of a syntype. GS.7111, X 2.

All these specimens are from Wolborough Quarry, Newton Abbot, South Devon and come from the Molarium Zone of the Givetian.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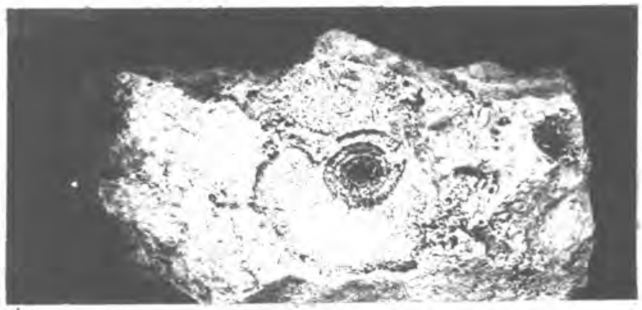
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PLATE 8

FIGURE 1. *Maenioceras terebratum* (G. & F. Sandberger). Lateral view of a specimen from Portquin, North Cornwall. Givetian, Terebratum Zone. GS.1570, X 5.

FIGURES 2 & 3. *Maenioceras molarium molarium* (Whidborne). Ventral and lateral views of a syntype from Wolborough Quarry, Devon. Givetian, Molarium Zone. GS.95333, X 2.

FIGURES 4 & 5. *Maenioceras* cf. *terebratum* (G. & F. Sandberger). Ventral and lateral views of a specimen from Wolborough Quarry, Devon. Givetian, Molarium Zone. BM.c15475 (=30306), X 2.

FIGURES 6 & 7. *Maenioceras decheni* (Kayser). Lateral and ventral views of a specimen from Lummaton Quarry, Torquay, South Devon. Givetian, Terebratum Zone. Exeter University Department of Geology collections, X 2.

FIGURES 8 & 9. *Maenioceras* aff. *decheni* (Kayser). Ventral and lateral views of a specimen from Wolborough Quarry, Devon. Givetian, Molarium Zone. GS.7117, X 2.


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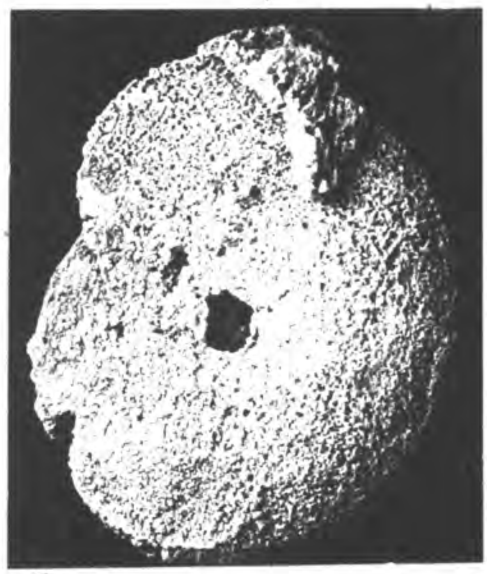
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PLATE 9

FIGURE 1. <u>Maenioceras</u> <u>terebratum</u> (G. & F. Sandberger). Lateral view of a specimen from the north side of Portquin estuary. Givetian, Terebratum Zone. D.715, X 4.

FIGURES 2 & 3. <u>Maenioceras</u> <u>terebratum</u> (G. & F. Sandberger) sp. juv. Ventral and lateral views of a specimen from Pentonwarra Point, Trevone, North Cornwall. Givetian, Terebratum Zone. D. 847, X 6.

FIGURES 4 & 5. <u>Maenioceras</u> <u>terebratum</u> (G. & F. Sandberger). Ventral and lateral views of a specimen from Lummaton Quarry, Torquay, Devon. Givetian, Terebratum Zone. Exeter University Department of Geology collections, X 2.

FIGURES 6 & 7. <u>Maenioceras</u> <u>terebratum</u> (G. & F. Sandberger). Lateral and ventral views of a specimen from Lummaton Quarry, Torquay, Devon. Givetian, Terebratum Zone. Exeter University Department of Geology collections, X 2.

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PLATE 10

FIGURES 1, 2 & 3. Sobolewia nuciformis (Whidborne). Ventral and lateral views of a syntype from Wolborough Quarry, South Devon. Givetian, Molarium Zone. BM.c9023, X 2.

FIGURES 4 & 5. Sobolewia nuciformis (Whidborne). Lateral and ventral views of a syntype from Wolborough Quarry, South Devon. Givetian, Molarium Zone. GS.95336, X 2.

FIGURES 6 & 7. Sobolewia nuciformis (Whidborne). Lateral and ventral views of a syntype from Wolborough Quarry, South Devon. Givetian, Molarium Zone. BM.c9024, X 2.1.


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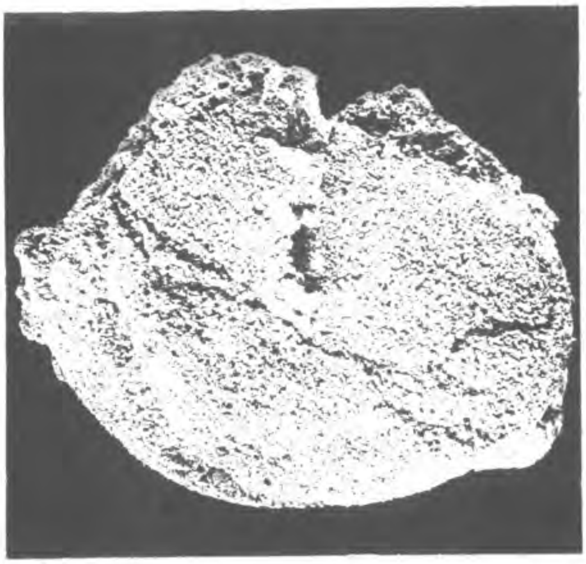
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PLATE 11

FIGURES 1, 2 & 6. <u>Sobolewia</u> <u>nuciformis</u> (Whidborne). Ventral and lateral views of a specimen from Pentonwarra Point, Trevone, North Cornwall. Givetian, Terebratum Zone. D.829. 1 & 2, X 4. 6, close-up to show pitting, X 12.

FIGURE 3. <u>Sobolewia</u> aff. <u>nuciformis</u> (Whidborne). Lateral view of a specimen from Pentonwarra Point, Trevone, North Cornwall. Givetian, Terebratum Zone. D.897, X 4.

FIGURE 4. ? <u>Foordites</u> sp. Lateral view of a specimen showing pitting on the internal mould. From Erg el Djemel (Ougarta), Algeria. 'Niveau à <u>Pinacites</u> <u>jugleri</u>', Eifelian. D.1035, X 2.

FIGURE 5. <u>Sobolewia</u> <u>nuciformis</u> (Whidborne). Ventral view of a specimen from Pentonwarra Point, Trevone, North Cornwall. Givetian, Terebratum Zone. D.896, X 4.

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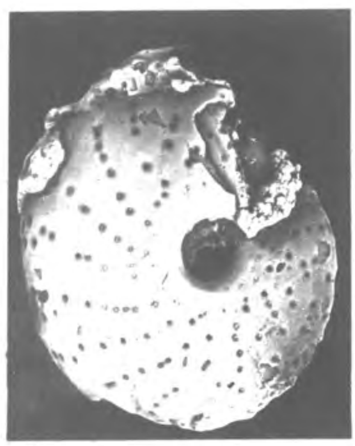

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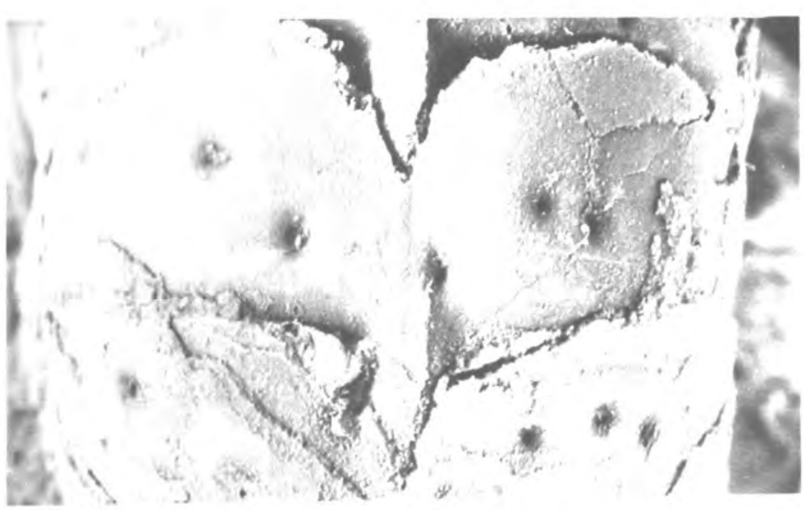

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PLATE 12

FIGURE 1. Ponticeras prumiense (Steininger). Lateral view of a specimen from locality E, St. George's Cove, Padstow, North Cornwall. Frasnian, Cordatum Zone. D.1278, X 4.4.

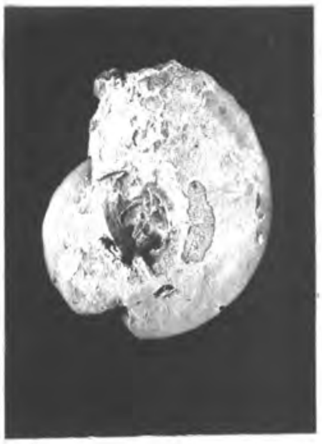
FIGURES 2 & 3. Ponticeras aff. gerolsteinense (Steininger). Lateral and ventral views of a specimen from locality B(i), St. George's Cove, Padstow. Frasnian, Cordatum Zone ?. D. 621, X 6.

FIGURE 4. Ponticeras sp. Lateral view of a specimen from locality E, St. George's Cove, Padstow. Frasnian, Cordatum Zone. D.1287, X 4.5.

FIGURES 5 & 6. Ponticeras prumiense (Steininger). Lateral and ventral views of a specimen from locality L(i), Harbour Cove, Padstow. Frasnian, Cordatum Zone.D.578X 5

FIGURE 7. Ponticeras prumiense (Steininger). Ventral view of a specimen from locality L(i), Harbour Cove, Padstow. Frasnian, Cordatum Zone. D.648, X 4.

FIGURES 8 & 9. Ponticeras forcipiferum (G. & F. Sandberger). Lateral and ventral views of a specimen from a quarry near St. John Baptist Chapel, Staverton Wood, South Devon. Frasnian, Lunulicosta Zone. GS. 95229, X 2. Specimen collected by Dr. G.V. Middleton.



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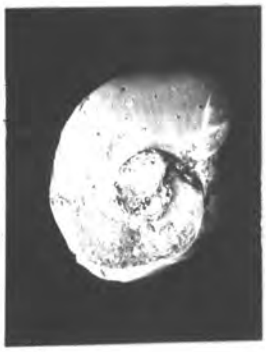

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PLATE 13

FIGURES 1 & 2. Manticoceras cordatum (G. & F. Sandberger), ventral and lateral views of a specimen from locality J(ii), Harbour Cove, Padstow. Frasnian, Cordatum Zone. D.547, X 4.

FIGURES 3 & 7. Manticoceras cordatum (G. & F. Sandberger). Lateral and ventral views of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1059, X 4.05.

FIGURE 4. Manticoceras cf. lamed (G. & F. Sandberger). Median section of a specimen from locality D(i), St. George's Cove, Padstow. Frasnian, Cordatum Zone. D.1267, X 4.

FIGURES 5 & 6. Manticoceras cf. cordatum (G. & F. Sandberger). Lateral and ventral views of a specimen from Lower Dunscombe Quarry, Chudleigh, South Devon. Frasnian, Cordatum Zone. D.107, X 1.

FIGURE 8. Manticoceras lamed (G. & F. Sandberger). Lateral view of a specimen from locality J(ii), Harbour Cove, Padstow. Frasnian, Cordatum Zone. D.617, X 6.

FIGURE 9. Manticoceras sp. Lateral view of a polished specimen from Shaldon Beach, Teignmouth, derived from the Trias. Ex Frasnian. BM.c12705, X 1.


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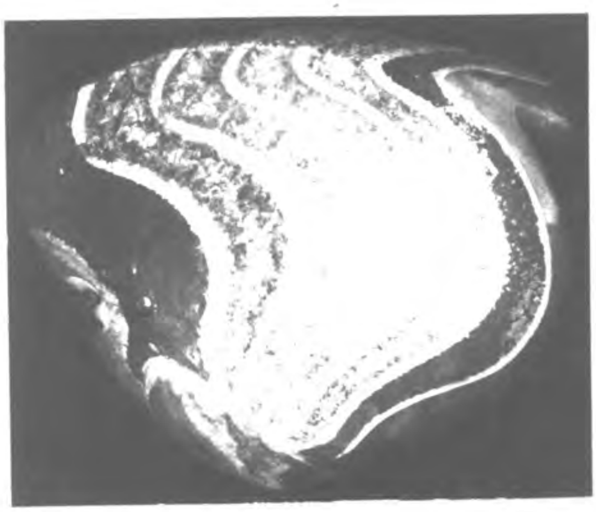
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PLATE 14

FIGURES 1 & 2. Manticoceras sp. nov. (aff. unduloconstrictum Miller). Ventral and lateral views of a specimen from Saltern Cove in the collection of Mr. L.G. Anniss. Frasnian, Holzapfeli Zone. X 6.

FIGURE 3. Manticoceras sp. Lateral view of a crushed specimen from the northern side of Daymer Bay, Padstow. Frasnian, ? Cordatum Zone. D.512, X 4.

FIGURE 4. Manticoceras cf. retrorsum (von Buch). Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c49454, X 3.7.

FIGURE 5. Manticoceras sp. Lateral view of a specimen from locality J(ii), Harbour Cove, Padstow. Frasnian, Cordatum Zone. D.620, X 3.7.

FIGURES 6 & 7. Manticoceras sp. Ventral and lateral views of a specimen from locality D(i), St. George's Cove, Padstow. Frasnian, Cordatum Zone. D.1023, X 4.

FIGURE 8. Manticoceras sp. Lateral view of a crushed specimen from Butter Cove, Stepper Point, North Cornwall. Frasnian, ? Cordatum Zone. D.645, X 3.8.

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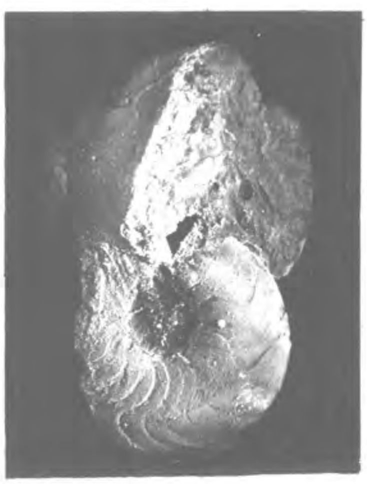

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PLATE 15

FIGURES 1 & 2. Manticoceras serratum (Steininger). Lateral and ventral views of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1052, X 6.

FIGURE 3. Manticoceras serratum (Steininger). Lateral view of a specimen from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1056, X 8.

FIGURE 4. Manticoceras aff. serratum (Steininger). Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.312, X 6.

FIGURE 5. Manticoceras cf. adorfense Wedekind. Lateral view of a specimen from Saltern Cove, Devon collected by Dr. K. Joysey. Frasnian, Holzapfeli Zone. D.299, X 2.3.

FIGURE 6. Manticoceras aff. calculiforme (Beyrich). Lateral view of a specimen collected by Mr. A. Pedder at Pentire Haven, Padstow Estuary, North Cornwall. Frasnian, ? Cordatum Zone. SM. H7364, X 8.

FIGURES 7 & 8. Manticoceras sp. nov. Ventral and lateral views of a specimen from locality D(ii), St. George's Cove, Padstow. Frasnian, Cordatum Zone. D.669, X 4.5.

FIGURES 9 & 10. Manticoceras aff. serratum (Steininger). Ventral and lateral views of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c18433, X 4.

FIGURE 11. Beloceras sagittarium (G. & F. Sandberger). Lateral view of a specimen from Lower Dunscombe Quarry, Chudleigh. Frasnian, Cordatum Zone. BM.c1852, X 3.

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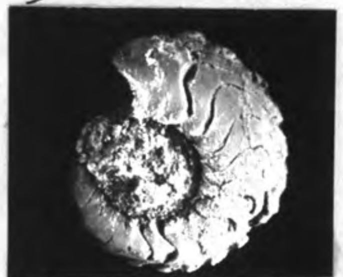

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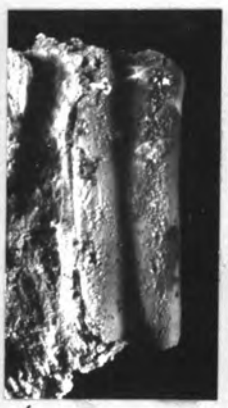

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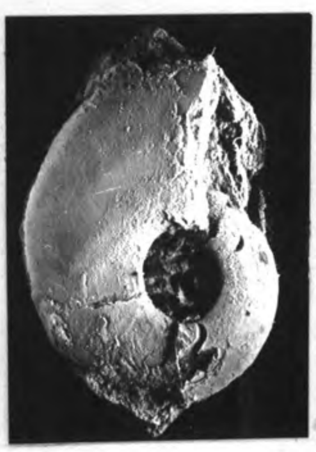

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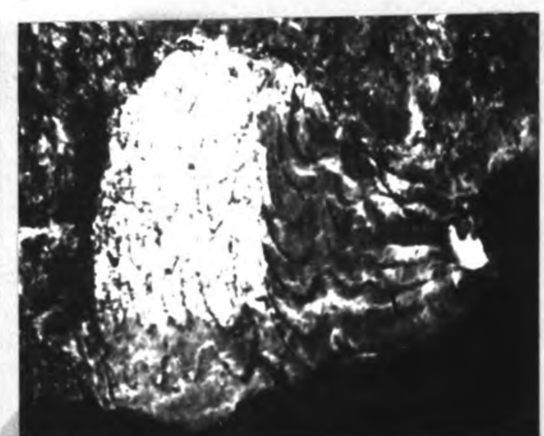

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PLATE 16

FIGURES 1 & 2. Crickites holzapfeli Wedekind. Lateral and ventral views of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c18436, X 4.

FIGURE 3. Crickites holzapfeli Wedekind. Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.202, X 6.

FIGURE 4. Beloceras sagittarium (G. & F. Sandberger). Lateral view of a specimen from Lower Dunscombe, Chudleigh, Devon. BM.c1969, X 1.

FIGURE 5. Koenenites sp. nov. Lateral view of a specimen from a quarry near St. John Baptist Chapel, Staverton Wood, Devon. Collected by Dr. G.V. Middleton. Frasnian, Lunulicosta Zone. GS.95230, X 6.

FIGURES 6 & 7. Beloceras sagittarium (G. & F. Sandberger). Lateral and ventral view of a specimen from Lower Dunscombe Quarry, Chudleigh, Devon. Frasnian, Cordatum Zone. BM.c49455, X 1.

FIGURE 8. Beloceras sagittarium (G. & F. Sandberger). Lateral view of a polished specimen from Shaldon Beach, Teignmouth. Derived from the Trias. Ex Frasnian, Cordatum Zone. BM.c12702, X 1.

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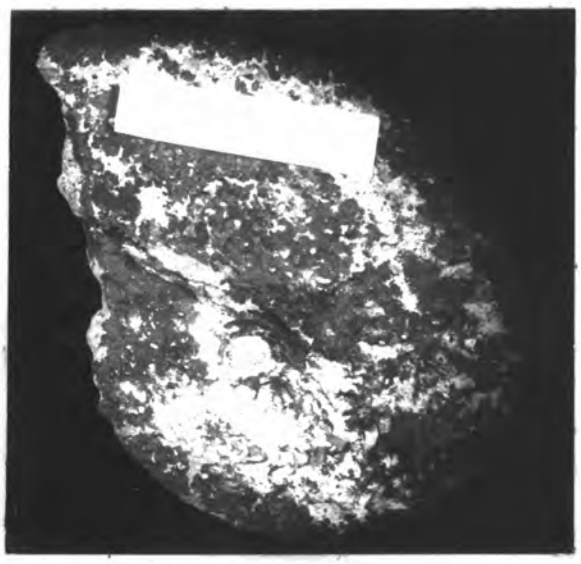

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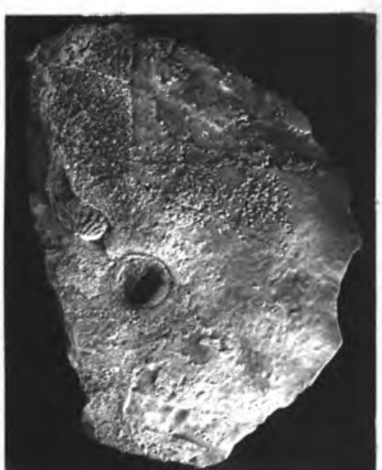

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PLATE 17

FIGURES 1 & 2. *Tornoceras* (*Tornoceras*) *simplex* (von Buch) var. B. Ventral and lateral views of a specimen from Trevone, North Cornwall. Givetian, Terebratum Zone. GS.95397, X 4.

FIGURES 3 & 4. *Tornoceras* (*Tornoceras*) *simplex* (von Buch) var. *ovata* Frech. Ventral and lateral views of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1057, X 4.

FIGURE 5. *Tornoceras* (*Tornoceras*) *whidbornei* (Foord and Crick. Lateral view of a specimen from Lummaton Quarry, Torquay collected by Dr. J.E. Prentice. Givetian, Terebratum Zone. KC.r368, X 1.

FIGURE 6. *Tornoceras* (*Tornoceras*) *simplex* (von Buch) var. *hughesii* (Whidborne). The Lectotype from Lummaton Quarry, Torquay, Devon. BM.c1528, X 1.

FIGURES 7 & 8. *Tornoceras* (*Tornoceras*) *simplex* (von Buch) var. A. Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.224, X 4.5.

FIGURE 9. *Tornoceras* (*Tornoceras*) *simplex* (von Buch) ? var. A. Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.253, X 4.


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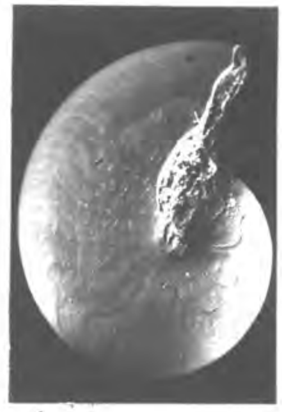
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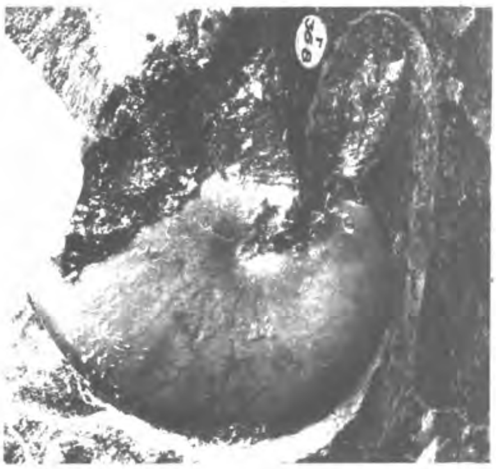
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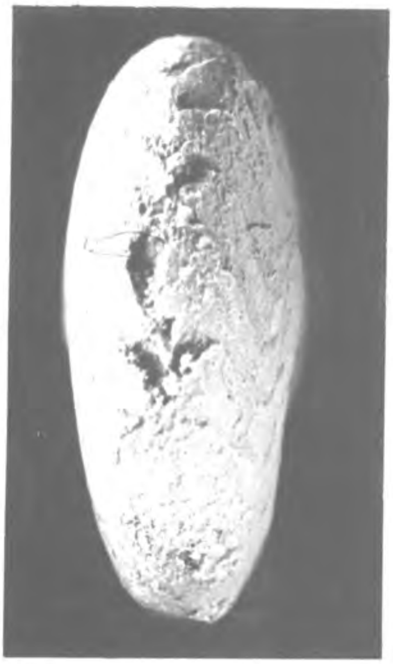
PLATE 18

FIGURES 1 & 2. Tornoceras (Tornoceras) aff. simplex (von Buch). Ventral and lateral views of a specimen from a quarry near St. John Baptist Chapel, Staverton Wood, Devon collected by Dr. G.V. Middleton. Frasnian, Lunulicosta Zone. GS.95228, X 4.

FIGURES 3 & 4. Tornoceras (Aulatornoceras) sp. nov. aff. auris (Quenstedt). Ventral and lateral views of a specimen from Saltern Cove. Frasnian, Holzapfeli Zone. BM.c18440, X 4.

FIGURE 5. Tornoceras (Tornoceras) cf. simplex (von Buch). Lateral view of a weathered specimen from Lower Dunscombe Quarry, Chudleigh, Devon. Frasnian, Cordatum Zone. Specimen in the collection of Mr. L.G. Anniss, X 1.

FIGURES 6 & 7. Tornoceras (Aulatornoceras) aff. sandbergeri Foord and Crick. Lateral and ventral views of a specimen from Pentonwarra Point, Trevone. Givetian, Terebratum Zone. D.891, X 4.



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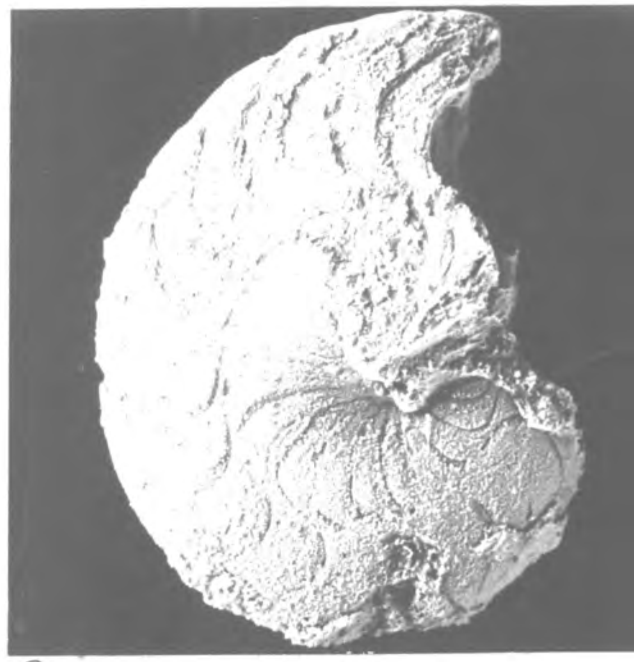

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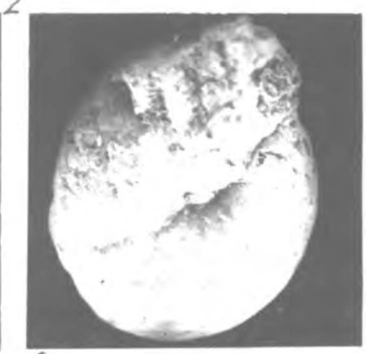

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PLATE 19

FIGURE 1. Tornoceras (Tornoceras) crassum Matern. Lateral view of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1055, X 8.

FIGURES 2 & 3. Tornoceras (Tornoceras) sp. nov. aff. crassum Matern. Lateral and ventral views of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. SM.H1541, X 6.

FIGURE 4. Tornoceras (Protornoceras) sp. nov. Lateral view of a specimen from Pentonwarra Point, Trevone. D.916, X 10. Givetian, Terebratum Zone.

FIGURE 5. Tornoceras (Protornoceras) sp. nov. Lateral view of a specimen from Trevone. Givetian, Terebratum Zone. GS.95399, X 6.

FIGURE 6. Tornoceras (Protornoceras) sp. nov. Median section of a specimen from Portquin. Givetian, Terebratum Zone. D.729, X 8.

FIGURES 7 & 8. Tornoceras (Protornoceras) sp. nov. Ventral and lateral views of a specimen from Portquin. Givetian, Terebratum Zone. D.786, X 9.4.

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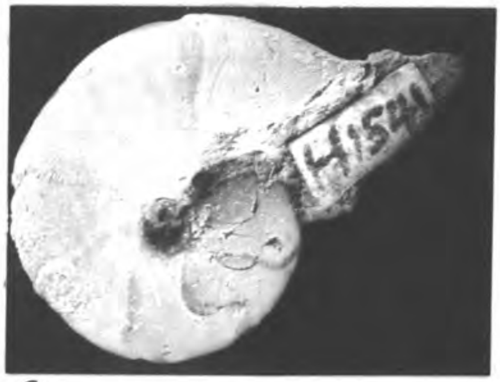

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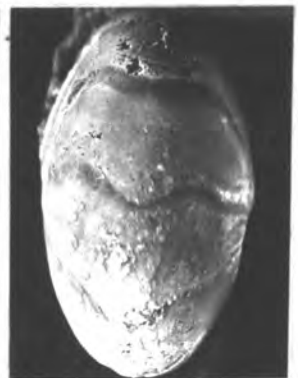

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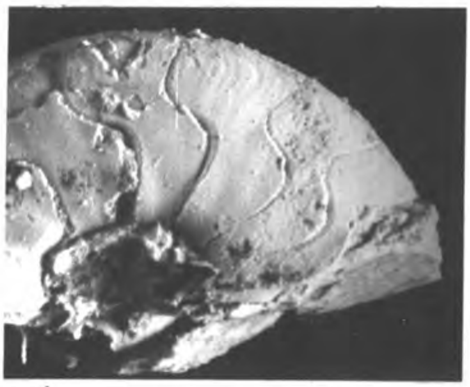

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PLATE 20

FIGURES 1 & 2. Tornoceras (Aulatornoceras) auris var. auris (Quenstedt). Ventral and lateral views of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1079, X 8.

FIGURE 3. Tornoceras (Aulatornoceras) cf. auris (Quenstedt). Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.231, X 3.6.

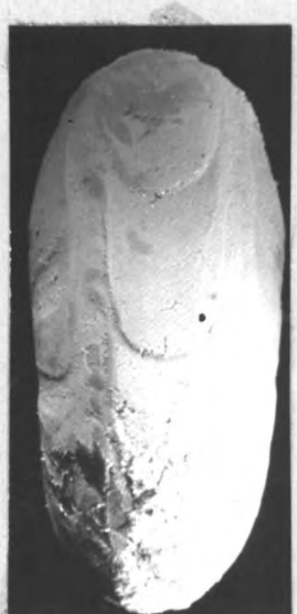
FIGURE 4. Tornoceras (Aulatornoceras) auris var. auris (Quenstedt). Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.267, X 10.

FIGURE 5. Tornoceras (Aulatornoceras) auris var. bickense Wedekind. Lateral view of a specimen from Saltern Cove, Devon, in the collection of Mr. L.G. Anniss. Frasnian, Holzapfeli Zone. X 10.

FIGURE 6. Tornoceras (Aulatornoceras) auris var. auris (Quenstedt). Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c18445, X 6.

FIGURE 7. Tornoceras (Aulatornoceras) cf. auris (Quenstedt) Ventral view of a specimen from Saltern Cove. Frasnian, Holzapfeli Zone. D.297, X 4.3.

FIGURE 8. Tornoceras (Aulatornoceras) auris var. auris (Quenstedt). Lateral view of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1080, X 4.3.



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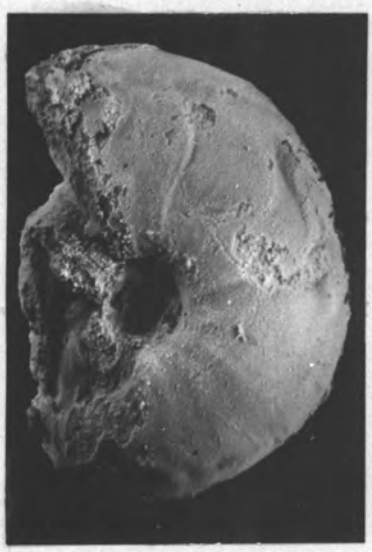

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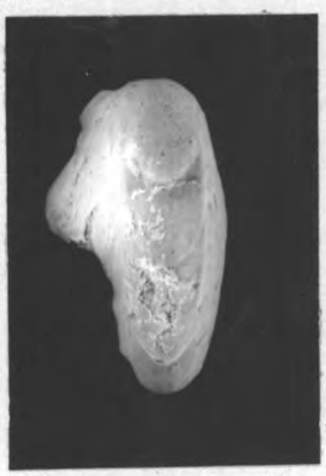

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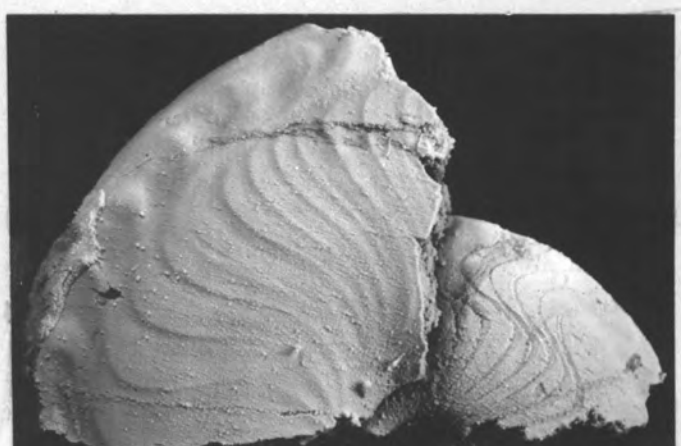

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PLATE 21

FIGURES 1 & 2. *Tornoceras* (*Aulatornoceras*) *paucistriatum* (d'Archaic and de Verneuil) var. nov. Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. SM.H1525, X 6.

FIGURE 3. *Lobotornoceras ausavense* (Steininger). Lateral view of a topotype from Büdesheim, Germany. Frasnian, Cordatum Zone. D.1054, X 6.

FIGURES 4 & 5. *Tornoceras* (*Aulatornoceras*) sp. nov. Lateral and ventral views of a specimen from Portquin North Cornwall. Givetian, Terebratum Zone. D.707, X 4.

FIGURE 6. *Tornoceras* (? *Aulatornoceras*) aff. *belgicum* Matern. Lateral view of a specimen in the collection of Mr. L.G. Anniss from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. X 6.

FIGURE 7. *Tornoceras* (? *Aulatornoceras*) aff. *belgicum* Matern. Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c18448, X 5.

FIGURE 8. *Tornoceras* (*Aulatornoceras*) cf. *constrictum* (Steininger). Lateral view of a specimen from the type locality of Büdesheim, Germany. Frasnian, Cordatum Zone. D.1060, X 6.

FIGURES 9 & 10. *Tornoceras* (*Aulatornoceras*) *paucistriatum* (d'Archaic and de Verneuil) var. nov. Lateral and ventral views of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. D.261, X 8.

FIGURE 11. *Tornoceras* (? *Aulatornoceras*) aff. *belgicum* Matern. Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c18451, X 8.


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PLATE 22

FIGURES 1 & 2. *Sobolewia* cf. *cancellata* (d'Archaic and de Verneuil). Lateral and ventral views of a specimen from Wolborough Quarry, South Devon. Givetian, Molarium Zone. BM.c15476, X 2.

FIGURE 3. *Tornoceras* (*Tornoceras*) *whidbornei* Foord and Crick. Close-up photograph showing microscopic striae on the shell surface.Specimen from Lummaton Quarry, Torquay. Givetian, Terebratum Zone. KC.r368, X 30. Top left = A, Bottom right = B on text fig. 55.

FIGURE 4. *Tornoceras* (*Aulatornoceras*) *auris* var. *auris* (Quenstedt). Lateral view of a specimen from Saltern Cove, Devon, figured by J.E. Lee in 1877. Frasnian, Holzapfeli Zone. BM.c49451, X 4.

FIGURES 5 & 6. *Tornoceras* (*Aulatornoceras*) sp. nov. aff. *auris* (Quenstedt). Lateral and ventral views of a specimen from Saltern Cove, Devon in the collection of Mr. L.G. Anniss. Frasnian, Holzapfeli Zone. X 5.

FIGURE 7. *Tornoceras* (*Tornoceras*) cf. *simplex* (von Buch). Lateral view of a specimen from Saltern Cove, Devon. Frasnian, Holzapfeli Zone. BM.c18461, X 4.

FIGURES 8 & 9. *Maenioceras* cf. *decheni* (Kayser). Ventral and lateral views of a specimen from Lummaton Quarry, Torquay in the collections of the University of Exeter Geology Department. Givetian, Terebratum Zone. X 2.1 .

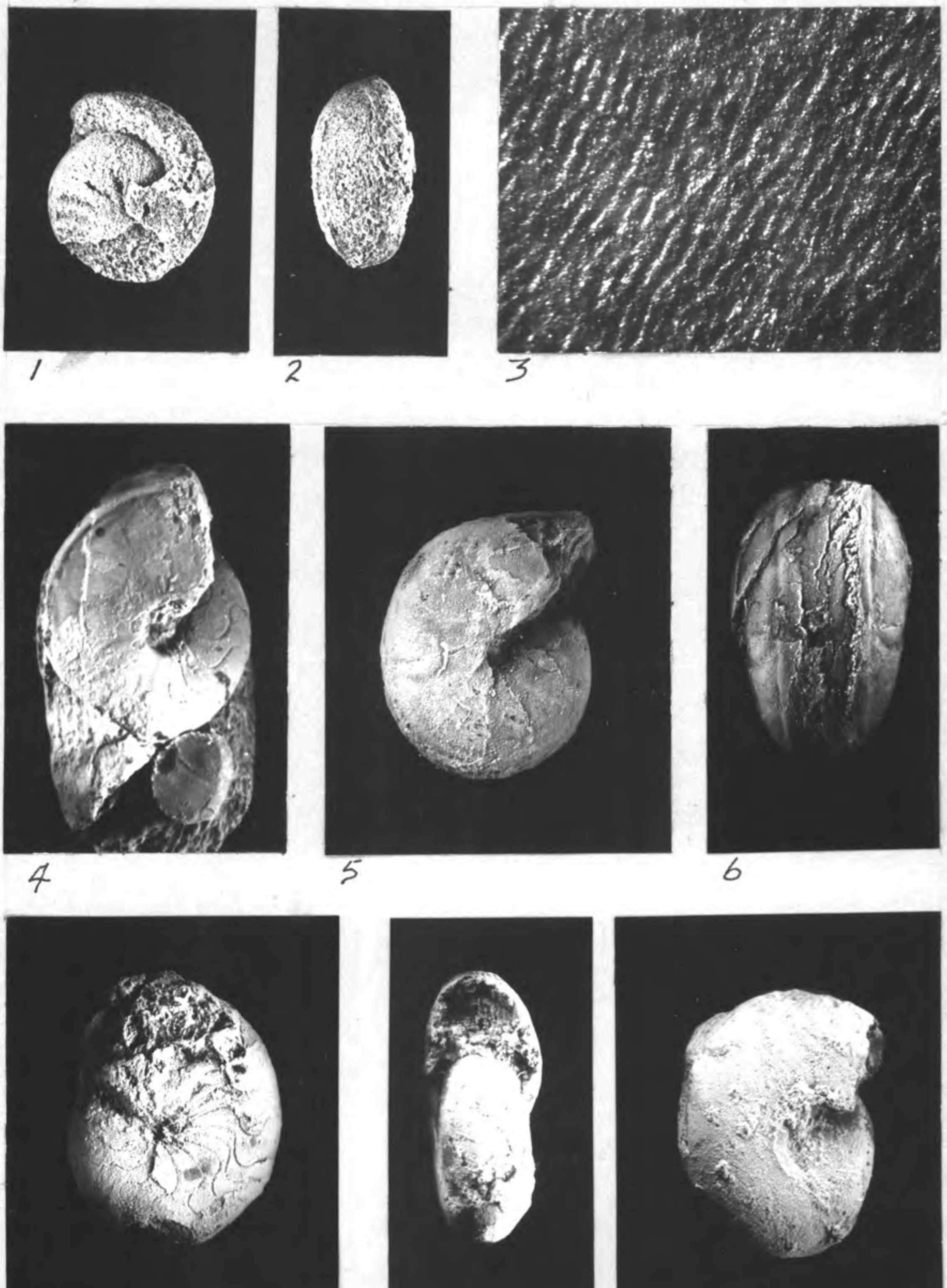
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PLATE 23

FIGURES 1 & 2. Imitoceras cf. quadripartitum (Münster). Lateral and ventral views of a specimen from South Petherwin. ? Clymenia Stufe.GS.57303, X 1.

FIGURES 3 & 4. Imitoceras sulcatum (Münster). Lateral and ventral views of a specimen from 680 yards north-west of Marytavy Church, Devon. ? Clymenia Stufe. GS. 57362, X 2.

FIGURE 5. Sporadoceras biferum (Phillips). Lateral view of a specimen from South Petherwin. ? Platyclymenia Stufe. GS.57301, X 2.1.

FIGURE 6. Imitoceras lineare (Münster). Lateral view of a specimen from South Petherwin in the Exeter City Museum. ? Clymenia Stufe. X 2.

FIGURE 7. Imitoceras lineare (Münster). Lateral view of a specimen derived from the Trias at Shaldon Beach, Teignmouth. BM.c12728, X 1.

FIGURES 8 & 9. Imitoceras ? sulcatum (Münster). Ventral and Lateral views of a specimen from South Petherwin. ? Clymenia Stufe. GS. 57302, X 1.


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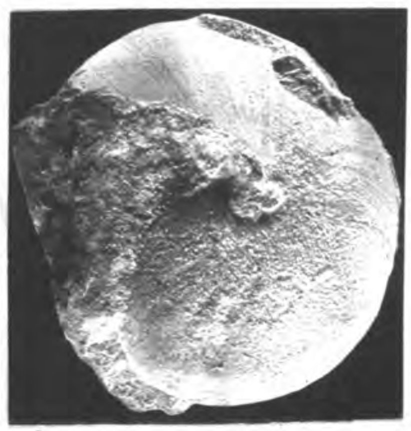
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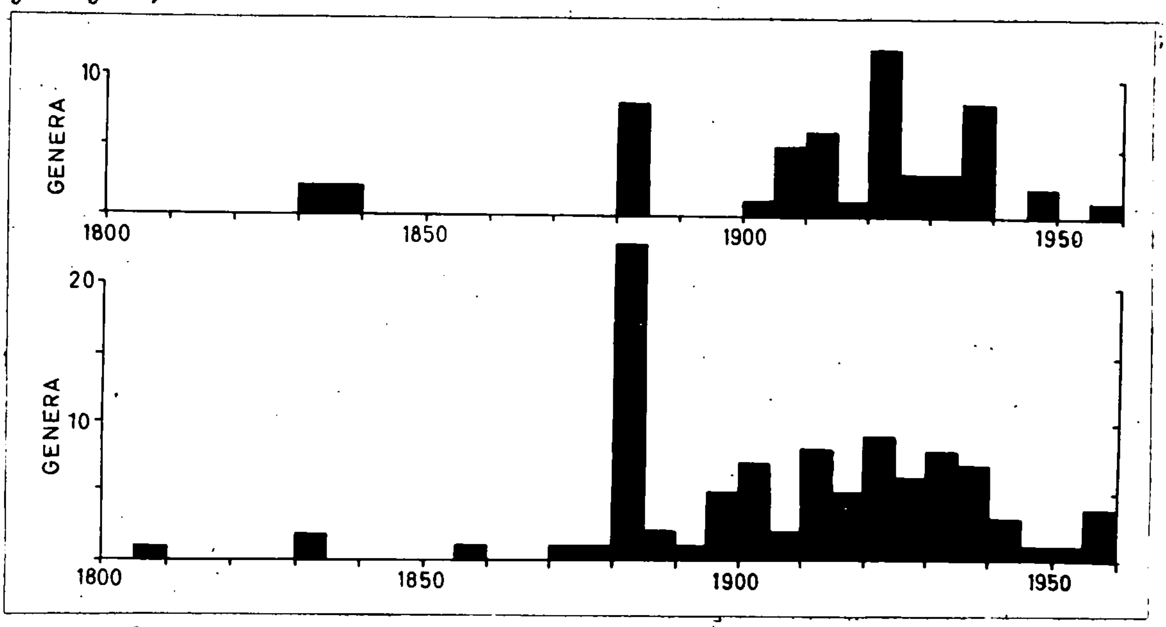
Appendix 1. AN INDEX OF DEVONIAN GONIATITE GENERA

The following list gives details of the generic and subgeneric names which have been applied to Devonian goniatites together, where possible, with the type species which were originally, or have been subsequently, designated for them. Genera generally considered, or here considered to be invalid, or junior synonyms are given in lower case. This list includes many genera not mentioned in the recent Treatise of Invertebrate Paleontology Part (L), 4. Details of the type species will not be given since they are included in the second appendix.

The growth in number of available names is indicated for Devonian goniatites and clymenids in the accompanying diagram (text fig. 67). This shows well the remarkable impact of Hyatt (1884). Subsequent "bursts" are due especially to Frech (around 1901), Wedekind (1908 to 1917) and Schindewolf (1920 onwards). Sobolew's genera are not included but the diagrams do include genera usually thought to be synonyms, or invalid.



Text fig. 67. Diagram showing the growth in number of generic names erected for Devonian Goniatites (below) and Clymenids (above).

The peculiar nomenclatorial problem posed by the compound-genera of Sobolew is discussed in a section at the end of this appendix. The best solution appears to be an application for their suppression to the I.C.Z.N.

Aganides	de Montfort 1808, p.30. Genotype by O.D. de Montfort 1804, pl.48, f.1 = ? Imitoceras. Relations obscure. Type probably Visean.
AGONIATITES	Meek 1877, p.99. Genotype by O.D. Goniatites (Agoniatites) expansus Vanuxem, 1842. M. Dev.
Anabeloceras	Clarke 1897, p.53. Genotype by monotypy A. pseustes Clarke 1897, p.53 nomen nudum. Probably a synonym of Neomanticoceras. Frasnian.
ANARCESTES	Mojsisovics 1882, p.181 footnote. Genotype by S.D. of Foord and Crick 1897, p.38 Goniatites plebeius. Barrande. L. & M. Dev.
ANETOCERAS	Schindewolf 1935, p.268. Genotype by O.D. Cyrto ceratites arduennensis. Steininger. L. Dev.
Aphyllites	Mojsisovics 1882, p.181 footnote. Genotype by S.D. Hyatt 1900, p.549 Goniatites ambigena Barrande. Junior subjective synonym of Gyroceratites.
ARCHOCERAS	Schindewolf 1937 a, p.243. Genotype by O.D. A. paeckelmanni Schindewolf. Frasnian & L. Famennian.
AULATORNOCERAS	Schindewolf 1922, p.188. Subgenotype by O.D. Goniatites auris Quenstedt. Subgenotype of Tornoceras. U. & M. Dev.
BACTRITES	Sandberger 1843, p.157. Genotype by monotypy B. subconicus G. & F. Sandberger. Dev. - Carb.
Balvia	Lange 1929, p.60 as subgenus of Gattendorfia. Genotype by O.D. G. globularis Schmidt. Junior subjective synonym of Imitoceras.
Balvites	Wedekind 1914, p.69. Genotype by monotypy Clymenia Buchi Wedekind. Junior subjective synonym of Cycloclymenia.
BELOCERAS	Hyatt 1884, p.333. Genotype by monotypy Goniatites multilobatus Beyrich = G. sagittarius G. & F. Sandberger. Frasnian.
Brancoceras	Hyatt 1884, p.325. Genotype by O.D. Goniatites ixion Hall. Junior homonym of Brancoceras Steimann 1881 and senior subjective synonym Imitoceras.

CELAECERAS	Hyatt 1884, p.312. Genotype by monotypy Goniatites praematura Barrande. M. Dev. (Pinacitinae).
Centroceras	Wedekind 1908, p.586.? Genotype Cheiloceras curvispina G. & F. Sandberger inter alia. Junior homonym Centroceras Hyatt 1884 hence Torleyoceras Wedekind 1917 and Centrocerotos Strand 1929.
CHEILOCERAS	Frech 1897, p.125. Genotype by S.D. Wedekind 1917, p.144 as C. subpartitum (Münster). Senior homonym Cheiloceras Trouessart 1898, p.321, Senior objective synonym Cheilocerotes Strand 1929 (see Richter 1929, p.382). L. Famennian.
Cheilocerotes	Strand 1929, p.8, pro Cheiloceras Frech q.v. Junior objective synonym Cheiloceras Frech.
Chiloceras	Misspelling of Cheiloceras Frech, e.g. Drevermann 1901, p.123, Dewey 1914, p.157.
Centroceratos	Strand 1929, p.7 pro Centroceras Wedekind non Hyatt. Objective junior synonym Torleyoceras Wedekind.
Clarkeoceras	Wedekind 1917, p.107. Genotype by O.D. Anarcestes (C.) umbonale Wedekind. Junior subjective synonym Anarcestes Mojsisovics 1882.
CLYMENOCERAS	Schindewolf 1937, p.246. Genotype by O.D. Clymenoceras insolatum Schindewolf. Famennian 3-4.
CRICKITES	Wedekind 1913, p.70. Genotype by S.D. Wedekind 1917, p.130 Crickites holzapfeli Wedekind. Frasnian.
Cryptoclymenia	Hyatt 1884, p.314. Genotype by O.D. Clymenia Beaumonti Gumbel. Status uncertain : considered by Frech (1902, p.42) and Miller & Furnish (in Moore 1957, p.49) to be a synonym of Sporadoceras Hyatt : thought by Schindewolf (1923 p.72) to be a synonym of Gattendorfia Schindewolf : thought by Librovitch (1940 p.230) to be a valid genus. ? Gattendorfia Stufe.
CYCLOCLYMENIA	Hyatt 1884, p.314. Genotype by S.D. ? Planulites planorbiforme Munster. Famennian.
DEVONOPRONORITES	Bogoslovsky 1954, p.323. Genotype by O.D. D. ruzhencevi Bogoslovsky. L. Frsnian.
DIMEROCERAS	Hyatt 1884, p.330. Genotypy by monotypy Goniatites mamillifer G. & F. Sandberger. L. Famennian.
DISCOCLYMENIA	Hyatt 1884, p. 314. Genotype by monotypy Clymenia Haueri. Famennian.

Dycheiloceras Misspelling for Dyscheiloceras Schmidt e.g. Matern 1931, p. 32.

DYSCHEILOCERAS Schmidt 1921, p.327. Genotype by S.D. of Matern 1931, p.32, D. biesenbergense Schmidt. L. Famennian.

EOBACTRITES Schindewolf 1932, p.174. Genotype by O.D. Bactrites sandbergeri Barrande. Ord.

EOBELOCERAS Schindewolf 1936, p.690. Genotype by O.D. Ammonites multiseptatus von Buch. Frasnian.

EPITORNOCERAS Frech 1902, p.51. Subgenotype by O.D. E. mithracoides Frech. ? Subgenotype of Tornoceras. U. Dev.

Eucheiloceras Schmidt 1921, p.541. Genotype inter alia E. verneuili Munster. Subjective synonym of Cheiloceras (Cheiloceras).

FOORDITES Wedekind 1917, p.113. Genotype by O.D. Aphyllites occultus platypleura Frech M. Dev.

GATTENDORFIA Schindewolf 1920, p.116, 123. Genotype by O.D. Goniatites subinvoluta Munster 1843. Gattendorfia Stufe.

Gephuroceras Hyatt 1884, p.316. Genotype by O.D. Goniatites sinuousus Hall. Senior synonym by one page of Manticoceras which is preferred (see Miller 1938, p.72).

Gephyroceras Misspelling of Gephuroceras, e.g. Clarke 1897, p.53, Hyatt in Zittel 1885, p.418.

GYROCERATITES von Meyer 1831, p.73. Genotype by S.D. of Schindewolf 1933, p.75 as G. gracilis Bronn. Emsian to Couvinian.

HEMINAUTILINUS Hyatt 1884, p.310. Genotype by O.D. Goniatites hybridus Munster. Possible senior synonym of Cheiloceras. Famennian.

HOENINGHAUSIA Gürich 1896, p.348. Genotype by O.D. Goniatites hoeninghausii d'Archaic and de Verneuil 1842 = H. archaici Gürich. Frasnian.

HOLZAPFELOCERAS Miller 1932, p.330. Genotype by O.D. Tornoceras convolutum Holzapfel 1895. Pro Parodiceras Wedekind non Hyatt, M. Dev.

IMITOCERAS Schindewolf 1923, p.325. Genotype by S.D. of Schindewolf 1926, p.70 as Ammonites rotatorius de

Koninck. Dev. to ? Perm.

KARAGANDOCERAS Librovitch 1940, p.88. Genotype by O.D. K. galeatum Librovitch 1940. L. Carb.

KAZAKHSTANIA Librovitch 1940, p.67. Genotype by O.D. Gattendorfia (K.) karagandaensis Librovitch 1940. L. Carb.

KOENENITES Wedekind 1913, p.47. Genotype by S.D. of Wedekind 1917, p.126 as K. lamellosus (G. & F. Sandberger). Frasnian.

LAGOWITES Bogoslovsk; 1957, p.46. Genotype by O.D. Praeglyphioceras niwae. Sobolew 1914. Famennian.

LATANARCESTES Schindewolf 1933, p.93. Genotype by O.D. Ammonites noegerathi von Buch. Subgenus of Anarcestes. M. Dev.

LOBOBACTRITES Schindewolf 1932, p.174. Genotype by O.D. B. ellipticus Frech 1897. L. to U. Dev.

LOBOTORNOCERAS Schindewolf 1936, p.689. Genotype by O.D. Goniatites ausavensis Steininger. M. and U. Dev.

Maeneceras Hyatt 1884, p.321. Genotype by O.D. Goniatites acutolaterale G. & F. Sandberger 1850. Subjective synonym of Sporadoceras proposed on the same page which is preferred.

MAENIOCERAS Schindewolf 1933, p.104. Genotype by O.D. Goniatites terebratus G. & F. Sandberger. Givetian.

MANTICOCERAS Hyatt 1884, p.317. Genotype by O.D. Goniatites simulator Hall 1843. Preferred to Gephuroceras which is a subjective synonym with page priority. Frasnian.

MESOBELOCERAS Glenister 1958, p.82. Genotype by O.D. M. thomasi Glenister 1958. Subgenus of Beloceras ? Frasnian.

MIMAGONIATITES Eichenberg 1931, p.181. Genotype by O.D. Goniatites zorgensis Roemer 1866. Emsian and Couvinian.

Mimoceras Hyatt 1884, p.309. Genotype by O.D. Ammonites compressus Beyrich 1837. Subjective junior synonym of Gyroceratites.

MIMOSPHINCTES Eichenberg 1931, p.184. Genotype by O.D. Mimosphinctes tripartitus Eichenberg 1931. Emsian.

NEOMANTICOCERAS Schindewolf 1936, p.690. Genotype by O.D. Manticoceras paradoxum Matern 1931. Frasnian.

Neopharciceras Bogoslovski 1955 a, p.95. Genotype by O.D. N. Kurbatovi

Bogoslovski. Frasnian. Subjective junior synonym of Synpharciceras.

NORDICERAS Bogoslovsky 1955, p.1104. Genotype by O.D. Prolecanites timanicus Holzapfel 1899 pl.2. fig. 6. Frasnian.

PALEOGONIATITES Hyatt 1900 in Eastman-Zittel, p.549. Genotype by O.D. Goniatites lituus Barrande 1865. Emsian and ? Couvinian.

Paragattendorfia Schindewolf 1924, p.105. Genotype by monotypy P. humilis Schindewolf. Subjective junior synonym of Gattendorfia.

PARAPHYLLITES Hyatt in Eastman-Zittel 1900, p.549. Genotype by O.D. Goniatites tabuloides Barrande 1865. M. Dev.

PARALYTOCERAS Frech 1902, p.83. Genotype by monotypy Clymenia crispa Teitze 1870. Famennian.

PARATORLEYOCERAS Bogoslovski 1957 p.45. Genotype by O.D. Goniatites globosus Munster 1832. Subjective junior synonym of Torleyoceras. Famennian.

PARATORNOCERAS Hyatt in Eastman-Zittel 1900, p.551. Genotype by O.D. Goniatites lentiforme Kayser 1873, G. & F. Sandberger nom. nud. Close to Dimeroceras of which it may be a senior synonym. Famennian.

Parodiceras Wedekind 1913a, p.85. Genotype by S.D. of Wedekind 1917, p.115 Goniatites brilonense Kayser. Non Parodiceras Hyatt 1884, hence Wedekindella Schindewolf 1928, Parodicerellum Strand 1929 and Holzapfeloceras Miller 1932 (with a different type species).

PARODICERAS Hyatt 1884, p.319. Genotype by O.D. Goniatites discoideus Hall 1860. Subgenus of Tornoceras. M. Dev.

Parodicerellum Strand 1929, p.9 pro Parodiceras Wedekind non Hyatt. Objective junior synonym of Wedekindella Schindewolf.

Paradimeroceras Bogoslovski 1957, p.46, Genotype by O.D. Dimeroceras beneckei Wedekind.

Parodoceras Misspelling of Parodiceras Hyatt e.g. Miller 1938, p. 143.

Pernoceras	Schindewolf 1922, p.188. Genotype by O.D. Tornoceras kochi Wedekind 1908. Subjective junior synonym of Protornoceras Dybczynski.
PHARICICERAS	Hyatt 1884, p.336. Genotype by O.D. Goniatites multiseptatum Quenstedt 1846, pl.3, fig. 3, Wedekind 1917, p.127 as Goniatites tridens G. & F. Sandberger 1951. Frasnian.
Phenacoceras	Frech 1902, p.42,62. Genotype by monotypy ? Planulites planorbiformis Münster 1832. Subjective junior synonym of Cycloclymenia Hyatt.
PINACITES	Mojsisovics 1882, p.181 footnote. Genotype by O.D. (monotypy) Goniatites emaciatus Barrande 1865 Roemer 1883 M. Dev.
POLONITES	Bogoslovski 1957, p.46. Genotype by O.D. Dimeroceras lentiforme Sobolew, Famennisn.
POLONOCERAS	Dybczynski 1913, p.519. Genotype by O.D. P. planum Dybczynski 1913. Subgenus of Tornoceras. U. Dev.
PONTICERAS	Matern 1929, p.151. Genotype by O.D. Ammonites aequabilis Beyrich 1837. Frasnian.
Postprolobites	Wedekind 1913a, p.87. Genotype by S.D. Wedekind 1917, p.157, P. yakowlewi. Subjective junior synonym of Prionoceras.
POSTTORNOCERAS	Wedekind 1910, p.768. Genotype by monotypy P. balvei Wedekind 1910, U. Dev.
PRAEGLYPHIOCERAS	Wedekind 1908, p.599. Genotype by monotypy Sporadoceras pseudosphaericum Frech 1902. Famennian.
PRIONOCERAS	Hyatt 1884, p.328. Genotype by O.D. Goniatites divisus Münster. Possible senior synonym of Imitoceras. U. Dev. to L. Carb.
PROBELOCERAS	Clarke 1899, p.90. Genotype by monotypy. Goniatites lutheri Clarke 1885. Frasnian.
PROLOBITES	Karpinski 1885, p.336. Genotype by O.D. Goniatites bifer var. delphinus G. & F. Sandberger 1851. L. Famennian.
PROTORNOCERAS	Dybczynski 1913, p.512. Genotype by O.D. T. polonicum Dybczynski 1913. M. to U. Dev. Subgenus of Tornoceras.
PSEUDARIETITES	Frech 1902, p.62. ? Genotype by S.D. Wedekind 1917, p.132 P. silisiacus Frech . Famennian.
PSEUDOCLYMENIA	Frech 1897, p.127. Genotype by S.D. Wedekind 1917,

p.137 Goniatites sandbergeri Gümbel 1862. U. Dev.

RAYMONDICERAS Schindewolf 1934, p.336, 338. Genotype by O.D. Prolobites simplex Raymond 1909. L. Famennian.

SANDBERGEROCERAS Hyatt 1884, p.333. Genotype by S.D. Goniatites tuberculoso-costatus G. & F. Sandberger 1850, pars = S. sandbergerorum Miller 1938, p.178. Frasnian.

SCHINDEWOLFOCERAS Miller 1938, p.181. Genotype by O.D. Goniaties chemungensis Vanuxem 1842. Frasnian.

Sedgwickoceras Bogoslovski 1957 p.45. Genotype by O.D. Goniatites acutolateralis G. & F. Sandberger. Objective junior synonym of Maeneceras, Subjective junior synonym of Sporadoceras.

SELLANARCESTES Schindewolf 1933, p.98. Genotype by O.D. Goniatites wenkenbachi Kayser 1884. L. & M. Dev.

SOBOLEWIA Wedekind 1917, p.118, 155. Genotype by O.D. Goniatites cancellatus d'Archaic & de Verneuil 1842. Givetian.

SPHAEROPHARCICERAS Bogoslovski 1955, p.1104. Genotype by O.D. S. sandbergerorum Bogoslovski 1955 (= G. tridens Sandberger 1852 pl.9, fig. 2 non pl.4, fig. 2). Frasnian.

SPORADOCERAS Hyatt 1884, p.321. Genotype by O.D. Goniatites bidens G. & F. Sandberger 1851 named G. bilanceolatus in the text. Famennian.

Staffites Wedekind 1917, p.142. Genotype by S.D. Matern 1931, p.32 Goniatites retrorsus var. curvispina G. & F. Sandberger 1851. Subjective synonym Torleyoceras.

SUBANARCESTES Schindewolf 1933, p.95. Genotype by O.D. S. macrocephalus Schindewolf. M. Dev.

SYNPHARCICERAS Schindewolf 1940, p. ? . Genotype by O.D. Goniatites clavilobus G. & F. Sandberger 1951. Frasnian.

TIMANITES Mojsisovics 1882, p.183. Genotype by O.D. Keyserling 1846, pl.12, fig.6. = T. keyserlingi Miller. See Glenister 1958, p.79. Frasnian.

TORLEYOCERAS Wedekind 1917, p.142 pro Centroceras Wedekind 1908 non Hyatt 1884. Genotype by S.D. Matern 1931, p.32 as Goniatites retrorsus var. oxyacantha G. & F. Sandberger 1852. L. Famennian.

TORNOCERAS	Hyatt 1884, p.320. Genotype by O.D. *Goniatites uniangularis* Conrad 1842. M. & U. Dev.
TRIAINOCERAS	Hyatt 1884, p.336. Genotype by monotypy. *Goniatites costatus* d'Archaic and de Verneuil 1842. U. Dev.
WEDEKINDELLA	Schindewolf 1928, p.311. Genotype by O.D. *Goniatites retrorsus* var. *brilonense* Kayser. Pro *Parodiceras* Wedekind non Hyatt. Givetian.
Wedekindoceras	Schindewolf 1923, p.352. Genotype by O.D. *Goniatites cucullatus* von Buch 1839. Subjective junior synonym of *Discoclymenia* Hyatt.
WERNEROCERAS	Wedekind 1917, p.108. Genotype by O.D. *Werneroceras subumbonale* Wedekind = *W. ruppachense* Kayser fide Schindewolf 1933, p. 96. M. to ? U. Dev.

DEVONIAN GENERA ERECTED BY SOBOLEW

In two papers (1914a, 1914b) Sobolew proposed a system of ammonoid nomenclature which would describe sutural and shell characters. He concerned himself chiefly with ammonoids from southern Poland described in part by Dybczynski (1913) which he considered showed an evolution series from the Tornoceratidae to the Clymeniina. This system, disarming in its simplicity, and useful in its presentation of morphological facts nevertheless presents a great potential stumbling block in Devonian Ammonoid systematics. Sobolew's 'genera' were all erected in the Linnaean binomial or trinomial manner and italiscised as is customary. These 'genera' have never been accepted by ammonoid authorities. The following account briefly summarises the system and ends with a list of the 'genera' which it is hoped will be suppressed eventually.

The basic generic roots used by Sobolew were as follows:-

Protomeroceras - very simple ventral suture with little or no trace of a lateral lobe.

Monomeroceras - ventral suture with a single lobe other than the ventral lobe.

Dimeroceras - ventral suture with two lobes other than the ventral lobe.

Pliomeroceras - ventral suture with many lobes.

For clymenids these generic roots were alterred to Protomeroclymenia, Monomeroclymenia and so on. To these roots were added prefixes as follows:-

Gomi = Gonio + micro) Omi = Ortho + micro)	Short body chamber
Goma = Gonio + macro) Oma = Ortho + macro)	Long body chamber

The intercalation "re" between the prefix and root implies a rather more regressive sutural stage than the root would indicate. Farther secondary prefixes of Greek letters were given according to the place of origin of new lobes according to the following rules:-

a - within the external (ventral) lobe.

b - upon the external saddle.

c. - between the lateral saddle and the umbilical seam.

to the following rules :-

a - within the external (ventral) lobe.

b - upon the external saddle.

c. - between the lateral saddle and the umbilical seam.

With this series of units Sobolew was able to apply combinations to any genus he wished. Some typical combinations were :-

Crickites = a-Omi-dimeroceras

Tornoceras (pars) = Gomi-monomeroceras

Maeneceras = b-Goma-dimeroceras

None of these combination genera had type species assigned to them but since many could have types by monotypy several well known genera could be replaced by them. The following list gives the combinations actually used in print by Sobolew in addition to those given above.

b-Goma-dimeroceras
Goma-monomeroceras
Goma-pliomeroceras
Goma-pliomeroclymenia
Goma-protomeroclymenia
Goma-re-monomeroceras
a-Gomi-dimeroceras
c-Gomi-dimeroceras
Gomi-monomeroclymenia
Gomi-protomeraclymenia
Gomi-protomeroceras
Gomi-protomeroclymenia
Gomi-re-monomeroceras
Gomi-re-protomeroceras
a-Oma-dimeroceras
b-Oma-dimeroceras
c-Oma-dimeroceras
Oma-monomeroceras
Omi-clymenia
Omi-protomeroclymenia
Omi-re-pliomeroceras

Appendix 2. AN INDEX OF DEVONIAN GONIATITE SPECIES

This list includes some 575 varietal or specific names which have been erected for Devonian goniatites over the past century and a half. An attempt has been made to make the list exhaustive but, with such a vast literature, many names are sure to have been missed. Details of the place of original description and illustration are given together with details of the original locality and horizon. Most species have been alloted to genera. No attempt has been made, except on the quoted authority of others, to note species synonomies. The names are given with the original spelling and not in agreement with the genera to which they are now assigned. Reference is given, where possible, to places where a re-description of the type material may be found.

ACCELERANS Clarke 1897, p.53 as *Manticoceras*, nom. nud., 1899, p.17,82, tf.60,64, pl.6, f.10. Also Miller 1938, p.74. Cashaqua Shale, Naples Formtn., Frasnian. Naples N.Y., U.S.A., MANTICOCERAS.

ACICULUM Hall 1843, p.244, tf.106(4) as *Orthoceras* (inadequate woodcut) see Miller 1938, p.30, pl2, f.11-14. Cashaqua Shale, Naples Formtn., Frasnian. Naples N.Y., U.S.A. ? BACTRITES.

ACUTIFORME H. & G. Termier 1950, p.53, pl.151, f.13-14 as *Manticoceras* (Clariond MS). Frasnian, Rich Gaouz, Morocco. MANTICOCERAS.

ACUTIDORSATUM Dybczynski 1913, p.521, pl.1, f.15, pl.2, f.15a,b as *Beloceras*. Frasnian. Kielce, Poland. BELOCERAS (? MESOBELOCERAS).

ACUTOLATERALE G. & F. Sandberger 1851, p.98, pl.6, f.1 as *Goniatites*. Famennian. Oberscheld, Germany. Genotype by O.D. *Maeneceras* Hyatt Genotype *Sedgwickoceras* Bogoslovski. SPORADOCERAS.

ACUTUM Frech 1902, p.47, pl.3(2), f.17 as *Tornoceras*. Non Kayser 1873 p.622). Famennian. Nehden, Germany. TORNOCERAS (TORNOCERAS).

ACUTUM Sobolew 1909 p.402, pl.4, f.4, 1914a, p.55, 1914b p.367, pl.8, f.27a,b as *Gomiprotomeroceras*. U. Dev. Kielce, Poland. Relation uncertain ? TORNOCERAS.

ACUTUM Schindewolf 1923a, p.338, pl.15, f.3,4, ft.4e1,e2 as *Imitoceras* . Famennian Wocklumeria Stufe, Gattendorf, Germany. IMITOCERAS.

ACUTUM Matern 1931, p.88, pl.2, f.8a-d as *Pharciceras*. Lunulicosta Zone, Frasnian. Oberscheld, Germany, PHARCICERAS.

ACUMTUM H. & G. Termier 1950 p.174, pl.151, f.32-33 as *Sandbergeroceras* (Clariond MS). Frasnian. Erfound, Morocco. SANDBERGEROCERAS.

ACUTUS Münster 1840, p.110, pl.16, f.11a,b as *Goniatites*. Famennian. Oberfranken, Germany. CHEILOCERAS (CHEILOCERAS)

ACUTUS Keyserling 1846 p.280, pl.12, f.6a-b as *Goniatites*. Invalid synonym of *G. acutus* Münster. Hence Miller

1938 p.130 proposed <u>keyserlingi</u> q.v.

ACUTUS — G. & F. Sandberger 1851 p.82, pl.7, f.1,1a,b as var. of <u>Goniatites intumescens</u>. See Müller 1956 p.38. Adorf Stufe, Frasnian. Adorf etc., CRICKITES.

ADORFENSE — Wedekind 1913, p.54, pl.4, f.5-6, tf.7c1,c2, as <u>Manticoceras</u>. Holzapfeli Zone, Frasnian. Martenberg, Germnay. MANTICOCERAS.

AEQUABILIS — Beyrich 1837, p.34, pl.2, f.1a,b as <u>Ammonites</u>. Frasnian Goniatiten-kalk. Sessacker, Oberscheld, Germany. Gelotype of PONTICERAS Matern.

AEQUALIBE — misspelling of <u>aequabilis</u> Beyrich 1837 commonly used.

AFFINIS — Steininger 1849, p.26, 1853, p.42, pl.1, f.4,4a as <u>Goniatites</u> (= Sandberger's <u>G</u>. <u>lamed</u> var. <u>latidorsalis</u> fide Steininger). Frasnian. Büdesheim, Germany. MANTICOCERAS.

ALOBATUM — Sobolew 1914a, p.61, pl.9,f.5,6, 1914b p.355 as <u>Gomireprotomeroceras</u>. Clymenienkalke, Famennian. Kielce, Poland, TORNOCERAS (PROTORNOCERAS)

ALTISELLATUM — Wedekind 1908, p.588, pl.39, f.23,pl.40, f.6 as <u>Centroceras</u> (?). L. Cheilocerasschichten, Famennian. Enkeberg, Germany. CHEILOCERAS.

ALTISELLATUM — Schindewolf 1923a, p.331, tf.4c1,c2 as <u>Imitoceras</u>. Clymenia Stufe 5a, Famennian. Gattendorf, Germany. IMITOCERAS.

ALVEOLATUM — Glenister 1958, p.69, pl.15, t.2,3, tf.3A,B. as <u>Probeloceras</u>. Gogo Formtn., Frasnian. Fitzroy Basin, W. Australia. PROBELOCERAS.

AMBIGENA — Barrande 1865, p.28, pl.3, f.17-22, pl.12, f.4-7. as <u>Goniatites</u>. L.M. Dev. Hlubocep, Czechoslovakia. Genotype of Aphyllites. GYROCERATITES.

AMBLYLOBUS — G. & F. Sandberger 1851, p.108, pl.10, f.8 as <u>Goniatites retrorsus</u> var. Cheiloceras Stufe 2, Famennian. Nehden etc., Germany. CHEILOCERAS (CHEILOCERAS).

AMMON — Keyserling 1846, p.283, pl.13, fig.2, 2a-c as Goniatites. Frasnian. Timan Mts., U.S.S.R. MANTICOCERAS.

AMOENUS — Barrande 1865, p.28, pl.4, f.13-14 as Goniatites. Eifelian. Hlubocep, Czechoslovakia. AGONIATES.

AMPLEXUS — Hall 1886, pl.127(12), f.1. as Goniatites. See Miller 1938 p.74. Tully Lst., ? L. Frasnian. Lodi Landing, Seneca Lake N.Y., U.S.A. ? MANTICOCERAS.

ANGULATOLOBATUM — Sobolew 1914b, p.355 pro Gomiremonomeroceras planilobum (pars) Sob. 1914a, p.60,61, pl.9, f.3,9 as Gomiremonomeroceras (Tornoceras). Clymenienschiefer, Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

ANGULATO-STRIATUS — Kayser 1883, p.306, pl.13, f.1,2 (Koch MS) as Goniatites. Orthoceras Scheifer, M. Dev. Ruppachthales, Germany. FOORDITES.

ANGULATUM — Donovan 1942, p.377, pl.13, f.1-6 as Archoceras. Holzapfeli Zone, Frasnian. Waterside Cove Saltern Cove, S. Devon. ARCHOCERAS.

ANGULATUS — G. & F. Sandberger 1852, p.108, pl.10, f.4 as Goniatites retrorsus var. See Schmidt 1921, p.325. Famennian, Cheiloceras Stufe. Warstein, Germany. CHEILOCERAS(CHEILOCERAS).

ANGULATUS — Frech 1889, p.251, t.f., as Aphyllites. Eifelian. Wildungen, Germany. ? AGONIATITES.

ANGULIFERUS — Roemer 1854, p.40, pl.6, f.12 as Goniatites. Iberger Kalk, Frasnian. N.W. Harz, Germany Affinities uncertain.

ANGUSTILOBATA — Holzapfel 1895, p.99 as Tornoceras simplex var. Nom. nud. L. U. Devonian.

ANGUSTILOBATUM — Wedekind 1908, p.588, pl.39, f.19, pl.40, f.7 as Centroceras. Famennian, L. Cheiloceras Stufe. Enkeberg, Germany. CHEILOCERAS (DYSCHEILOCERAS).

ANGUSTISELLATUM Wedekind 1908, p.597, pl.39, f.36,45, pl.40, f.1,1a as <u>Sporadoceras</u>. Platyclymenia Stufe, Famennian. Enkeberg, Germany. SPORADOCERAS.

ANGUSTISEPTATUS Münster 1832, p.18 as <u>Goniatites</u> nom, nud. non <u>Planulites angustiseptatus</u> Münster 1832, p.8 = <u>Cyrtoclymenia</u>.

ANGUSTUS Glenister 1958, p.79, pl.11, f.1-5, pl.12, f.9, tf.9 as <u>Timanites</u>. Gogo Formtn., Frasnian. Fitzroy Basin, W. Australia. TIMANITES.

ANNULATUS Maurer 1876 pl.7, f.10,11 = <u>anulatus</u>.

ANULATUS Maurer 1876, p.20 (of reprint) pl.1, f. 3a,3b as <u>Goniatites</u>, M. Devonian. Grube Langsheid, Germany. Fide Wedekind 1917, p.114, FOORDITES.

APERTUM Foord & Crick 1897, p.126, tf.59 as <u>Maeneceras</u>. Lower Givetian Limestone. Wolborough, Devon. MAENIOCERAS MOLARIUM var.

APHYLLITIFORME Dybczynski 1913, p.513, pl.1, f.1, pl.2, f.2 as <u>Protornoceras.</u> U. Dev. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

APPLANATA Frech 1897, p.169 as <u>Anarcestes lateseptatus</u> var. pro Barrande 1865, pl.7, f.13. L.M. Dev. Hlubocep, Czechoslovakia. ANARCESTES LATESEPTATUS var.

APPLANATA Wedekind 1917, p.122,166, pl.21,f.3, tf.28b as <u>Gephyroceras</u> <u>Pernai</u> var. Frasnian ld. Grube Prinz Kessel, Germany. PONTICERAS PERNAI var.

APPLANATA Schindewolf 1923a, p.310, pl.14, f.2, tf.2b1, 2b2 as <u>Pseudoclymenia</u>. Famennian. Platyclymenia Stufe (3a). Gattendorf, Germany. PSEUDOCLYMENIA.

APPRIMATUM Clarke 1899, p.62, 80. tf.63,64, pl.6, f.27-29 as <u>Manticoceras</u>. Naples Formtn. Frasnian. N.Y. State, U.S.A. MANTICOCERAS.

ARATUS Whidborne 1890, p.66, pl.6, f.16,16a as <u>Goniatites</u>. Barton, Torquay, Devon. U. Givatian, Terebratum Zone. WEDEKINDELLA BRILONENSE var.

ARCHAICI Gürich 1896, p.348 pro <u>Goniatites hoeninghausi</u> d'Archaic & de Verneuil 1842 non <u>Ammonites hoeninghausi</u> von Buch. Objective synonym of

HONINGHAUSIA HOENINGHAUSI q.v.

ARCUATOLOBATUM Sobolew, 1914b, p.353, pl.8, f.4a-b, tf.2 as Gomiremonomeroceras (Tornoceras) planilobum var. Clymenienkalk, L. Famennian. Lagow, Poland. TORNOCERAS (? PROTORNOCERAS).

ARDUENNENSE Steininger 1853, p.41, pl.1, f.1a,b as Cyrtoceratites. ? Emsian, L. Dev. Neueburg, Germany. Genotype of ANETOCERAS Schindewolf.

ARKONENSIS Whiteaves 1898, p.407, pl.48, f.15,16a as Bactrites (obliqueseptatus? var.). See Miller 1938, p.32. Arkona Shale, ? Givetian. S. Ontario, Canada. BACTRITES.

ASTARTE Clarke 1885, p.29, pl.2, f.9,10 as Goniatites. Fide Miller 1938, p.160 = TORNOCERAS (TORNOCERAS) UNIANGULARE.

ATAVA Frech 1902, p.78, tf.33a as Prolobites delphinus var. L. Clymenienkalk. Famennian. Enkeberg, Germany. PROLOBITES DELPHINUS var.

AURIS Quenstedt 1846, p.64, pl.3, f.7a-c as Goniatites. Frasnian 1b(c). Büdesheim, Germany. Genotype of Autatornoceras Schindewolf. TORNOCERAS (AULATORNOCERAS).

AURITUM Holzapfel 1899, p.35, pl.6, f.7, tf.7 as Gephyroceras. Frasnian. Fluss Tschut, S. Timan Mts., U.S.S.R. ? PONTICERAS.

AUSAVENSIS Steininger 1853, p.43, pl.1, f.6,7 as Goniatites. Frasnian 1b(c). Büdesheim, Germany. Genotype of LOBOTORNOCERAS Schindewolf.

AUSTRALIS Delepine 1935, p.211, pl.12, f.4-8, tf.1d as Pseudoclymenia. Famennian. Mt. Pierre, Australia. PSEUDOCLYMENIA.

AVARICATUM Sobolew 1914a, p.60, pl.9, f.10 as Gomiremonomeroceras (Tornoceras) planilobum var. Clymenienkalk. Famennian. Lagow, Poland. TORNOCERAS (PROTORNOCERAS).

backlundi Holzapfel 1899, p.21,26, pl.2, f.3,4 as Manticoceras. Frasnian. Fluss Tschut & Lyja Jo, S. Timan Mts., U.S.S.R. MANTICOCERAS.

Caps

BALVEI Wedekind 1908, p.768, 1917, p.139, pl.17, f. 5 as Posttornoceras. Platyclymenia Stufe, Famennian. Balve, Germany. Genotype of POSTTORNOCERAS.

BARROISI Frech 1902, p.45, tf.8a as Aphyllites pro. Goniatites subundulata var. major Frech 1888b, p.465. M. Dev. Pic de Bissous, S. France. AGONIATITES.

BARROISI Wedekind 1917, p.167, pl.21, f.7, tf.28 as Gephyroceras. Frasnian la. Grube Prinzkessel, Germany. PONTICERAS.

BEAUMONTI Münster 1839a, p.23 nom. nud., Gumbel 1863, p.158, pl.20, f.5 as Clymenia. "Clymenienkalk", Gattendorfia Stufe. Gattendorf, Germany. Genotype of Cryptoclymenia. ? GATTENDORFIA.

BECHERI von Buch 1831, p.171, pl.2, f.2. as Ammonites. Frasnian la, Eibach, Oberscheld, Germany. PHARCICERAS.

BELGICUM Matern 1931a p.9, text fig. 2 as Tornoceras. U. Frasnian. Boussu-en-Fagne Belgium. TORNOCERAS (? AULATORNOCERAS).

BENECKEI Wedekind 1908, p.602, pl.39, f.31, pl.41, f. 3,3a as Dimeroceras. U. Cheiloceras Stufe, Famennian. Enkeberg, Germany Genotype of Paradimeroceras Bogoslovski. DIMEROCERAS.

BERTRANDI Frech 1902, p.46, tf.10 as Tornoceras. U.M. Dev. Cabrieres, S. France. TORNOCERAS (TORNOCERAS).

BEUELENSE Lange 1929, p.49, pl.1, f. 4 as ? Tornoceras. Platyclymenia Stufe, Famennian, Beuel, Germany. TORNOCERAS (? TORNOCERAS).

BEUSHAUSENI Wedekind 1917, p.115, 165 nom. nud. as Parodiceras. Givetian. FOORDITES.

BIARCUATUS G. & F. Sandberger 1851, pl.10, f.5, pl.10b, f. 16, 17 as Goniatites retrorsus var. Cheiloceras Stufe, Famennian. ? Nehden, Germany. CHEILOCERAS (? CHEILOCERAS).

BICANALICULATUS G. & F. Sandberger 1851, p.112, pl.11, f.5a-q, 6a-f (? non h-k) as Goniatites. M. Dev. Wissenbach, Sechshelden etc., Germany. AGONIATITES.

BICKENSIS — Wedekind 1917, p.137 nom. nud. as Tornoceras auris var. Frasnian 1a. Bicken, Germany. TORNOCERAS (AULATORNOCERAS) AURIS var.

BICKENSE — Wedekind 1913, p.69, pl.6, f.6 as Gephyroceras. Frasnian. Bicken, Germany. Junior synonym of Archoceras varicosum Dreverman.

BICOSTATUS — Hall 1843, p.246, tf.107(3) as Goniatites. See Miller 1938 p.167. Naples Formtn., Frasnian. Lake Erie, N.Y. State, U.S.A. TORNOCERAS (AULATORNOCERAS).

BIDENS — G. & F. Sandberger, 1850, pl.8, f.11 as Goniatites. Thus named on the plate but referred to in the text as G. bilanceolatus q.v. Famennian, Enkeberg, Germany. Genotype of SPORADOCERAS Hyatt.

BIESENBERGENSE — Schmidt 1921, p.328, f.5 (p.323) as Dyscheiloceras. Cheiloceras Stufe, Famennian. Biesenberg, Germany. Subgenotype of CHEILOCERAS (DYSCHEILOCERAS).

BIFERUS — Phillips 1841, p.120, pl.49, f.230 as Goniatites. Platyclymenia Stufe, Famennian. South Petherwin, Cornwall. SPORADOCERAS.

BIFORME — Schindewolf 1937, p.15 as Prionoceras pro Schmidt 1924b pl.6, f.11 (non10,10a), pl.6, f.12,12a (holotype by O.D., non 13,13a). Wocklumeria Stufe, Famennian. Hönnetal, Germany. ? PRIONOCERAS.

BIIMPRESSA — Schmidt 1924, p.118, pl.6, f.6 as Aganides sulcatus var. Platyclymenia Stufe, Famennian, Dasberg Schichten. Wildungen, Germany. IMITOCERAS.

BILANCEOLATUS — G. & F. Sandberger 1851, p.71, pl.9, f.7a-b,?pl.8, f.11,?pl.5, f.2 as Goniatites (so referred in text, on the plate description pl.8, f.11 is named G. bidens and pl.5, f.2 is named G. munsteri : plates 1-8 were published in 1850 with pp.1-72, plates 9-13 were published in 1851 with pp.73-104). Famennian. Haasenhütte etc., Germany. Genotype of SPORADOCERAS.

BILOBATIFORME — Dybczynski 1913, p.513, pl.1, f.2, pl.2, f.2 as

Protornoceras. U. Dev. ? Frasnian. Kielce, Poland. THORNOCERAS (PROTORNOCERAS).

BILOBATUM — Wedekind 1908, p.579, pl.39, f.35, pl.40, f.8 as Tornoceras. Cheiloceras Stufe, Famennian. Enkegerg, Germany. LOBOTORNOCERAS.

BIPARTITUS — Eichenberg 1931, p.185, pl.10, f.4 as Mimosphinctes. Schönauer Kalk, L. Emsian, Mimosphintes Stufe. Nr. Bad Lauterberg, Harz, Germany. MIMOSPHINCTES.

BISENBERGENSE — Not uncommon spelling variant for biesenbergesense Schmidt 1921 q.v.

BISULCATUS — Kayserling 1846, p.282, pl.12, f.7,7a-f as Goniatites. Frasnian. Petschora Land, Timan Mts., U.S.S.R. MANTICOCERAS.

BISULCATUS — Roemer 1854, p.39, pl.6, f.8 as Goniatites. Frasnian Iberger Kalk. Harz, Germany. MANTICOCERAS.

BIVARICATA — Wedekind 1917, p.144, pl.18, f.4 as Cheilococeras subpartitum var. L. Cheiloceras Stufe, Famennian. Nehden, Germany. CHEILOCERAS (CHEILOCERAS).

BOHEMICUS — Barrande 1865, p.29, pl.1, f.1-13, pl.2, pl.3, f.15, 16, pl.242, pl.244 as Goniatites. L. Devonian. Hlubocep, Czechoslovakia. MIMAGONIATITES.

BRACHYLOBA — Frech 1902, p.80 tf.34d as Sporadoceras muensteri var. L. Famennian. Enkeberg, Germany. SPORADOCERAS.

BREDELARENSE — Wedekind 1908, p.600, pl.39, f.18, pl.41, f.5 as Dimeroceras. U. Cheiloceras Stufe, Famennian. Enkeberg, Germany. Lange 1929 as D. padbergense var. DIMEROCERAS.

BRILONENSIS — Kayser 1872, p.664, pl.25, f.2a-e as Goniatites retrorsus var. (Beyrich M.S.). U. Givetian, Brilon Ironstone. Brilon, Germany, Gentotype of Parodicerellum Strand and WEDEKINDELLA Schindewolf.

BRONNII — Munster 1839a, p.22 nom. nud., 1840, p.103, pl.16, f.9 as Goniatites. Famennian, Clymenienkalk. Geiser near Presseck, Germany. SPORADOCERAS.

BUCHI — d'Archaic and de Verneuil 1842, p.340, pl.26, f.1, 1a, 1b as Goniatites. Frasnian. Oberscheld, Germany. MANGICOCERAS.

BUCHI — Wedekind 1908, p.622, pl.39, f.28,29 as Clymenia. Famennian. Enkeberg, Germany. Genotype of Balvites 1929, p.64 as CYCLOCLYMENIA.

BUDESHEIMENSIS Roemer 1876, pl.35, f.14a-c as Bactrites. Frasnian. Büdesheim, Germany. BACTRITES.

BULBOSUM Born 1912, p.610, pl.21, f.5 as Dimeroceras. ?Cheiloceras Stufe. Aekatal, Germany. DIMEROCERAS.

BULLATUM Wedekind 1913, p.56, pl.4, f.12-13, pl.7, f.7, tf.7c. as Manticoceras. Frasnian Id. Berg near Messinghausen, Germany. MANTICOCERAS.

BULLATUM Lange 1929, p.39, pl.1, f.3,3a,3b, tf.3,4 as Dimeroceras. U. Cheiloceras Stufe. Enkeberg, Germany. DIMEROCERAS.

BURGENSE Wedekind 1908, p.603, pl.39, f.39, pl.41, f.6 as Dimeroceras. U. Cheiloceras Stufe, Famennian, Enkeberg, Germany. DIMEROCERAS.

BUTTSI Miller 1938, p.147, pl.33, f.1, tf.31 as Tornoceras (T). ? Onondaga Lst., M. Dev. Newcastle, Virginia, U.S.A. TORNOCERAS (TORNOCERAS).

CALCULIFORME Beyrich 1837, p.37, pl.2, f.5 as Ammonites, Frasnian. Schiefergebirge, Germany. MANTICOCERAS.

CANCELLATUS d'Archaic and de Verneuil 1842, p.339, pl.25, f.6,6a, 6b as Goniatites. U. Givetian. Brilon, Germany. Genotype of SOBOLEWIA Wedekind.

CARINATUS Beyrich 1837, p.35, pl.2, f.2 as Ammonites, Frasnian. Schiefergebirge, Germany. MANTICOCERAS.

CARINATUS G. & F. Sandberger 1852, p.129, pl.17, f.3 as Bactrites carinatus Munster. Non Orthoceratites carinatus Munster. Fide Schindewolf 1933 p.73 - LOBOBACTRITES ELLIPTICUS.

CARINATUS Schmidt 1924, p.149, pl.8, f.5 as Aganides. Hangenbergschichten, Famennian. Slockum, Germany. IMITOCERAS.

CATAPHRACTUM	Clarke 1899, p.87, pl.6, f.3-9, tf.6,7 as Gephyroceras. See Miller 1938 p.77. Naples or Hanover Shale, Frasnian. Wyoming County. N.Y., U.S.A. MANTICOCERAS.
CERYCEUM	Clarke 1897 p.52 as Gephyroceras nom. nud. See Miller 1938 p.88 ? = MANTICOCERAS GENUNDEWA.
CHEMUNGENSIS	Vanuxem 1842, p.182, tf.49(1) as Goniatites. See Miller 1938 p.181. Cayuta Shale, Chemung, Frasnian. Owega, N.Y. Genotype of SCHINDEWOLFOCERAS.
CINCTUM	Keyserling 1844, p.227, pl.A, f.2,3 as Goniatites. Junior homonym of G. cinctus Munster 1842 : fig.3 selected as holotype of T.(A.) keyserlingi Muller 1956, p.49. Frasnian. Domanik, U.S.S.R. TORNOCERAS (AULATORNOCERAS) KEYSERLINGI.
CINCTUM	Glenister 1958, p.75, pl.10, f.1-3, tf.7A,B as Manticoceras. Virgin Hills Formtn., Frasnian. Fitzroy Basin, W. Australia. MANTICOCERAS.
CINCTUS	Munster 1842, p.127, pl.12, f. 7 as Goniatites. Famennian. Gattendorf, Germany. Fide Gumbel = G. planidorsatus Munster. PSEUDOCLYMENIA.
CIRCUMFLEXIFERUM	F. & F. Sandberger 1851, p.111, pl.11, f.8 as Goniatites. Cramberg, Germany. M. Dev. HOLZAPFELOCERAS.
CIRCUMFLEXUM	F. & F. Sandberger 1851, p.108, pl.10, f.9, pl.10a, f.9, pl.10b, f.26 as Goniatites retrorsus. Cheiloceras Stufe, Famennian. ? Nehden, Germany. ? Parts = CHEILOCERAS (CHEILOCERAS).
CLARKEI	HOLZAPFEL 1895, p.89, pl.7, f.10 as Tornoceras. U. Givetian, Obere Stringocephalenschichten. Martenburg, Germany. WEDEKINDELLA.
CLARKEI	Wedekind 1908, p.598, pl.42, f.4,4a as Sporadoceras. Platyclymenia Stufe, 3b, Famennian. Enkeberg, Germany. SPORADOCERAS.
CLARKEI	Delepine 1935, p.212, pl.13, f.11a,b, 12a,b, tf.1k as Dimeroceras. Famennian. Mount Pierre, Australia, DIMEROCERAS.
CLARKEI	Miller 1938, p.80, pl.14, f.15-17 as Manticoceras.

Frasnian. Forestville, Chatangua, N.Y., U.S.A. MANTICOCERAS.

CLAUSUM — Glenister 1958, p.92, pl.15, f.7-9, tf.16a,c as Tornoceras (T.). Virgin Hills Formatn., Frasnian. Fitzrof Basin, W. Australia, TORNOCERAS (TORNOCERAS).

CLAVILOBUS — G. & F. Sandberger 1851 p.67, pl.8, f.3 as Goniatites. Frasnian 1a. Eibach, Germany. Genotype of SYNPHARCICERAS.

CLAVUS — Hall 1879, p.316, pl.84, f.15, pl.113, f.1-5 as Bactrites. See Miller 1938, p.40. ? Marcellus, M. Dev. Schoharie, N.Y., U.S.A. BACTRITES

CLYMENIOIDES — Schindewolf 1923a, p.417, pl.16, f.11, tf.16b1,b2 as Phenacoceras. Clymenia Stufe, Famennian. Gattendorf, Germany. CYCLOCLYMENIA.

COMPLANATUM — Matern 1931, p.34, pl.3, f.15a, 15b as Cheiloceras (C.) sacculum. Nehdener Scheifer, Cheiloceras Stufe, Famennian. Nehden, Germany. CHEILOCERAS (CHEILOCERAS) SACCULUM var.

COMPLANATUS — G. & F. Sandberger 1850, p.90, pl.8, f.5,5a-d, & pl,6, f.6c (only) as Goniatites lamed. pl.8, f.5 selected by Miller 1932, p.331 as Manticoceras lamed Miller but the specific appelation must remain the Sandbergers'. Frasnian. Oberscheld, Eibach and Büdesheim, Germany. = MANTICOCERAS LAMED.

COMPLANATUS — Wedekind 1917, p.112, tf.21f as Agoniatites. M.Dev. Martenburg, Germany. AGONIATITES.

COMPRESSUM — Clarke 1899, p.116-118, pl.8, f.18 as Tornoceras uniangulare var. See Miller 1938, p.160. Genundewa Lst., Genesee Formtn., Frasnian. Canadaigua Lake, N.Y., U.S.A. TORNOCERAS (T) UNIANGULARE.

COMPRESSUS — Munster 1832, p.33, 1839a, p.31 as Goniatites nom. nud. Relations unknown.

COMPRESSUS — Beyrich 1837, p.5, pl.1, f.6 as Ammonites. Couvinian, Germany. Genotype of Mimoceras. GYROCERATITES.

CONTRACTUM — Glenister 1958, p.90, pl.15, f.4-6, tf.16B,D as Tornoceras (Tornoceras). Gogo Formtn., Frasnian 1a. Fitzroy Basin, W. Australia. TORNOCERAS (TORNOCERAS).

CONSTRICTUS — Steininger 1853, p.43, pl.1, f.9 as Goniatites. Frasnian. Büdesheim, Germany. TORNOCERAS (? TORNOCERAS).

CONTIGUUS — Munster 1832, p.26,27, pl.3, f.8s-c as Clymenia. Famennian. Schübelhammer, Germany. SPORADOCERAS.

CONTRACTUM — Clarke 1897, p.53 as Manticoceras Patersoni var., 1899, p.69, tf.44,63,64, pl.6, f.1,2 as Manticoceras. See Miller 1938 p.81. Genundewa ("Styliola") Lst., Genessee Formtn., Frasnian. Canadaigua Lake, N.Y., U.S.A. MANTICOCERAS.

CONVOLUTA — G. & F. Sandberger 1852, p.116, pl.11, f.2 as Goniatites subnautilinus. M. Dev. Wissenbach Slate. Wissenbach. Germany. SOBOLEWIA.

CONVOLUTUM — Holzapfel 1895, p.88, pl.4, f.1-3 as Tornoceras. Givetian, Untere Stringocephalenschichten. Wildungen, Germany. Genotype of Holzapfeloceras Miller.

COOPERI — Miller 1938, p.126, pl.27, f.8-11, pl.28, f.1-5, tf.25,26 as Koenenites. Base of Antrim Formtn., Frasnian. Partridge Point, Alpena, Michigan. KOENENITES.

CORDATUS — G. & F. Sandberger 1851, p.90, pl.8, f.6,6a,b,d-g. Goniatites lamed var. (Fide Wedekind 1913, p.57, f.6c = G. complanatus). Frasnian 1b(c). Büdesheim etc., Germany. MANTICOCERAS

CORDIFORME — Miller 1938, p.82, pl.21, f.2-4 as Manticoceras. Carcajou Mt. Sst., Frasnian. Oil Creek, Mackenzie District, Canada. MANTICOCERAS.

COSTATUS — d'Archaic & de Verneuil 1842, p.340, pl.31, f.1-1a as Goniatites. Frasnian 1a. Eibach, Germany. Genotype of Triainoceras Hyatt, fide Miller 1957, = SANDBERGEROCERAS.

COSTULATUS d'Aarchaic & de Verneuil 1842, p.341, pl.26, f.3,3a, 3b as Goniatites. M. Dev., ? U. Givetion. Brilon, Germany. AGONIATITES.

CRASSA Holzapfel 1895, p.7, f.16 as Agoniatites evexus. U. M. Dev. Westphalia, Germany. AGONIATITES.

CRASSA Wedekind 1913, p.66, tf.12a4 as Manticoceras calculiforme var. non M. crassum Wedekind hence crassoides Matern 1931. Frasnian 1b(c). Martenburg, Germany. MANTICOCERAS CALCULIFORME CRASSOIDES.

CRASSA Wedekind 1917, p.144 as Cheiloceras subpartitum var. nom. nud. L. Cheiloceras Stufe, Famennian. Nehden, Germany. CHEILOCERAS. (CHEILOCERAS) SUPBARTITUM var.

CRASSOIDES Matern 1931, p.67 pro Wedekind 1913, p.66, tf.12a4 M. calculiforme var. crassa q.v. MANTICOCERAS CALCULIFORME.

CRASSUM Wedekind 1913, p.59, tf.8c as Manticoceras. Frasnian 1d. Martenburg, Germany. MANTICOCERAS.

CRASSUM Matern 1913, p.27, pl.3, f.14a,b as Tornoceras ausavense subsp. Frasnian 1(b) c. Büdesheim, Germany TORNOCERAS (TORNOCERAS).

CRASSUS Holzapfel 1895, p.64, pl.7, f.16, pl.8, f.6 as Agoniatites inconstans var. Obere Stringocephalenschicht -en, Givetian. Enkeberg, Germany. AGONIATITES.

CREBRISEPTUS Barrande 1865, p.31, pl.7, f.1-2. as Goniatites. ? L. M. Dev. Hlubocep, Czechoslovakia. ANARCESTES.

CREBRISEPTUM Raymond 1909, p.153, pl.8, f.5-7 (non 8) tf.4 as Tornoceras. See Miller 1938 p.149. Three Forks Shale, L. Famennian. Three Forks, Montana, U.S.A. TORNOCERAS (TORNOCERAS).

CRISPA Tietze 1870, p.135, pl.16, f.12 as Clymenia. Famennian Clymenienkalk. Ebersdorf, Germany. Genotype of PARALYTOCERAS Frech.

CRISPIFORME Kayser 1879, p.301, pl.5, f.1 as Goniatites. See Schmidt 1950 p.89. Eifelian ? Eifel, Germany. WERNEROCERAS.

CRISPUS	Barrande 1865, p.31, pl.9, f.24-32 as Goniatites. M. Dev. Hlubocep and Konieprus, Czechoslovakia. WERNEROCERAS.
CUSULLATUS	von Buch 1839, p.156, pl.1, f.4 as Goniatites. Clymenia Stufe, Famennian. Gattendorf, Germany. Genotype of DISCOCLYMENIA Hyatt 1884 and Wedekindoceras Schindewolf 1923.
CURVATA	Perna 1914, p.45, pl.2, f.2,3, tf.37,38 as Tornoceras dorsatus var. ? L. Famennian. S. Urals, U.S.S.R. TORNOCERAS (PROTORNOCERAS).
CURVIDORSATUM	Sobolew 1914a, p.59,60, pl.8. f.24,25, pl.9. F.1,2, (1914b p.354) as Gomiremonomeroceras (Tornoceras). L. Famennian. Lagow, Poland. ? TORNOCERAS (PROTORNOCERAS).
CURVISPINA	G. & F. Sandberger 1851, p.108, pl.10, f.2 as Goniatites retrorsus var. Cheiloceras Stufe, Famennian. Genotype of Staffites. CHEILOCERAS (TORLEYOCERAS).
CUSPIDATA	Perna 1914, p.51, pl.2, f.14a,b, 15 as Cheiloceras. subpartitum var. L. Famennian. S. Urals, U.S.S.R. CHEILOCERAS (CHEILOCERAS).
DANNENBERGI	Beyrich 1837, p.26, pl.1, f.5 as Ammonites. M. Dev. Wissenbacher Schiefer. Wissenbach, Germany. AGONIATITES.
DECHENI	Kayser 1872, p.66, pl.26, f.1a-d (Beyrich MS.) as Goniatites. Brilon Ironstone, U. Givetian. MAENIOCERAS.
DELPHINUS	G. & F. Sandberger 1851, p.72, pl.9, f.5 as Goniatites bifer var. Famennian, Platyclymenia Stufe. Enkeberg, Germany. Genotype of PROLOBITES.
DELPHIENSIS	Kindle 1901, p.563, 577, pl.2, f.1,1a as Goniatites. See Miller 1938, p.83. Lr. New Albany Shale, Frasnian. Delphi, Indiana, U.S.A. MANTICOCERAS.

DENCKMANNI	Holzapfel 1895, p.72, pl.3, f.22-24 as <u>Anarcestes</u>. Untere Stringocephalenshichten. Ense, Germany. SOBOLEWIA.
DENCKMANNI	Wedekind 1913, p.49, tf.5c as <u>Beloceras</u>. Frasnian lb. Martenburg, Germany. BELOCERAS.
DENCKMANNI	Wedekind 1917, p.170, pl.17, f.15,16 as <u>Brancoceras.</u> Wocklumeria Stufe, Famennian. Balve, Germany. IMITOCERAS.
DENTICULATUM	Perna 1914, p.36, pl.1, f.10a,b, pl.4, f.3, tf.22,23 as <u>Sporadoceras</u>. Famennian. S. Urals, U.S.S.R. SPORADOCERAS.
DESCENDENS	Schmidt 1921, p.330, tf.6bl as <u>Sporadoceras</u> <u>bifer</u> var. Platyclymenia Stufe, Famennian. Drewer, Germany. SPORADOCERAS.
DESIDERATUS	Walcott 1884, p.203, pl.17, f.10 as <u>Goniatites</u>. See Miller 1938 p.44, pl.4, f.10). Lr. Nevada Lst., E. Ev. Comb's Park, Nevada, U.S.A. ? AGONIATITES.
DESIDERATUS	Teichert 1948, p.65, pl.16, f.1-6, tf.4 as <u>Gyroceratites</u>. ? L. Dev. Buchan District, Vicoria, Australia. GYROCERATITES.
DILLENSIS	Drevermann 1901, p.131, pl14, f.1-4 as <u>Tornoceras</u> sandbergeri var. Frasnian, Cheiloceras Stufe. ? Enkeberg, Germany. PSEUDOCLYMENIA.
DISCIFORME	Schindewolf 1952, p.291 as <u>Imitoceras</u> pro <u>I</u>. <u>discoidale</u> Schindewolf 1923a (non Smith 1903) qv.
DISCOIDALE	Wedekind 1908, p.599, pl.39, f.44, pl.42, f.5,5a as <u>Sporadoceras</u>. Platyclymenia Stufe, Famennian. Enkeberg, Germany. SPORADOCERAS.
DISCOIDALE	Schindewolf 1923a, p.329, pl.14, f.9 as <u>Imitoceras.</u> Non. <u>Imitoceras</u> <u>discoidale</u> (Smith 1903), Carb, U.S.S. Clymenia Stufe, Famennian. Gattendorf, Germany. IMITOCERAS DISCIFORME Schindewolf 1952, p.291.
DISCOIDALE	Glenister 1958, p.65, pl.5, f.7-9, pl.12, f.10,11, tf.1c, 2a as <u>Ponticeras</u>. Sadler and Gogo Formtns, Frasnian. Fitzroy Basin, W. Australia. PONTICERAS.

DISCOIDES — Trenkner 1876, pl.1, f.13 as Goniatites. Relations obscure.

DISCOIDES — Waldschmidt 1885, p.920, pl.39, f.3 as Goniatites. Stringocephalenschichten, M. Dev. Wildungen, Germany. AGONIATITES.

DISCOIDEUS — Hall 1860, p.97, tf.3-5 as Goniatites. See Miller 1938, p.144. Cherry Valley Lst. etc., Marcellus, ? L. M. Dev. Manlino, Schonarie, N. York, U.S.A. Subgenotype of TORNOCERAS (PARODOCERAS).

DISCUS — Roemer 1854, p.39, pl.6, f.7 as Goniatites. Iberger Kalk, Famennian. N.W. Harz, Germany. Relations obscure.

DISCUS — Erben 1953, p.202, pl.19, f.7, tf.7,8 as Mimagoniatites. Hasselfelder Kalk, L.M. Dev. Harz., Germany. MIMAGONIATITES.

DIVISUS — Münster 1832, p.24, pl.4, f, f.6a-d as Goniatites. Famennian. Geigen, near Hof, Germany. Genotype of PRIONOCERAS Hyatt.

DJEMELI — Petter 1955, p.510, pl.1, f.2-4, 8-12 as Holzapfeloceras. U. Eifelian, M. Dev. l'Erg Djemel, Morocco. FOORDITES.

DOMANICENSE — Holzapfel 1899, p.32, pl.5, f.9,11,13 & ?8, tf.5 as Gephyroceras. Frasnian. S. Timan Mts., U.S.S.R. PONTICERAS.

DORSATUM — Wedekind 1908, p.579 pro Kayser 1873, p.627, pl.19, f.3a-d (sic) as Tornoceras. Platyclymenia Stufe, Femennian. Enkeberg, Germany. PSEUDOCLYMENIA.

DORSICOSTA — Roemer 1854, p.40, pl.6, f.10 as Goniatites. Iberger Kalk, Frasnian. N.W. Harz., Germany. MANTICOCERAS.

DORSOLAMELLATUS — Erben 1953, p.185, pl.17, f.7-9, tf.3 as Gyroceratites. Hasselfelder Kalk, L.M. Dev. Harz, Germany. GYROCERATITES.

DORSOPLANUM — Sobolew 1914a, p.59, pl.8, f.21,22 as Gomimonteroceras. Cheiloceras Stufe, Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

DORSOPLANA — Schmidt 1924, p.152, pl.8, f.13 as Pseudarietites westfalicus var. Hangenburg Schichten, Famennian. Hönnetal and Hangenburg, Germany. PSEUDARIETITES.

DOUGLASSI	Raymond 1909, p.155, tf 6, pl.8, f.9-14 as Tornoceras. See Miller 1938, p.149. Three Forks Shale, Famennian. Three Forks, Montana, U.S.A. TORNOCERAS (TORNOCERAS) CREBRISPTUM fide Miller.
DREVERMANNI	Born 1912, p.597 as Tornoceras pro T. sandbergeri var. dillensis Drevermann 1901, pl.14, f.4. Aekatal, Germany. Cheiloceras Stufe, Famennian. PSEUDOCLYMENIA.
DREVERMANNI	Wedekind 1913, p.61, pl.5, f.5,6, tf.11b1,b2 as Manticoceras. Frasnian 1d. Bicken, Germany. MANTICOCERAS.
EBERLEI	Sweet and Miller 1956, p.815, pl.94, f.34, ft.1C as Tornoceras (T.). U. Columbus Lst., M. Dev. Scioto River, Delaware County, Ohio, U.S.A. TORNOCERAS (TORNOCERAS).
EDWIN-HALLI	Clarke 1899, p.111, tf.85 as Tornoceras. See Miller 1938, p.151. Conneaut Formtn., L. Famennian. Nile, Allegany County, N. York State, U.S.A. TORNOCERAS (TORNOCERAS).
EIFLIENSIS	Steininger 1849 p.27, as Goniatites, 1853 p.43, pl.1, f.1,2.2a,3,3a. Frasnian 1b(c). Büdesheim, Germany. TORNOCERAS (AULATORNOCERAS).
ELLIPTICA	Wedekind 1908, p.591 nom. nud., 1913 p.96, pl.8, f.3 as Prolobites delphinus var. Lr. Clymenienschichten, Famennian. Enkeberg, Germany. PROLOBITES DELPHINUS var.
ELLIPTICUS	Frech 1897, pl.30a, f.7a-c as Bactrites. L.M. Dev., Wissenbacher Schiefer. Wissenbach, Germany. Genotype of LOBOBACTRITES.
EMACIATUS	Barrande 1865, p.43, pl.3, f.1-6, pl.12, f.1-3 as Goniatites. L.M. Dev. Hlubocep, Czechoslovakia. PINACITES.
ENKEBERGENSE	Wedekind 1908, p.587, pl.39, f.9, pl.40, f.10,10a, as Centroceras. Stufe, Famennian. Enkeberg, Germany. CHEILOCERAS (TORLEYOCERAS).
EQUICOSTATUS	Hall 1874, p.34 nom. nud., 1876, pl.69, f.10 as Goniatites chemungense var. See Miller 1938, p.184. Chemung, U. Dev. ? Near Athens, N.Y., U.S.A. SCHINDEWOLFOCERAS.

ERATO — Hall 1861, p.36 nom.nud., 1962, p.64, pl.10, f.1 as *Clymenia*. See Miller 1938, p.69. Naples Formtn., Frasnian. Ontario County, N. Y., U.S.A. Fide Miller = ? PROBELOCERAS LUTHERI.

ERFOUNDENSE — H. & G. Termier 1950, p.49, pl.145, f.23-25 as *Subanarcestes* (Clariond M.S.). M. Eifelian. Bon Tcharafine, Morocco. ANARCESTES LATESEPTATUS PLEBEIUS.

ERRATICUM — Glenister 1958, p.81, pl.11, f.6-9, tf.10A,11 as *Neomanticoceras*. Virgin Hills Formtn., Frasnian. Fitzroy Basin, W. Australia. NEOMANTICOCERAS.

ESCOTI — Frech 1902, p.48, pl.3(2), f.19, tf.13b4 as *Tornoceras*. Clymenienkalk, Famennian. La Serre, Cabrières, S. France. LOBOTORNOCERAS.

EURYOMPHALA — Holzapfel 1895, p.65, pl.6, f.4 as *Agoniatites inconstans* var. Stringocephalenschichten, Givetian. Adorf, Germany. AGONIATITES.

EURYOMPHALA — Wedekind 1917, p.138, pl.17, f.1, tf.43a as *Pseudoclymenia planidorsata* var. Famennian Cheiloceras Stufe. Enkeberg, Germany. PSEUDOCLYMENIA.

EVEXUS — Von Buch 1832, p.33, pl.1, f.3-5 as *Ammonites*. M. Dev., Germany. ? AGONIATITES.

EVOLUTUM — Sobolew 1914a, p.68, pl.9, f.38 ? as *Gomimonomeroceras*. Clymenienschiefer, Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

EXCAVATUS — Phillips 1841, p.121, pl.50, f.232, pl.60 f.232 as *Goniatites* non *G. excavatus* Phillips 1836 hence *G. molarium* Whidborne qv. L. Givetian. Wolborough, S. Devon. MAENIOCERAS MOLARIUM.

EXPANSUS — von Buch 1832, p.31, pl.1, f.1,2 as *Ammonites*. M. Dev., Germany ? ANARCESTES.

EXPANSUS — Vanuxem 1842, p.146, tf.1 as *Goniatites*. See Miller 1938, p.50. Marcellus Formtn., M. Dev. Onandaga County, N. Y., U.S.A. Genotype of AGONIATITES.

EXPECTATUM — Wedekind 1913, p.71, pl.7, f.1(?),2,3 as *Crickites*. Frasnian 1d. Martenburg and Oberscheld, Germany. CRICKITES.

FALCATA	Frech 1887b, p.465 nom. nud. as Goniatites (Tornoceras) subundulatum var.
FASCICULATUM	Clarke 1899, p.71, pl.6, f.13-22, tf.45-53 as Manticoceras. Genundewa Lst., Genesee Formtn., Frasnian. Canandaigua Lake, N.Y., US.A. MANTICOCERAS.
FECUNDUS	Barrande 1865, p.32, pl.7, f.10-11, pl.10, f.8-18, pl.11, f.1-20, pl.17, f.10-12 as Goniatites. Emsian. Hlubocep etc, Czechoslovakia. MIMAGONIATITES.
FIDELIS	Barrande 1865, p.33, pl.8, f.1-23, pl.9, f.9,10 as Goniatites. Emsian. Hlubocep, Konieprus etc., Czechoslovakia. AGONIATITES.
FERRONIERI	See Prantl 1954, p.16. Emsian, Czechoslovakia. PALAEOGONIATITES.
FLENDERI	Wedekind 1917, p.127, pl.22, f.3, tf.37e as Pharciceras. Frasnian la. Oberscheld, Germany. PHARCICERAS.
FLEXUOSUM	Sobolew 1914a p.62, pl.9, f.11-13, 1914b as Gomiremonomeroceras. L. Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).
FLOWERI	Miller 1938, p.45, pl.11, f.1,2, nomen nud. in Flower 1936, p.280. Cherry Valley, Marcellus, M. Dev. Stockbridge Falls, N.Y., U.S.A. AGONIATITES.
FORCIPIFER	G. & F. Sandberger 1850, p.81, pl.6, f.3a-c as Goniatites. Rotheisenstein, L. Frasnian. Mühlengrube, Eibach, Germany. PONTICERAS.
FRECHI	Wedekind 1913, p.88, pl.8, f.7-9 as Postprolobites. Platyclymenia Stufe, Famennian. Beul, Balve, Germany. Müller 1956 as Prionoceras, IMITOCERAS.
FRECH	Wedekind 1917, p.136, pl.16, f.9, tf.41 as Tornoceras. Frasnian la. Dillenburg, Germany. TORNOCERAS (TORNOCERAS).
FULGURALIS	Whidborne 1890, p.59, pl.5, f.4,4a as Goniatites. U. Givetian. Lummaton, S. Devon. AGONIATITES.
FUNDIFER	Perna 1914, p.47, tf.42,43, pl.2, f.6,6b as Tornoceras. L. Famennian. S. Urals, U.S.S.R. PSEUDOCLYMENIA.
GALEATUM	Wedekind 1913, p.60, pl.4, f.3-4, tf.8a as Manticoceras. Frasnian 1d. Martenburg and Oberscheld, Germany. MANTICOCERAS.

GALEATUM	Wedekind 1917, p.128, 168, pl.20, f.1 as Pharciceras. Frasnian 1a. Grube Prinzkessel, Germany. PHARCICERAS.
GALEATUS	Matern 1931, p.75, pl.2, f.10a-d as Koenenites. Frasnian 1a. Grube Köningszug, Westphalia, Germany. KOENENITES.
GENULOBATUM	Sobolew 1914b, p.358 tf.14 as Gomiremonomeroceras pro 1914a, p.66, pl.9, f.36. L. Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).
GENUNDEWA	Clarke 1899, p.86, pl.8, f.1-3 as Gephyroceras ?, 1897 p.53, 1898, p.53 as G. genundewah (sic) nom. nud. See Miller 1938, p.88. Genundewa Lst., Genesee, Frasnian. Canadaigua Lake, N.Y., U.S.A. MANTICOCERAS.
GEROLSTEINENSE	Steininger 1853, p.43, pl.1, f.8 &8a as Goniatites. Frasnian 1b(c). Büdesheim, Germany. PONTICERAS.
GLOBOSUM	Schindewolf 1923a, p.336 nom. nud. as Imitoceras. Famennian, Clymenia Stufe. Gattendorf, Germany. IMITOCERAS.
GLOBOSUS	Münster 1832, p.21, pl.4, f.4a-e as Goniatites. Clymenienkalk, Cheiloceras Stufe, Famennian. Gattendorf, Germany. CHEILOCERAS (TORLEYOCERAS).
GLOBULARIS	Schmidt 1924, p.120, f.(12),13 as Gattendormia, (f.12 subsequently chosen as type of Prionoceras biforme). Wocklumeria Stufe, Famennian. Hönnetal, Germany. = Genotype of Balvia Lange. GATTENDORFIA.
GRACILIOR	Clarke 1899, p.124, pl.9, f.1-16 as Bactrites. See Miller 1938, p.33. Styliola Lst., Genesee Formtn., Frasnian. N. York State, U.S.A. BACTRITES.
GRACILIS	Münster 1832, p.33 as Goniatites nom. nud. Relations obscure.
GRACILIS	Bronn 1835, p.102, pl.1, f.6 as Gyroceratites. ? Wissenbacher Schiefer, L.M. Dev. Wissenbach. Genotype of GYROCERATITES.
GRACILIS	G. & F. Sandberger 1851, p.130, pl.11, f.9, pl.12, f.2 as Bactrites. Wissenbacher Schiefer, L.M. Dev. Wissenbach, Germany. BACTRITES.
GRACILLIMUS	Kayser 1883, p.308 as Goniatites evexus var, nom. nud. AGONIATITES
GUESTFALICUM	Frech, 1897, pl.32a, f.8 (= Tornoceras westfalicum Hoszapfel 1895 fide Frech 1902, p.49: = T. loeschmanni

Frech fide Frech 1913, p.17) as Tornoceras..L.U. Dev. Nehden, Germany, TORNOCERAS (?TORNOCERAS).

GUMBELI — Wedekind 1908, p.601, pl.39, f.42, pl.41, f.2,2a as Dimeroceras (=latisellatum Born fide Wedekind). Cheiloceras Stufe, L. Famennian. Enkeberg, Germany.

GUPPYI — Glenister 1958, p.74, pl.7, f.1, pl.8, f.3,4, pl.10, f.4,5, tf.5A,6A-D as Manticoceras. Virgin Hills, Formtn. etc., Frasnian. Fitzroy Basin, W. Australia. MANTICOCERAS.

GURICHI — Frech 1902, p.47, pl.3(2), f.20 a,b as Tornoceras. Famennian. Nehden, Germany. ? TORNOCERAS (TORNOCERAS).

HERCYNICUS — Gümbel 1862, p.323, pl.5, f.34 as Discoclymenia. (= W. cucullatum v. Buch fide Frech 1902, p.43). Famennian. Germany. DISCOCLYMENIA.

HETEROLOBATUM — Lange 1929, p.50, pl.1, f.7,7a as Sporadoceras. L. Platyclymenia Stufe, Famennian. Enkeberg, Germany. SPORADOCERAS.

HOENINGHAUSI — d'Archaic and de Verneuil 1841, p.339, pl.25, f.7 as Goniatites (archaici proposed for this by Gürich 1896, p.348 who considered G. hoeninghausi d'a & V. pre-occupied by Ammonites honinghausi von Buch; in fact A. & V. thought they were dealing with von Buch's species). Frasnian. Refrath and Eifel, Germany. Genotype of Hoeninghausia. HOENINGHAUSIA ARCHAICA.

HOLZAPFELI — Clarke 1899, p.87, tf.65, pl.7, f.17 as Gephyroceras. See Miller 1938 p.89. Eighteen Mile Creek, Erie County, N. York, U.S.A. ? Cashaqua Shale, Naples, Frasnian. MANTICOCERAS.

HOLZAPFELI — Frech 1902, p.46, pl.5(4), f.6d,7 as Tornoceras (?). U.L.Dev.(?), Pic de Cabrieres, S. France, TORNOCERAS (? TORNOCERAS = Parodoceras).

HOLZAPFELI — Wedekind 1913, p.72, pl.7, f.5,6 (Lecto.) as Crickites. Frasnian ld. Bicken etc., Germany. Genotype of CRICKITES.

HOLZAPFELI — Wedekind 1917, p.113, pl.15, f.13,14, tf.21i as Agoniatites U. Givetian. Martenburg, Germany. AGONIATITES.

HONINGHAUSI — von Buch 1832 p.172, pl.2, f.3 as Ammonites. Frasnian. Germany. ? MANTICOCERAS.

HOWITTI — Teichert 1948, p.63, pl.16, f.19,20 as Bactrites.

? M. Dev. Buchan District, Victoria, Australia. BACTRITES

HUGHESII — Whidborne 1889, p.29, 1890, p.69, pl.vi, f.2,2a, 1, 1a as Goniatites. U. Givetian. Lummaton Quarry, Torquay, Devon. TORNOCERAS (TORNOCERAS) SIMPLEX var.

HUMILE — Lange 1929, p.49, pl.1, f.6,6a, tf.5,6 as Sporadoceras. Famennian 3b. Enkeberg, Germany. SPORADOCERAS.

HUMILIS — Schindewolf 1924 p.105 as Paragattendorfia L. Carb. Germany. Genotype of Paragattendorfia. ? GATTENDORFIA.

HYBRIDUS — Munster 1832, p.19, pl.3, f.6 as Goniatites. (= Imitoceras linearis fide Gümbel 1862 p.300). Genotype of HEMINAUTILINUS Hyatt.

INCERTUS — d'Archaic & de Verneuil 1842, p.342, pl.26, f.66a as Goniatites. Frasnian 1a. Brilon, Germany. PONTICERAS (or Pseudarietites).

INCONSTANS — Phillips 1841, p.123, pl.61, f.238a-e as Goniatites. Commonly referred to Agoniatites by Devonian specialists (e.g. Frech 1902 p.44, Wedekind 1917 p.164) but the species is a Namurian Reticuloceras (Bisat 1924, p.67).

INEXPECTATUS — Frech 1887c, p.733, pl.28, f.10,10b as Goniatites (? Tornoceras). U. Dev. (not L.L.Dev) Wolayer Thörl, Germany. ? CHEILOCERAS.

INFLATA — H. & G. Termier 1950, p.61, pl.153, f.56-58 as Sobolewia. L. Givetian. Tafilelt, N. Africa. SOBOLEWIA.

INFLEXUM — Wedekind 1908, p.595, pl.39, f.43, pl.42, f.3,3a as Sporadoceras. Platyclymenia Stufe, Famennian. Enkeberg, Germany. SPORADOCERAS.

INOPINATUM — Teichert 1948, p.64, pl.16, f.10-12, 16,17 tf.3 as Lobobactrites. ? L. or M. Dev. Buchan District, Victoria. Australia. LOBOBACTRITES.

INSOLATUM — Schindewolf 1938, p.247, pl.19, f.9 as Clymenoceras. Famennian 3b. Enkeberg. Germany. Genotype of CLYMENOCERAS.

INSULCATA	Lange 1929, p.56, pl.1, f.10,10a as <u>Prolobites delphinus</u> var. Famennian 2c. Enkeberg, Germany. PROLOBITES DELPHINUS var.
INTERMEDIUM	Foord and Crick 1897, p.125 as <u>Maenioceras</u> pro Phillips 1841 p.120, pl.50, f.231 and Whidborne 1890 p.67, pl.6, f.5,5a. Givetian. Molarium Zone. Wolborough, S. Devon. MAENIOCERAS MOLARIUM var.
INTERMEDIUM	Sandberger 1851, p.82, pl.7, f.2 (1850) as <u>Goniatites intumescens</u> var. Frasnian. ? Oberscheld, Königzug, Adorf, Germany. MANTICOCERAS.
INTERMEDIUM	Schindewolf 1923a, p.333, pl.16, f.2a,2b, tf.4f1,f2 as <u>Imitoceras</u>. Gattendorf and Geigen near Hof, Germany. Famennian 6. IMITOCERAS.
INTUMESCENS	Beyrich 1837, pl.2, f.3 as <u>Goniatites</u>. Frasnian. Seesacker, Oberscheld, Germany. MANTICOCERAS.
INVERSUM	Wedekind 1913, p.60, pl.4, f.1, 2 as <u>Manticoceras</u>. Frasnian 1b. Martenburg, Germany. MANTICOCERAS.
INVERSUM	Wedekind 1917, p.116, pl.16, f.5, tf.24f as <u>Parodiceras</u>. Oderhäuser Kalk, Givetian. Ense near Wildungen. Recorded Petter 1955 as <u>Holzapfeloceras</u>. <u>WEDEKINDELLA</u> ?
IOWAENSE	Miller 1936, p.337, 1938, p.152, pl.39, f.5, pl.35, f.7,8 as <u>Tornoceras</u> (<u>T</u>). Cedar Valley Lst., U. Dev. Otter Creek, Linn County, Iowa, TORNOCERAS (TORNOCERAS).
IRIDEUM	Frech 1902, p.53, tf.14e as <u>Tornoceras</u> (<u>Epitornoceras</u>). Orthocerasschiefer, M. Dev. Wissenbach, Germany. PINACITES.
IXION	Clarke 1897, p.53, 1898, p.53, 1899, p.103, tf.77-79, pl.7, f.11-16 as <u>Beloceras</u>. See Miller 1938 p.137. Cashaqua Shale, Naples, Frasnian. Naples N. York State, U.S.A. NODOBELOCERAS.
JUGLERI	Roemer 1883, p.34, pl.9, f.6a-c as <u>Goniatites</u>. L. M. Dev. Orthocerasschiefer. Harz. Germany. Genotype of PINACITES.
KARPINSKYI	Holzapfel 1895, p.77, pl.3, f.15-20, pl.5, f.3 as <u>Anarcestes</u>. U. & L. Stringocephalenschichten, Givetian. Martenburg, Wildungen etc., Germany. WERNEROCERAS.

KAYSERI Holzapfel 1882, p.238, pl.45, f.7,8,9, tf.4cf. as Goniatites. Frasnian. Adorf, Germany. BELOCERAS (MESOBELOCERAS).

KAYSERI Wedekind 1917, p.128, tf.27c, pl.20, f.2 as Pharciceras. Frasnian 1a. Grube Prinzkessel, Germany, PHARCICERAS.

KAYSERI Wedekind 1917, p.110, pl.15, f.10, tf.21c as Agoniatites L. M. Dev., Wissenbacher Scheifer. Germany. AGONIATITES.

KAYSERI Wedekind 1917, p.123, 167, pl.21, f.4, tf.28d as Gphyroceras. Frasnian 1a. Grube Königszug, Germany. PONTICERAS.

KAYSERI Schindewolf 1923a, p.354, tf.9b as Wedekindoceras. Famennina, Clymenia Stufe. Wolayer Thorl, Carnic Alps. WEDEKINDOCERAS.

KEYSERLINGI Holzapfel 1899, p.38, pl.6, f.1-6, tf.9 as Gephyroceras. Fluss Tshut, S. Timan Mts., U.S.S.R. ? MANTICOCERAS.

KEYSERLINGI Miller 1938, p.130 pro Keyserling 1846, p.280, pl.12, f.6a-b as Timanites. Frasnian. Timan Mts., U.S.S.R. Genotype of TIMANITES.

KEYSERLINGI Müller 1952, p.49 pro G. cinctum Keyserling 1844 (non G. cinctum Münster 1842) as Tornoceras (A.). TORNOCERAS (AULATORNOCERAS).

KIELCENSE Dybczynski 1913, p.514, pl.1, f.3, pl.2, f.3 as Protornoceras. Frasnian ? Kielce, Poland, TORNOCERAS (PROTORNOCERAS).

KILIANI Frech 1902, p.64, pl.3(2), f.14a-f as Prolecanites. L. U. Dev., Frasnian 1a. Pic de Cabrieres, S. France. PHARCICERAS.

KINDLEI Miller 1938, p.91, pl.14, f.8-11 as Manticoceras. L. New Albany Shale, Frasnian. Near Delphi, Indiana, U.S.A. MANTICOCERAS.

KOCHI Wedekind 1908, p.580, pl.40, f.3,3a as Tornoceras. Platyclymenia Stufe. Enkeberg, Germany. Genotype of Pernoceras. TORNOCERAS (PROTORNOCERAS).

KOENENI Holzapfel 1882, p.244, pl.3, f.4-6 as Goniatites. Adorf, Germany. Frasnian. MANTICOCERAS.

KOENENI Frech 1902, p.54, pl.5(4), f.10 as Laeneceras. Famennian (not Obserstes Unterdevon). Pic de Cabrieres, S. France. SPORADOCERAS.

KONTKIEWICZI — Dubczynski 1913, p.522, pl.1, f.16, pl.2, f.16 as Dimeroceras. ? L. Famennian. Kielce, Poland. DIMEROCERAS.

KSEIRENSIS — H. & G. Termier, 1950, p.172, pl.150, f.38-39 as Pharciceras tridens var. Frasnian. Oued Kseir, N. Africa. PHARCICERAS TRIDENS var.

LAEVIS — Eichenberg 1931, p.181, pl.10, f.6 as Mimoceras. Emsian, L. Dev. Harz, Germany. GYROCERATITES.

LAGOWIENSE — Gurich 1896, p.345, pl.13, f.2a-c as Maeneceras. Famennian, Cheiloceras Stufe, Sacculus Bank. Lagow, Poland. CHEILOCERAS.

LAGOWIENSE — Sobolew 1912, p.10, pl.3, f.5, 1914b, pl.9, f.28a,b, 29a,b as Gomiprotomeroclymenia. ? CYRTOCLYMENIA.

LAMED — G. & F. Sandberger 1850, p.90, pl.8 as Goniatites with the varieties complanatus f.5, cordatus f.6, tripartitus f.7, rugosus f.4, calculiformis f.9, and latidorsalis f.8. Miller 1932, p.330, ~~as type but Wedekind showed that this~~ selected pl.8, f.5a-d as type of lamed but Wedekind pointed out that pl.8, f.6c also represented the variety complanatus. Frasnian. Oberscheld, Germany. MANTICOCERAS.

LAMELLOSUS — G. & F. Sandberger 1851, pl.8, f.1 as Goniatites. Frasnian 1a. Oberscheld, Germany. Genotype of KOENENITES.

LATEROCONCAVUM — Dybczynski 1913, p.518, pl.1, f.9, pl.2, f.9 as Tornoceras. ? Frasnian. Kielce, Poland. TORNOCERAS (TORNOCERAS).

LATESEPTATUS — Beyrich 1837, p.25, pl.1, f.1,2, tf.20 as Ammonites. Anarcestes Stufe, M. Dev. Wissenbacher Schiefer. Wissenbach, Germany. Genotype of ANARCESTES (ANARCESTES).

LATESEPTATUS — Frech 1902, p.69, pl.3(2), f.11a-c as Prolecanites. Frasnian 1a. Pic de Cabrieres, S. France. PHARCICERAS.

LATESTRIATUS — d'Archaic and de Verneuil 1842, p.341, pl.26, f.5 as Goniatites. Famennian. Eibach, Germany. ? CYCLOCLYMENIA.

LATIDORSATUM — G. & F. Sandberger p.90, pl.8, as Goniatites lamed var. Frasian. Oberscheld, Eibach, Budesheim etc. Germany. MANTICOCERAS.

LATILOBATUM — Schindewolf 1923a, p.342, pl.14, f.11, tf.5c as Sporadoceras. Famennian 2b and 3c. Gattendorf, Germany. SPORADOCERAS.

LATILOBUM — Perna 1914, p.56, pl.4, f.17a, 17b, tf.52-54 as Cheiloceras. L. Famennian. S. Urals, U.S.S.R. CHEILOCERAS (CHEILOCERAS).

LATISELLATUM — Born 1913, p.611, pl.21, f.7a,b as Dimeroceras. L. Famennian. DIMEROCERAS.

LATISELLATUM — Nalivkina 1936, p.92, tf.3 as Manticoceras. Frasnian, Novaya Zemlya, U.S.S.R. MANTICOCERAS.

LATISELLATUS — Erben 1953, p.210, pl.19, f.8 (holotype), tf.11,12 as Anarcestes (Latanarcestes). Zorgensis Kalk, Emsian. Harz Mts., Germany. ANARCESTES (LATANARCESTES).

LATUM — Dybczynski 1913, p.520, pl.1, f.12, pl.2, f.12 as Polonoceras. ? L. Famennian. Kielce, Poland. TORNOCERAS (POLONOCERAS).

LEBEDEFFI — Holzapfel 1899, p.39, pl.6, f.11, tf.10 as Gephyroceras Frasnian. Fluss Tschut, S. Timan Mts., U.S.S.R. MANTICOCERAS.

LENTIFORME — Kayser 1896, 1900 p.347, pl.14, f.1-3 as Brancoceras. L. Famennian. Lagow, Poland. Genotype of Paratornoceras. = CHEILOCERAS.

LENTIFORME — G. & F. Sandberger 1857 nom. nud. as Goniatites. Figured Kayser 1873, p.612, pl.19, f.1. L Famennian. Enkeberg, Germany. Genotype of PARATORNOCERAS.

LEWINSKII — Dybczynski 1913, p.518, pl.1, f.10, pl.2, f.10 as Tornoceras. Frasnian. Kielce, Poland. TORNOCERAS (TORNOCERAS).

LINDERI — Glenister 1958, p.72, pl.6, f.1,2, pl.7, f.2, pl.9, f. 1,2, tf.4,5B,C as Manticoceras. Virgin Hills Formtn., Frasnian. Fitzroy Basin, W. Australia. MANTICOCERAS.

LINEARIS — Münster 1832, p.17, pl.5, f.1a-d as Goniatites. Famennian. Geigen near Hof, Germany. IMITOCERAS.

LINEATUS — Munster 1842, p.128, pl.11, f.18a,b as Goniatites tripartitus var. ? Famennian. Oberfranken, Germany. IMITOCERAS ?.

LINGUA — G. & F. Sandberger 1852, p.109, pl.10, f.2021 as Goniatites retrorsus var. Frasnian 1b(c). Büdesheim, Germany. TORNOCERAS (TORNOCERAS).

LIRATA Schmidt 1924, p.117, pl.6, f.5 as Acanides sulcatus var. Dasberg Schichten, U. Famennian. Drewer, Germany. IMITOCERAS.

LITUUS Barrande 1865, p.35, pl.10, f.1-7 as Goniatites. ? Emsian, L. Dev. Chotecz, Czechoslovakia. Genotype of Palaeogoniatites.

LOESCHMANNI Frech 1902, p.49, pl.4(5), f.9a-c as Tornoceras. I. U. Dev. Nehden near Brilon. TORNOCERAS (AULATORNOCERAS).

LUNATUS Eichenberg 1930, p.378, pl.56, f.4 as Anarcestes. Schönauerkalk, Emsian. Shönau, Kellerwald, Germany. ANARCESTES.

LUNULICOSTA G. & F. Sandberger 1851, p.69, pl3, f.14,14b,c,f (non 14a,d,e fide Matern 1931, p.89) as Goniatites. Frasnian Ia. Oberscheld and Königzug, Germany. PHARCICERAS.

LUTHERI Clarke 1885, p.50, pl.2, f.8 as Goniatites. See Miller 1938, p.63. Naples Formtn. Frasnian. Ontario County, N.Y., U.S.A. Genotype of PROBELOCERAS.

LYNX pro iynx Clarke, e.g. Frech 1902, p.55.

MACROCEPHALUS Schindewolf 1933, p.95, pl.4, f.14, tf.27 as Subanarcestes (Beyrich MS.). Wissenbacher Schiefer, L.M. Dev. Olkenbach, Germany. Genotype of SUBANARCESTES.

MAGNOSELLARIS Holzapfel 1895, p.97, pl.4, f.8,9 as Tornoceras simplex var. L. Stringocephalenschichten, Givetian. Wildungen and Ense, Germany. TORNOCERAS (TORNOCERAS).

MAJOR Frech 1887b, p.465 as Goniatites subundulatus var. nom. nud. ? L. Dev. Pic de Bissous, S. France. Frech 1902 p.45 states = Aphyllites Barroisi Frech. AGONIATITES.

MAMMILIFER G. & F. Sandberger 1850, p.70, pl.5, f.5a-e as Goniatites. L. Famennian. Oberscheld, Germany. Genotype of DIMEROCERAS.

MAURERI Kayser 1896, p.24, pl.5, fr.9 as Mimoceras. U. L. Dev., Giessen, Germany. GYROCERATITES.

MEDIUS	Wedekind 1913, p.89, pl.8, f.10,11 as Postprolobites. Annulata Kalk, Platyclymenia Stufe, Famennian. Beul, near Balve, Germany. Fide Schindewolf 1952, p.284 = Prionoceras sulcatum. IMITOCERAS.
MERIDIONALIS	Frech 1902, p.81, pl.4(3), f.21, tf.35b as Sporadoceras subbilobatum var. U. Clymenienkalk, Famennian. La Serre, Cabrieres, S. France. SPORADOCERAS.
MICROMPHALUS	Roemer 1854, p.19, pl.3, f.30a-c as Goniatites. Wissenbacher Schiefer, L. M. Dev. N.W.Harz, Germany. ? SUBANARCESTES.
MICROSTOMA	Lange 1929, p.38 nom. nud. as Pseudoclymenia pseudogoniatites var. Famennian. Enkeberg, Germany. PSEUDOCLYMENIA PSEUDOGONIATITES.
MILLERI	Flower and Gaster 1935, p.56, pl.6, f.1,2 as Paralegoceras ? See Miller 1938, p.175. ? L. Conewango, Famennian. Erie County, Penns., U.S.A. SPORADOCERAS.
MIRABILE	Dybczynski 1913, p.514, pl.1, f.4, pl.2, f.4 as Protornoceras. Frasnian. Kielce, Poland. TORNOCERAS (TORNOCERAS).
MIRUS	Wedekind 1908, p.591, pl.40, f.9,9a as Prolobites. Platyclymenia Stufe, Famennian. Enkeberg, Germany. PROLOBITES.

MITHRACOIDES — Frech 1887d, p.30, pl.2, f.1 as Goniatites. L.U. Dev. Eibach, Germany. Genotype of Epitornoceras. TORNOCERAS (EPITORNOCERAS).

MITHRAX — Hall 1860, p.98, tf.7 as Goniatites. See Miller 1938, p.153. ? Columbus Limestone, L.M. Dev. Columbus, Ohio. TORNOCERAS (TORNOCERAS).

MOJSISOVICSI — Miller 1938, p.181 pro G. & F. Sandberger 1850, p.67, pl.3, f.13,13a. Genotype of PROLECANITES.

Molarius — Whidborne 1889, p.64, pl.8, f.11,11a, pl.6, f.4,4a as Goniatites. Molarium Zone, Givetian. Wolborough, S. Devon. MAENIOCERAS.

MORAVICUM — Rzehak 1910, p.195, pl.3, f.6,7 as Praeglyphioceras. L. Clymenienkalk, Famennian. Haidenburg, Germany. SPORADOCERAS.

MULTILOBATUS — Beyrich 1837, p.33, f.6 as Ammonites. Oberscheld, Frasnian. Non A. multilobatus Bronn 1832. BELOCERAS SAGITTARIUM.

MULTISEPTATUS — v. Buch 1832, p.42, pl.2, f.6 as Ammonites. Locality unknown, germany. frasnian. Genotype of EOBELOCERAS.

MULTISULCATUS — Lange 1929, p.57, pl.1, f.12,12a, b (holotype) as Prolobites. Platyclymenia Stufe, Famennian 3b. Enkeberg, Germany. PROBLOBITES.

MULTIVARICATA — Wedekind 1917, p.144, pl.18, f.5 as Cheiloceras subpartitum var. L. Cheilocerasschichten, Famennian 2. Nehden, Germany. CHEILOCERAS (CHEILOCERAS) SUBPARTITUM var.

MUNSTERI — von Buch 1832, p.41, pl.2, f. 5 as Ammonites. Famennian. Germany. SPORADOCERAS.

NANA — Perna 1914 p.25, pl.1, f.6a,b. 7a,b, tf.13 as Prolobites delphinus var. Platyclymenia Stufe, Famennian. Urals, U.S.S.R. PROLOBITES DELPHINUS var.

NAPLESENSE — Clarke 1899, p.105, tf.78, pl.7, f.18 as Probeloceras? Cashaqua Shale, Naples Formtn., Frasnian. Naples, New York State, U.S.A. NEOMANTICOCERAS.

NEHDENSE — Kayser 1873, p.625, pl.19, f.4 as Goniatites globosus var. L. Famennian. Nehden, Germany. CHEILOCERAS (TORLEYOCERAS).

NEHDENSE — Lange 1929, p.33, pl.1, f.1, tf.1,2 as Manticoceras. L. Cheiloceras Stufe, Famennian. Nehden, Germany. MANTICOCERAS.

NEGLECTUS — Barrande 1865, p.35, pl.3, f.7-13 as Goniatites. ? L. M. Dev. Hlubocep, Czechoslovakia. ANARCESTES (LATANARCESTES).

NEVADENSE — Miller 1938, p.46, pl.6, f.1, tf.4,5 as Agoniatites. L. Nevada Lst., ? L.M. Dev. Lone Mt., S.W. Eureka, Nevada. AGONIATITES.

NIEDZWIEDZKII — Dybczynski 1913, p.521, pl.1, f.14, pl.2, f.14 as Gephyroceras. Frasnian. Kielce, Poland. ? MANTICOCERAS.

NITIDUS — Raymond 1909, p.152, pl.7, f.9-12 as Bactrites. Three Forks Shale, L. Famennian. Three Forks, Montana, U.S.A. BACTRITES.

NODIFER — Clarke 1885 p.21, as Goniatites, 1899 p.74, tf.54,63, 64, pl.6, f.24-26 as Manticoceras. Genundewa Lst., Genesee Formtn., Frasnian. Canadaigua Lake, N. York State, U.S.A. MANTICOCERAS.

NODIFERUS — Hall 1886, pl.12, f.7 as Goniatites vanuxemi var. See Miller 1938 p.47. Lr. Cherry Valley, Marcellus Formtn., M. Dev. Cherry Valley, New York State, U.S.A. AGONIATITES.

NODIGER — pro nodiferus Hall eg. Holzapfel 1885, p.61.

NODULOSUM — Wedekind 1913, p.68, pl.6, f.4,5, tf.12b1,2 as Gephyroceras. Frasnian 1b. Martenburg, Germany. MANTICOCERAS.

NOEGGERATHI — von Buch 1832, p.166, pl.1, f.6-8 as Ammonites. L.M.Dev. ? Wissenbach, Germany. Subgenotype of ANARCESTES (LATANARCESTES).

NUCLEUS ~~NUCIFORMI~~S — Schmidt 1924 p.119 pl.6, f.10,11 as Glatziella. U. Dasbergschichten, Wocklumeria Stufe. F.10, Dasberg, Germany. ? GATTENDORFIA (BALVIA).

NUMISMALIS — Petter 1955, p.572, pl.1, f.1,5-7 as Holzapfeloceras U. Eifelian, M. Dev. Erg Djemel, N. Africa. FOORDITES.

NUNDAIA — Hall 1874, p.3, 1875, p.134 as Goniatites (Clymenia ?) See Miller 1938 p.106,7 who states = MANTICOCERAS SINUOSUM.

OBEA — pro obesum Clarke eg. Frech 1913 p.18.

NUCIFORMIS — Whidborne 1890 p.77, pl. 6, f. 7, 7a, b, pl. 7. f. 1, 1a as Goniatites. Molarium Zone, Givetian, Wolborough, S. Devon. SOBOLEWIA.

OBESUM Clarke 1899, p.116, pl.8, f.17 as Tornoceras uniangulare var. See Miller 1938 p.160. Cashaqua Shale, Naples Formtn., Frasnian. Naples, New York State, U.S.A. TORNOCERAS (TORNOCERAS) UNIANGULARE fide MILLER.

OBLIQUA Whidborne 1889 p.29 nom. nud., 1890 p.156, pl.5, f.1-3 as Goniatites. Molarium Zone, Givetian, Wolborough, S. Devon. AGONIATITES.

OBLIQUESEPTATUS G. & F. Sandberger 1852, p.160, pl.18, f.2 as Orthoceras. Orthocerasschiefer, L.M. Dev. Wissenbach, Germany. BACTRITES.

OBLIQUUM Perna 1914, p.50, pl.2, f.7a,7b, tf.45, 46 as Tornoceras. ? L. Famennian. S.Urals, U.S.S.R. TORNOCERAS (TORNOCERAS).

OBSCURUS Münster 1839, p.31, 1840 p.110 as Goniatites nom. nud. Relations obscure.

OCCIDENTALIS Miller and Warren 1936a, p.634, tf.4-6 as Timanites. Minnewanka Formtn., Jasper Park, Alberta, Canada. TIMANITES.

OCCULTUS Barrande 1865, p.36, pl.9, f.14-17. as Goniatites. L.M. Dev. Hlubocep, Czechoslovakia, ? FOORDITES.

OHIOENSIS Hall and Whitfield 1872, p.13 as Goniatites discoideus var. nom. nud., 1875, pl.13, f.13,19. See Miller 1938, p.167. Sellersburg Lst., Ohio, M. Dev. Near Lexington Ohio ?, U.S.A. TORNOCERAS (TORNOCERAS).

ORBICELLA Hall 1860, p.99, tf.8 as Goniatites. See Miller 1938, p.154. Hamilton Shale, M. Dev. Ludlowville, Cayuga County, New York, U.S.A. ? TORNOCERAS (? TORNOCERAS).

ORBICULARE Munster 1843, p.20,26, pl.5a, a.4a-c as Goniatites. Famennian. Ebersdorf, Fichtelgebirge, Germany. SPORADOCERAS.

ORBICULUS Beyrich 1837, p.36, pl.2, f.4a,b as Ammonites, Frasnian. Gerolstein area, Eifel, Germany. MANTICOCERAS.

ORNATUM Dybczynski 1913, p.515, pl.1, f.5, pl.6, f.5 as Protornoceras. U. Dev., Frasnian ? Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

OVATA Holzapfel 1895, p.99 as Tornoceras simplex var. ovata Frech 1902, p.47 pl.3(2), f.21a, b. Frasnian ld. Budesheim, Germany. TORNOCERAS (TORNOCERAS) SIMPLEX var.

OVATUS — Münster 1832, p.18, pl.4, f.1 as <u>Goniatites</u>. Famennian. Gattendorf, Germany. CHEILOCERAS (STAFFITES).

OXY — Clarke 1897, p.53 nom. nud. as <u>Manticoceras</u>, 1899 p.77, tf.61,63,64, pl.2, f.5,6, pl.3, f.1-3, ? 4. See Miller 1938 p.93. Chemung Formtn., Frasnian, New York, U.S.A. MANTICOCERAS.

OXYACANTHA — G. & F. Sandberger 1852, p.108, pl.10, f.3, pl.10a, f.9,10 as <u>Goniatites</u> <u>retrorsus</u> var. Famennian 2. Nehden and Oberscheld, Germany. Genotype of <u>Torleyoceras</u>. CHEILOCERAS (TORLEYOCERAS).

OXYNOTUS — Wedekind 1917, p.112, tf.21e as <u>Agoniatites</u>. U. M. Dev. Martenburg, Germany. AGONIATITES.

OXYPHYLLA — Lange 1929, p.56 pro Frech 1902 tf.33d, Wedekind 1913, tf.5c as <u>Prolobites</u> <u>delphinus</u> var. ? Platyclymenia Stufe, Famennian 3b. Enkeberg, Germany. PROLOBITES DELPHINUS var.

PADBERGENSE — Wedekind 1908, p.602, pl.39, f.17,41, f.1,1a as <u>Dimeroceras</u>. Cheiloceras Stufe, Famennian 2. Enkeberg, Germany. DIMEROCERAS.

PAECKELMANNI — Schindewolf 1937, p.343, pl.19, f.1-4 as <u>Archoceras</u>. Famennian 2a. Nehden, Germany. Genotype of ARÇHOCERAS.

PARADOXUM — Matern 1931, p.63, pl.3, f.18s,b, tf.3c,5 as <u>Manticocerum</u>. Frasnian. Büdesheim, Germany. Genotype of NEOMANTICOCERAS.

PARVUS — Loomis 1903, p.916, pl.4, f.12,13 as <u>Bactrites</u>(sp.). See Miller 1938, p.36. U. Hamilton (not Tully), Givetian. New York, U.S.A. BACTRITES.

PATERSONI — Hall 1860, p.99, tf.9,10. See Miller 1938 p.106. Frasnian. N. York State. MANTICOCERAS SINUOSUM fide Miller.

PATTERSONI — pro <u>patersoni</u> Hall eg. Hyatt 1883, p.318.

PAUCISTRIATUM — d'Archaic and de Verneuil 1841, p.339, pl.25, f.8,8b as <u>Goniatites</u>. Frasnian. Adorf and Oberscheld, Germany. TORNOCERAS (AULATORNOCERAS).

PERACUTUM — Hall 1876, pl.69, f.8, pl.74, f.13 as <u>Goniatites</u>. See Miller 1938 p.155. Naples Formtn., Frasnian. Ithaca, New York, U.S.A. TORNOCERAS (? TORNOCERAS).

PERLATUM — Hall 1874, p.1 as <u>Goniatites</u> <u>complanatus</u> var. nom. nud., 1876, pl.70, f.12. See Miller 1938, p.95.

Frasnian. Homer, Cortland County, New York, U.S.A. MANTICOCERAS.

PERNAI — Wedekind 1917, p.122, 166, pl.21, f.1, tf.28a2 as Gephyroceras. Frasnian la. Grube Prinzkessel. Germany. PONTICERAS.

PHILLIPSI — Wedekind 1917, p.112, pl.16, f.1, tf.21h as Agoniatites fulguralis var. U. M. Dev. Martenburg, Germany. AGONIATITES.

PLANIDORSATUS — Münster 1839a, pl21, pl.7a-c as Goniatites. Famennien, Clymenienkalk. Gattendorf, Germany. PSEUDOCLYMENIA.

PLANILOBUS — G. & F. Sandberger 1852, p.108, pl.10, f.6,7, pl.10a, f.16, pl.10b, f.27. Famennian 2. Nehden, Oberscheld etc. Germany. CHEILOCERAS (CHEILOCERAS).

PLANILOBUM — Sobolew 1914a, p.59, 1914b, pl.8, f.4a,b etc. tf.2 as Gomiremonomeroceras (Tornoceras), with varieties arcuatolobatum, angulatolobatum, avaricatm. ? L. Famennian. Lagow, Poland, TORNOCERAS (PROTORNOCERAS).

PLANORBIFORMIS — Münster 1832, p.8, pl.2, f.1 as ? Planulites. Famennian, Clymenienkalk. Fichtelgebirge, Germany. Genotype of Phenacoceras Frech and CYCLOCLYMENIA Hyatt.

PLANORBIS — G. & F. Sandberger 1851, p.96, pl.0, f.3a,b,d,e, (? not 3c,f,g) as Goniatites. Frsnian la. Oberscheld and Eibach, Germany. PONTICERAS.

PLANUM — Dybczynski 1913, p.520, pl.1, f.13, pl.2, f.13 as Plonoceras. Frasnian Kielce, Poland. Genotype of Polonoceras. TORNOCERAS (POLONOCERAS).

PLANUM — Perna 1914, p.43, pl.4, f.5a,b as Tornoceras. ? L. Famennian. S. Urlas, U.S.S.R. PROTORNOCERAS.

PLANUM — Sobolew 1914b, p.358, pl.8, f.21a-b as Gomiremonoeroceras (Tornoceras) genulobatum var. Famenian, Clymenienscheifer. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

PLATYPLEURA — Frech 1889, p.242 as Aphyllites occultus var. pro Kayser 1883, pl.5, f.8-10, pl.6, f.10. Eifelian. Nassau and Oberharz, Germany. Wissenbacher Schiefer. Genotype of FOORDITES.

PLEBEIFORME   Hall 1879, p.448, pl.16, f.25,26, pl.110, f.3-9 as Goniatites pro "Porcellia ? rotatoria" Hall 1876 See Miller 1938, p.58. M. Dev. Anarcestes Lst., L. Cherry Valley, Marcellus Formtn. Near Cherry Valley New York, U.S.A. WERNEROCERAS.

PLEBEIUS   Barrande 1865, p.37, pl.5,6,12,13, pl.241,f.6-8, pl. 242, f.2-10 as Goniatites. Emsian and Eifelian. Hlubocep etc., Czechoslovakia Genotype of Anarcestes.ANARCESTES (ANARCESTES) LATESEPTATUS var.

PLEBEJA,US   pro plebeius Barrande eg. Wedekind 1917, p.108

PODOLICUS   Siemiradzki 1906,p.229,pl. 18(4),f.8-9 as Anarcestes. ?U. Dev, Poland. ?PARATORNOCERAS.

POLONICUM   Sobolew 1909, p.404, pl.4, f.6, 1914a, p.28, 1914b, pl.9, f.32a-b as Gomiprotomeroceras (Pinacites?). M. Dev. Sniadka, Poland. ? PINACITES.

POLONICUM   Dybczynski 1913, p.515, pl.1, f.6, pl.2, f.6 as Protornoceras. Frasnian. Kielce, Poland. Genotype of Protornoceras TORNOCERAS (PROTORNOCERAS).

POMPECKJI   Wedekind 1917, p.137 as Tornoceras nom. nud. Famennian 2. Nehden, Germany. TORNOCERAS (AULATORNOCERAS).

POMPECKJI   Wedekind 1917, p.146, tf.46g as Cheiloceras. Famennian 2b. Nehden, Germany. CHEILOCERAS (TORLEYOCERAS).

POMPECKJI   Wedekind 1917, p.149, tf.47b as Sporadoceras. Famennian, 2b. Warstein, Germany. SPORADOCERAS.

POMPECKJI   Schindewolf 1923a, p.329, pl.15, f.2, tf.4b1,b2 as Imitoceras. Famennian 5b. Gattendorf, Germany. IMITOCERAS.

PONS   Glenister 1958, p.77, pl.5, f.4-6, pl.12, f.5-8, tf. 8A-D as Hoeninghausia. Gogo Formtn.,Frasnian. Fitzroy Basin, W.Australia. ? HOENINGHAUSIA.

PONTIFORMIS   H. & G. Termier 1950, p.52, pl.150, f.1-5, pl.169, f.3-5 as Manticoceras. U. Frasnian. Gara M'Douat, N. Africa. PONTICERAS (? = pernai pernai).

POSTHUMA   Wedekind 1917, p.149, 171, pl.18, f.13, tf.47k as Sporadoceras contiguum var. Famennian 5a. Hoevel near Balve, Germany. SPORADOCERAS.

PRAECURSOR   Frech 1897 as Anarcestes pro Barrande 1865, pl.7, f.3-9, pl.5, ? Emsian. Mnenian, Czechoslovakia. ANARCESTES (? ANARCESTES).

PRAECURSOR Frech 1897, p.126 with fig., 1902 p.61, pl.4, f.2 as Beloceras. Frasnian not L. Devonian. Wolayer Thörl, Carnic Alps, Austria. = BELOCERAS SAGITTARIUM.

PRAECURSOR Frech 1902, p.77, pl.4(3), f.16a,b as Aganides. M. U. Dev. Nehden near Brilon, Germany. IMITOCERAS.

PRAEMATURA Barrande 1877, pl.522 as Goniatites. M. Dev. not Silurian. Czechoslovakia. Genotype of CELAECERAS.

PRAELAGOWIENSE Sobolew 1914a, pl.1, f.3 ? as Cheiloceras. Famennian Poland. CHEILOCERAS.

PRIMAEVUM Schindewolf 1923a, p.340, tf.5a as Sporadoceras. Famennian 2b. Gattendorf, Germany. SPORADOCERAS.

PRIMORDIALIS Quenstedt 1846, p.67, pl.3, f.9 as Goniatites. Frasnian. Germany. MANTICOCERAS.

PRUMIENSIS Steininger 1853, p.43, pl.1, f.5,5a, as Goniatites. Frasnian Büdesheim, Germany. PONTICERAS.

PSEUDOBILOBATUM Dybczynski 1913, p.519, pl.2, f.11 as Tornoceras. Frasnian. Kielce, Poland. Tornoceras (TORNOCERAS).

PSEUDOGONIATITES G. Sandberger 1853, pl.7, f.2-4,9,10, pl.8, f.4 as Clymenia. Famennian. Germany. PSEUDOCLYMENIA.

PSEUDOSPHAERICUM Grech, 1902, p.82, pl.3, f.20 as Sporadoceras. Platyclymenia Stufe, Famennian 3. Enkeberg, Germany. Genotype of PRAEGLYPHIOCERAS.

PSEUSTES Clarke 1897, p.53 as Anabeloceras nom. nud. See Miller 1938, p.136. Genotype of Anabeloceras Probable synonym of NEOMANTICOCERAS NAPLESENSE.

PSITTACINUM Whidborne 1890, p.72, pl.6, f.9-13 as Goniatites. Molarium Zone, L. Givetian. Wolborough, S. Devon. WEDEKINDELLA.

PULLA Keyserling 1846, p.284, pl.12, f.1a-c as Goniatites ammoni var. Frasnian. Petschora Land, U.S.S.R. MANTICOCERAS.

PUNCTATUS Conrad 1838, p.111 nom. nud. as Goniatites. See Miller 1938 p.49. Hamilton, M. Dev. New York State, U.S.A. ? AGONIATITES.

PYGMAEUS Loomis 1903, p.915, 919, pl.5, f.4,5 as Bactrites. U. Hamilton (mot Tully), M. Dev. New York State, U.S.A. BACTRITES.

QUADRIPARTITUS Münster 1839a, p.19 as Goniatites nom. nud. Figd. Gumbel 1862, p.317, pl.5, f.12. See Schindewolf 1923, p.333. Famennian, Clymenienkalk. Gattendorf, Germany. IMITOCERAS.

QUADRATUS	Trenkner 1867, p.6, pl.1, f.8 as Goniatites. Frasnian. ? Germany. Fide Wedekind 1913, p.66 = MANTICOCERAS CALCULIFORME.
REFLEXICOSTA	Kayser 1883, p.307, pl.13, f.3,3a,b as Goniatites. Frasnian. Bredelar, Germany. MANTICOCERAS.
REGALE	Holzapfel 1899, p.31, pl.3, f.5, tf.3 as Gephyroceras. Frasnian. S.Timan Mts., Fluss Tschut, U.S.S.R. ? MANTICOCERAS.
REGULARE	Fenton and Tenton 1924, p.196, pl.39, f.1-3 as Manticoceras, 1919 p.373, nom. nud. Lime Creek Formtn., Hackberry, Frasnian. Rockford etc., Iowa. MANTICOCERAS.
RETORQUATUM	Glenister 1958, p.66, pl.5, f.2,3, tf1a,2b as Ponticeras. Virgin Hills Formtn., Frasnian. Fitzroy Basin, W. Australia. PONTICERAS.
RETRORSUM	von Buch 1832, p.181, pl.2, f.13 as Ammonites. Frasnian. W.Germany. Manticoceras.
RHIPAEUS	Bogoslovski 1957, p.47, fig. 1a. as Lagowites. V. Dev. U.S.S.R. ? LAGOWITES.
RHYNCHOSTOMA	Clarke 1899, p.65, tf.30-43, 63 64, pl.4, f.6-13, pl. 5, f.1 as Manticoceras. See Miller 1938, p99. Chemung and Canadway Formtns., Frasnian. W. New York State, U.S.A. MANTICOCERAS.
RHYSUM	Clarke 1899, p.121, tf100, pl.8, f.14 as Tornoceras. Hanover Shale, Chemung, Frasnian. Java, Wyoming County, N.Y. State, U.S.A. TORNOCERAS (TORNOCERAS).
RICHTERI	Schindewolf 1923a, p.328 pro Munster 1842, p.18, pl. 3a, f.7a-c as Imitoceras. Famennian 3. ? Enkeberg, Germany. IMITOCERAS.
ROEMERI	Holzapfel 1882, p.234, pl.(45)2, f.1,1a as Goniatites. M. Dev. Adorf, Germany. AGONIATITES.
ROTELLA	Holzapfel 1895, p.70, pl.7, f.2,3,5,11 as Anarcestes. Stringocephalenschichten, Givetian, Martenberg etc., Germany. SOBOLEWIA.
ROTUNDATUM	Perna 1914, p.41, pl.4, f.7a.b as Tornoceras. ? L. Famennian. S. Urals, U.S.S.R. TORNOCERAS (PROTORNOCERAS).
ROTUNDATUM	Sobolew 1914b, p.361 pro Sobolew 1914a, p.63, pl.9, f. 16 (only), 1914b, pl.9, f.18a-b as Gomiremonomeroceras. (Tornoceras) simplicius var.

Famennian, Clymenienschiefer. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

ROTUNDOLOBATA — Perna 1914, p.55, pl.2, f.10a,b, 16a,b, tf.50 as Cheiloceras Lagowiense var. L. Famennian. S. Urals, U.S.S.R. CHEILOCERAS (? CHEILOCERAS).

ROTUNDOLOBATUM — Schindewolf 1928, p.143, tf.1a,b as Sporadoceras. M. U. Dev. Reschwitzer Wehre near Saafeld. Germany. SPORADOCERAS.

ROTUNDUM — Wedekind 1908, p.594, pl.39, f.21, pl.42, f1,1a as Sporadoceras. Platyclymenia Stufe, Famennian 3. Enkeberg, Germany. SPORADOCERAS.

ROUVILLEI — von Koenen 1886, L. M. Dev. Germany. Fide Schindewolf 1933, p.94 = WERNEROCERAS RUPPACHENSE (not Sellanarcestes).

RUGOSUS — G. & F. Sandberger 1850, p.90, pl.8, f.4,4a-e as Goniatites lamed var. Frasnian. Oberscheld and Eibach, Germany. MANTICOCERAS.

RUPPACHENSE — Kayser 1879, p.304 pro G. & F. Sandberger 1852, p. 115, pl.11, f.3,3a-f figd. as G. vittiger, non G. vittiger Phillips 1836, p.237, pl.20, f.59,60. M. Dev. Lerbach and Madfeld, Germany. Genotype of WERNEROCERAS.

RUZHENCEVI — Bogoslovsji 1954, p.324, tf.1,2,3 as Devonopronorites. Frasnian 1a. U.S.S.R. Genotype of DEVONOPRONORITES.

SACCULUS — G. & F. Sandberger 1851, p.109, pl.10b, f.7,20,22, pl. 10, f.22 as Goniatites retrorsus var. Cheiloceras Stufe, Famennian. Nehden, Germany. CHEILOCERAS (CHEILOCERAS).

SAGITTARIUS — G. & F. Sandberger 1851, p.77, pl.4, f.3,3a-1 as Goniatites. Oberscheld and eibach, Germany. Frasnian. Genotype of BELOCERAS.

SAHLGRUNDENSIS — Matern 1931, p.72, pl.3, f.16a,b as Crickites. Adorf Stufe, Frasnian 1b(c). Oberscheld, Germany. CRICKITES.

SAHLGRUNDENSIS — Matern 1931, p.80, pl.2, f.11a-c as Ponticeras. Frasnian 1a. Oberscheld, Germany. PONTICERAS.

SALFELDI — Wedekind 1813, p.91 nom. nud. Famennian 3. Germany. IMITOCERAS.

SANDBERGERI — Gümbel 1862, p.320, pl.5, f.32 as Goniatites (Beyrich MS.). Famennian, Clymenienkalk. Enkeberg, Germany. Genotype of PSEUDOCLYMENIA.

SANDBERGERI Barrande 1867, p.49, 1868, pl.245, f.9-21, 1870, pl. 413, f.10-14 as Bactrites. Ordovician, Czechoslovakia. Genotype of EOBACTRITES.

SANDBERGERI Foord and Crick 1897, p.112, pro Goniatites retrorsus var. undulatus G. & F. Sandberger 1851, p.101,pl.10, f.17,17a nonG. undulatus Brown 1841. Frasnian. Büdesheim, Germany. TORNOCERAS (AULATORNOCERAS).

SANDBERGERI Wedekind 1913, p.69, pl.6, f.9,10, tf.13a as Gephyroceras. Frasnian lc. Martenberg, Germany. PONTICERAS.

SANDBERGERORUM Miller 1938 p.178 pro G. & F. Sandberger 1850, pl.4, f.1,la-f. Frasnian la. Oberscheld and königzug, Germany. Genotype of SANDBERGEROCERAS.

SCHELDENSIS Matern 1931, p.73, pl.3, f.17a,b as Crickites. Frasnian lb(c), Oberscheld and Sessacker, CRICKITES.

SCHELLVIENI Wedekind 1913, p.65, pl.5, f.1-2, tf.10c as Manticoceras. U. Frasnian. Burg, Messinghausen, Germany. MANTICOCERA.

SCHINDEWOLFI Matern 1931, p.47, tf.2a,b as Sporadoceras. Hemberg, Famennian. Oberscheld, Germany. SPORADOCERAS.

SCHLOSSERI Gallwitz 1938, p.379. tf.2 as Archoceras. Frasnian 1d. Bicken, Germany. ARCHOCERAS.

SCHLOTHEIMII Quenstedt 1846, pl.4, f.7 as Bactrites. U. Dev. Germany. BACTRITES.

SEDGWICKI Wedekind 1908, p.595, pl.39, f.14, pl.41, f.4 as Sporadoceras. Cheiloceras Stufe, Famennian 2. Enkeberg, Germany. Fide Matern 1931, p.44 and Schmidt 1921, p.329 = SPORADOCERAS ACUTOLATERALE.

SEMIFLEXUM Schindewolf 1923, p.347, pl.14, f.10, tf.6 as Sporadoceras. Platyclymenia Stufe, Famennian 3b. Gettendorf, Germany. SPORADOCERAS.

SEPTENTRIONALE Miller 1938, p.102, pl.23, f.1,2 as Manticoceras. Carcajou Mt. Sst., Frasnian. Oil Creek, Mackenzie District, Canada. MANTICOCERAS.

SERRATUS Steininger 1849, p.27, 1851, p.95, pl.9, f.3a-g, 1853 p.43, pl.1, f.10,10a as Goniatites. Frasnian. Büdesheim, Germany. MANTICOCERAS.

SIEMIRADSKII	Dybczynski 1913, p.516, pl.2, f.7a,b as Protornoceras. Frasnian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS.)
SILECIACUS	Frech 1902, p.63, pl.11, f.2, tf20a as Pseudarietites. Clymenia Stufe, Famennian 5. Ebersdorf, Germany. Genotype of PSEUDARIETITES.
SIMPLEX	Von Buch, 1832, p.42, pl.2, f.8 as Ammonites. ? Fresnain. Rammelsberg, Goslar, Germany. TORNOCERAS (TORNOCERAS).
SIMPLEX	Raymond 1909, p.152, tf.3, pl.7, f.13,14, pl.8, f.1-3 as Prolobites. See Miller 1938, p.173. Three Forks Shale, L. Famennian. Three Forks, Montana, U.S.A. Genotype of RAYMONDICERAS.
SIMPLICISSIMUM	Sobolew 1914a, p.63, pl.9, f.18 as ? Gomireprotomeroceras. Famennian, Clymenienschiefer. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).
SIMULANS	Barrande 1865, p.39, pl.9, f.18-23 as Goniatites. ? Emsian. Hlubocep, Czechoslovakia. ANARCESTES.
SIMULATOR	Hall 1874, p.2 as Goniatites nom. nud., 1876, pl. 69, f.1,2, pl.74, f.8. See Miller 1938, p.104. Naples Formtn., Frasnian. Ithaca, New York U.S.A. Genotype of MANTICOCERAS.
SINUOSUS	Hall 1843, p.244, tf106(6), 107(9) as Goniatites. See Miller 1938, p.106. Frasnian, W. New York, U.S.A. Genotype of Gephuroceras. MANTICOCERAS.
SINUVARICATUM	Sobolew 1914a, p.59, pl.8, f.23 as ? Tornoceras, 1914b as Gomiremonomeroceras. ? L. Famennian. ? Kielce, Poland. TORNOCERAS (? PROTORNOCERAS).
SOLUS	Barrande 1865, p.40, pl.3, f.14 as Goniatites. ? Emsian. Konieprus, Czechoslovakia. ? ANARCESTES.
SORORIUM	Clarke 1899, p.75, tf.56-59,63,64, pl.4, f.1-5 as Manticoceras. See Miller 1938, p.117, Chemung, Frasnian. Angola, Erie County, New York, U.S.A. MANTICOCERAS.
SPHAERICUM	Born 1912, p.610, pl.21, f.6a-c as Dimeroceras. Cheiloceras Stufe, Famennian 2. Aikatal, Germany. DIMEROCERAS.
SPIRALE	Wedekind 1917, p.149,171, pl.18, f.17. as Sporadoceras Famennian 5a. Hoevel, Germany. Fide Schindewolf 1952, p.28 = SPORADOCERAS UNGERI Munster.
SPIRIFERA	Lange 1929, p.43 as Sporadoceras rotundum var. pro

	Wedekind 1917, p.149, pl.18, f.7. Famennian 3a. Enkeberg, Germany. SPORADOCERAS.
SPIRULAEFORMIS	Münster 1839a, p.31 as Goniatites nom. nud. Elbersreuth, Germany.
SPURIUS	Münster 1832, p.31,32, 1839a, p.27 as Goniatites nom. nud.
STAINBROOKI	Miller 1936, p.336 nom. nud., 1938a, p.231, pl.1, f.5-8, 1938b p.71, pl.27, f.1-4. Independance Shale, Frasnian. Brandon, Iowa, U.S.A. PONTICERAS.
STACHEI	Frech 1887c, p.733, pl.28, f.11,11a as Goniatites. ? U. Dev. Wolayer Thöri, Carnic Alps. TORNOCERAS (TORNOCERAS).
STAUFFERI	Sweet and Miller 1956, p.814, pl.94, f.5,6, tf.1ab,b,c, as Werneroceras. Columbus Lst., M. Dev. Columbus, Ohio. WERNEROCERAS.
STILLEI	Wedekind 1917, p.147, 170, pl.18, f.14, tf.54 as Brancoceras. Famennian 5a. Hoevel, Germany. IMITOCERAS.
STRANGULATUS	Keyserling 1846, p.277, pl.12, f.4 as Goniatites. Famennian 2. Petschora Land, U.S.S.R. CHEILOCERAS.
STRIATA	Lange 1929, p.57, pl.1, f.11,11a as Prolobites delphinus var. Famennian 3a. Enkeberg, Germany. PROLOBITES DELPHINUS var.
STRIATUS	Münster 1839a, p.20, nom. nud. as Goniatites non G. striatus Sowerby 1812, p.115, pl.53, f.1 hence substriatus Munster 1840.
STUCKENBERGI	Holzapfel 1899, p.45, pl.7, f.8-9 as Timanites. Frasnian. Fluss Tschut, S. Timan Mrs., U.S.S.R. TIMANITES.
STYLIOPHYLUM	Clarke 1897, p.53 as Manticoceras, 1899 p.47,75,82 tf.2,55,63,64, pl.6, f.30. See Miller 1938 p.119. Genundewa Lst., Genesee Formtn., Frasnian. Canandaigua Lake, New York, U.S.A. MANTICOCERAS.
SUBACUTUM	Sobolew 1914b p.360 pro Sobolew 1914a, p.63, pl.9, f.17 as Gomimonomeroceras (Tornoceras) simplificatum. Fammenian, Clymenienscheifer. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).
SUBBILOBATUS	Münster 1839a, p.21, pl.17, f.1a-c as Goniatites. Famennian, Clymenienkalk. Gattendorf, Germany. SPORADOCERAS.

SUBCONICUS G. & F. Sandberger 1843, p.157, 1852 p.131, pl.12, f.1a-e as Bactrites. Wissenbach Slate, Eifelian. Wissenbach, Germany. Genotype of BACTRITES.

SUBCONTIGUUS Münster 1840, p.108 as var. of Goniatites contiguus. Nom. nud.

SUBEVEXUS Münster 1839a, p.18 as Goniatites nom. nud.

SUBFLEXUOSUS Keyserling 1846, p.270, pl.13, f.9-10 as Orthoceratites. Frasnian. Petschoraland, U.S.S.R. LOBOBACTRITES.

SUBGLOBOSUS Münster 1839a, p.19 as Goniatites globosus var. nom. nud.

SUBINVOLUTUS Münster 1938a, p.23, pl.17, f.2a-e as Goniatites. L. Carb., Gattendorfia Stufe. Gattendorf, Germany. Genotype of GATTENDORFIA.

SUBLAEVIS Münster 1832 p.20 pl.4, f.2a-c as Goniatites. Famennia. Gattendorf, Germany. ? CHEILOCERAS.

SUBLAMELLOSUS G. & F. Sandberger 1851, p.85, pl.6, f.2 as Goniatites. Frasnian 1a. Oberscheld, Germany. KOENENITES.

SUBLINEARIS Münster 1832, p.22, pl.4, f.5 as Goniatites. L. Famennian. Gattendorf, Germany. Fide Schindewolf 1923, p.317 = CHEILOCERAS Pompeckjii.

SUBNAUTILINUS Schlotheim 1832, p.26, nom. nud. Quenstedt 1846, p.63, pl.3, f.4a,b, G. & F. Sandberger 1852, p.114, pl.11, f.1, 1a-f. Wissenbach Slate, Eifelian. Dillenburg, Germany. ANARCESTES.

SUBPARTITUS Münster 1839a, p.18 as Goniatites. See Wedekind 1917, p.144, pl.18, f.1-6, tf.46a. L. Famennian. Gattendorf, Germany. Genotype of CHEILOCERAS (CHEILOCERAS).

SUBSTRIATUS Münster 1839, p.20 nom. nud. as Goniatites. Famennian. Schubelhammer, Germany. Fide Schindewolf 1923, p.336 = IMITOCERAS denckmanni.

SUBSULCATUS Münster 1832, pl.5, f.2a-d (non pl.3, f.7 ?), 1840 p.107 as Goniatites. Famennian. Schubelhammer, Germany. Fide Schindewolf 1923, p.335 = IMITOCERAS stillei.

SUBTUMIDA Perna 1914, p.44, pl.4, f.4a,b, tf.35,36 as Tornoceras dorsatum var. ? L. Famennian. S.Urals, U.S.S.R. TORNOCERAS (PROTORNOCERAS).

SUBUMBONALE Wedekind 1917, p.108, pl.15, f.6 as Wereneroceras. L. M. Dev. Grube Langsheid, Germany (not Wissenbach).

	Genotype of Werenroceras. Fide Schindewolf 1933 = WERNEROCERAS RUPPACHENSE.
SUBUNDULATUM	Frech 1887b, p.371,388,464(tf.) as Goniatites, 1902 p.50, pl.3(2), f.15 as Tornoceras. ? M. Dev. Cabrieres. S. France. ? TORNOCERAS (TORNOCERAS).
SUBVARICATUM	Sobolew 1914, p.35, pl.6, f.5a,b. tf.47a1-2. Famennian. S. Poland. SPORADOCERAS.
SULCATUS	Münster 1832, p.23, pl.3, f.7a-c as Goniatites. Famennian. Schubelhammer, Germany. Fide Müller 1957, p.65 = Prionoceras. IMITOCERAS.
SULCATUS	Richter 1848, p.32, pl.4, f.100.112 as Goniatites sulcatus Münster. Wedekind 1917 interprets this species on specimens ~~fot he~~ of the form figured by Richter which differ from Munster's holograph. IMITOCERAS.
SULCATUM	Matern 1931, p.69, pl.1, f.1a,b, tf.6 as Manticoceras. Frasnian 1d. Wildungen, Germany. MANTICOCERAS.
SULCIFERA	Lange 1929, p.43, pl.1, f.5 as var. of Sporadoceras biferum. Famennian 2b,c. Enkeberg, Germany. SPORADOCERAS.
SUPERSTES	Wedekind 1908, p.575, pl.40, f.5,5a As Gephyroceras. Famennian 2a. Enkeberg, Germany. MANTICOCERAS.
SUPRADEVONICUS	Schindewolf 1926, p.88, as Protocanties. Claimed by Librovitch 1940, p.244 as belonging to a new subgenus or even genus. ? PROTOCANITES.
SYNGONUM	Clarke 1897, p.53 nom. nud., 1899, p.106, tf.79-81, pl.6, f.23, pl.7, f.19,20 as Sandbergeroceras. See Miller 1938, p.179. Cashaqua Shale, Frasnian. New York State, U.S.A. SANDBERGEROCERAS ?
SYRJANICUM	Holzapfel 1899, p.40, pl.6, f.9, tf.11 as Gephyroceras. Frasnian. Fluss Tschut, U.S.S.R. MANTICOCERAS.
TABULOIDES	Barrande 1865, p.41, pl.4, f.1-12 as Goniatites. L.-M. Dev. Hlubocep, Konieprus, Czechoslovakia. Genotype of PARAPHYLLITES.
TAFILENSE	H. & G. Termier 1950, p.174, pl.151, f.22-24 (Clariond MS.) as Pharciceras. Frashian 1a. Oued Kseir, N. Africa. PHARCICERAS.
TARDESCULCATA	Lange 1929, p.56, pl.1, f.9,9a as Prolobites delphinus var. Famennian 3b. Enkeberg, Germany. PROLOBITES DELPHINUS var.
TARDUM	Clarke 1897, p.53 nom. nud. as Manticoceras, 1899 p.63-64,81, tf.63,64, pl.1, f.13, pl.6, f.31.

See Miller 1938 p.121. Cashaqua Shale, Frasnian. Briggs Gully, New York, U.S.A. MANTICOCERAS.

TENUE — Holzapfel 1895, p.111, pl.6, f.8 as Maeneceras. U. Givetian. Martenberg, Enkeberg etc., Germany. MAENIOCERAS.

TENUICOSTATUS — Erben 1954, p.199, pl.19, f.4,5 as Mimagoniatites zorgensis var. Shönauerkalk, L. Emsian. Rothäser Tal, Lautenburg, Germany. MIMAGONIATITES ZORGENSIS.

TENUIDISCUS — Schindewolf 1923, p.242, pl.14, f.10, tf.6 as Sporadoceras. Famennian 3b. Gattendorf, Germany. SPORADOCERAS.

TENUISTRIATUS — d'Archaic and de Verneuil 1842, p.343, pl.31, f.7-8 as Goniatites. Frasnian. Oberscheld, Germany. BELOCERAS.

TEREBRATUS — G. & F. Sandberger 1850, p.99, pl.5, f.3a-d as Goniatites. Stringocephalenkalk, U. Givetian. Villmar and Grube Christiane etc., Germany Genotype of MAENIOCERAS.

TERMIERI — H. & G. Termier 1950, p.48, pl.144, f.6,12-14 as Agoniatites (Clariond MS.). U. Eifelian. Mreb Amerloh, N. Africa. AGONIATITES.

TETRAGONA — Lange 1929, p.51, tf.9,10 as Gattendorfia (Balvia) globularis var. Famennian 6, Wocklumeria Stufe. Wocklum, Germany. BALVIA GLOBULARIS var.

TETRAGONUS — Roemer 1854, p.39, pl.6, f.9 as Goniatites. Iberger Kalk, Frasnian. N.W.Harz, Germany. Affinities uncertain.

THOMASI — Glenister 1958, p.83, pl.8, f.2, pl.10, f.6, tf. 12a,b,13b as Mesobeloceras. Fossil Downs Formtn., Frasnian. Fitzroy Basin, W. Australia. Genotype of Mesobeloceras. BELOCERAS (MESOBELOCERAS).

TIMANICUS — Holzapfel 1899, p.47, pl.2, f.6 as Prolecanites. Buchiola Kalk, Frasnian. Fluss Domanik, S. Timan Mts., U.S.S.R. Genotype of NORDICERAS

TIMANICUS — Schindewolf 1933, p.68, pro 'Bactrites subflexuosus Kays.' Holzapfel 1899, p.8, pl.10, f.1-3,9b. ? Frasnian. Fluss Tschut, S. Timan Mts., U.S.S.R. LOBOBACTRITES.

TRANSITORISU — Phillips 1841, pl.60, f.227 as Goniatites. L. Givetian. Wolborough, S. Devon. AGONIATITES.

TRIDENS — G. & F. Sandberger 1851, p.66, pl.4, f.2, pl.9, f.2,2a as Goniatites. Frasnian 1a. Oberscheld, Königzug, Germany. Genotype of PHARCICERAS.

TRIPARITITUS — Münster 1939a, p.20 as Goniatites nom. nud.

TRIPARTITUS — G. & F. Sandberger 1850, p.90, pl.8, f.7,7a,7b as Goniatites lamed var. Frasnian. Oberscheld, Eibach etc., Germany. MANTICOCERAS.

TRIPARTITUS — Eichenberg 1931, p.185, pl.10, f.3a-e as Limosphinctes. L. Emsian. Near Bad Lauterberg, Germany. Genotype of LIMOSPHINCTES.

TRIVARICATA — Wedekind 1917, p.144, pl.18, f.6 as Cheiloceras subpartitum var. Famennian 2a. Nehden, Germany. CHEILOCERAS (CHEILOCERAS) SUBPARTITUM var.

TSCHERNYSCHEWI — Holzapfel 1899, p.30, pl.4, f.1-6, pl.6, f.8, tf.2 as Gephyroceras. Frasnian. S. Timan Mts., U.S.S.R. PONTICERAS.

TUBERCULATUM — Holzapfel 1882, p.244, pl.45, pl.7-10 as Goniatites. Frasnian. W. Germany. MANTICOCERAS.

TUBERCULOSOCOSTATUS — G. & F. Sandberger 1850, pl.4, f.1-1f, pl.8, f.2 as Goniatites. Combination of tuberculosus and costatus d'Arch. & Vern. Miller 1938, p.178 named pl.4, f.1 as Sandbergeroceras sandbergerorum. Frasnian. Germany. SANDBERGEROCERAS.

TUBERCULOSUS — d'Archaic and de Verneuil 1841, p.342, pl.26, f.4 as Goniatites. Frasnian. Oberscheld, Germany. SANDBERGEROCERAS.

UCHTENSE — Keyserling 1846, p.282, pl.13, f.1,1a-c as Goniatites. Frasnian. Timan Mts., U.S.S.R. MANTICOCERAS.

UMBILICATUM — G. & F. SANDBERGER 1852, p.107, pl.10b, f.11,12,13 as Goniatites retrorsus. var. Famennian 2. Nehden, Oberscheld etc., Germany. CHEILOCERAS (TORLEYOCERAS)

UMBILICATOIDES — Sobolew 1914a, p.64, pl.9, f.29, 1914b, p.358 as Gomeremonomeroceras. L. Famennian. Lagow and Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

UMBILICATUM — Sobolew 1914a, p.61, pl.9, f.4, 1914b, p.355 as Gomiremonomeroceras. L. Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS).

UMBILICATUS — Münster 1839a, p.20 as Goniatites nom. nud.

UMBONALE Wedekind 1917, p.108, pl.15, f.5, tf.3 as <u>Clarkeoceras</u>. U. Anarcestes Stufe, Eifelian. Gees, Eifel, Germany. Genotype of <u>Clarkeoceras</u> = ANARCESTES (ANARCESTES).

UNDULATA Holzapfel 1895, p.110 as <u>Maeneceras</u> <u>terebratum</u> mut. nom. nud.

UNDULATUS Roemer 1850 p.84, pl.13, fig. 1a,b, as <u>Goniatites</u> <u>retrorsus</u> var <u>undulatus</u>. M. Devonian. Harz, Germany. ? MAENIOCERAS.

UNDULATUS G. & F. Sandberger 1851, p.101, pl.10, f.17,18,19 as <u>Goniatites retrorsus</u> var. non <u>G</u>. <u>undulatus</u> Brown 1841 hence <u>T</u>. <u>sandbergeri</u> Foord and Crick. Frasnian. Büdesheim, Germany. TORNOCERAS (AULATORNOCERAS).

UNDULOCONSTRICTUM Miller 1938, p.123, pl.22, f.7-9 as <u>Manticoceras</u>. L. New Albany Shale, Frasnian. Delphi, Indiana, U.S.A. MANTICOCERAS.

UNDULOSUS Münster 1832, p.20, pl.4, f.3a-d as <u>Goniatites</u>. Famennian. Germany. ? CHEILOCERAS.

UNGERI Münster 1840, p.107, pl.16, f.8 as <u>Goniatites</u>. Famennien, Clymenienkalk. Schubelhammer, Germany. SPORADOCERAS.

UNIANGULARIS Conrad 1842, p.268, pl.16, f.4 as <u>Goniatites</u>. See Miller 1938, p.157. Moscow member of Hamilton, M. Dev. Leicester, New York, U.S.A. Genotype of TORNOCERAS (TORNOCERAS).

UNILOBATUS Hall 1874, p.2,4 nom. nud., 1876, pl.71, f.15,16, pl. 74, f.5 as <u>Goniatites</u>. See Miller 1938, p.49 Hamilton, M. Dev. Cayuga Lake, New York, U.S.A. AGONIATITES.

URALICUM Holzapfel 1899, p.34, pl.5, f.2, tf.6 as <u>Gephyroceras</u>. Frasnian. Fluss Tschut, Timan Mts., U.S.S.R. PONTICERAS.

URMENSIS Correns 1924, p.221, pl.13, f.8 as <u>Agoniatites</u>. Givetian. Germany. ? AGONIATITES.

VAGANS Clarke 1899, p.78,82, tf.62,63,64, pl.6, f.11,12 as <u>Manticoceras</u>. See Miller 1938, p.124, Naples, Frasnian. Naples, New York, U.S.A. MANTICOCERAS.

VANUXEMI Hall 1879, p.434, pl.66, f.1,2, pl.67, f.1, pl.68, f.1, pl.69, f.3-6, pl.109, f.7,8 as <u>Goniatites</u>.

Cherry Valley member of Marcellus, L.Dev. Onandaga County, New York, U.S.A. Genotype of AGONIATITES.

VARICATUM Wedekind 1908, p.598, pl.42, f.6,6a as Sporadoceras. Famennian 3. Enkeberg, Germany. SPORADOCERAS.

VARICATA Wedekind 1917, p.136, pl.16, f.10 as Tornoceras. Frasnian 1c. Martenberg, Germany. TORNOCERAS (TORNOCERAS).

VARICOSUM Drevermann 1901, p.140, pl.14, f.10,10a as Euomphalus. Frasnian. Germany. ARCHOCERAS.

VARICOSUM Schindewolf 1923a, p.405, tf.3b as Postprolobites. Gattendorfia Stufe, L. Carb. Gattendorf, Germany. IMITOCERAS.

VERAE Frech 1902, p.46, pl.5(6), f.6,6c, tf9b as Tornoceras. ? M. Dev (not L. Dev.). Pic de Cabrieres, S. France. TORNOCERAS (TORNOCERAS).

VERNA Barrande 1865, p.41, pl.9, f.1-13 as Goniatites. L. Dev. Konieprus and Hlubocep, Czechoslovakia. AGONIATITES.

VERNA-RHENANUS Maurer 1876, p.821, pl.1,a-c as Goniatites. M. Dev. Ruppbachtales, Grube Konigsberg etc., Germany. AGONIATITES.

VERNEUILI Münster 1839a, p.17, pl.3, f.9a-c as Goniatites. Famennian 2a,b. Gattendorf, Germany. ? Genotype of Eucheiloceras. CHEILOCERAS (CHEILOCERAS).

VITTATUS Kayser 1884, p.46, pl.5, f.11-17 as Goniatites = vittiger G. & F. Sandberger qv. = WERNEROCERAS RUPPACHENSE.

VITTIGER G. & F. Snadberger 1852, p.115, pl.9, f.3,3a-f as Goniatites subnautilinus var. Non G. Vittiger Phillips 1836. M. Dev. Cramberg and Lerbach, Germany. WERNEROCERAS RUPPACHENSE.

WABASHENSE Kindle 1901, p.563, 577, pl.12, a.4,4a as Goniatites. See Miller 1938, p.61. L. New Albany Shale, Frasnian. Indiana, U.S.A. ARCHOCERAS.

WARTHINI Miller 1938, p.38, pl.2, f.3-10, pl.35, f.9 as Bactrites. L. Antrim Formtn., Frasnian. Michigan, U.S.A. BACTRITES.

WEDEKINDI Schindewolf 1923a, p.349, tf.7b as Sporadoceras. U. Famennian. Gattendorf, Germany. SPORADOCERAS.

WEDEKINDI	Sun 1935, p.249, tf.1, pl.1, f.1,2 as Manticoceras. Shaitienchiao Series, Frasnian. Changsha, Central Hunan, China. MANTICOCERAS.
WEISSI	Wedekind 1908, p.581, pl.39, f.34, pl.40, f.4,4c as Tornoceras. Famennian 3. Enkeberg, Germany. TORNOCERAS (TORNOCERAS).
WENKENBACHI	Kayser 1884, p.42, pl.4, f.1-6 as Goniatites (Koch MS.). L.M. Dev. Ruppbach, Germany. Genotype of SELLANARCESTES.
WESTFALICUS	Schmidt 1926, p.152, pl.8, f.12 as Pseudarietites. U. Dev. Hönnetal and Hangenberg, Germany. PSEUDARIETITES.
WESTFALICUM	Holzapfel 1895, p.104, pl.4, f.11,12 as Tornoceras. U. Givetian. Fretterthales, Germany. TORNOCERAS (TORNOCERAS).
WHIDBORNEI	Foord and Crick 1897, p.120, tf.56 pro Whidborne 1890, pl.6, f.3 as Tornoceras. U. Givetian.
WHITFIELDI	Miller 1932, p.331, pro Hall and Whitfield 1875, pl. 13, f.18,19 as Tornoceras. Pro G. discoideus, var. ohioensis non G. ohioensis Winchell. Sellersberg Lst., M. Dev. Ohio, U.S.A. TORNOCERAS (?TORNOCERAS).
WILDUNGENSIS	Waldschmidt 1885, p.921, pl.40, f.1 as Goniatites. Frasnian. Wildungen, Germany. PONTICERAS.
WILLIAMSI	Wells 1956, p.751, pl.82, f.4, tf.2A,2C as Beloceras. Chemung. Frasnian. Brooktondale New York State, U.S.A. BELOCERAS.
WURMII	Roemer 1843, p.33, pl.9, f.7 as Goniatites. Frasnian. Germany. MANTICOCERAS.
YAKOWLEWI	Wedekind 1913, p.87, pl.8, f.4,5,6 as Postprolobites. Famennian 4, Platyclymenia Stufe. Beuil, Germany. Fide Schindewolf 1952, p.284 etc. Genotype of Postprolobites = PRIONOCERAS DIVISUM.
ZORGENSIS	Roemer 1866, p.209, pl.34, f.9a-d as Goniatites. Zorgensis Kalk, Emsian. Joachimskopf, Zorge, Harz, Germany. Genotype of MIMAGONIATITES.

ZUBERI Dybczynski 1913, p.517, pl.1, f.8, pl.2, f.8 as *Protornoceras*. ? L. Famennian. Kielce, Poland. TORNOCERAS (PROTORNOCERAS.).