ITALIAN EXPEDITIONS TO THE KARAKORUM (K²) AND HINDU KUSH

Prof. A. DESIO Leader

IV - PALEONTOLOGY-ZOOLOGY-BOTANY

Volume I

1st Pt. FOSSILS OF KARAKORUM AND CHITRAL

2nd Pt. STUDY OF ENTOMOLOGICAL COLLECTION OF KARAKORUM AND HINDU KUSH

3th Pt. LIST OF SPERMATOPHYTA COLLECTED IN THE KARAKORUM

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SCIENTIFIC REPORTS

I

Geography

II

Geophysics

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Geology - Petrology

IV

Paleontology - Zoology - Botany

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Prehistory - Anthropology

UNDER THE AUSPICES OF THE
ITALIAN NATIONAL COUNCIL OF RESEARCH

E. J. BRILL - LEIDEN

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IV - Paleontology - Zoology - Botany

Volume I

1st Pt. - FOSSILS OF KARAKORUM AND CHITRAL

by

M. AMIOT, R. CIRY, N. FANTINI SESTINI, I. PREMOLI SILVA, C. ROSSI RONCHETTI, P. SARTENAER, A. VANDERCAMMEN, A. VON SCHOUPPÉ, C. ZANIN BURI

2nd Pt. - RESULTS OF THE STUDY OF THE ENTOMOLOGICAL COLLECTION OF THE KARAKORUM AND HINDU KUSH (1954 - 1955)

by

E. GRIDELLI and G. MÜLLER with collaborators

3th Pt. - LIST OF SPERMATOPHYTA COLLECTED IN THE KARAKORUM ABOVE 4000 m (1953 - 1954)

by

L. H. J. WILLIAMS

E. J. BRILL - LEIDEN

1965

PRINTED IN ITALY
OFFICINE GRAFICHE FRATELLI STIANTI
SANCASCIANO VAL DI PESA (FLORENCE)

PREFACE

The expedition to the Karakorum range which, during the summer of 1954 conquered K^2 (8611 m) — the second highest peak in the world — had, according to Italian tradition, a scientific as well as a mountaineering objective.

Besides the actual ascent, the programme of the expedition included research and study on the Geography, Geophysic, Geology, Anthropology and Ethnography of the area. Also, a small collection of specimens of local flora and fauna from elevated heights was made occasionally.

The expedition was carried out in three campaigns. A preliminary reconnaissance was made by Professor Desio with a guide (Mr. Riccardo Cassin), during the summer of 1953. The main stage followed in 1954 and lasted six months: it was carried out by an Italian team of five scientists (Professors Paolo Graziosi, Antonio Marussi, Bruno Zanettin, Ardito Desio and Dr. Guido Pagani, the physician of the expedition), eleven climbers and a photographer; a medical officier (Colonel Dr. M. Ata Ullah) and an assistant surveyor (Bad Shah Jan of the Survey of Pakistan), both from Pakistan, also joined the staff.

The scientific research was continued in the 1955 campaign which lasted about three months. The team this time consisted of three Italian scientists (Paolo Graziosi, Antonio Marussi and Ardito Desio) and three Pakistan assistants (Dr. N. M. Khan of the Geological Survey, Mr. M. Azizullah of the Survey of Pakistan, and Mr. Javed, a student at the University of Lahore).

The territory examined during the first campaign is to be found between the upper course of the Indus river, from Skardu as far west as the Stak valley, and the principal ridge of the Karakorum to the north. However, some reconnaissance was carried out westwards as far as Hunza and Gilgit and eastwards as far as Bagicha. The territory covered in 1955 lies between the Gilgit area and Chitral.

A new scientific campaign was organized by Professor Desio during the summer of 1961 in order to explore geologically the Wakhan territory, placed between the Hindu Kush and the Pamirs, and to extend westwards the geophysical observations. The leader was accompanied by Professor Marussi and two assistants (Dr. Giorgio Pasquarè and Dr. Ercole Martina) and by an Afghan geologist (Mr. Ajruddin).

While the geophysical programm was completely performed, the geological one was reduced to the survey of Central Badakhshan, for the espedition was not allowed to cover Wakhan.

In order to complete the geological researches over an area which had been omitted from the itineraries of previous expeditions and to clear up a number of unsolved problems of its stratigraphical geology, Prof. Desio, accompanied by two assistants (Dr. Ercole Martina and Dr. Roberto Galimberti) organized in 1962 a further campaign to the Western Karakorum. The territory covered this time is to be found between the Chogo Lungma and the Sosbun glaciers, and the high valley of the Hunza river.

The present volume is somewhat different from the others: it is the most heterogeneous one, in that it is concerned with varied arguments and it has been written by several authors. Moreover, this volume has an essentially documentary character. It consists of three parts: Paleontology, Zoology, and Botany.

The three parts have been developed in different ways, in that the respective material collected during the expeditions presents different aspects and interest, and because the authors themselves have carried out their studies according to their needs, habits, and orientation: it would have been incorrect to interfere with their methods. It is obvious that each author assumed the responsability of his own scientific subject as well as of the development of his work.

Though it would have been suitable for all the works contained in the present volume to be written in the same language, since it was not possible to obtain this from the authors themselves, we did not feel we should translate them but prefered to have them published as they had originally been written. We limited ourselves to giving some conformity so far as it was possible, to the printing of the various parts of the volumes, and to matching, so far as possible, the structure of the present volume with that of the other volumes of the same collection.

The paleontological part, which has been co-ordinated by Prof. Carla Rossi Ronchetti, director of the Institute of Paleontology of the University of Milan, contains the descriptions of the fossils collected in various parts of the territory explored, fossils which belong to different groups, and to different ages that are however included between Permian and Cretaceous. Besides the fossils collected during the 1954, 1955, 1962 expeditions, the fossils collected by myself in the 1929 expedition on the northern slope of the Karakorum (Shaksgam Valley) are also described: these last had never been described before. Others, too, have been found and illustrated here for the first time.

The second and third parts of this volume are concerned with the systematic

studies of fauna and flora which were collected during the 1954, 1955, and 1962 expeditions. In this connection, it has to be recorded that in none of the programmes of expeditions organized and directed by me had I either planned to study or to collect animals and plants.

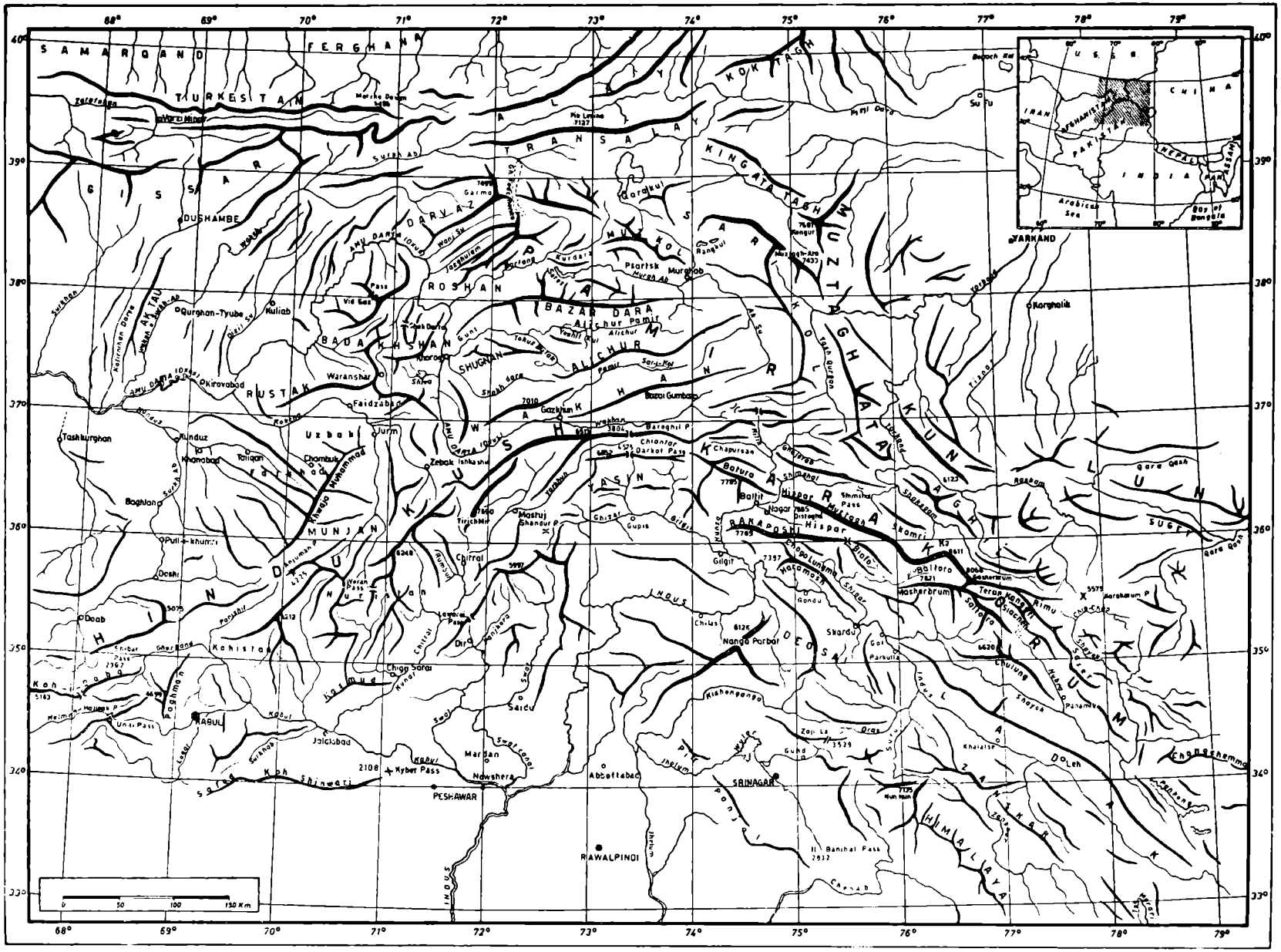
Notwithstanding this, I thought that at least in the highest regions, those most difficult to be reached, some occasional collections, which were not in our programme, might be of scientific interest, at least in that they can rarely be reached by any zoological or botanical expeditions. In view of this, some of us, particularly Prof. A. Marussi for that which concerns the zoological part and more precisely the insects, and Prof. A. Desio for that which concerns the plants living at over 4000 m a. s. l., carried out occasional collectioning excursions.

The second part of the present volume deals with the description of the insects collected during the 1954 and 1955 expeditions to the Karakorum and western Hindu Kush. The study of the entomological collection was organized and co-ordinated by Prof. E. Gridelli of the University of Trieste, and was continued, after his death, by Prof. G. Müller of the Museum of Natural History of the same town. Several experts co-operated in the systematic classification of the insects; also several new species were recognized among the material collected.

The third part of the present volume, as already mentioned, deals with botany. In this part the plants composing the collection from the Karakorum are not illustrated, but only a list of the species is given. A first systematic examination of the above-mentioned collection was made by Prof. A. Chiarugi of the University of Florence. After his death, also after the addition of new material subsequently collected, the whole small collection was examined by L. H. I. Williams of the British Museum (Natural History): his conclusions will be given in this part.

Before concluding this short preface, I wish to thank all the students who have co-operated in the description of the material collected during the expeditions directed by myself to the Karakorum and Hindu Kush, as well as all those who organized and carried out the paleontological, zoological, and botanical studies.

Ardito Desio



Orographic sketch-map of the Karakorum-Hindu Kush ranges and surrounding regions

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PALEONTOLOGY

INTRODUCTION

by

ARDITO DESIO

The section of the present volume which is devoted to Paleontology includes 10 works illustrating the fossil collections which were collected during the expeditions to the Karakorum and Hindu Kush, directed by myself, in 1954, 1955, 1962. The fossil collection of the 1929 expedition to the Karakorum is also to be added: this collection has never been previously described. The illustration of the fossils collected in Badakhshan during the 1961 Italian Expedition to the Hindu Kush is not included in the present volume: we did not want to delay the publication of the volume uselessly, taking into account the time which would be needed for the examination of the relatively rich faunas collected in that region. The illustration of such faunas will be included in an appendix to the geological volume, concerned with the scientific results of that expedition.

The paleontologic works included in the present volume have been co-ordinated by Prof. Carla Rossi Ronchetti, director of the Institute of Paleontology of Milan University: they have been divided into four groups on the basis of the geological age of the fossils which were described therein. The four groups are respectively concerned with Devonian, Permian, Jurassic, and Cretaceous fossil faunas. The names of the authors and the faunas examined by them are listed here below:

Devonian fossils

A. VON SCHOUPPÉ of the Geological-Paleontological Institute of the University of Münster (Westfalia):

Devonian Corals from Chitral.

P. SARTENAER of the Royal Institute of Natural Science of Belgium, Brussels:

Devonian *Rhynchonelloidea* from Chitral.

A. VANDERCAMMEN of the Royal Institute of Natural Science of Belgium, Brussels:

Devonian *Spiriferidae* from Chitral.

Permian fossils

C. ZANIN BURI of the Institute of Paleontology of the University of Milan (Italy):

Permian Alga from the Hunza valley (Karakorum).

I. PREMOLI SILVA of the Institute of Paleontology of the University of Milan (Italy):

Permian Foraminifera from the Hunza valley (Karakorum).

R. CIRY and M. AMIOT of the Laboratory of Geology of the Faculty of Science of Dijon (France):

Permian Foraminifera from the Shaksgam valley (Karakorum) and Bulola (Hindu Kush).

N. FANTINI SESTINI of the Institute of Paleontology of the University of Milan (Italy):

a) Permian fossils of the Upper Hunza valley (Karakorum) (Bryozoans, Brachiopods, Pelecypods, Trilobites).

b) Permian fossils of the Shaksgam valley (Brachiopods, Bryozoans, Corals, Pelecypods, Gastropods and Cephalopods).

Jurassic fossils

N. FANTINI SESTINI of the Institute of Paleontology of the University of Milan (Italy):

Corals of the Upper Jurassic of the Shaksgam valley (Karakorum).

Cretaceous fossils

C. ROSSI RONCHETTI, director of the Institute of Paleontology of the University of Milan (Italy):

Cretaceous Rudists and Nerineids from Yasin neighbourhoud (Gilgit).

Among the forms described, there are seven species of Devonian Corals and Tabulata, of which one species and one sub-species are new; four species of Brachiopods of the same age, and among them a representative of a new genus.

There are also a new species of Permian Calcareous Algae (the only fossil plant), thirty-five species of Foraminifera, they, too, of Permian age, among them two species are new; one species of Corals, two of Bryozoans, sixty-eight of Brachiopods (among them one is new), six of Pelecypods (among them a new one), two of Gastropods, one of Cephalopods, one of Trilobites, all of the Permian.

The Jurassic fossil fauna consists of seven species of Corals and one of Bryozoans; the Cretaceous, three species of Rudists, among them one new and four species of Nerineids, among them two new species.

Concerning the occurrence of the fossil faunas, it has to be recorded that the Devonian fossils come from the two following localities: Kuragh and Shogran Peak in Chitral (NW Pakistan). The first had already been discovered by H. H. Hayden and a part of the species had been described in 1922 by F. R. C. Reed.

The second was found by the author, and the fossils were mostly collected in some layers well marked by the local stratigraphic sequence.

The geographical references of the two localities are:

Kuragh:

Latitude 36° 13′ North
Longitude 72° 11′ East of Greenwich

Shogran Peak:

Latitude 26° 10′ North
Longitude 72° 07′ East of Greenwich.

The Permian fossil localities are more numerous: only one of them, the Bulola locality, which was already well known, lies in the Afghanistan Hindu Kush; the others lie in the Karakorum.

The geographical references of the Bulola locality are as follows:

Latitude 34° 54′ North
Longitude 68° 09′ East of Greenwich.

The other Permian fossil localities lie in the Karakorum, in two well distinct areas however. Two localities lie in the upper basin of the Hunza river, namely near the Mor Khun village, and in the low Chapursan valley.

Their geographical references are:
Near Mor Khun:

Latitude 36° 37′ North
Longitude 74° 52′ East of Greenwich.

Low Chapursan valley:

Latitude 36° 42′ North
Longitude 74° 46′ East of Greenwich.

The mentioned localities are not only new, but it must be added that no fossil fauna had been formerly described for that territory.

All the fossils come from the same Permian formation, called Gircha Formation (A. Desio, E. Martina, R. Galimberti 1963), prevalently composed of brown and black sandy and clayey schists in the upper part, of light coloured quartz sandstones in the lower part.

The Permian fauna from the other region is more abundant, that is from the Shaksgam valley lying on the northern side of the Karakorum range, more precisely between this range and the Aghil range.

This is not a single locality, but includes four localities dispersed in the vicinity of the talweg; these localities will be listed here below together with their geographical references:

Camp Staghar, glacier front:

Latitude 35° 49′ North
Longitude 76° 47′ East of Greenwich.

Shaksgam valley, east side, approximately 4 km below Kyagar glacier:

Latitude 35° 00′
Longitude 77° 00′

Slightly above Singhié glacier:

Latitude 35° 42′ North
Longitude 77° 01′ East of Greenwich.

Near to the Gasherbrum Gilga « Signal Camp »:

Latitude 35° 59′ North
Longitude 76° 40′ East of Greenwich.

We will give some more data on the fossils from the Shaksgam valley. They were collected by the author in the months of June and July of 1929 during the exploration of the valley, whose geological structure was unknown before that date. On that occasion two boxes of samples were collected (we

could not transport any more fossils because of extraordinary transport difficulties), unfortunatly one of these boxes was later emptied by the porters and its contents were substituted with garments. Thus part of the fossils, precisely those collected in the lowest part of the valley, have been lost. Only a small collection of Jurassic corals (see further on) could be saved, in that they were hastily collected on the way back, and put among the personal luggage.

The Permian fossils from the Shaksgam valley wich were taken to Italy were given for examination to Prof. G. Merla, who published only a preliminary note on the subject (1935) consisting of the list of fossils, and stratigraphic-paleontological comments. The paleontological descriptions were neither compiled nor published, thus nothing could be known of the collection, leaving out the above-mentioned list. Only several years after, the collection was given for examination to Dr. N. Fantini Sestini who describes it in the present volume.

Meanwhile, the high Shaksgam valley was covered by R. Wyss, of the 1935 Visser's Expedition. Visser found some of the fossil localities already signalized by the author in some geological works (1930, 1936) and other fossils were collected by him in these localities as well as in others discovered by him. A description of the fossils collected by the above mentioned author was issued in the reports of Vissers' 1939 expedition, by H. Renz and M. Reichel.

I think, however, that our original material was worthy of illustration all the more so as other forms are present which were not listed by the two authors mentioned above.

Geological information on the occurrence of the fossils is included in various previous works by the author of the present introduction (Desio 1930, 1936): more will be issued in the volumes devoted to the geology of the present collection. Here the author wishes only to mention that all the forms described come from the « Shaksgam Formation » (Desio 1963) which was defined as follows: « Brown to black and gray limestone and shaly marl associated with beds of brown and yellowish quartz-sandstone. Some light coloured beds of limestone in the upper part of sequence. The Shaksgam Formation is generally very fossiliferous. The most frequent fossils are: Brachiopods of the genus *Productus*, Pelecypods, Bryozoans, Corals, Crinoids and Foraminifera (mostly *Parafusulina*) ». The formation, or group, was ascribed to the « Permian and probably Upper Carboniferous ».

The Mesozoic fossils include also a small collection of Upper Jurassic

Corals from a saddle near the confluence of the Sarpo Laggo valley with the Shaksgam valley. Fossils were abundant in that locality, and besides the Corals, Pelecypods, Brachiopods and also some Ammonite were present. Only one example of the last group could be saved, but it is not so well preserved as to permit of classification. Besides that in the previously recorded works, geological information on this small fauna as well as on its stratigraphic poor position appeared in a note by A. Desio and N. Fantini Sestini (1960). The geographical references of the fossil locality are:

Latitude 36° 05′ 00″ North
Longitude 76° 24′ 45″ Est of Greenwich.

The Cretaceous fossils come from a single locality, the Yasin in the region of Gilgit (NW Pakistan). The locality was discovered by H. H. Hayden (1916) and the fauna had previously been illustrated by H. Douvillé (1926).

Thanks to the relatively abundant and well preserved material collected in situ, Prof. C. Rossi Ronchetti was able to recognise the presence of a new species of Rudists, and two new species of Nerineids.

It has to be mentioned that the Yasin fauna is not only formed by Gastropods and Pelecypods, but also by *Orbitolina*, illustrated by M. B. Cita and M. Ruscelli (1959), and by M. R. Shani (1957); it also consists of Corals, which have been sent for examination to J. Alloiteau of the French C. N. R. S. The stratigraphic position of the Yasin fauna was already described by myself together with that from other Cretaceous layers of the territory included between the Karakorum and the Hindu Kush (Desio 1959); it will be more widely illustrated in the geological volumes of the present collection.

The geographical references of the Yasin fossil locality are the following:

Latitude 36° 22′ North
Longitude 73° 22′ Est of Greenwich.

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DEVONIAN FOSSILS

DIE MITTEL- BIS OBERDEVONISCHE KORALLENFAUNA VON KURAGH (CHITRAL)

von

ALEXANDER VON SCHOUPPÉ
Geologisches-paläontologisches Institut der Universität Münster, Westfalien

Das im folgenden beschriebene Material wurde mir von Prof. A Desio (Mailand) zur Bestimmung übersandt. Es enthält sechs Arten und eine Unterart; eine Spezies und die Subspezies wurden neu aufgestellt. Das gesamte Material stammt vom gemeinsamen Fundpunkt 55 PD - 77 Kuragh (Chitral).

PTEROCORALLIA

Familie STRINGOPHYLLIDAE Wedekind 1925 sensu

Genus **Grypophyllum** Wedekind 1922 sensu

1826 *Cyathophyllum* Goldfuss, e. p., S. 58.
1850 *Cystiphyllum* — d'Orbigny, e. p., S. 106.
1852 *Strephodes* — Mc Coy, e. p., S. 73.
1889 *Spongophyllum* — Schlüter, e. p., S. 54.
1922 *Grypohyllum* Wedekind, e. p., S. 13.
1925 *Leptoinophyllum* Wedekind, S. 4.
1925 *Stenophyllum* Wedekind, e. p., S. 9 [non Verhoeff 1897].
1937 *Ptenophyllum* — Ma, e. p., S. 29.
? 1937 *Neomphyma* Soshkina, e. p., S. 78.
1950 *Acanthophyllum* — Wang, e. p., S. 217.
1951 *Hooeiphyllum* Taylor, S. 173.
1961 *Acanthophyllum* (*Grypohyllum*) — Birenheide, S. 114; cum syn.

(Diese Synonymaliste erhebt keinen Anspruch auf Vollständigkeit. Es werden nur die wichtigsten Zitate berücksichtigt).

Generoholotyp — *Grypophyllum denckmanni* Wedekind 1922, S. 13, Abb. 13, 14.

Diagnose — Einzelformen mit pseudoradial angeordneten, wechselnd zahlreichen, teils langen und achsial gedrehten, teils kürzeren Großsepten aus schräg von außen unten nach innen oben gerichteten parallelen Trabekelreihen. Hauptseptum mitunter verlängert. Kleinsepten vollständig bis unvollständig, mitunter von Wandblasen II (1) ausgehend oder auch unterdrückt. Im Raume unvollständiger oder fehlender Kleinsepten ergeben die Schnitte der Dissepimente bzw. Wandblasen II ein Fischgrätenmuster. Längsschnitt aus Mantelzone und wechselnd breiter Schlotzone. Mantelzone aus Dissepimenten und untergeordnet aus in der Entwicklung nur vorübergehend auftretenden Wandblasen I und II. Epithek wechselnd stark entwickelt.

Bemerkungen — Birenheide (1961) sieht nach Untersuchung des umfangreichen Wedekind'schen Originalmaterials die Gattungen *Leptoinophyllum* und *Stenophyllum* als Synonyma von *Grypophyllum* an und stellt *Grypophyllum* als Subgenus zu *Acanthophyllum* Dybowski 1873. Seiner Meinung nach erweisen sich nämlich die bislang angeführten Unterschiede als nicht konstant und daher als nicht ausreichend zu einer gattungsmäßigen Trennung.

Bezüglich der Zuordnung von *Grypophyllum* zu *Acanthophyllum* kann ich Birenheide's Auffassung jedoch solange nicht folgen, als das Originalmaterial von Edwards & Haime nicht in Hinsicht auf die Bildung seiner Septalauswüchse eingehend untersucht ist, vor allem, da die Typen von *Acanthophyllum* einerseits und *Grypophyllum* anderseits diesbezüglich ein grundverschiedenes Bild zeigen. So wäre vor allem zu klären, ob die von Birenheide an seinem weit gefaßten Genus beobachteten septalen Querelemente (Septalhöcker nach Birenheide) sämtlich tatsächlich Septalauswüchse in Form von Einzelhöckern darstellen oder ob es sich bei den beim Typus von *Acanthophyllum* so regelmäßig auftretenden Querelementen nicht doch um Carinen (siehe Schouppé & Stacul 1959, S. 215) handelt. In diesem Falle wäre nämlich unbedingt eine systematische Abtrennung erforderlich.

Außerdem aber liegt auch in der halbfächerförmigen Anordung der Trabekeln und in der entsprechenden Stellung der Dissepimente (an der Peripherie senkrecht nach oben, im übrigen Teil schräg nach innen-oben gerichtet) bei *Acanthophyllum* ein Merkmal vor, das meines Erachtens Ausdruck eines Bauplanes ist, der von jenem von *Grypophyllum*, *Leptoinophyllum* usw. abweicht, wo Trabekeln und Dissepimente durchwegs bereits von der Epithek aus schräg

(1) Siehe dazu Engel & Schouppé 1958, S. 69.

nach innen-oben weisen. Diese Unterschiede in der Anordnung der Trabekeln und des Dissepimentariums, die auch in der verschiedenen Ausbildung des Kelches zum Ausdruck kommen (Krempen- und Trichterkelche), erwähnt bereits Birenheide (1961, S. 81, Abb. 3), mißt ihnen jedoch keine generische Bedeutung zu, obwohl alle bisher beschriebenen Acanthophyllen das geschilderte, von *Grypophyllum* abweichende Längsschliffbild zeigen.

Ein weiteres Kriterium, *Grypophyllum* und *Neostringophyllum* Wedekind 1922 als Subgenera von *Acanthophyllum* zu betrachten, erblickt Birenheide darin, daß die Septen all dieser Formen aus Faserbüscheln aufgebaut seien, die keine räumliche, sondern lediglich eine flächenhafte Ausdehnung quer zu den Seitenflächen der Septen besitzen sollen. In der dazu beigefügten Abb. 1 lassen sich die Bilder des Quer-und des radiären Längsschnittes nur schwer mit jenem des tangentialen in Einklang bringen. Der Umstand, daß in erstgenannten Schnittlagen statt einzelner, in ihrer Gesamtheit Linien vortäuschender Durchstoßungspunkte von Fasern lediglich Striche gezeichnet sind, erschwert außerdem das Verständnis von Birenheides Vorstellung, die übrigens nicht den Tatsachen entspricht. Untersuchungen an radiären Längsschliffen zeigen, daß nicht lediglich bei *Stringophyllum* Wedekind 1922 und *Neospongophyllum* Wedekind 1922, wie Birenheide meint, sondern auch bei *Grypophyllum* deutliche, von einem Kristallisationspunkt ausgehende Faserbüschel zu erkennen sind. Dies dürfte aber bei einer flächenhaften Ausbildung in Schliffen parallel zu den Septenflanken (Seitenflächen) niemals der Fall sein.

Was anderseits die Vereinigung von *Leptoinophyllum* und *Stenophyllum* mit *Grypophyllum* betrifft, so sei erwähnt, daß bereits Engel & Schouppé (1958, S. 102) auf die Möglichkeit einer Zusammenlegung des erstgenannten Genus mit *Grypophyllum* hingewiesen haben. Als trennende Merkmale wurden damals die wesentlich größere Septenzahl, die Drehung ihrer Achsialenden und die im allgemeinen vollständigere Ausbildung der längeren Kleinsepten bei *Leptoinophyllum* angeführt. Birenheide (S. 116) bemerkt nun, daß die bedeutendere Septenzahl und die stärker konkaven Tabellae bei der Art *vermiculare* (mit der der Wedekind'sche Typus von *Leptoinophyllum* – *Leptoinophyllum multiseptatum* – synonym ist) eine generische Trennung von *Grypophyllum* und *Leptoinophyllum* « in keiner Weise » berechtigen. Gleichwertige Unterscheidungsmerkmale – durchwegs dickere Septen, weniger häufige Wandblasen sowie mehr blasenförmige Tabellae – « reichen » nach Birenheide (S. 82) jedoch anderseits « gerade aus », um *Neostringophyllum* neben *Grypophyllum* als weiteres Subgenus von *Acanthophyllum* bestehen zu lassen. Bei konsequenter Bewertung dieser Kriterien müßten demnach entweder sowohl *Leptoinophyl-*

lum als auch *Neostringophyllum* mit *Grypophyllum* vereint oder aber alle drei in diesem Falle – nach Birenheide – als gleichwertige Subgenera von *Acanthophyllum* betrachtet werden.

Auf Grund der obig angeführten Bemerkungen wird in vorliegender Arbeit daher *Leptoinophyllum* als Subgenus von *Grypophyllum* beschrieben.

Nicht näher wird in diesem Rahmen auf die Beziehungen zu *Neostringophyllum*, *Moravophyllum* Kettnerova 1932 und *Mictophyllum* Lang & Smith 1939 eingegangen.

Vorkommen — Mitteldevon: Europa, Asien, Australien.

Subgenus **Leptoinophyllum** Wedekind 1925

1826 *Cyathophyllum* Goldfuss, e. p., S. 54.
1850 *Cystiphyllum* — d'Orbigny, e. p., S. 106.
1851 *Cyathophyllum* — Edwards & Haime, e. p., S. 360.
1852 *Strephodes* — Mc Coy, e. p., S. 73.
? 1853 *Cyathophyllum* — Edwards & Haime, e. p., S. 224.
1855 *Cyathophyllum* — Roemer, e. p., S. 17.
1860 *Cyathophyllum* — Edwards, e. p., S. 366.
? 1871 *Cyathophyllum* — Stur, e. p., S. 128.
1873 *Cyathophyllum* — Dybowski, e. p., S. 416.
? 1881 *Cyathophyllum* — Quenstedt, e. p., S. 483.
? 1885 *Zaphrentis* — Maurer, e. p., S. 90.
1886 *Cyathophyllum* — Frech, e. p., S. 53.
1889 *Spongophyllum* — Schlüter, e. p., S. 54.
? 1891 *Cyathophyllum* — Frech, e. p., S. 684.
? 1894 *Cyathophyllum* — Frech, e. p., S. 17, 262.
? 1896 *Cyathophyllum* — Gürich, e. p., S. 155.
1902 *Cyathophyllum* — Lebedew, e. p., S. 68.
1904 *Cyathophyllum* — Felix, e. p., S. 67.
? 1911 *Cyathophyllum* — Gortani, S. 143, 144, 145.
? 1922 *Cyathophyllum* — Fliegel, S. 370, 374.
1922 *Cyathophyllum* — Reed, e. p., S. 9.
1925 *Leptoinophyllum* Wedekind, S. 4.
1925 *Stenophyllum* Wedekind, e. p., S. 9.
? 1927 *Cyathophyllum* — Heritsch, e. p., S. 171-73.
1927 *Leptoinophyllum* — Heritsch, S. 172.
? 1932 *Leptoinophyllum* — Kettnerova, e. p., S. 85.
1934 *Cyathophyllum* (*Leptoinophyllum*) — Le Maitre, S. 149, 224, 225.
1935 *Leptoinophyllum* — Schmidt, S. 317.
1937 *Ptenophyllum* — Ma, e. p., S. 29.

1937 *Leptoinophyllum* — Wedekind, S. 49.
1937 *Stenophyllum* — Wedekind, e. p., S. 49.
1939 *Stenophyllum* — Sanford, e. p., S. 415.
1940 *Leptoinophyllum* — Lang, Smith & Thomas, e. p., S. 76.
1949 *Stenophyllum* — Soshkina, e. p..
1949 *Leptoinophyllum* — Stumm, S. 23.
1950 *Acanthophyllum* — Wang, e. p., S. 217.
1950 *Leptoinophyllum* - Bassler, e. p., S. 95, 110, 111.
1951 *Leptoinophyllum* — Taylor, S. 171.
1952 *Stenophyllum* — Soshkina, e p., S. 93.
1952 *Leptoinophyllum* — Lecompte in Piveteau, e. p., S. 468.
1955 *Stenophyllum* — Bulvanker, e. p.
? 1956 *Acanthophyllum* — Hill in Moore, e. p., S. 303.
1956 *Acanthophyllum* — Ma, e. p., S. 58.
1956 *Spongophyllum* — Jux, S. 301, 306.
1958 *Leptoinophyllum* — Engel & Schouppé, S. 100, 102.
non 1958 *Stenophyllum* — Bulvanker, e. p., S. 146 [nur Synonyma e. p.].
1958 *Leptoinophyllum* — Gräf, S. 79.
non 1960 *Stenophyllum* — Spasskij, e. p., S. 57 [nur Synonyma e. p.].
1961 *Acanthophyllum* (*Grypophyllum*) — Birenheide, e. p., S. 114.

Subgeneroholotyp — *Grypophyllum* (*Leptoinophyllum*) *vermiculare* (Goldfuss), S. 58, Taf. 17, Fig. 4.

(Das Genus *Leptoinophyllum* wurde von Wedekind 1925 durch die von ihm neu aufgestellte Art *multiseptatum* typisiert (1925, S. 9, Taf. 1, Fig. 1, 2). Diese Art erwies sich als synonym mit *Cyathophyllum vermiculare* Goldfuss 1826, welch letzterem Namen daher die Priorität zukommt).

Diagnose — Subgenus von *Grypophyllum* mit zahlreichen, im Polyparzentrum leicht gedrehten Großsepten. Kleinsepten verhältnismäßig lang und vollzählig, vielfach jedoch unvollständig. Schlotzone relativ schmal und nur undeutlich gegen die Mantelzone abgegrenzt. Epithek verhältnismäßig dünn.

Vorkommen — Mitteldevon: Europa, Asien.

Grypophyllum (Leptoinophyllum) vermiculare (Goldfuss 1826)

Taf. 1, Fig. 1-4; Abb. 1

1826 *Cyathophyllum vermiculare* Goldfuss. *Petrefacta Germaniae*, S. 58, Taf. 17, Fig. 4.
1922 *Cyathophyllum torquatum* var. *orientalis* Reed. *Chitral and Pamirs*, S. 9, Taf. 1, Fig. 1-3.
1958 *Leptoinophyllum vermiculare* — Gräf. « *Cyathophyllum* » *vermiculare*, S. 79, Taf. 3, Fig. 3, 4 (*cum syn.*).
1961 *Acanthophyllum* (*Grypophyllum*) *vermiculare* Birenheide. *Acanthophyllum-Arten*, S. 117, Taf. 1, Fig. 7; Taf. 6, Fig. 19-21; Taf. 7, Fig. 22 (*cum syn.*) (*Synonyma* e. p.).

Holotyp (Monotypie) — Das in Goldfuss (1826, Taf. 17, Fig. 4) abgebildete Exemplar (Sammlung des geol.-palaeont. Mus. Univ. Bonn, Sammlung Goldfuss Nr. 198).

Locus typicus — Eifel (näheres siehe bei Birenheide, 1961, S. 117).

Stratum typicum — « Übergangskalk lose unter der Dammerde » (näheres siehe bei Birenheide, 1961, S. 117).

Material — Es lagen zwei Exemplare (1751/1,2) vor, von denen mehrere Quer-und Längsschliffe sowie Querschnittsabzüge angefertigt wurden.

Diagnose — Großwüchsiger Vertreter des Subgenus *Leptoinophyllum* mit Durchmesser im Extremfall bis 5 cm. Großsepten zahlreich, 30-50, im Zentrum leicht gedreht, abschnittsweise geringfügig verdickt.

Beschreibung — Äußere Form: Das Polypar weist im unteren Teil eine kegelförmige bis leicht hornförmig gebogene Form auf, nimmt aber im oberen Teil subzylindrische Gestalt an (Taf. 1, Fig. 1). Das größere der zwei vorliegenden Individuen erscheint ausgewachsen und erreicht eine Höhe von 12 cm und einen Kelchdurchmesser von 4.4 cm. Bereits bei einer Höhe von etwa 3 cm übersteigt bei beiden Exemplaren der Polypardurchmesser 3 cm. Die Wand ist verhältnismäßig dünn und trägt eine wechselnd deutliche Querrunzelung. Häufig scheinen die Rücken der Septen durch oder sind sogar nach Abrollung der Epithek herausgewittert. An solchen Stellen treten zwischen den Septen zusätzlich noch die blasigen Elemente der Mantelzone in Erscheinung. Aus dem durch Gesteinsmaterial gefüllten Kelch des größeren Individuums erhebt sich eine randständige zylindrische Knospe, die etwa 1.5 cm Durchmesser erreicht. Der Kelchrand ist an einer einzigen Stelle erkennbar und wird hier aus der Epithek mit deutlichen peripher keilförmig verbreiterten Septenabschnitten gebildet, an die nach innen zu eine zweite, konzentrische, durch eine Verjüngung bedingte Wandbildung anschließt.

Beobachtungen an Querschliffen: Sämtliche vorliegenden Querschliffe stammen aus mittleren bis höheren Mittellagen und zeigen in wesentlichen dasselbe Bild.

Der Septalapparat umfaßt bei 3.4-3.8 cm Durchmesser 36-37 Großsepten und ebensoviele Kleinsepten (Taf. 1, Fig. 2, 3). Die Großsepten nehmen eine pseudoradiale Stellung ein und reichen bei im einzelnen unregelmäßiger Länge und leicht geschlängeltem Verlauf bis in das Polyparzentrum, wo ihre Achsialenden eine leichte Drehung erfahren. Eine Unterscheidung von Protosepten - namentlich des Hauptseptums-erscheint nicht möglich. Die Großsepten sind im gesamten gesehen verhältnismäßig dünn, weisen aber eine abschnittsweise wechselnde Stärke auf. Im allgemeinen sind sie an den Achsialenden sowie

besonders an ihrem mittleren Abschnitt kräftiger als am peripheren Anteil, wo mitunter sogar eine annähernd fadenförmige Ausdünnung auftritt. Seltener sind sie an der Peripherie am stärksten und nehmen nach innen zu gleichmäßig an Breite ab. Beide Ausbildungsarten treten auch in ein und demselben Schliff nebeneinander auf (Taf. 1, Fig. 3). In der Regel besitzen sowohl die Groß- als auch die Kleinsepten verhältnismäßig kräftige keilförmig verbreiterte peripherste Abschnitte, die zwar eine Abhängigkeit von der allgemeinen Stärke der Septen aufweisen, aber selbst bei deren fadenförmig dünnen Ausbildung deutlich in Erscheinung treten. Nur ganz vereinzelt gehen die Großsepten nicht von der Epithek, sondern von unscheinbaren Wandblasen I aus. Besonders im Achsialabschnitt weisen die Großsepten, seltener auch die Kleinsepten höckerartige Ausbuchtungen auf, deren Auftreten allerdings nicht nur von Individuum zu Individuum, sondern auch schon beim selben Exemplar von schliff zu Schliff Schwankungen unterworfen ist. Die Kleinsepten erreichen bei etwas ungleicher Länge rund drei Viertel des Polyparradius. Sie sind dünner als die Großsepten und können mitunter auch, wie diese, gegen die Peripherie fadenförmig ausdünnen. Im allgemeinen gehen sie von der Epithek, nur vereinzelt auch von kleinen Wandblasen II aus. Häufig sind sie vollständig ausgebildet, besonders in älteren Entwicklungsstadien jedoch oft in zwei, seltener in mehrere Einzelstücke aufgelöst (Taf. 1, Fig. 2, 3). Die Kontinuitätsunterbrechung betrifft ausschließlich den der Peripherie genäherten Abschnitt, in dem die Septen am dünnsten sind, so daß dieselben dann in einen kürzeren peripheren und einen längeren achsialen Teil zerfallen.

Die dünne Epithek ist nur unvollständig erhalten und scheint aus den tief eingelassenen Sockeln der Groß-und Kleinsepten sowie zwischengeschalteten Wandstücken zusammengesetzt zu sein.

Der Basalapparat zeigt im Querschliff eine abschnittsweise verschiedene Ausbildung. Im randlichen Bereich, der etwa ein Drittel des Polyparradius einnimmt, sind die Schnitte der Dissepimente weitständiger und verhältnismäßig unregelmäßig in ihrer Form. Wo sie tangentialen Verlauf besitzen, weisen sie eine relativ starke Konkavität nach dem Polyparzentrum hin auf. Häufig jedoch stellen sie sich schräg (namentlich an der äußersten Peripherie) oder nehmen, falls die Kleinsepten unterbrochen sind, eine fischgräten-musterartige Anordnung an. Im zentralen Anteil hingegen treten regelmäßige, enger gescharte, tangential stehende und nur mäßig nach innen konkave Dissepimentschnitte auf. Sie setzen sich in annähernd gleichbleibender Ausbildung bis in das Polyparzentrum fort. Eine Grenze zwischen Mantel-und Schlotzone ist im Querschliff nicht immer feststellbar. Vorwiegend im Bereiche der unre-

gelmäßig entwickelten Dissepimente lassen sich ferner auch spärliche Periseptalblasen (nach Birenheide 1961, S. 88: Blasen, die sich nur von einer Septenwand aus vorwölben; Abb. 1) beobachten.

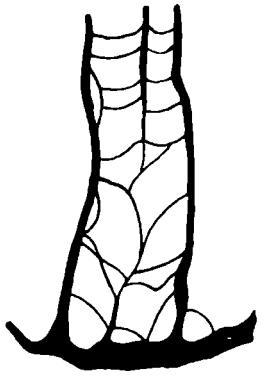


Abb. 1. – *Grypophyllum (Leptoinophyllum) vermiculare* (Goldfuss).
Ausschnitt aus dem Querschnitt von Taf. 1, Fig. 3. 1751/1. × 5. Vom linken Großseptum wölben sich zwei Periseptalblasen vor.

Beobachtungen an Längsschliffen: Der Längsschliff (Taf. 1, Fig. 4) zeigt eine lediglich unscharfe Trennung des Basalapparates in Mantel-und Schlotzone. Die Mantelzone besteht aus von der dünnen Epithek durchwegs schäg von außen unten nach innen oben gerichteten Dissepimentalblasen von wechselnder Größe. Sie nehmen nach innen zu am Übergang zur Schlotzone eine etwas steilere Stellung ein. Die Schlotzone selbst ist sehr schmal und scheint, soweit erkennbar, aus leicht eingesenkten Basalelementen zu bestehen, die zufolge der bis in das Polyparzentrum reichenden Großsepten auch nicht speziell als Böden anzusprechen sind. An einem in Polyparzentrum angeschnittenen Septum ist ein einzelner nach unten hackenförmig gekrümmter Auswuchs erkennbar.

Vorkommen — Mitteldevon (Couvinium, jedoch vorwiegend Givetium): Deutschland (Eifel, Bergisches Land, Harz?); Österreich (Grazer Devon, Kärnten); ? Tschechoslowakei (Mähren); Frankreich; England (Devonshire); Polen?; Pakistan (Kuragh [Chitral]).

Familie Disphyllidae Hill 1939

Genus **Disphyllum** de Fromentel 1861

1826 *Cyathophyllum* Goldfuss, e. p., S. 54.
1846 *Cladocora* — Geinitz, e. p., S. 569.
1850 *Diphyphyllum* — d'Orbigny, S. 106.
1851 *Cyathophyllum* — Edwards & Haime, e. p., S. 360.
1861 *Disphyllum* De Fromentel, e. p., S. 302.
1866 *Astrocalamocyathus* Ludwig, S. 188.
1866 *Astrodendrocyathus* Ludwig, S. 188.
1866 *Taeniodendrolopas* Ludwig, S. 188.
1866 *Taeniocalamolopas* Ludwig, S. 188.
1873 *Cyathophyllum* — Dybowski, e. p., S. 416.
1879 *Cyathophyllum* — Quenstedt, e. p.

1886 *Cyathophyllum* — Frech, e. p., S. 53.
1902 *Cyathophyllum* — Počta in Barrande, e. p., S. 87.
1922 *Schlüteria* Wedekind, S. 3.
1922 *Cyathophyllum* (*Thamnophyllum*?) — Reed, e. p., S. 14.
1922 *Cyathophyllum* (*Phacellophyllum*) — Reed, e. p., S. 15.
1934 *Disphyllum* — Lang & Smith, S. 78.
1935 *Disphyllum* — Lang & Smith, e. p., S. 544.
1937 *Disphyllum* — Ma, e. p., S. 9.
1939 *Disphyllum* — Hill, S. 224.
1939 *Disphyllum* — Sanford, S. 409.
1939 *Pseudostringophyllum* Soskina, e. p., S. 54.
1939 *Megaphyllum* Soshkina, S. 14, 16 [non Verhoeff 1894].
1940 *Disphyllum* — Lang, Smith & Thomas, S. 53.
? 1941 *Ceratinella* Soshkina [non Emerton, 1882].
1947 *Disphyllum* — Le Maitre, e. p., S. 24, 45.
1949 *Disphyllum* — Stumm, S. 32.
1950 *Disphyllum* — Wang, S. 218.
1950 *Disphyllum* — Bassler, e. p., S. 88-163.
1951 *Megaphyllum* — Soshkina, S. 108.
1952 *Disphyllum* — Lecompte in Piveteau, e. p., S. 470.
1952 *Megaphyllum* — Soshkina, e. p., S. 104.
1953 *Megaphyllum* — Iwanija, e. p., S. 30.
1954 *Schlüteria* — Soshkina, S. 44.
1956 *Disphyllum* — Hill in Moore, S. 280.
1956a *Disphyllum* — Flügel, H., S. 7.
1956 *Disphyllum* — Schouppé, S. 148 ff.
1958 *Disphyllum* — Müller, S. 214.
1958 *Megaphyllum* — Bulvanker, S. 186.
1960 *Megaphyllum* — Spasskij, e. p., S. 64.
1961 *Disphyllum* — Flügel, H., S. 382.

(Da zu diesem Genus gehörende Formen in der Literatur häufig beschrieben wurden, stellt die Synonymaliste lediglich eine Auswall der wesentlichsten Zitate dar).

Generolectotyp — *Cyathophyllum caespitosum* Goldfuss 1826, S. 60, Taf. 19, Fig. 2b.

Diagnose — Koloniebildende, büschelige Formen mit Lateral-und Calicinalsprossung und Septen aus schräg von aussen unten nach innen oben verlaufenden Trabekelreihen. Die in der Schlotzone fadenförmig verdünnten Großsepten erreichen das Zentrum nicht. Kleinsepten von mittlerer Länge, Epithek dünn. Mantelzone aus einer äußeren, charakteristischen Zone größerer, globulöser bis relativ flach gestreckter Dissepimente (keine Hufeisenelemente!), an die sich normal ausgebildete, schräg gewölbte nach innen an-

schließen. Schlotzone aus in zentralen Teilen mehr oder weniger horizontalen Böden und periachsialen schrägen plattigen bis blasigen Elementen aufgebaut.

Bemerkungen — Die angeführte charakteristische Dissepimentzone (Wachstumstendenz schräg nach innen oben!) darf nicht mit den Hufeisenelementen der Formen der *Macgeeidae* verwechselt werden (Wachstumstendenz senkrecht nach oben!). Dementsprechend sind auch die Septen bei *Disphyllum* als Einstülpungen von Fußscheibe und Pallium gebildet und entspringen der äußeren Epithek. Sie sind aus parallelen, von unten außen nach oben innen gerichteten Trabekelreihen aufgebaut (Wachstumstendenz schräg nach innen oben), während bei den Formen der *Macgeeidae* die Septen aus Einstülpungen der Fußscheibe allein gebildet werden und in Form von Fächertrabekeln senkrecht nach oben wachsen, ohne mit der Epithek direkt in Verbindung zu stehen (siehe Schouppé, 1956).

Vorkommen — Silurium von Australien; Devon: weltweit verbreitet.

Disphyllum caespitosum tricyclicum n. sp.

Taf. 1, Fig. 5, 6; Abb. 2-4

1922 *Cyathophyllum* (*Thamnophyllum*?) sp. — Reed. *Chitral and Pamirs*, S. 14, Taf. 2, Fig. 12; Taf. 3, Fig. 1, 2.
? 1922 *Cyathophyllum* (*Phacellophyllum*) *caespitosum*? — Reed. *Ibidem*, S. 15, Taf. 3, Fig. 3-5.
1939 *Pseudostringophyllum caespitosum* Soshkina. *Rugosa urala*, S. 36, Taf. 10, Fig. 81, 82; Taf. 12, Fig. 97, 98.
1951 *Megaphyllum caespitosum* — Soshkina. *Poznedevon. Korally Rugosa*, S. 110, Taf. 20, Fig. 5.
1952 *Megaphyllum caespitosum* — Soshkina. *Cetyrechluc. Korallov*, S. 105, Taf. 46.
? 1953 *Megaphyllum caespitosum* — Iwanija. *Rugosa Kuzbassa*, S. 32, Taf. VI, Fig. 30, 31.
1958 *Megaphyllum caespitosum* — Bulvanker. *Atlas Sibiri*, S. 189, Taf. 57, Fig. 2; Taf. 58, Fig. 1 a.

Derivatio nominis — *tricyclicus, a, um* = dreizyklisch; wegen der zumindest andeutungsweisen Ausbildung eines dritten Septenzyklus.

Holotypus — Das auf Taf. 1, Fig. 5, 6; Abb. 2, 3 abgebildete Exemplar (1752/1 a-d, Querschliff 1, Längsschliff 1).

Locus typicus — Kuragh (Chitral).

Stratum typicum — Nicht näher feststellbar.

Material — Drei Bruchstücke aus mittleren Wachstumsstadien (1752/1-3) liegen von dieser Subspezies vor. 3 Quer-und 3 Längsschliffe sowie ein Querschnittsabzug wurden hergestellt.

Diagnose — Subspezies von *Disphyllum caespitosum* mit mehr oder weniger deutlich auftretenden Entwicklungsstadien eines dritten Septenzyklus.

Beschreibung — Die vorliegenden drei Bruchstücke sind zylindrisch und haben einen Durchmesser von 12-13 mm. Eines davon zeigt einen nur mehr teilweise erhaltenen Kelchabschnitt von 8 mm Tiefe. Der Kelchboden ist mit Sediment erfüllt, die Septen erheben sich fast senkrecht und bilden somit eine steile Kelchbegrenzung. Die periphere glatte Epithek ist nur mehr teilweise erhalten. Wo sie fehlt, werden die peripheren Septenenden als Längsrippen, sowie mitunter auch die balkenförmigen Querschnitte der periphersten Dissepimentreihe sichtbar.

Beobachtung an Querschliffen: Der auf Taf. 1, Fig. 5 abgebildete Schnitt zeigt ein Reifestadium. Bei einem Durchmesser von 13 mm erscheinen 28 Groß- und ebensoviele Kleinsepten in pseudoradialer Anordnung. Die Großsepten sind in ihren peripheren Teilen verdickt, im achsialen Abschnitt dünnen sie fadenförmig aus. Der zentrale Raum bleibt, wie auch schon in tieferen Lagen, immer von Septen frei und nimmt in mittleren bis höheren Stadien (mit Ausnahme der Kelchregion) etwa ein Viertel bis ein Drittel des Durchmessers ein. Die Kleinsepten erreichen die Hälfte der Länge der Großsepten.

Der Basalapparat läßt schon vielfach im Querschnitt eine Schlot-und Mantelzone erkennen. Die Schnitte durch Elemente der Mantelzone (Dissepimente) verlaufen im allgemeinen in konvexen, nach außen gerichteten Bögen und sind in der Regel verhältnismäßig stark ausgebildet. Die sich daran anschließenden Querbalken der Schlotzone sind dagegen meist fadenförmig dünn und ziehen mehr oder weniger gerade durch die einzelnen Interseptalräume. Sie stellen Schnitte durch periachsiale schräge plattige bis blasig ausgebildete Elemente der Schlotzone dar (siehe Längsschnitt). Die nur mehr stellenweise erhaltene Epithek ist dünn, die Septen sind in diese eingelassen. Abschnittsweise ragen aus ihr in den Interseptalräumen kurze Spitzen hervor, welche als Entwicklungsstadien eines dritten Septenzyklus (Taf. 1, Fig. 5; Abb. 2) angesprochen werden müssen.

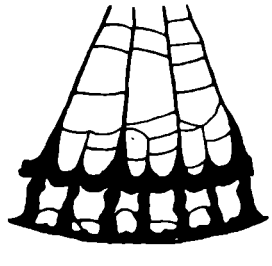
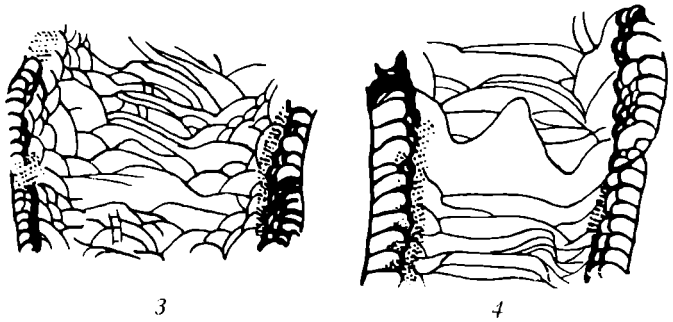


Abb. 2. – *Disphyllum caespitosum tricyclicum* n. ssp. Ausschnitt aus dem Querschnitt von Taf. 1, Fig. 5. 1752/1; QS 1 (Holotyp). × 6. Andeutungsweise zeigt sich die Entwicklung eines dritten Septenzyklus.

Beobachtungen an Längsschliffen: Peripher, unmittelbar an der nicht immer erhaltenen dünnen Epithek befinden sich meist eine, seltener auch zwei Reihen der für das gesamte Genus charakteristischen, verhältnismäßig großen, mitunter steil aufgeblähten bis schräg nach innen gestreckten Dissepimente

(Taf. 1 Fig. 6; Abb. 3, 4). An diese schließen nach innen eine bis mehrere Reihen normaler schräg gestellter Dissepimente an. Die Wände sämtlicher Dissepimente sind in der Regel stärker ausgebildet als jene der blasigen Elemente der Schlotzone, wodurch im allgemeinen eine Trennung beider Zonen möglich ist. Die Schlotzone besteht aus im Zentrum mehr oder weniger horizontalen und dünnen, teils entfernt, teils dichter stehenden Böden, die gegen die Peripherie zu durch plattige bis blasige Elemente ersetzt werden können.



3 4

Abb. 3. – *Disphyllum caespitosum tricyclicum* n.ssp. Längsschnitt von Taf. 1, Fig. 6. 1752/1; LS 1 (Holotyp). × 3.

Abb. 4. – *Disphyllum caespitosum tricyclicum* n.ssp. Längsschnitt. 1752/2. × 3. Man erkennt die für *Disphyllum* typischen verhältnismässig grossen, steil aufgeblähten bis schräg nach innen gestreckten randlichen Dissepimente. Lokal treten schräg von außen-unten nach innen-oben gerichtete parallele Trabekelreihen in Erscheinung.

Bemerkungen — Bezüglich der charakteristischen Ausbildung des Dissepimentalapparates siehe Bemerkungen zum Genus.

Beziehungen — Diese Unterart unterscheidet sich von allen übrigen Subspezies von *Disphyllum caespitosum* (siehe Flügel 1961, S. 382) durch die andeutungsweise Entwicklung eines dritten Septenzyklus.

Vorkommen — Oberes Mitteldevon – unteres Oberdevon (Givetium – Frasnium): Russland (Kuzneck Becken, Ural, Armenien); Pakistan (Kuragh [Chitral]).

Familie Macgeeidae (Rozkowska 1957, subfam.) Schouppé 1958

Genus **Macgeea** Webster 1889 sensu Schouppé 1949

1826 *Lithodendron* — Goldfuss, e. p., S. 43.
1826 *Cyathophyllum* Goldfuss, e. p., S. 54.
1830 *Caryophyllia* — De Blainville, e. p., S. 312.
1845 *Cladocora* — Geinitz, e. p., S. 569.

1851 *Lithostrotion* — Edwards & Haime, e. p., S. 432.
1873 *Pachyphyllum* — Hall & Whitfield, S. 232.
1881 *Fascicularia* — Schlüter, e. p., S. 220, 225.
1889 *Macgeea* Webster, S. 711.
1890 *Diphyphyllum* — Etheridge, S. 19.
1894 *Thamnophyllum* Penecke, S. 593.
1909 *Phacellophyllum* Gürich, S. 102.
1928 *Pexiphyllum* Walther, e. p., S. 34.
1935 *Disphyllum* {*Phacellophyllum*} — Lang & Smith, S. 546.
1937 *Campophyllum* — Yoh, e. p., S. 59.
1939 *Phillipsastraea* — Sanford, e. p., S. 410.
1939 *Peneckiella* Soshkina, e. p., S. 23.
1949 *Temnophyllum* — Stumm, e. p., S. 36.
1949 *Macgeea* — Schouppé, e. p., S. 120.
1958 *Macgeea* — Schouppé, S. 220.

(Diese Synonymaliste stellt keinen Anspruch auf Vollständigkeit. Es werden hier nur die wichtigsten Zitate berücksichtigt. Eine vollständige Liste wurde in einer eigenen Arbeit (Schouppé & Stacul 1963) gegeben).

Generolectotyp — Macgeea solitaria (Hall & Whitfield) = *Pachyphyllum solitarium* Hall & Whitfield 1873, S. 232, Taf. 9, Fig. 6, 7 (siehe Lang, Smith & Thomas 1940, S. 82).

Diagnose — Einzel - bündelige Formen mit Septen aus Trabekelfächern (1) und im Reifestadium gelegentlich erkennbarem Hauptseptum. Mantelzone charakteristisch ausgebildet, bestehend aus stets deutlich ausgeprägten Hufeisenelementen und nach außen anschließender Zone aus meist horizontalen, bis mitunter mehr oder weniger blasigen, schräg nach außen oben gewölbten Dissepimenten. Zusätzlich kann an der Grenze zur Schlotzone eine in ihrer Ausbildung stark schwankende und wechselnd kontinuierlich entwickelte innere Zone von schräg nach innen oben gerichteten Dissepimenten auftreten. Äußere Dissepimentzone und abschließende, von den Septen unabhängig gebildete dünne Epithek (2) vielfach nicht mehr erhalten. Böden einfach und vollständig bis aus achsialen und periachsialen Teilen zusammengesetzt.

(1) Rozkowska (1957, S. 102, 118) sieht *Macgeea* und *Thamnophyllum* als zwei getrennte Genera an. Nach ihr soll sich *Macgeea* neben anderen Merkmalen auch durch den Besitz von deutlichen Carinen von *Thamnophyllum* unterscheiden. Wie ich feststellen konnte, handelt es sich bei den von Rozkowska nur an Kelchen von Ganzstücken beobachteten (jedoch in keinem Querschliff erkenntlich!) und als Carinen angesehenen knöpfchenartigen Septenauswüchsen jedoch nicht um Septalleisten, sondern um Vorwölbungen der einzelnen Trabekeln am jeweiligen Septenoberrand. Die Beziehungen zwischen *Macgeea* und *Thamnophyllum* (ich sehe *Thamnophyllum* nach wie vor als Subgenus von *Macgeea* an) wurden in einer eigenen Arbeit erörtert (Schouppé & Stacul 1963).

(2) Siehe Schouppé 1956, S. 160.

Bemerkungen — Neuere Erkenntnisse bezüglich der Variabilität der Ausbildungsmöglichkeiten der Mantelzone (siehe bei *Macgeea multizonata*) führten zu einer Erweiterung der Diagnose. In dem außerhalb der Hufeisenzone gelegenen Bereich können nämlich die Dissepimente nicht nur horizontal ausgebildet, sondern auch mehr oder weniger blasig gewölbt sein und außerdem treten mitunter auch an der Innenseite der Hufeisenzone zusätzliche Dissepimentblasen auf.

Vorkommen — Oberes Unterdevon – unteres Oberdevon: Europa, Asien, Australien. Unteres Oberdevon: Nordamerika.

Subgenus **Macgeea** Webster 1889

1826 *Lithodendron* — Goldfuss, e. p., S. 43.
1826 *Cyathophyllum* — Goldfuss, e. p., S. 54.
1830 *Caryophyllia* — De Blainville, e. p., S. 312.
1846 *Cladocora* — Geinitz, e. p., S. 569.
1851 *Lithostrotion* — Edwards & Haime, e. p., S. 432.
1873 *Cyathophyllum* — Dybowski, e. p., S. 416, 428.
1873 *Pachyphyllum* — Hall & Whitfield, S. 232.
1881 *Fascicularia* — Schlüter, e. p., S. 99.
1889 *Macgeea* Webster, S. 711.
non 1894 *Thamnophyllum* Penecke, e. p., S. 593 [nur *Synonyma* e. p.].
1909 *Phacellophyllum* Gürich, S. 102.
1922 *Cyathophyllum* (*Thamnophyllum*) — Reed, e. p., S. 12.
1928 *Pexiphyllum* Walther, e. p., S. 34.
1935 *Disphyllum* [*Phacellophyllum*] Lang & Smith, e. p., S. 546.
1935 *Disphyllum* (or *Macgeea*) — Lang & Smith, e. p., S. 577.
1937 *Campophyllum* — Yoh, e. p., S. 59.
1939 *Phillipsastraea* — Sanford, e. p., S. 410.
1939 *Macgeea* — Soshkina, S. 17.
1949 *Macgeea* (*Macgeea*) — Schouppé, S. 120.
1949 *Macgeea* (*Thamnophyllum*) — Schouppé, e. p., S. 100.
1949 *Thamnophyllum* — Soshkina.
1949 *Temnophyllum* — Stumm, e. p., S. 36.
1951 *Macgeea* — Soshkina, S. 80.
1952 *Macgeea* — Lecompte in Piveteau, S. 471.
1952 *Disphyllum* — Lecompte in Piveteau, e. p., S. 470.
1952 *Macgeea* — Soshkina, e. p., S. 83.
non 1952 *Thamnophyllum* — Soshkina, e. p., S. 85 [? nur *Synonyma* e. p.].
1953 *Macgeea* — Rozkowska, S. 18.
1953 *Pexiphyllum* — Rozkowska, ?e. p., S. 30.

1954 *Macgeea* — Soshkina, S. 6, 7.
non 1954 *Thamnophyllum* — Soshkina, e. p., S. 65 [? nur *Synonyma* e. p.].
1956 *Macgeea* — Rozkowska, S. 288.
1956 *Thamnophyllum* — Rozkowska, e. p., S. 304.
1956 *Macgeea* — Hill in Moore, S. 282.
1956 *Phacellophyllum* — Hill in Moore, e. p., S. 282.
1956 *Pexiphyllum* — Hill in Moore, e. p., S. 282.
1957 *Macgeea* — Rozkowska, S. 83.
1957 *Thamnophyllum* — Rozkowska, e. p., S. 83.
1957 *Pexiphyllum* emend. — Rozkowska, e. p., S. 119.
1958 *Macgeea* (*Macgeea*) sensu — Schouppé, S. 222.
1958 *Macgeea* (*Thamnophyllum*) sensu — Schouppé, e. p., S. 226.
1959 *Macgeea* — Flügel, H., S. 115.
1959 *Thamnophyllum* — Flügel, H., e. p., S. 115, 117.
1960 *Macgeea* — Rozkowska, S. 44.
1960 *Thamnophyllum* — Rozkowska, e. p., S. 44.

Da sich auf Grund neuerer Untersuchungen die bisher als *Macgeea* (*Thamnophyllum*) *caespitosa* und teilweise auch als *Macgeea* (*Thamnophyllum*) *trigemme trigemme* beschriebenen Formen als Vertreter von *Macgeea* (*Macgeea*) erwiesen haben, weicht die vorliegende Synonymaliste von den bisher veröffentlichten ab. In dieser Arbeit ist jedoch nur eine Auswahl der wichtigsten Zitate angeführt. Die vollständige Synonymaliste sowie die Klärung der taxionomischen Fassungen von *Macgeea* (*Macgeea*) und *Macgeea* (*Thamnophyllum*) erschienen in einer gesonderten Arbeit (Schouppé & Stacul 1963).

Subgenerolectotyp — *Macgeea* (*Macgeea*) *solitaria* (Hall & Whitfield 1873) (siehe Generolectotyp).

Diagnose — Einzel - bis leicht verzweigte Vertreter von *Macgeea* mit komplizierter gebauter Bodenzone; immer aus achsialen und schräg gestellten sowie blasig aufgewölbten periachsialen Bodenteilen zusammengesetzt.

Vorkommen — Oberes Mitteldevon - unteres Oberdevon: Europa, Asien; Unteres Oberdevon: Nordamerika, Australien.

Macgeea (Macgeea) multizonata (Reed 1922).

Taf. 2, Fig. 1-10; Abb. 5

1922 *Cyathophyllum* (*Thamnophyllum*) *multizonatum* Reed. *Chitral and Pamirs*, S. 12, Taf. 1. Fig. 7-12; Taf. 2, Fig. 1-7.
1935 *Macgeea multizonata* — Lang & Smith. *Cyathophyllum caespitosum* Goldf., S. 500, Taf. 37, Fig. 13-15.
1949 *Macgeea* (*Macgeea*) *multizonatum* — Schouppé. *Die Thamnophyllen*, Taf. 11, Fig. 34.
1951 *Macgeea multizonata* — Soshkina. *Poznedevon. Korally Rugosa*, S. 80, Taf. 14, Fig. 1-4.
1952 *Macgeea multizonata* — Soshkina. *Devonskich cetyrechluc. Korallov*, S. 84, Taf. 19, Fig. 68.

1953 *Macgeea* cf. *multizonata* — Rozkowska. *Pachyphyllinae et Phillipsastraea*, S. 27, Taf. 3, Fig. 1-7; Abb. 14.
1954 *Macgeea multizonata* — Soshkina, e. p. *Devonskich cetyrechluc. Korallov*, S. 68.
1957 *Macgeea multizonata* — Rozkowska. *Middle and Upper Devon. Thamnophyllidae*, S. 115, Abb. 20.
1958 *Macgeea multizonata* — Bulvanker, e. p. *Atlas Sibiri*, S. 88.
1960 *Macgeea multizonata* — Spasskij, e. p. *Korally rudnogo Altai*, S. 45, Taf. 20, Fig. 2, 3.

Lectotyp — Das von Reed 1922 auf Taf. 1, Fig. 9,10 abgebildete Exemplar.

Material — Der weitaus größte Teil des bearbeiteten Materials ist zu dieser Art zu stellen. Es liegt eine Anzahl von Bruchstücken (etwa 70) vor.

Von verschiedenen Bruchstücken (1753/1 - 23) wurde eine größere Anzahl von Quer-und Längsschliffen sowie Querschnittsabzügen angefertigt.

Diagnose — Verhältnismäßig großwüchsiger Vertreter des Subgenus *Macgeea* mit in der Mantelzone verdickten, in der Schlotzone typisch fadenförmig ausdünnenden und mehr oder weniger zickzackartig geschlängelten Großsepten. Mantelzone kompliziert gebaut, in drei Abschnitte gegliedert: eine zentrale Hufeisenzone, eine periphere Zone aus weitgehend blasig ausgebildeten Elementen und eine innere, jedoch nicht vollkommen kontinuierlich ausgebildete, aus schrägen blasigen Dissepimenten.

Beschreibung — Äußere Form: Ein kennzeichnendes Merkmal dieser Art ist ihre in jungen Wachstumsstadien lang kegelförmige, später fast zylindrische Gestalt (1). Frühe Jugenstadien sind an keinem unserer Exemplare erhalten. Der Durchmesser der vorliegenden höheren Stadien schwankt zwischen 15 und 22 mm. Zwei Individuen weisen eine Kelchsprossung auf (Taf. 2, Fig. 1), wobei in einem Falle drei gleichwertige parricidale Sprosse (wie bei *Thamnophyllum trigemme*) entwickelt sind. Die sehr dünne Epithek ist nur stellenweise erhalten. Meist ist sie abgerollt, so daß die peripheren Septenenden als Längsrippen nach außen vorstehen. Zwischen ihnen sind mitunter noch die blasigen Dissepimente der äußeren Mantelzone deutlich sichtbar. Bei wohl erhaltenen Kelchen ohne Sprossung erheben sich die Septen bogenförmig über den Rand der Epithek.

Beobachtungen an Querschliffen: Der auf Taf. 2, Fig. 2 abgebildete, für das Reifestadium charakteristische Querschnitt mit einem Durchmesser von

(1) Rozkowska, die *Macgeea* und *Thamnophyllum* als getrennte Genera ansieht, führt zylindrisches Wachstum als spezielles Merkmal für *Thamnophyllum* an, obwohl es bei diesen sonst typischen Vertreter von *Macgeea* s. str. ebenfalls deutlich auftritt. Auch die hier wieder an zwei Exemplaren festgestellte Kelchsprossung zeigt, daß zwischen *Thamnophyllum* und *Macgeea* in dieser Beziehung fließende Übergänge vorliegen.

21 mm zeigt 30 Groß-und ebensoviele Kleinsepten in pseudoradialer Stellung. Die Großsepten sind in ihren peripheren Teilen (im Bereich der Mantel- sowie der äußeren Schlotzone) gerade und stärker verdickt, dünnen jedoch innerhalb der Schlotzone fadenförmig aus, wobei sie sich gleichzeitig mehr oder weniger stark zu schlängeln beginnen. Das Zentrum des Polypars bleibt immer von Septen frei. In jüngeren Stadien (Taf. 2, Fig. 3) ist der freie Raum verhältnismäßig klein, später nimmt er – wie in dem auf Taf. 2, Fig. 2 abgebildeten Schliff – etwa bis auf ein Viertel des Polypardurchmessers zu. Protosepten lassen sich auch nicht andeutungsweise von den übrigen Großsepten unterscheiden. Die regelmäßig zwischen den Großsepten stehenden Kleinsepten endigen sämtlich an der vielfach verdickten inneren Begrenzung der Mantelzone. Sie sind etwa halb so stark wie die Großsepten.

Die peripheren Septenenden werden noch besonders (mitunter kropfförmig) durch Anlagerung von Lamellen verstärkt, die sich als direkte Fortsetzungen der äußeren verdickten Hufeisenwände erweisen. Diese kontinuierliche, vom basalen in den septalen Bereich überleitende lamelläre Anlagerung kann nur dadurch erklärt werden, daß gleichzeitig mit der Absonderung der Hufeisenelemente auch eine Reaktivierung der Ausscheidung in den randlichen Teilen der Septentaschen erfolgte (1). Aus dieser Erkenntnis ergibt sich weiterhin, daß beim Genus *Macgeea* Epithek und Septen unabhängig voneinander zur Bildung gelangten. Auch vorliegende Schliffe zeigen dementsprechend, daß die Septen nicht überall mit der Epithek in Berührung treten (Taf. 2, Fig. 2, 3, 4). Die Epithek selbst ist dünn und meist nur mehr in Resten erhalten. Wo sie fehlt, wird die äußere Umgrenzung der Koralle von den zahnkranzartig vorspringenden, kropfartig verdickten peripheren Septenenden und den dazwischenliegenden, vielfach verstärkten Wänden der Hufeisenelemente bzw. der äußeren Blasenzone gebildet.

Die Gliederung des Basalapparates in Schlot-und Mantelzone ist deutlich. Das Erscheinungsbild der Mantelzone im Querschnitt weist dabei eine starke Variabilität auf, wie im übrigen auch schon die Abbildungen von Rozkowska (1953, Taf. 3, Fig. 1-5) zeigen. Im allgemeinen zeichnet sich die Mantelzone durch eine im Vergleich zu den meisten übrigen Vertretern dieser Gattung auffallend starke Gliederung aus (Taf. 2, Fig. 2), doch ist dieses Merkmal nicht nur von Individuum zu Individuum, sondern vielfach auch schon innerhalb eines einzigen Schliffes Schwankungen unterworfen (Taf. 2, Fig. 3).

(1) Die speziellen Baueigentümlichkeiten von *Macgeea* werden ebenfalls in einer eigenen Arbeit (Schouppé & Stacul 1963) behandelt.

Diese Tatsache findet ihre Erklärung in der lokal unterschiedlichen Ausbildung namentlich des inneren Abschnittes der Mantelzone (siehe unten). Den mittleren und auffallendsten Teil der Mantelzone bildet der Bereich der großen Hufeisenelemente, deren Außen-und Innenwände im Querschnitt als Dissepimentkranz mit gegen die Hohlräume zu konvexen Bögen verlaufen. Die Außenwand der Hufeisenzone ist – wie bereits bei der Beschreibung der Septen erwähnt – meist stark verdickt und leitet in die peripheren Teile der Septen über, während die Innenwand der Hufeisenzone bei dieser Art vielfach keine besondere Verstärkung besitzt. Im peripheren Bereich außerhalb der Hufeisenzone sind noch weitere Schnitte von Basalelementen in verschiedensten Lagen erkennbar. Mitunter erscheinen sie als tangentiale Querbalken deutlich zwischen den verdickten peripheren Septenköpfen (Taf. 2, Fig. 2) oder aber nehmen, mehr bogenförmig verlaufend, den Raum zwischen den Septenenden und der Epithek ein (Taf. 2, Fig. 2). Der sich achsialwärts an die Hufeisenelemente anschließende Bereich der Mantelzone ist in seiner Ausbildung, wie bereits erwähnt, mitunter starken Schwankungen unterworfen. In typischer Entwicklung liegen hier mehrere Reihen von Dissepimentschnitten hintereinander, deren innerste merklich verdickt ist und damit die Grenze zur Schlotzone deutlich markiert. Vielfach jedoch treten auch nur einzelne Schnitte auf bzw. können diese lokal auch fehlen oder mit der Innenwand der Hufeisenzone zu einem einheitlichen breiten Querelement verschmelzen (Taf. 2, Fig. 3, 4). In der Schlotzone treten zwischen den fadenförmig geschlängelten Großsepten ebenfalls basale Querelemente auf. Sie sind meist wesentlich dünner und lassen sich dadurch in den meisten Querschnitten deutlich von den Elementen der Mantelzone unterscheiden. Es handelt sich dabei, wie ebenfalls im Längsschnitt ersichtlich, um Schnitte durch periachsiale Bodenteile.

Beobachtungen an Längsschliffen: Die abgebildeten Längsschliffe (Taf. 2, Fig. 5-10; Abb. 5) zeigen eine vorwiegend einwandfreie Trennung des Basalapparates in Schlot-und Mantelzone. Die Mantelzone wird in ihrem zentralen Teil von dem deutlich ausgeprägten Bereich der großen Hufeisenelemente eingenommen. Sie sind vorwiegend einreihig, kettenförmig übereinandergelagert und übergreifen sich vielfach gegenseitig. An einigen Stellen erkennt man deutlich, daß diese Elemente nicht überall ausgesprochene Hufeisenform besitzen (d. h. sich nach unten zu verengen), sondern daß die Innenwände achsialwärts schräg abbiegen, wodurch ein etwas asymmetrisches Schnittbild entsteht (Taf. 2, Fig. 5-8; Abb. 5 rechts unten). Andere Schnitte zeigen, wie z. B. auch bei Rozkowska 1953 etc. abgebildet (s. unten), daß die Hufeisenzone stellenweise auch zwei- oder mehrreihig ausgebildet sein kann, was

auf die Variabilität dieses Bereiches allgemein bei derartigen Formen, in besonderem Maße jedoch bei vorliegender Art hinweist. Die Außenwände der Hufeisenelemente sind durchwegs stark verdickt und täuschen häufig, wie übrigens auch bei anderen Vertretern dieses Genus, die Außenbegrenzung des Polypars vor. Die äußere Dissepimentzone, die bei der Gattung *Macgeea* vorwiegend von horizontalen Skelettelementen durchzogen wird, erscheint hier in charakteristicher Weise größtenteils blasig ausgebildet (Taf. 2, Fig. 5; Abb. 5). Diese blasigen Elemente sind im einzelnen unregelmäßig in der Form und können auch mitunter in zwei Reihen nebeneinander auftreten. Überdies zeigen sich stellenweise auch schräg nach der Peripherie hin abfallende gewölbte sowie lokal auch noch horizontal verlaufende flache Schnitte durch Dissepimetalelemente. Diese Unregelmäßigkeit der Ausbildung bzw. die Übergänge von flachen zu blasigen Dissepimenten gehen auch bereits aus Längsschliffbildern anderer Autoren (z. B. Rozkowska 1953, Taf. 3, Fig. 6) deutlich hervor. Die äußere Mantelzone wird nach außen hin durch eine dünne Epithek abgeschlossen, die jedoch an unseren Exemplaren, wie auch bei anderen Vertretern dieses Genus, nur mehr in kleinen Resten erhalten ist. Nach innen hin schließt an die Hufeisenelemente eine allerdings im allgemeinen nicht vollkommen kontinuierlich ausgebildete Zone aus schrägen blasigen Dissepimenten an. Diese treten normalerweise in mehreren bis auch nur einer Reihe auf und können stellenweise sogar fehlen. Vorwiegend als Folge dieser Schwankungen in der Entwicklung der inneren Elemente ergeben sich die bereits erwähnten variablen Querschliffbilder. Die jeweils innerste, an die Schlotzone grenzende Wand der Dissepimente ist im allgemeinen stärker verdickt, so daß hier dann eine mehr oder weniger deutliche Abgrenzung gegen die Schlotzone erkenntlich ist. Abschnittsweise sind in der Mantelzone Septenteile angeschnitten, deren fächerförmige Trabekelstruktur bzw. deren Anwachslamellen in Erscheinung treten (Abb. 5).

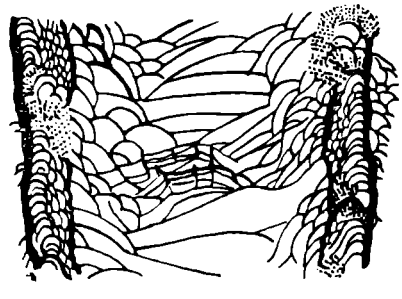


Abb. 5. – *Macgeea (Macgeea) multizonata* (Reed).
Längsschnitt von Taf. 2, Fig. 8. 1753/1. × 2.7. Rechts erkennt man die für diese Art typische blasige Ausbildung der äußeren Dissepimentzone. Rechts unten zeigen sich einige asymmetrische Hufeisenelemente. Die inneren Blasen der Mantelzone sind fast durchwegs mehrreihig ausgebildet. Stellenweise sind Trabekelfächer angeschnitten.

Die Schlotzone zeigt den für die Untergattung *Macgeea* kennzeichnenden komplizierteren Bau. In ihrem zentralen Teil verlaufen die Böden mehr oder weniger horizontal bis leicht konkav eingesenkt. Sie sind hier entweder vollständig oder aber unvollständig ausgebildet und überlappen sich dann abschnitts-

weise. Ihre Abstände sind ebenfalls stärkeren Schwankungen unterworfen. Gegen die Mantelzone hin werden die Böden in wechselndem Maße periachsial aufgespalten bis blasig ausgebildet. Krümmungsradius und Größe der blasigen Bodenabschnitte unterscheiden sich meist deutlich von jenen der inneren Dissepimente der Mantelzone.

Beziehungen — Vorliegende Art unterscheidet sich von einer Reihe anderer Vertreter dieses Genus schon durch die charakteristische Aufgliederung der Mantelzone in die drei obig besprochenen Abschnitte, wobei der äußere, im allgemeinen durch horizontale Dissepimente gebildete Bereich hier mehr oder weniger stark blasig ausgebildet ist. Ferner zeichnet sich die Art *multizonata* durch die kennzeichnende fadenförmige Ausdünnung und Schlängelung der Septen in der Schlotzone aus. Von den beiden Arten *Macgeea* (*Macgeea*) *gallica* Lang & Smith 1935 und *Macgeea* (*Macgeea*) *araxis* (Frech 1900), die ebenfalls eine stärkere Gliederung der Mantelzone bzw. eine mehr oder weniger blasige Ausbildung der äußeren Dissepimentzone aufweisen und damit unserer Art in dieser Beziehung ähneln, unterscheidet sich die Art *multizonata* jedoch durch die wesentlich kleinere Septenzahl (30 Großsepten gegenüber mehr als 50 bei etwa gleichem Durchmesser) sowie die fadenförmige Ausdünnung der achsialen Septenabschnitte in der Schlotzone. Von *Macgeea* (*Macgeea*) *berdensis* Soshkina 1939 – die Ausbildung der äußeren Dissepimentzone ist nicht näher bekannt – unterscheidet sich vorliegende Art durch eine wesentlich geringere Septenverdickung. Außerdem ist die Hufeisenzone bei *berdensis* ausgesprochen kleinblasig und die Böden zeigen eine regelmäßigere horinzontale Anordnung.

Vorkommen — Unteres Oberdevon (Frasnium): Polen (Lysa Gora); Russland (Timan, Ural, Russische Tafel, Armenien, Altai); Pakistan (Kuragh [Chitral]).

Macgeea (Macgeea) desioi n. sp.

Taf. 1, Fig. 7-13; Abb. 6

1922 *Cyathophyllum* (*Thamnophyllum*) *trigeminum* — Reed, e. p. *Chitral and Pamirs*, S. 13, Taf. 2. Fig. 8-11.

1954 *Macgeea multizonata* — Soshkina, e. p. *Devonski cetyrechluc. Korallov*, S. 68, Taf. 19, Fig. 4, 5; Abb. 21.

1958 *Macgeea multizonata* — Bulvanker, e. p. *Atlas Sibiri*, S. 88, Taf. 42, Fig. 1, 2.

1960 *Macgeea multizonata* — Spasskij, e. p. *Korally rudnogo Altai*, S. 45, Taf. 24, Fig. 5, 6.

Derivatio nominis — Nach A. Desio, Leiter der Expedition nach Pakistan.

Holotyp — Das auf Taf. 1, Fig. 7-9,12; Abb. 6 abgebildete Exemplar (1754/1 a-c, Querschliff 1-3, Längsschliff 1).

Locus typicus — Kuragh (Chitral).

Stratum typicum — Nicht näher feststellbar.

Material — Es lagen mehrere kleine Bruchstücke (1754/1-8) sowie ein bis auf die fehlenden Jugendstadien vollständig erhaltenes Exemplar vor. Mehrere Quer-und Längsschnitte sowie Querschnittsabzüge wurden hergestellt.

Diagnose — Kleinerer Vertreter des Subgenus *Macgeea* (10-14 mm Durchmesser) mit 22-28 im allgemeinen schon frühzeitig verkürzten Großsepten. Sporadisch treten innerhalb der Hufeisenzone an den Septenflanken kleine Auswüchse (keine Carinen) auf. Mantelzone aus meist einreihiger zentraler Hufeisenzone und vorwiegend schräg nach außen zur Epithek abfallenden peripheren Dissepimenten. Eine innere Zone schräg gestellter blasiger Dissepimente ist, wenn überhaupt, dann nur sporadisch und einreihig entwickelt. Kelchsprossung.

Beschreibung — Äußere Form: Das vor Anfertigung der Schliffe annähernd vollständige Exemplar weist einen subzylindrischen, lediglich ganz leicht gekrümmten Wuchs auf. Sein kleinster Durchmesser beträgt 9 mm. Der größte, allerdings knapp unterhalb einer Kelchsprossung, dürfte mit 14 mm wohl einen Extremwert darstellen. Die Höhe mißt einschließlich der Kelchsprosse (drei parricidale Knospen; Taf. 1, Fig. 7) 38 mm. Die Außenwand ist nur stellenweise erhalten, im allgemeinen ragen die Septenrücken als Leisten vor und zwischen ihnen treten zusätzlich noch Elemente der Mantelzone in Erscheinung. Die drei Kelchsprosse sind unterschiedlich groß, die bedeutendste Höhe beträgt 10 mm, der größte Durchmesser 12 mm. Ein Sproß zeigt einen deutlichen Kelch mit 22 kurzen, annähernd gleichartig ausgebildeten Septen.

Beobachtungen an Querschliffen: Es liegt ein einziger und infolge des Auftretens eines Sprosses nicht ganz typischer Querschliff durch ein hohes Reifestadium vor (Taf. 1, Fig. 8). Der Septalapparat umfaßt hier bei 14 mm Durchmesser 28 pseudoradial gestellte Groß-und ebensoviele Kleinsepten. Die Großsepten weisen eine beachtliche Verkürzung auf und erreichen nur mehr etwa ein Drittel des Polyparradius. Protosepten oder auch nur einzelne von ihnen lassen sich nicht unterscheiden. Die Großsepten sind dünn und nur im Bereich der Außen-und Innenwände der Hufeisenelemente durch sekundäre Anlagerung verdickt. Die Verstärkung ist besonders an den Innenwänden beträchtlich, so daß der achsiale Abschnitt der Septen eine keilförmige Gestalt annimmt.

Innerhalb der Hufeisenelemente weisen die Groß – wie im übrigen auch die gleichstarken Kleinsepten vereinzelte seitliche Ausbuchtungen auf, die jedoch keine Carinen (im Sinne durchgehender Bildungen) darstellen. Die Kleinsepten durchlaufen lediglich die Mantelzone und endigen an den Innenwänden der Hufeisenelemente.

Die eigentliche, das Polypar nach außen abschließende und hier von den Septen unabhängige dünne Epithek (siehe unter *multizonata*) ist durchwegs zerstört und die äußeren Septenenden sind meist bis zu den verdickten äußeren Wänden der Hufeisenzone abgerollt, welch letztere dann eine epithekale Begrenzung vortäuschen. Der Basalapparat tritt lediglich in der Mantelzone in Erscheinung, von der meist nur der innere Abschnitt (Hufeisenelemente) erhalten ist. Ihre angeschnittenen Innen-und Außenwände bilden im Querschnitt zwei konzentrische Dissepimentkränze und verlaufen jeweils in einem Interseptalraum in bikonvexen Bogen nach dem zentralen Hohlraum hin. Mitunter treten auch innerhalb der Hufeisenzone undeutliche, meist schräge Schnitte durch Wände auf, die entweder durch Ineinanderschachtelung von Hufeisenelementen oder durch deren Abweichen aus der Senkrechten zustande kommen. Von dem äußeren Abschnitt der Mantelzone sind lediglich spärliche Dissepimentschnitte zwischen den verdickten peripheren Septenenden sichtbar. Im Bereich der Schlotzone fehlt jegliche Spur von Basalelementen. In der einen Hälfte des Schliffes erscheint das geschilderte Bild durch den schrägen Anschnitt eines Sprosses gestört. Die Septen sind hier allgemein, besonders aber in ihrem achsialen Anteil stärker verdickt, die inneren Hufeisenwände sind breiter, die äußere Dissepimentzone weist mehr Querbalken auf und in der Schlotzone treten unregelmäßig netzförmige Schnitte durch Basalelemente auf.

Mittlere Schnittlagen (Taf. 1, Fig. 9, 11) zeigen bei 10-12 mm Durchmesser 20-23 Groß-und ebensoviele Kleinsepten. Lokal läßt sich nur noch das eine oder andere in Einschaltung begriffene Septum erkennen. Daraus ist zu ersehen, daß auch im Reifestadium die Gesamtseptenzahl sich nicht mehr wesentlich erhöht. Die Großsepten sind entweder bereits durchwegs ebenso stark verkürzt wie im Reifestadium (Taf. 1, Fig. 11) oder aber weisen eine sehr unregelmäßige Länge auf (Taf. 1, Fig. 9). In diesem Falle treten neben kurzen Septen vereinzelt auch solche auf, die bei leicht geschlängeltem Verlauf bis weit in das Innere vorragen, ohne daß jedoch diesbezüglich eine Abhängigkeit von der Einschaltungsfolge festgestellt werden könnte. Die Dicke der Septen wechselt von Individuum zu Individuum, vielfach sogar schon innerhalb ein und desselben Schliffes. Stets werden die Septen im Bereich der In-

nen-und Außenwände der Hufeisenelemente durch sekundäre Anlagerung verstärkt. Ihr mittlerer Abschnitt erscheint dann im Bereich der inneren Hufeisenwände häufig keilförmig verbreitert. Wo die Septen dünn sind, weisen sie mitunter vereinzelte seitliche Auswüchse auf. Die Kleinsepten zeigen dasselbe Bild wie im Reifestadium. Die Natur der über die periphere Verdickung mitunter hinausragenden, bis an die Epithek stoßenden, scheinbar septenartigen Fortsätze wird in einer besonderen Arbeit behandelt (Schouppé & Stacul 1963) (es handelt sich hierbei entweder um Septalfortsätze im Sinne von Schouppé & Stacul 1955, S. 114 oder auch um rein basale Bildungen). Die dünne Epithek ist nur abschnittsweise erhalten, so daß vielfach die Außenwände der Hufeisenzone in Verbindung mit den Septenenden auch hier eine Umgrenzung des Polypars vortäuschen.

Abb. 6. - *Macgeea (Macgeea) desioi* n.sp.
Längsschnitt von Taf. 1, Fig. 12. 1754/1; LS 1 (Holotyp). × 3. In rechten oberen Abschnitt ist ein Spross angeschnitten, unter dem Epithek und Mantelzone winkelig nach innen einspringen. Hier erscheinen die an sich horizontalen äußeren Dissepimente daher schräggestelt. Rechts ist die äussere Dissepimentzone infolge Abrollung verloren gegangen. Die Schlotzone weist einen verhältnismäßig einfachen Bau auf. Lokal ist die fächerförmige Anordnung der Trabekel der Septen sichtbar.

Auch der Basalapparat zeigt im Bereich der Mantelzone im wesentlichen dasselbe Bild wie im Reifestadium. Die Wände der Hufeisenzone sind meist stark verdickt, wobei die Innenwände die äußeren mitunter an Stärke übertreffen. Bisweilen, in einzelnen Schliffen auch durchgehend, ist die einheitliche Innenwand jedoch durch einen etwas unregelmäßigen Kranz dünnerer Dissepimentschnitte ersetzt, von denen zwei bis drei auf einen Interseptalraum entfallen (Taf. 1, Fig. 9). Es kann sich dabei, wie aus Längsschliffen ersichtlich, um Schnitte entweder durch sich übergreifende Hufeisenelemente oder durch Hufeisenelemente und sich nach innen zu anlagernde schräge blasenartige Dissepimente handeln. Was die Schlotzone betrifft, so erscheinen lediglich in ihrem peripheren Bereich spärliche und im einzelnen unregelmäßig verteilte Schnitte durch Basalelemente.

Beobachtungen an Längsschliffen: Längsschnitte (Taf. 1, Fig. 10, 12, 13; Abb. 6) lassen eine deutliche Gliederung des Basalapparates in Schlot-und Mantelzone erkennen. Der innere, durchgehend entwickelte Abschnitt der Mantelzone wird von den vorwiegend einreihig angeordneten, mitunter sich übergreifenden, jedoch in ihrer Form regelmäßigen Hufeisenelementen eingenommen (1). Ihre Innen-und Außenwände sind in wechselndem Maße, aber doch

(1) Neben ausgesprochen Hufeisenelementen können aber nach Reed (1922, Taf. 2, Fig. 8) mitunter auch nach der Polyparperipherie zu schräg abfallende gewölbte Dissepimente auftreten. Über-

meist auffallend verdickt. Abschnittsweise legen sich an die Innenseite der Hufeisenelemente hier nur sporadisch und einreihig entwickelte kleinere, steil schräg nach innen oben gewölbte Dissepimente an. In diesem Falle sind nicht die Innenwände der Hufeisenelemente, sondern jene der genannten inneren Dissepimente gegen die Schlotzone hin verstärkt. Der häufig nicht mehr erhaltene äußere Abschnitt der Mantelzone besteht aus wechselnd ausgebildeten Dissepimenten: meist fallen ihre Schnitte schräg gegen die Epithek hin ab, mitunter aber sind sie auch horizontal gelagert oder, seltener, blasig. Die Ausbildung der Schlotzone weist ebenfalls eine gewisse Variabilität auf. Die Böden verlaufen im zentralen Teil mehr oder weniger horizontal, mitunter auch leicht konkav bis konvex gewölbt. Meist sind sie unvollständig ausgebildet und überlappen sich abschnittsweise. Gegen die Peripherie hin sind sie blasig ausgebildet, wobei vorwiegend einige wenige größere Blasen auftreten (Taf. 1, Fig. 12, 13), die mitunter aber auch von einer größeren Anzahl kleinerer ersetzt werden können (Taf. 1, Fig. 11). Derartige unterschiedliche Ausbildungen wechseln jedoch bereits stark innerhalb ein und desselben Individuums, weswegen ihnen keine trennende systematische Bedeutung zukommt.

Der Längsschnitt (Taf. 1, Fig. 12; Abb. 6) – knapp unterhalb des Querschnittes von Taf. 1, Fig. 8 gelegt – zeigt ein asymmetrisches Bild, da in seinem rechten Teil der tiefste der drei am Ganzstück beobachteten Sprosse angeschnitten ist. Darunter springen Epithek und Mantelzone winkelig nach innen ein und die äußeren, an sich hier horizontal gelagerten Dissepimente erscheinen infolge der ungewöhnlichen Stellung schräg von außen oben nach innen unten zu verlaufen.

Bemerkungen — Mit vorliegenden Formen übereinstimmende Exemplare wurden von Soshkina (1954), Bulvanker (1958) und Spasskij (1960) zu *Macgeea* (*Macgeea*) *multizonata* gestellt, so daß diese Art nach der Fassung der genannten russischen Autoren Individuen von 10-21 mm Durchmesser mit 21-35 Großsepten umfaßt. Obwohl bezüglich der Größe (14 mm größter Durchmesser bei der Art *desioi* und 15 mm kleinster Durchmesser bei *multizonata*) in Extremfällen gewissen Annäherungen vorliegen, bestehen doch in der Septenzahl, in der normalerweise schon in mittleren Lagen einsetzenden Verkür-

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einstimmend geformte Skelettelemente erwähnt und bildet auch Rozkowska (1960, Abb. 27) von *Peneckiella* ab. Derartige Elemente weisen eine gewisse Ähnlichkeit mit den charakteristischen aufgeblähten bis schräg nach innen gestreckten Dissepimente von *Disphyllum* auf, unterscheiden sich jedoch i. allg. deutlich durch das bedeutend steilere Abfallen der peripheren Schenkel. Eine Verwechslung macgeeider Formen mit *Disphyllum* ist weiterhin aber vor allem auf Grund des Auftretens vorwiegend regelmäßiger Hufeisenelemente und des Septenbaues aus Fächertrabekeln bei ersterer Gruppe nicht möglich.

zung der Septen, im einfacher gebauten Basalapparat sowie auch im gelegentlichen Auftreten von Septalauswüchsen bei der Art *desioi* Merkmale, die eine artliche Trennung dieser kleineren Formen erfordern. Was die Septenzahl betrifft, so kann infolge des Fehlens typischer Reifestadien von *desioi* – der auf Taf. 1, Fig. 8 abgebildete Schnitt ist auf Grund des angetroffenen Sprosses nicht als charakteristisch anzusehen – lediglich jene mittlerer Stadien miteinander verglichen werden. Hier zeigt es sich, daß 20-23 Großsepten von *desioi* etwa 30 bei *multizonata* gegenüberstehen.

Beziehungen — Der Art *desioi* nahestehende Formen sind: *Macgeea* (*Macgeea*) *socialis* Soshkina 1939, *Macgeea* (*Macgeea*) *supradevonica* Penecke 1903, *Macgeea* (*Macgeea*) *cylindrica* (Yoh 1937), *Macgeea* (*Macgeea*) *caespitosa* (Goldfuss 1826) und *Macgeea* (*Macgeea*) *solitaria* (Hall & Whitfield 1873).

Die Art *socialis* zeigt im Bau des Basalapparates, abgesehen von der engeren Stellung der Böden, eine weitgehende Übereinstimmung mit vorliegender Art, unterscheidet sich aber durch die etwas größeren Ausmaße, die zahlreicheren Septen und Lateralknospung. Die Arten *supradevonica* und *cylindrica* anderseits stimmen mit der Art *desioi* in den Ausmaßen und der Septenzahl überein; *supradevonica* ist aber durch den Besitz großer, sich kappenförmig überlagernder Hufeisenelemente, die beachtliche blasige Ausbildung der Schlotzone und Lateralknospung ausgezeichnet, während *cylindrica* bei weiterhin auch ähnlich gebauter Schlotzone eine überwiegend mehrreihige, breite Hufeisenzone besitzt.

Die Arten *caespitosa* und *solitaria* weisen eine änlich ausgebildete Schlotzone auf. Die Art *caespitosa* unterscheidet sich jedoch durch die noch kleineren Ausmaße, eine geringere Septenzahl, regelmäßig horizontale äußere Dissepimente sowie Lateralknospung. Die Art *solitaria* weicht infolge ihrer kleineren Dimensionen, jedoch dennoch zahlreicheren Septen ab.

Bezüglich der Unterschiede gegenüber *Macgeea* (*Macgeea*) *multizonata* siehe unter Bemerkungen.

Vorkommen — Unteres Oberdevon (Frasnium): Rußland (Bohrung im Moskauer Gebiet, Kuzneck Becken, russische Tafel, Altai); Pakistan (Kuragh [Chitràl]).

TABULATA

Familie THAMNOPORIDAE (Hill 1956 subfam.)

Genus **Thamnopora** Steininger 1831 sensu Lecompte 1936 u. Weissermel 1939

1803 *Madreporites* Blumenbach, e. p., S. 25.
1820 *Milleporites* Schlotheim, e. p., S. 363.
1826 *Calamopora* Goldfuss, e. p., S. 77.
1830 *Alveolites* — De Blainville, e. p., S. 369.
1831 *Thamnopora* Steininger, S. 10.
1834 *Thamnopora* — Steininger, S. 337.
1834 *Alveolites* — De Blainville, e. p., S. 404.
1834 *Favosites* — De Blainville, e. p., S. 402.
1849 *Favosites* — Edwards & Haime, e. p., S. 260.
1850 *Favosites* — d'Orbigny, e. p., S. 107.
1850 *Alveolites* — d'Orbigny, e. p., S. 107.
1851 *Cladopora* Hall, e. p., S. 400.
1851 *Favosites* — Edwards & Haime, e. p., S. 152, 230.
1851 *Alveolites* — Edwards & Haime, e. p., S. 254.
1852 *Favosites* — d'Orbigny, e. p., S. 176.
1853 *Favosites* — Edwards & Haime, e. p., S. 215, 216.
1855 *Alveolites* — Edwards & Haime, e. p., S. 263.
1857 *Favosites* — Pictet, e. p., S. 440.
1859 *Favosites* — Billings, e. p., S. 99.
1860 *Favosites* — Edwards & Haime, e. p., S. 246.
1872 *Favosites* — De Koninck, e. p., S. 136.
1873 *Cladopora* — Hall & Whitfield, e. p., S. 230.
1874 *Cladopora* — Nicholson, e. p., S. 54.
1876 *Favosites* — Rominger, e. p., S. 19.
1877 *Favosites* — Gosselet, e. p., S. 271.
1878 *Favosites* — Quenstedt, e. p., S. 7.
1878 *Pachypora* — Nicholsons & Etheridge, S. 361.
1879 *Pachypora* — Nicholson, e. p., S. 77.
1881 *Favosites* — Quenstedt, e. p., S. 5.
1882 *Pachypora* — Barrois, S. 214.
1883 *Favosites* — Roemer, e. p., S. 419.
1883 *Pachypora* — Roemer, S. 435.
1885 *Favosites* — Frech, e. p., S. 100.
1886 *Pachypora* — Waagen, S. 844.
1889 *Cladopora* — Miller, S. 178.
1894 *Pachypora* — Penecke, S. 606.
1896 *Cladopora* — Sardeson, e. p., S. 319.

1896 *Pachypora* — Sardeson, e. p., S. 321.
1896 *Pachypora* — Gürich, S. 134.
1896 *Striatopora* — Gürich, S. 137.
1899 *Favosites* — Lambe, e. p., S. 2.
1899 *Pachypora* — Bogatirev, S. 114.
1902 *Pachypora* — Počta, S. 247.
1902 *Favosites* — Lebedew, e. p., S. 12.
1904 *Pachypora* — Penecke, S. 150.
1904 *Favosites* — Felix, e. p., S. 14.
1907 *Favosites* — Walther, e. p., S. 274.
1908 *Pachypora* — Reed, S. 15.
1913 *Striatopora* — Paeckelmann, e. p., S. 343.
1922 *Striatopora* — Paeckelmann, e. p., S. 80.
1922 *Pachypora* — Reed, S. 18.
1922 *Striatopora* — Reed, S. 20.
1929 *Pachypora* — Heritsch, S. 242.
1933 *Favosites* — Lecompte, e. p., S. 9.
1934 *Pachypora* — Le Maitre, S. 173.
1936 *Favosites* — Lecompte, e. p., S. 9.
1936 *Thamnopora* — Lecompte, S. 32
1936 *Favosites* — Asselberghs, e. p.
1937 *Thamnopora* — Hill, S. 56.
1938 *Emmonsia* — Stewart, e. p., S. 67.
1939 *Thamnopora* — Lecompte, S. 102 cum syn.
1939 *Thamnopora* — Weissermel, S. 66.
1939 *Pachypora* — Kelus, S. 48.
1940 *Thamnopora* — Lang, Smith & Thomas, e. p., S. 133.
1940 *Cladopora* — Lang, Smith & Thomas, e. p., S. 37.
1945 *Thamnopora* — Smith, e. p., S. 61.
1949 *Coenites* (= *Cladopora*) — Shimer & Shrock, e. p., S. 111.
1950 *Thamnopora* — Termier, G. & H., S. 77.
1950 *Thamnopora* — Bassler, S. 81 ff.
1951 *Thamnopora* — Tschernychev, S. 49.
1951 *Thamnopora* — Schouppé, S. 257 cum syn.
1952 *Thamnopora* — Sokolov, S. 57.
1952 *Thamnopora* — Lecompte in Piveteau, S. 511.
1952 *Thamnopora* — Dubatalov, S. 126.
1953 *Thamnopora* — Kropfitsch & Schouppé, S. 91.
1953 *Thamnopora* — Dubatalov, S. 208.
1954 *Thamnopora* — Hill, S. 114.
1955 *Thamnopora* — Dubatalov, S. 23.
1956 *Thamnopora* — Hill, e. p., S. 464.
1956 *Thamnopora* — Dubatalov, S. 92.
1958 *Thamnopora* — Stasinska, S. 200.

1959 *Thamnopora* — Dubatalov, Lin & Tchi, S. 28.
1959 *Thamnopora* — Tschudinova, S. 71.
1959 *Thamnopora* — Dubatalov, S. 74.

Generolectotyp — *Thamnopora cervicornis* (De Blainville 1830) = *Calamopora polymorpha* var. *ramoso-divaricata* (var.) Goldfuss 1826, S. 79, Taf. 27, Fig. 4a = *Alveolites cervicornis* De Blainville 1830, S. 370; 1834, e. p., S. 405 = *Thamnopora madreporacea* Steininger 1834 emend. 1849 = *Thamnopora milleporacea* Steininger 1834 emend. 1849 (siehe Lang, Smith & Thomas 1940, S. 133).

Diagnose — Vorwiegend bäumchenförmige, aber auch massige Thamnoporiden mit polygonalen, innen abgerundeten Polyparen, deren Wände sich nach außen zu verdicken. Mauerporen häufig, Böden dünn, Septaldornen selten.

Vorkommen — Devon - Perm: weltweit verbreitet.

Thamnopora reticulata (de Blainville 1830) [1]

Taf. 3, Fig. 1-4

1826 *Calamopora spongites* var. *ramosa* Goldfuss, e. p. *Petrefacta Germaniae*, S. 80, Taf. 28, Fig. 2a-c.
1830 *Alveolites reticulata* de Blainville. *Zoophytes*, S. 369.
1894 *Pachypora orthostachys* — Penecke. *Grazer Devon*, S. 607, Taf. 10, Fig. 7, 8; Taf. 11, Fig. 11.
1922 *Pachypora polymorpha* var. *viator* Reed. *Chitral and Pamirs*, S. 19, Taf. 4, Fig. 1-5.
1936 *Favosites reticulatus* — Lecompte. *Tabulés dévoniens*, S. 45, Taf. 8, Fig. 5; Taf. 9, Fig. 1,2 (*cum syn.*).
1939 *Thamnopora reticulata* — Lecompte. *Bassin de Dinant*, S. 111, Taf. 16, Fig. 3-6.
1939 *Pachypora nicholsoni* — Kelus. *Volhynien*, S. 48, Abb. 40, 41 (*Synonyma* e. p.).
1953 *Thamnopora reticulata* — Kropfitsch & Schouppé. *Thamnoporen und Striatoporen*, S. 98, Fig. 4 (*cum syn.*).

Bemerkungen zu den Synonyma — Siehe Lecompte 1936, S. 45 und Kropfitsch & Schouppé 1953, S. 98.

Lectotyp — Das von Goldfuss 1826 auf Taf. 28, Fig. 2a abgebildete Exemplar.

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[1] Die Synonymaliste erhebt keinen Anspruch auf Vollständigkeit. Ergänzende Angaben siehe unter den mit « *cum syn.* » bezeichneten Autoren. Auch ist die neueste russische Literatur uns derzeit erst teilweise zugänglich.

Material — Es lag eine Anzahl kleinerer Bruchstücke vor (1755/1-23). Es wurden je ein Quer-und ein Längsschliff angefertigt.

Diagnose — Bäumchenförmiger Vertreter von *Thamnopora* von dreierlei Wuchsform: Die zylindrischen bis seitlich leicht zusammengedrückten Äste sind entweder seitlich miteinander verwachsen (Typus A nach Lecompte 1936, S. 48), subparallel (Typus B) oder unregelmäßig miteinander verbunden (Typus C). Polypare rechtwinkelig zur Oberfläche ausmündend, Durchmesser 0. 7 bis 1.0 mm (1). Mauern nach außen zu stark verdickt. Mauerporen häufig, Durchmesser etwa 0.15 mm. Böden zahlreich, Abstand etwa 0.7 mm.

Beschreibung — Äußere Form: Es liegen Bruchstüke verschiedener Gestalt vor. Größtenteils handelt es sich dabei um zylindrische bis seitlich leicht zusammengedrückte Astfragmente von maximal 30 mm Länge und durchschnittlich 7 mm (maximal bis 12 mm) Durchmesser. Einige erhaltene Astenden zeigen eine zapfenartige, progressiv sich verjüngende Form (Taf. 3, fig. 1). Aus den vorliegenden Gabelungen, die entweder eine unvollständige Trennung der einzelnen Äste oder aber eine gänzlich unregelmäßige Anordnung derselben zeigen (Taf. 3, Fig. 2), geht hervor, daß hier Formen der Lecomptschen Typen A und C entwickelt sind. Die in sich wieder vielfach höckerige Oberfläche der Bruchstücke wird von polygonalen, mehr oder weniger gleich großen Polyparkelchen eingenommen. Der Durchmesser der Kelche beträgt maximal etwa 1.0 mm.

Beobachtungen an Querschliffen: Die im mittleren Teil des Schliffes (Taf. 3, Fig. 3) annähernd senkrecht angetroffenen Polypare zeigen eine verhältnismäßig einheitliche Größe. Ihr Umriß (durch die Grenzlinien zwischen den einzelnen Polyparwänden markiert) ist polygonal (vier-bis achteckig), das Lumen hingegen deutlich abgerundet. Der Durchmesser der Polypare beträgt 0.7-1.0 mm, jener des freien Lumens 0.4-0.6 mm. Die mehreckige Grenzlinie ist wechselnd deutlich ausgebildet. Die Skelettsubstanz der Mauer weist eine faserige Radiärstruktur auf. Nach der Peripherie des Schliffes hin sind allseits scharf nach außen abbiegende Polypare meist annähernd parallel zu ihren Mauern angeschnitten. Abschnittsweise zeigen sich in den einzelnen benachbarten Polyparen ungefär in derselben Höhe angeordnete einreihige Mauerporen. Die Abstände innerhalb der einzelnen Reihen betragen durchschnittlich 0.6 mm, die Durchmesser der Poren schwanken von 0.15 bis etwa 0.3 mm.

Beobachtungen an Längsschliffen: Der Längsschliff (Taf. 3, Fig. 4) zeigt fächerförmig verlaufende, nach außen zu plötzlich annähernd rechtwinkelig

(1) Die Durchmesser werden stets von Grenzlinie zu Grenzlinie bzw., wenn nicht erkenntlich, von Wandmitte zu Wandmitte gemessen.

ausbiegende Polypare. Sie entspringen jeweils entweder aus der Mittelzone des 7 mm starken Astes oder aber nahe an den erwähnten scharfen Umbiegungsstellen. Im mittleren Abschnitt sind die Mauern dünn, im Bereich der Umbiegung setzt ziemlich unvermittelt eine keulenförmige Verdickung ein. Im allgemeinen läßt sich die Wandgrenze zwischen den Polyparen als dunkle Linie (hier deutlicher als im Querschnitt) erkennen. Die Wand selbst besteht aus mehr oder weniger senkrecht zu den Grenzlinien angeordneten hellen Fasern. Verhältnismäßig selten sind Mauerporen angeschnitten. Wo der Schnitt radial zu einem Polypar verläuft, kann man erkennen, daß der Durchmesser der Poren durch die gesamte Mauerstärke (zwischen zwei benachbarten Lumina) hindurch gleichbleibt. Die relativ häufigen Böden sind dünn und horizontal bis leicht nach außen schräg abfallend. Ihr Abstand beträgt im Durchschnitt etwa 0.7 mm.

Vorkommen — Oberes Unterdevon (Emsium): Nordwest-Frankreich; ?Deutschland (Thüringen). Mitteldevon: Belgien (Couvinium + Givetium: Dinant); Deutschland (Couvinium + Givetium: Rheinland, Givetium: Bergisches Land); Frankreich (Couvinium: Ardennen, Bassin d'Ancenis); Österreich (Couvinium: Grazer Paläozoikum, Karnische Alpen); Polen (Couvinium: Lysa Gora); Rußland (Couvinium: Armenien); Spanien (Givetium: Asturien); China (Couvinium + Givetium: Szechuan); Mauretanien (Couvinium + Givetium); Australien (Givetium: N. S. Wales). Unteres Oberdevon (Frasnium): Spanien (Asturien); England (South Devonshire); Belgien (Dinant); Polen (Lysa Gora); Pakistan (Kuragh [Chitràl]). Devon (ohne nähere Angabe): Rußland (Petschora); Mongolei (Chirgik Range).

Thamnopora boloniensis (Gosselet 1877) [1]

Taf. 3, Fig. 5-9

1803 *Madreporites cristatus* Blumenbach. *Archaeologiae telluris*, S. 25, Taf. 3, Fig. 12.
1840-47 *Alveolites cervicornis* — Michelin. S. 187, Taf. 48, Fig. 2; Taf. 49, Fig. 3.
1851 *Favosites dubia* — Edwards & Haime. *Monographie*, S. 243.
1877 *Favosites boloniensis* Gosselet. S. 271.
1922 *Pachypora cristata* — Reed. *Chitral and Pamirs*, S. 18, Taf. 3, Fig. 11-14.
1922 *Striatopora devonica* var. *chitralensis* Reed. *Ibidem*, S. 20, Taf. 4, Fig. 6-9.
1922 *Striatopora angulosa* var. *kuraghensis* Reed. *Ibidem*, S. 21, Taf. 4, Fig. 10-14.
1939 *Thamnopora boloniensis* — Lecompte. *Bassin de Dinant*, S. 122, Taf. 17, Fig. 1-24; Taf. 18, Fig. 1 (*cum syn.*).

[1] Siehe S. 40.

1953 *Thamnopora boloniensis* — Kropfitsch & Schouppé. *Thamnoporen und Striatoporen*, S. 91, Fig. 1 (*cum syn.*).
1958 *Thamnopora boloniensis* — Stasinska. *Monts de Sainte Croix*, S. 198, Taf. 9-11.
1959 *Thamnopora boloniensis* — Dubatalov. *Devon Tabulaty i geliolitidy*, S. 111, Taf. 39, Fig. 2a-d (*cum syn.*).

Bemerkungen zu den Synonyma — Siehe Lecompte 1939, S. 124 und Kropfitsch & Schouppé 1953, S. 92.

Holotyp — Das von Michelin 1840-47 auf Taf. 48, Fig. 2 und Taf. 49, Fig. 3 abgebildete Exemplar (siehe Gosselet 1877, S. 271).

Material — Es lag eine größere Anzahl verhältnismäßig kleiner Bruchstücke vor (1756/1-23). Ein Quer-und ein Längsschliff gelangten zur Herstellung.

Diagnose — In einer Ebene verzweigte bäumchenförmige Vertreter von *Thamnopora* mit schräg zur Oberfläche ausmündenden Polyparen von 1.5-2.3 mm Durchmesser. Mauern stark, nach außen zu nur mäßig verdickt, trichterförmige Mauerporen häufig, Durchmesser etwa 0.2 mm. Böden selten, in unregelmäßigen Abständen.

Beschreibung — Äußere Form: Die vorliegenden Astfragmente sind zylindrisch bis seitlich leicht zusammengedrückt und erreichen eine Länge von maximal 40 mm und einen Durchmesser von 18 mm. Die Oberfläche wird von den polygonalen, mitunter auch oval gestreckten, verhältnismäßig ungleich großen Polyparkelchen eingenommen (Taf. 3, Fig. 5, 6). Die größten ermittelten Ausmaße liegen bei etwa 2.3 mm.

Beobachtungen an Querschliffen: Die im zentralen Abschnitt der Querschliffe (Taf. 3, Fig. 7, 9) annähernd senkrecht angetroffenen Polypare weisen eine stark unregelmäßige Größe und Form auf. Ihr Umriß ist polygonal, wobei die Seitenzahl mit dem Durchmesser zunimmt. Kleinere Polypare besitzen 4-5, die größten 7-8 Seiten von meist unregelmäßiger Länge. Die Begrenzung des Lumen ist mehr oder weniger stark abgerundet. Der Durchmesser der Polypare mißt 0.7 mm bis ausnahmsweise 2.0 mm, im Mittel liegt er bei 1.2-1.5 mm. Das freie Lumen beträgt im allgemeinen um 0.3-0.4 mm weniger. Die Grenze zwischen den einzelnen Polyparwänden ist als deutliche dunkle Linie ausgebildet. Die Mauer des Einzelpolypars-von der Grenzlinie bis zum freien Lumen – besteht aus zwei Lagen: einer äußeren helleren und einer inneren dunkleren. Die äußere erscheint in allen Zellröhren annähernd gleich dick entwickelt zu sein, während die Stärke der inneren bedeutenden Schwankungen unterworfen ist. Stellenweise kann die innere Schicht auch ganz fehlen. Beide Lagen weisen eine wechselnd deutliche radiäre Faserstruktur auf. Nach der Peripherie der Schliffe zu vergrößern sich die Polyparöffnungen ent-

sprechend ihrer Lage zur Schittebene und am Rand geht das Querschnittsbereits in ein Längsschnittsbild über. Namentlich in den äußeren Schliffabschnitten erkennt man runde Mauerporen mit einem Durchmesser von 0.2-0.3 mm.

Beobachtungen an Längsschliffen: Längsschliffe (Taf. 3, Fig. 8) zeigen fächerförmig angeordnete, randlich stärker nach außen ausbiegende und sich leicht verbreiternde Polypare, die sich schräg zur Oberfläche des Astes öffnen. Die Mauern sind durchwegs, wenngleich unregelmäßig, stark und weisen gegen die Mündung der Polypare hin eine allmähliche Verdickung bis auf 0.5 mm Stärke auf. Die Mauern selbst bestehen aus einer äußeren helleren und einer inneren dunkleren Lage. Namentlich in dieser zeigt sich eine mehr oder weniger deutliche Faserstrucktur senkrecht zu den Grenzlinien. Lokal läßt sich auch eine den Mauergrenzen parallel laufende Anwachsstreifung erkennen. Die Grenze zwischen benachbarten Polyparen ist durch einen wechselnd breiten dunklen Streifen gekennzeichnet, in dem bei stärkerer Vergrößerung vielfach eine transversale Faserung aufscheint. In parallel zu ihrer Erstrechung angeschnittenen Mauern zeigen sich stellenweise runde bis leicht ovale einreihig angeordnete Poren. Ihr Durchmesser beträgt etwa 0.2, maximal 0.3 mm, ihr Abstand schwankt zwischen 0.6 und 1.0 mm, wobei in einer einzelnen Mauer, soweit feststellbar, der Abstand mehr oder weniger konstant sein dürfte. In quer zu ihrer Erstreckung (radial) angeschnittenen Mauern tritt die trichterförmige Einsenkung der Poren in Erscheinung. Der kleinste Durchmesser der Poren an der Grenze zwischen zwei benachbarten Polyparmauern beträgt 0.2 mm. Die dünnen Böden sind sehr spärlich entwickelt, sie liegen entweder horizontal oder fallen schräg nach außen ab, in Abständen von 0.5-4.0 mm.

Bemerkungen — Reed (1922) beschreibt unter anderem zwei tabulate Formen als *Striatopora devonica chitralensis* und *Striatopora angulosa kuraghensis*, führt dazu aber aus, daß sie sich nur geringfügig von seiner *Pachypora cristata* (= *Thamnopora boloniensis*) unterscheiden. Beide Formen sind meines Erachtens mit der Art *boloniensis* zu vereinen, die nach Lecompte (1939, S. 123) namentlich in Bezug auf Polypardurchmesser, — form und Wandstärke eine sehr große Variabilität aufweist.

Vorkommen — Mitteldevon (Couvinium + Givetium): Deutschland (Rheinland, Harz); Österreich (Grazer Paläozoikum); Polen (Lysa Gora). Unteres Oberdevon (Frasnium): Belgien (Dinant, Namur); Deutschland (Rheinland, Harz, Thüringen); Polen (Lysa Gora); Rußland (Kuzneck Becken).

Als *cristata* beschriebene Formen, deren Übereinstimmung mit *boloniensis* Fall für Fall zu überprüfen wäre, werden aus folgenden Stufen und Lokali-

täten angeführt: Unterdevon (Emsium): Deutschland (Thüringen); Rußland (Ural); Türkei (Istambul). Mitteldevon: Frankreich (Couvinium: Bassin d'Ancenis); Deutschland (Couvinium: Hessen, Givetium: Bergisches Land); Spanien (Givetium: Asturien); Belgien (Givetium: Dinant); Rußland (Couvinium: Armenien, Ural); Türkei (Istambul). Oberdevon (Frasnium): England (South Devonshire); Frankreich (Pas de Calais); Spanien (Asturien); Türkei (Antitaurus). Devon (ohne nähere Angaben): Rußland (Petschora, Sibirien [Stanovoi]).

Familie ALVEOLITIDAE Duncan 1872

Genus **Alveolites** Lamarck 1801 sensu Sokolov 1952

1801 *Alveolites* Lamarck, S. 375.
1922 *Alveolites* — Reed, ? e. p., S. 22.
1933 *Alveolites* — Lecompte, e. p., S. 7.
1936 *Alveolites* — Lecompte, e. p., S. 17.
1939 *Alveolites* — Lecompte, e. p., S. 17.
1951 *Alveolites* — Schouppé, e. p., S. 266.
1959 *Alveolites* — Dubatalov, S. 136.

Da die alte Gattung *Alveolites* von den neueren russischen Autoren in drei Genera *Alveolites* Lamarck 1801, *Crassialveolites* Sokolov 1955 und *Alveolitella* Sokolov 1952 aufgeteilt wurde und mir nicht die gesamte diesbezügliche einschlägige Literatur zur Verfügung steht, kann die Synonymaliste keinen Anspruch auf Vollständigkeit erheben. Die gesamte ältere Literatur muß im Hinblick auf diese neue Aufteilung durchgesehen werden.

Generolectotyp — *Alveolites suborbicularis* Lamarck 1801, S. 376 [1].

Diagnose — Massige Alveolitiden mit schräg zur Oberfläche ausmündenden Polyparen von zusammengedrückt vieleckigem bis halbmondförmigem Querschnitt. Septaldornen normalerweise einreihig, in der Mitte der unteren Polyparwand gelegen. Wand dünn, Mauerporen groß, Böden dünn.

Vorkommen — Silurium: Russland; Devon: weltweit verbreitet.

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[1] Falls *Caliapora* Schlüter 1889 sich tatsächlich, der Auffassung von Charlesworth 1914 und Schouppé 1951 entsprechend, als Subgenus von *Alveolites* erweisen sollte, wäre obige Bezeichnung in *Alveolites* (*Alveolites*) umzuändern. Da in der neuen russischen Literatur *Caliapora* jedoch wieder als eigene Gattung angesehen wird, eine erschöpfende Behandlung dieser Frage aber in vorliegendem Ramen nicht möglich ist, muß die Stellung von *Caliapora* vorläufig noch ungeklärt bleiben.

Alveolites hudlestoni Reed 1922

Taf. 3, Fig. 10,11

1922 *Alveolites suborbicularis* var. *Hudlestoni* Reed. *Chitral and Pamirs*, S. 22, Taf. 4, Fig. 16-18; Taf. 5, Fig. 1-3.

Lectotyp — Das von Reed 1922 auf Taf. 4, Fig. 16, 17 17a abgebildete Exemplar.

Material — Es lagen einige Bruchstücke vor (1757/1-2), von denen zwei Schliffe angefertigt wurden.

Diagnose — Subgloboser Vertreter von *Alveolites* mit einander vielfach überwuchernden Stockpartien und nur spärlich entwickelten Septaldornen.

Beschreibung — Äußere Form: Die vorliegenden unvollständigen Stöcke sind halbkugelig bis subglobulös und weisen bei einer größten Höhe von 35 mm einen Durchmesser von maximal 45 mm auf. An der mehr oder weniger glatten Oberfläche erkennt man entweder die kleinen zusammengedrückten Mündungen der Polypare oder aber eine vielfach wirbelartig gedrehte feine Streifung, die mehr oder weniger parallel zu ihrer Längserstreckung angeschnittenen Polyparen entspricht. Überdies tritt im Stock häufig ein Wechsel hellerer und dunklerer konzentrischer Lagen in Erscheinung (Taf. 3, Fig. 10).

Beobachtungen an Schliffen: In verschiedenen Richtungen gelegte Schnitte (Taf. 3, Fig. 11) zeigen, daß die Kolonie aus einem Bündel von Zellröhren besteht, die vom Zentrum aus allseits nach außen biegen. Im Laufe des Wachstums ändern die Polypare vielfach ihre Richtung, ja einzelne Stockpartien können sogar annähernd senkrecht von ihrem ursprünglichen Verlauf abbiegen und benachbarte Anteile überwuchern. Dieses eigenartige Verhalten setzt eine unterschiedliche Wachstumsgeschwindigkeit in den einzelnen Abschnitten des Stockes voraus. Die Polypare weisen einen zusammengedrückten unregelmäßig polygonalen bis halbmondförmigen Querschnitt auf. Der größere Durchmesser beträgt im Mittel 0.7-0.8 mm, der kleinere etwa 0.5 mm. Die Stärke der Mauer wechselt abschnittsweise. Die Grenze zwischen benachbarten Polyparen ist im Längsschnitt deutlicher als im Querschnitt als dunkle Linie entwickelt. Mitunter treten kleine zapfenartige Septaldornen auf, die jeweils einzeln, von der unteren, mehr oder weniger geraden Wand in das Innere der Polypare ragen. Die verhältnismäßig häufigen, einreihig angeordneten Mauerporen besitzen einen Durchmesser von 0.1-0.15 mm. Die Böden sind dünn, liegen vorwiegend horizontal, aber auch schräg und weisen einen wechselnden Abstand von 0.2-0.8 mm auf.

Bemerkungen und Beziehungen — Mit dem hier vorliegenden Material übereinstimmende Exemplare wurden bereits von Reed (1922) als *Alveolites suborbicularis* var. *hudlestoni* beschrieben. Allein schon die eigenartige Wuchsform unterscheidet sie jedoch so deutlich von der Art *suborbicularis*, daß sie als eigene Spezies angesehen werden müssen. In Bezug auf die auffallende Wuchsform besteht eine weitgehende Übereinstimmung der Art *hudlestoni* mit der von Lecompte (1939, S. 51) als *Alveolites edwardsi* beschriebenen Form. Die pakistanische Art unterscheidet sich jedoch durch die kleineren Ausmaße des Stockes, die spärlicher ausgebildeten Septaldornen und die stärkere Wand. Außerdem ist *Alveolites edwardsi* ausschließlich aus dem oberen Couvinium und dem unteren Givetium von Belgien bekannt.

Vorkommen — Unteres Oberdevon (Frasnium): Pakistan (Kuragh [Chitràl]).

ANHANG

BRYOZOA

In dem uns zur Untersuchung vorliegenden Material waren auch noch sechs Bruchstücke von *Polypora hudlestoni* Reed 1922 vorhanden (nähere Beschreibung siehe Reed 1922, S. 28).

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Manuscript revised 14 February 1964.

RHYNCHONELLOIDEA DE SHOGRAN ET KURAGH (CHITRAL)

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Le sous-ordre est représenté par une unique espèce appartenant à un genre nouveau:

CYPHOTERORHYNCHUS n. gen.

Derivatio nominis — κυφότερος, η, ον (grec) = plus voûté, plus gibbeux, plus bossu; τὸ ῥύγχος (grec, neutre) = bec.

Espèce-type — *Uncinulus* (*Uncinulina*) *koraghensis* Reed, F. R. C., 1922.

Diagnose — Taille moyenne à grande. Uniplissée. Enflée. Sinus large et peu profond. Bourrelet et sinus débutant à une certaine distance des crochets. Plis en nombre variant d'une espèce à l'autre. Plis pariétaux. Plis simples, réguliers, peu élevés, partant des crochets. Commissures tranchantes et nettement indentées. Commissures latérales et antéro-latérales situées relativement haut. Plaques dentales robustes et courtes. Dents courtes, robustes, à face interne dentelée épousant la forme similaire des cavités glénoïdes. Septum court supportant un septalium recouvert dans sa partie antérieure. Crura courts, incurvés en leur partie distale. Champ musculaire ventral long et large.

Cyphoterorhynchus koraghensis (Reed, F. R. C., 1922)

Pl. 4 et 5

Lectotype — Fig. 10, 10a, pl. VII *in* F. R. C. Reed (1922)

SYNONYMIE

1902 *Rhynchonella*, species W. H. Hudleston. *Hindu Khoosh*, p. 56, pl. III, fig. 10a-c.
1911 *Rhynchonella* (*Camarotoechia*) cf. *Omaliusi* F. R. C. Reed. *Chitral, Persia, Afghanistan*, p. 104, p. 105, pl. 8, fig. 2, 2a.
1911 *Rhynchonella* (*Wilsonia?*) cf. *Dumonti* F. R. C. Reed. *Ibidem*, p. 104, pp. 105-6, pl. 8, fig. 1, 1a.
1922 *Uncinulus* (*Uncinulina*) *koraghensis* [*Rhynchonella* sp.] F. R. C. Reed. *Chitral and Pamirs*, p. 124.
1922 *Uncinulus* (*Uncinulina*) *koraghensis* F. R. C. Reed. *Ibidem*, pp. 40-42, p. 123, p. 125, pl. VII, fig. 10-13.
1922 *Uncinulus* (*Uncinulina*) *koraghensis* var. *pentagonalis* F. R. C. Reed. *Ibidem*, pp. 42-43, p. 123, p. 125, pl. VII, fig. 14-17.
1922 *Uncinulus* (*Uncinulina*) *koraghensis* var. *transiens* F. R. C. Reed. *Ibidem*, pp. 43-44, p. 123, p. 125, pl. VII, fig. 18-20.
1922 *Uncinulus* (*Uncinulina*) *koraghensis* var. *ponderosa* F. R. C. Reed. *Ibidem*, p. 44, p. 123, p. 125, pl. VII, fig. 21-22; pl. VIII, fig. 1.

Récolte. Etat de conservation

Les 31 spécimens dont nous disposons ont été récoltés, les 19 (Shogran) et 22 (Kuragh) août 1955, par l'expédition italienne du Karakorum. 30 spécimens proviennent de l'affleurement de Kuragh cité et photographié par Hayden (1916, p. 288, pl. 27, photographie du bas) et portent les numéros de localité suivants: 55 PD – 76 (niveaux inférieurs) (1 spécimen), 55 PD – 77 (22 spécimens), 55 PD – 78 (niveaux supérieurs) (5 spécimens), 55 PD – ? (2 spécimens). Un seul spécimen 55 PD – 71 est issu de l'affleurement de Shogran. 13 spécimens sont en état de conservation bon ou satisfaisant; 3 sont écrasés; les 15 autres sont fragmentaires.

La figure dans le texte donne un tableau indicatif et approximatif de la localisation des collections existantes connues d'après les informations trouvées dans la littérature et recueillies par l'expédition italienne.

Les spécimens mesurés et photographiés sont conservés à l'Institut de Géologie de l'Université de Milan où ils portent les numéros 1769 à 1778. Des moules des spécimens n° 1772 et n° 1776 ont été confectionnés; ils accompagnent ce qui reste des spécimens après usure.

Collection de Hudleston selon Reed (1922, p. 124)	Collection de Hayden selon Reed (1922, p. 3, pp. 122-124)		Collection de l'expédition italienne	Collection de Hayden selon Reed (1922, p. 3, pp. 124-126)	Collection de l'expédition italienne	
Localité: Shogran				Localité: crête de Kuragh		
				quartzite		
Provient des mêmes roches que: K 18741 K 18743 K 18744 K 18746	K 18746 Provient de une des couches K 18741 à K 18744	K 18741 = calcaire dévonien K 18743 = débris sous la couche contenant K 18741 K 18744 = bande inférieure de K 18743 K 18742 = calcaire corallien	55 PD - 71 (débris)	K 18748 = débris au pied de l'affleurement dévonien de la crête K 18750 = bandes de coraux K 18749 = bande schisteuse à *Atrypa aspera*	55 PD -77 (débris)	55 PD - 78 (in situ) 55 PD - 76 (in situ)
				quartzite		

DESCRIPTION

CARACTÈRES EXTERNES

Valve pédonculaire — Une coupe longitudinale médiane, du bec au bord frontal, dessine une demi-ellipse légèrement déversée postérieurement du fait de l'enflure de la région umbonale. La pente des flancs est douce vers les commissures antéro-latérales et latérales; elle est raide vers les commissures postéro-latérales, à proximité desquelles les flancs deviennent concaves.

Le sinus prend naissance à une distance du crochet variant entre 53/100mes et 71/100mes de la longueur de la coquille ou entre 42/100mes et 56/100mes de la longueur déroulée de la valve. Le sinus peu profond – deux à quatre fois la hauteur des plis (peu élevés) au passage à la languette – débute brusquement et possède aussitôt une largeur appréciable. Au front, la largeur du sinus se situe entre 48% et 63% de celle de la coquille. Bien délimité par rapport aux flancs, le sinus passe d'une façon progressive à une languette peu élevée, trapézoïdale (mi-elliptique dans deux spécimens), à bords usuellement tranchants, à sommet légèrement à fortement convexe, devenant parfois tangente à un plan vertical dans sa partie extrême-supérieure. Le fond du sinus est plat ou très faiblement convexe.

Le bec est légèrement à fortement incurvé. L'état du matériel n'a permis aucune observation relative au foramen. Les deux parties de l'interarea, en forme de pales d'hélice, sont concaves et nettement séparées du reste de la valve par les arêtes qui les bordent. La hauteur de l'interarea oscille autour de 1 mm; sa longueur varie entre 41 et 54% de la largeur de la coquille. Les plaques deltidiales n'ont été observées qu'en sections sériées transverses.

Valve brachiale — Après s'être élevée rapidement depuis le bord cardinal, la valve se courbe d'une façon plus ou moins prononcée vers les commissures latérales et antéro-latérales. La pente est raide en direction des commissures postéro-latérales, à proximité desquelles la valve devient concave. Le bourrelet retombe vers le bord frontal en pente généralement douce, mais parfois assez forte.

Le bourrelet, comme le sinus, naît à une certaine distance du crochet. Il est bien marqué et son sommet est convexe.

Ornementation — Voici la formule générale (1) des plis:

$$\frac{6\text{-}7}{5\text{-}6};\ \frac{1\text{-}1}{1\text{-}1};\ \frac{14\text{-}15}{15\text{-}16}$$

(1) Il s'agit d'une formule groupant, dans chacune des trois subdivisions, 75% au moins des spécimens étudiés.

Le nombre des plis médians et pariétaux, comptés ensemble sur 23 spécimens, se répartit comme suit: $\frac{7}{6}$ (1 sp.); $\frac{8}{7}$ (14 sp.); $\frac{9}{8}$ (4 sp.); $\frac{10}{9}$ (3 sp.); $\frac{12}{11}$ (1 sp.).

Sur 17 spécimens, les plis médians ont pu être séparés des plis pariétaux. La répartition des plis médians est: $\frac{6}{5}$ (12 sp.); $\frac{7}{6}$ (3 sp.); $\frac{5}{4}$ (1 sp.); $\frac{4}{3}$ (1 sp.); celle des plis pariétaux est: $\frac{1-1}{1-1}$ (16 sp.); $\frac{2-2}{2-2}$ (1 sp.).

L'effacement ou la mauvaise préservation des plis latéraux les plus externes n'a permis de faire des observation satisfaisantes que dans 7 spécimens: $\frac{13}{14}$ (1 sp.); $\frac{14}{15}$ (2 sp.); $\frac{15}{16}$ (4 sp.).

Tous les plis partent du crochet, sont simples, réguliers, bien marqués mais peu élevés, arrondis. Les plis médians sont parfois angulaires (obtus) près de la commissure frontale, où leur largeur est de 1,5 à 2 mm et où ils sont occasionnellement incisés par de faibles rainures.

Dans la plupart des spécimens, les plis pariétaux s'effacent avant d'atteindre les bords de la languette qu'ils n'incisent donc pas. Quand les plis médians externes se situent nettement plus bas que les autres, comme c'est le cas notamment quand la languette est mi-elliptique, on peut soit les compter parmi les plis pariétaux, soit renoncer à faire une distinction entre plis médians et plis pariétaux; de toute manière, les plis médians en contre-bas incisent les bords de la languette. Il arrive que l'un des plis latéraux ventraux internes, ou les deux, soient situés légèrement plus haut que les autres plis latéraux, sans qu'ils puissent toutefois être considérés comme des plis pariétaux.

Les sillons ont les mêmes caractéristiques que les plis.

Caractères généraux — La coquille est de taille moyenne et d'aspect boulot. En vue dorsale, le contour de la coquille, abstraction faite du bec ventral, est circulaire à transversalement ovalique.

Les valves sont accolées par des commissures saillantes nettement indentées par les plis. Les commissures latérales et antéro-latérales ont une position assez élevée dans la coquille.

Les coquilles sont plus larges que longues, mais les deux dimensions sont voisines, sauf, exceptionnellement, dans certains spécimens très larges. Tout en étant nettement inférieure à celle de la valve brachiale, la hauteur de la valve pédonculaire est relativement grande. Le sommet de la languette ne correspond jamais au sommet de la coquille; ce dernier occupe une position variable entre la mi-longueur et la commissure frontale.

Dimensions — Voici les dimensions de 9 spécimens (1).

en cm	55PD - 78 n° 1769	55PD - 77 n° 1770	55PD - 77 n° 1771	55PD - 77 n° 1772	55PD - 77 n° 1773	55PD - 77 n° 1774	55PD - 77 n° 1775	55PD - ? n° 1777	55PD - 78 n° 1776
L.	1.82	1.55	1.54	1.62 ?	1.72	1.75	1.88	1.76	2.06
l.	1.82	1.66	1.68	1.88	1.80	1.77	2.47 ?	1.97	2.20
longueur déroulée v. p.	2.65	2.20	2.30	2.60	2.50 ?	2.90	2.95	2.60	3.10
h.	1.46	1.17	1.15	1.45	1.39	1.56	1.60	1.36	1.75
h. v. p.	0.51	0.50	0.55	0.57	0.54	0.56	0.65	0.53	0.55
h. v. b.	0.95	0.67	0.60	0.88	0.85	1.—	0.95	0.83	1.20
L./l.	1.—	0.93	0.90	0.86 ?	0.96	0.99	0.76 ?	0.89	0.94
h./l.	0.80	0.70	0.68	0.77	0.77	0.88	0.65 ?	0.69	0.80
h./L.	0.80	0.75	0.75	0.89 ?	0.81	0.89	0.85	0.77	0.85
angle d'épaule	115°	110°	106°	112°	115° ?	?	110°	115° ?	107°

La plus grande largeur de la coquille se situe au voisinage des 6/10mes de la longueur de la coquille.

Caractères internes

C'est à partir des sections sériées transverses de deux spécimens que la plus grande partie de la description ci-dessous a été établie. Le test est épais dans la région apicale et les cavités umbonales sont de ce fait relativement réduites.

Les plaques dentales robustes et courtes de divergentes postérieurement deviennent sub-parallèles puis convergentes antérieurement; dans un des deux spécimens, les parties inférieures des plaques dentales restent divergentes.

Les dents courtes, larges et robustes ont la face interne dentelée.

(1) Signification des abréviations: L. = longueur; l. = largeur; h. = hauteur; v. p. = valve pédonculaire; v. b. = valve brachiale.

Les denticula sont très prononcés. Les cavités glénoïdes sont largement ouvertes et ont une dentelure correspondant à celle des dents; au cours de la croissance, elles s'ouvrent rapidement et se déplacent vite latéralement.

Des plaques deltidiales ont été observées dans un des deux spécimens usés. Dans la valve brachiale se trouve un septum médian s'amincissant et rapetissant antérieurement. Le septum est court: 23% à 38% de la longueur de la coquille ou 45% à 55% de la longueur déroulée de la valve brachiale. Le septum supporte, sur une distance réduite, un septalium profond. La partie antérieure du septalium est fermée par une couverture se prolongeant au delà du septalium jusqu'au début des crura. Un renflement longitudinal plus ou moins prononcé marque la couverture du septalium en son milieu. Dans un des deux spécimens sectionnés, la couverture est très robuste, dans l'autre elle l'est moins. Les crura sont courts, concaves sur leur face interne; dans un des deux échantillons étudiés, ils sont recourbés à leurs extrémités.

Les parties extérieures du plateau cardinal sont légèrement concaves; elles sont légèrement bombées à leur jonction avec le septalium et sont bordées par les crêtes intérieures élevées des cavités glénoïdes.

Le champ musculaire ventral a une longueur variant entre 40% et 56% de la longueur déroulée de la valve pédonculaire et une largeur oscillant entre 33% et 57% de la largeur de la coquille. Les empreintes des muscles adducteurs sont réniformes. Les empreintes des muscles diducteurs contournent celles des muscles adducteurs; elles sont flabellées et leurs bords antérieur et antéro-latéraux sont peu clairement délimités. La partie postérieure des empreintes des muscles pédonculaires ventraux est la seule qui soit bien en évidence.

Le champ musculaire dorsal a une longueur variant entre 46% et 52% de la longueur déroulée de la valve brachiale; sa largeur est voisine de 30% de celle de la coquille. Le contour des empreintes des deux paires de muscles adducteurs est en général peu précis, vu qu'elles n'ont quasiment pas de relief. La paire postérieure est indiquée par deux petites ellipses situées en diagonale par rapport au septum tandis que la paire antérieure est formée de deux demi-ellipses appliquées de part et d'autre du septum.

Croissance

Les deux plus petits spécimens à notre disposition sont fragmentaires et ne peuvent être dégagés du sédiment qui les enrobe. Ils permettent de constater l'absence de languette, de sinus et de bourrelet délimités.

Discussion de la synonymie

L'unique spécimen décrit et figuré par Hudleston (1902) a été récolté par le capitaine B. E. N. Gurdon qui l'aurait découvert, selon le major A. H. McMahon (McMahon, 1902, p. 3, p. 5), « ... from a bed of limestone exposed in a cliff on the right bank of the Chitral river, *immediately* opposite Reshun ». C'est de cette couche de calcaire et probablement de la même localité que Hayden (1916, p. 283) a prélevé les exemplaires ultérieurement étudiés par Reed (1922), aussi n'y a-t-il rien d'étonnant que ce dernier, adoptant (p. 124) les données de Hayden relatives au gisement, ait englobé la *Rhynchonella* sp. de Hudleston dans sa nouvelle espèce.

L'indisponibilité de l'échantillon de *Rhynchonella* (*Camarotoechia*) cf. *Omaliusi* décrit et figuré par Reed (1911) ne permet pas de considérer la mise en synonymie comme acquise. De toute manière il ne s'agit pas de l'espèce fondée par Gosselet. L'exemplaire de *Rhynchonella* (*Wilsonia*?) cf. *Dumonti* figuré par Reed (1911) n'a rien en commun avec l'espèce de Gosselet; quoique nous n'ayons pas eu l'occasion de voir ce spécimen, nous le plaçons dans la synonymie de *Cyphoterorhynchus koraghensis* sur la foi des figures données et du fait que Reed (1922, p. 43) le place, ainsi que les échantillons non figurés, dans la variété *pentagonalis*. Nous estimons, au vu de la petite collection étudiée, que les variétés distinguées par Reed pourraient entrer dans les limites de la variabilité de l'espèce; des récoltes plus abondantes et plus serrées sont nécessaires pour trancher en la matière.

Discussion de l'attribution générique

Reed (1922) a donné des figures abondantes et de haute qualité ainsi qu'une description fidèle des caractères externes de l'espèce (et de ses variétés). Il nous a fourni moins d'indications sur les structures internes; leur étude détaillée nous a conduit à fonder un genre nouveau.

Voici, accompagnées des données (l'espèce-type, sa localisation, son niveau stratigraphique) des publications originales, les unités taxionomiques citées dans la discussion:

— Sous-genre *Hemiplethorhynchus* von Peetz, H., 1898 (*H. fallax* von Peetz, H., 1898, Bassin du Kouznetzk, U.R.S.S., Carbonifère Inférieur);

— Genre *Moorefieldella* Girty, G. H., 1911 (*M. eurekensis* (Walcott, C. D., 1884), Eureka District, Nevada, Etats-Unis, Mississippien Inférieur);

— Genre *Greenockia* Brown, R. A. C., 1952 (*G. snaringensis* Brown, R. A. C., 1952, Alberta, Canada, « Banff formation, Upper member », 531 pieds au-dessus de la base du Mississippien);
— Genre *Cupularostrum* Sartenaer, P., 1961 (*C. recticostatum* Sartenaer, P., 1961, New-York, Etats-Unis, « Skaneateles formation (Upper Pompey member) »; considéré comme étant d'âge Givetien Inférieur);
— Genre *Cassidirostrum* McLaren, D. J., 1961 (*C. pedderi* McLaren, D. J., 1961, Territoires du Nord-Ouest, Canada, « basal Hare Indian formation », Givetien Inférieur).

Les genres mississippiens qui proviennent de régions éloignées les unes des autres ainsi que les genres givetiens sont monospécifiques, ce qui réduit une comparaison des genres à une comparaison d'espèces de bassins de sédimentation distincts et ne permet pas d'évaluer la variabilité de certains caractères au niveau générique.

Le sous-genre russe *Hemiplethorhynchus* est le noeud d'un problème de taxionomie et de nomenclature (Sartenaer, 1961, p. 3). Il n'existe aucune description complète, détaillée et critique des caractéristiques internes de *Hemiplethorhynchus fallax* von Peetz, H., 1898. L'auteur original y a observé un septalium dorsal recouvert dans sa partie antérieure et un spondylium ventral; une vue dorsale, une vue latérale et deux dessins des structures internes de la valve brachiale ont été donnés. Tolmatchev (1924, pp. 134-5) signale que la mention d'un spondylium n'est apparemment qu'un *lapsus calami* de la part de von Peetz et n'attache aucune importance à la présence d'une couverture du septalium. Cette couverture a été observée directement par von Peetz dans des spécimens silicifiés, traités à l'acide chlorhydrique. Les caractères internes connus, comme les informations qui peuvent être déduites des figures publiées (par ex.: Tolmatchev, 1931, pl. 6, fig. 15-20; Rjonsnitzkaia, 1960, pl. XLIII, fig. 16 a-b; Sokolskaia *in* Sarytcheva, Sokolskaia, Beznosova, Maksimova, 1963, pl. XL, fig. 17-21, fig. 106 *in textu*, p. 247) nous font estimer que le sous-genre pourrait être promu au niveau du genre.

Il n'est pas impossible que des études ultérieures prouvent que le genre *Greenockia* tombe dans la synonymie du genre *Hemiplethorhynchus*; aucune différence essentielle ne les sépare. Le genre *Cyphoterorhynchus*, proche par des nombreux traits, se distingue des deux genres précités par les caractères suivants: enflure prononcée; variabilité plus nette des dimensions; taille plus grande; champ musculaire ventral plus long et plus large; courbure usuelle du sommet de la languette; bec ventral légèrement à fortement incurvé, touchant parfois la partie umbonale dorsale; septum median dorsal un peu plus long; plaques dentales à surfaces internes non systématiquement concaves.

Cupularostrum recticostatum diffère de l'espèce pakistanaise par les caractères ci-dessous énumérés: sinus et bourrelet débutant, dans la majorité des spécimens, plus près du crochet et avec une largeur moindre; languette souvent plus élevée et jamais mi-elliptique; flancs usuellement cornés à proximité des commissures antéro-latérales; formule générale des plis très différente tant par le nombre des plis que par leur distribution; plis pariétaux absents dans plus de la moitié des cas; plis pariétaux incisant les bords de la languette; plis anguleux et plus élevés; taille plus petite; cavités umbonales proportionnellement plus grandes; plaques dentales plus courtes, devenant plus vite sub-parallèles ou convergentes antérieurement; dents et cavités glénoïdes moins larges et non ou grossièrement denticulées; denticula moins nettement découpés; septum plus long et supportant plus complètement le septalium; septalium moins profond et aussi large (ou plus) que profond; le plateau cardinal se prolonge moins vers l'avant de sorte qu'il reste en retrait par rapport à la couverture du septalium; crura plus élevés; champ musculaire ventral plus étroit et de relief plus accusé. Les caractères non cités sont similaires ou identiques. Par suite de cette mise en parallèle, nous estimons les différences observées comme suffisamment notables que pour écarter le genre *Cupularostrum*. Sous la description du genre *Cupularostrum*, nous avons (1961, p. 4) donné les différences entre ce genre et le genre *Cassidirostrum* McLaren, D. J., 1961 du Givetien Inférieur. Les caractéristiques internes de ce dernier genre l'éloignent de ceux considérés dans ce travail.

Contrairement à ce qu'affirme Brown (1952, p. 91), le septalium de l'espèce-type de *Moorefieldella* est recouvert dans sa partie antérieure. *M. eurekensis* se distingue aisément de l'espèce pakistanaise par: une interarea ventrale plus élevée et notablement plus longue; une languette jamais tangente à un plan vertical dans sa partie supérieure; une valve brachiale jamais enflée; des plis plus nombreux et plus bas; une taille usuellement plus petite; une hauteur proportionnellement plus petite; un test plus mince dans la région apicale; des cavités umbonales proportionnellement plus grandes; des plaques dentales plus frêles, plus courtes encore, restant sub-parallèles antérieurement; une variabilité plus grande dans la forme du septalium, des crura et du plateau cardinal et dans l'élévation des crêtes internes des cavités glénoïdes.

D'après la littérature ancienne, basée sur l'ensemble de la faune, et d'après l'étude, dans le présent volume, de groupes auxquels on incline à attribuer une valeur systématique et stratigraphique plus certaine, l'âge des couches contenant l'espèce ici décrite est frasnien.

Nous plaçons dans notre nouveau genre l'espèce *Camarotoechia puteana*

Veevers, J. J., 1959 décrite dans la « *Gneudna formation* » (Frasnien) du Bassin de Carnavon, Australie de l'Ouest. *Camarotoechia puteana* possède en commun avec l'espèce fondée par Reed les nombreux caractères suivants: convexité des valves; sinus et bourrelet débutant à une certaine distance du bec avec une largeur appréciable; faible profondeur du sinus; largeur du sinus au front; forme de la languette; allure de l'interarea ventrale; formule générale des plis similaire (sauf le nombre de plis latéraux); nature des plis (simples, réguliers, bien marqués, peu élévés); plis pariétaux s'effaçant avant d'atteindre les bords de la languette; aspect boulot; position assez élévée des commissures latérales et antéro-latérales; rapports des dimensions; valeur de l'angle d'épaule; situation du sommet de la coquille; épaisseur du test dans la région apicale; robustesse, longueur des plaques dentales; nature des dents, des cavités glénoïdes, de la couverture du septalium; élévation des crêtes intérieures des cavités glénoïdes; relief et forme des champs musculaires dorsal et ventral. Voici toutefois des caractéristiques par lesquelles *C. puteana* se distingue: sinus et bourrelet débutant généralement moins loin du bec; bec plus incurvé; flancs dorsaux plus raides à proximité des commissures latérales et antéro-latérales; plis anguleux à sommets arrondis plutôt que plis arrondis; taille usuellement plus grande; contour souvent longitudinalement ovalique en vue dorsale; septum plus long. Quelle importance donner à ces différences? Nous ne pensons pas qu'elles soient autres que spécifiques, quoique nous devrions pouvoir étudier des spécimens en plus grand nombre pour évaluer la variabilité encore insuffisamment établie de divers caractères et donc pour établir un bilan de comparaison plus certain.

M. S. Abramian a décrit (1957, pp. 55-58) la variété *Camarotoechia radiata arpaensis* Abramian, M. S., 1957. Il nous semble que cette variété mérite le rang d'espèce et qu'elle entre dans notre nouveau genre. Nous sommes toutefois très surpris qu'il s'agisse d'une forme famennienne et espérons que cette donnée stratigraphique sera corrigée ou précisée dans l'avenir. D'autre part, malgré le peu d'informations dont nous disposons sur les structures internes, nous pouvons affirmer que la forme arménienne est spécifiquement et génériquement différente de la forme arctique: *Camarotoechia radiata* Nalivkin, D. V., 1960.

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Manuscript revised 9 march 1964

LES SPIRIFERIDAE DE SHOGRAN ET KURAGH (CHITRAL)

par

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Introduction

La détermination de fossiles provenant de contrées lointaines constitue toujours un délicat problème pour le paléontologue. N'étant pas familiarisé ni avec les formes qu'il doit identifier ni avec les strates qui les contiennent, il risque de commettre des erreurs. La multiplicité des espèces décrites dont la distinction s'avère souvent délicate, la conservation des spécimens qui, excellente en apparence mais insuffisante dans la plupart des cas, ne répond pas aux exigences actuelles et enfin l'interprétation stratigraphique des faunes, sont autant d'écueils auxquels est exposé le déterminateur.

Le nombre des genres et des espèces croissant continuellement dans tous les groupes, il devient indispensable de confier l'étude des matériaux à des paléontologues spécialisés si on veut augmenter les chances d'exactitude dans les déterminations.

Les Rhynchonelles ont été étudiées par mon collègue P. Sartenaer.

Les Brachiopodes autres que les *Spiriferidae* ont été déterminés d'après le travail de C. Reed (Palaeont. Indica, N. S., VI, 2, 1922) et avec toutes les réserves qui s'imposent.

Parmi les *Spiriferidae* une seule espèce fait l'objet d'une étude approfondie, les deux autres étant insuffisamment représentées.

Origine des materiaux

D'après les étiquettes les matériaux proviennent de deux localités: Shogran (= Shugram de C. Reed) – comprenant les points 55 PD – 59, 70 et 71. Kuragh (=Koragh de C. Reed) – comprenant les points 55 PD – 76, 77 et 78.

Les différents points de récolte ont fourni les faunes suivantes:

55 PD – 59 – M. Shogran – Série Liv. 14 – 19-8-55.
Spirifer sp. indéterminable
restes indéterminables

55 PD – 70 – M. Shogran – Série Liv. 14 – 19-8-55.
Bryozoaires
Crinoïdes
Douvillina dutertrei var. *asiatica* C. Reed
Cyrtospirifer pamiricus (C. Reed)
Athyris chitralensis C. Reed
Athyris chitralensis var. *gentilis* C. Reed
Gastéropode
Phacops sp.

55 PD – 71 – M. Shogran Vers. Sud – 19-8-55.
Productella fallax var. *chitralensis* C. Reed
Cyrtospirifer pamiricus (C. Reed)
Cyrtospirifer mastujensis (C. Reed)
Athyris gurdoni C. Reed.
Atrypa spinosa var. *chitralensis* C. Reed

55 PD – 76 – Kuragh – Liv. inf. Devonico Loc. Hayden – 22-8-55.
Craniella obsoleta (A. Goldfuss)
Cyrtospirifer cf. *verneuili* (R. I. Murchison)

55 PD – 77 – Kuragh – Devonico Loc. Hayden – 22-8-55.
Polypiers
Bryozoaires
Douvillina dutertrei var. *asiatica* C. Reed
Athyris acuminata F. Drevermann
Athyris chitralensis C. Reed
Athyris chitralensis var. *pseudoglobularis* C. Reed
Athyris chitralensis var. *gentilis* C. Reed
Athyris gurdoni C. Reed
Spirifer indéterminable

Cyrtospirifer pamiricus (C. Reed)
? *Aviculopecten ingriae* E. Verneuil
Gastéropodes
Orthoceras sp.
Phacops sp.

55 PD - 78 - Kuragh - Devonico Loc. Hayden Liv. sup. - 22-8-55.
Polypiers
Athyris chitralensis? var *gentilis* C. Reed
Cyrtospirifer pamiricus (C. Reed)

C. Reed a discuté (1922, p. 130 et 131) la valeur stratigraphique des faunes et déclare que les niveaux de Shogran et Kuragh son d'âge frasnien, mais ainsi que nous le verrons plus loin ils pourraient être famenniens.

Description des spiriferidae

Cyrtospirifer pamiricus (C. Reed, 1922)

Pl. 6, Fig. 1-21; Pl. 7, Fig. 1-18

1922 *Spirifer pamiricus* C. Reed. *Chitral and Pamirs*, p. 109, pl. 16, fig. 1-6.
1922 *Spirifer pamiricus* var. *parilis* C. Reed. *Ibidem*, p. 110, pl. 16, fig. 7-13.
1922 *Spirifer murchisonianus* C. Reed. *Ibidem*, p. 57, pl. 10, fig. 3-13; pl. 11, fig. 1-11.
1922 *Spirifer Verneuili* var. *Archiaci* C. Reed. *Ibidem*, p. 63, pl. 11, fig. 14.
1947 *Cyrtospirifer pamiricus* D. Nalivkin. *Devonian system*, pl. 29, fig. 1-2.
1957 *Cyrtospirifer pamiricus* M. S. Abramian. *Armenia*, p. 81, pl. 12, fig. 3; pl. 13, fig. 1.

Diagnose — Coquille atteignant une taille moyenne, de contour très variable, aliforme ou subquadratique. Aréa ventrale élevée et courbée, apsacline, crochet pointu et courbé, quelquefois en surplomb sur l'aréa. Deltidium constitué par des lamelles deltidiales. Sinus ventral costulé large, peu profond, de section arrondie, nettement limité. Bourrelet dorsal arrondi, large et peu élevé, nettement limité. Côtes radiaires simples au nombre de 20 à 25 par flanc, élevées, de section arrondie, séparées par des espaces intercostaux larges et profonds. Microsculpture consistant en microépines disposées irrégulièrement en quinconce sur les côtes radiaires. Plaque delthyriale forte. Lamelles dentaires subsinales courtes, épaisses et divergentes. Myoglyphe ventral peu apparent non excavé.

Description

L'espèce est représentée par plus de 200 spécimens dont beaucoup sont déformés ou fragmentaires. La plupart sont presque entièrement décortiqués.

1. *Valves* — L'espèce présente le dimorphisme classique à savoir une forme large, ailée mégathyride, à aréa ventrale élevée et un peu courbée (Forme I) et une autre équi-ou brachythyride gibbeuse à aréa ventrale élevée mais sensiblement plus courbée, à crochet en surplomb dans les stades gérontiques (Forme II). La Forme I tend à devenir plus gibbeuse mais conserve cependant ses mucronations. Celles-ci étaient peut-être beaucoup plus développées, mais elles ont été détruites à cause de leur grande fragilité.

Le contour est donc très variable et d'aliforme dans la Forme I il devient subquadratique dans la Forme II.

La valve ventrale est toujours plus profonde que la dorsale.

Le test est composé des trois couches classiques. Le callotest apical central et latéral ainsi que le prismotest sont visibles dans les lamelles dentaires. Le fibrotest a généralement disparu dans la région du crochet.

2. *Aréa* — L'aréa ventrale est élevée dans les deux Formes, plus courbée avec crochet en surplomb dans les stades gérontiques de la Forme II. Le crochet est droit et pointu dans les stades jeunes de la Forme I. Les bords marginaux sont souvent sigmoïdes, ce qui implique une croissance rapide de la hauteur de l'aréa dans le jeune âge, suivie d'un ralentissement par rapport à la largeur cardinale. Une estimation de Ha/lc (hauteur de l'aréa mesurée en courbe sur la largeur cardinale, compte non tenu des mucronations brisées) donne une valeur approximative de 1/3.

L'aréa dorsale très petite n'a pas été observée.

3. *Deltidium* — Cet organe est représenté par des lamelles deltidiales. La rainure deltidiale est large mais peu profonde. Le bourrelet deltidial est mince et de section subcirculaire. La rainure hypodeltidiale est large et peu profonde. L'épaississement de raccord au plateau cardinal est presque inexistant.

4. *Sinus* — Le sinus ventral est large, peu profond et commence très près du crochet. Sa section est généralement arrondie, il a cependant quelquefois tendance à devenir anguleux. Il est nettement limité par deux côtes bordières à peine plus grosses que leurs voisines. Il traverse le myoglyphe qu'il creuse de son sillon. Le bourrelet dorsal est large et peu élevé, de section arrondie et nettement limité par deux sillons bordiers un peu plus larges que les

côtes radiaires voisines. La languette sinale est peu élevée et de forme subcirculaire, quelquefois semi-elliptique. Tous ces caractères varient beaucoup suivant les individus.

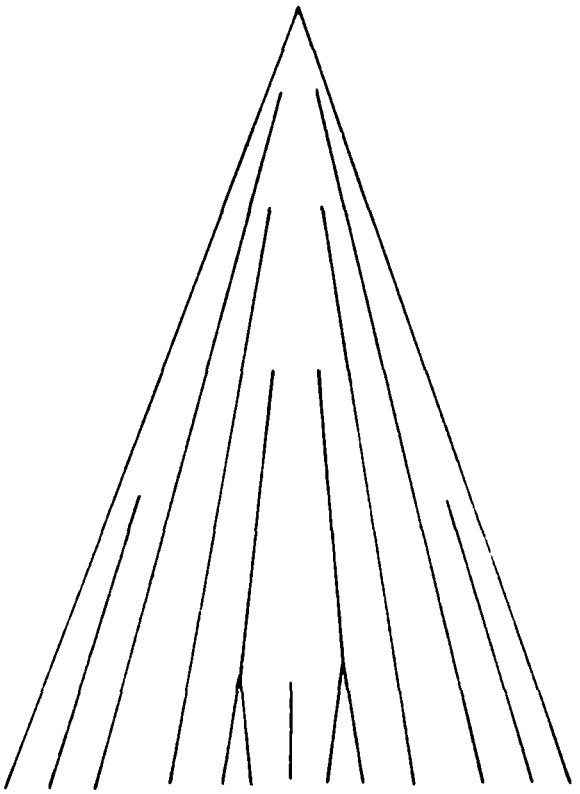

Fig. 1. - *Cyrtospirifer pamiricus* (C. Reed).
Formule sinale.

5. *Macrosculpture* — a) Sur les flancs. Les flancs sont garnis de côtes radiaires relativement fines puisqu'on en compte de 20 à 25 par flanc. Elles sont de section subcirculaire, paraissent quelquefois à sommet aplati (mais ceci peut être dû à la décortication) et séparées par des espaces intercostaux larges et profonds (environ la valeur d'une côte). On remarque la présence de fins chevrons principalement dans la région de la commissure où ils sont serrés les uns contre les autres. Ils ne sont que rarement visibles plus haut.

b) Dans le sinus. Peu de spécimens se prètent à l'établissement de la formule sinale à cause de la mauvaise conservation du crochet. La formule donnée ici a été établie et vérifiée sur plusieurs individus. Il semble donc qu'elle soit proche de la vérité. Il y a d'abord apparition de deux côtes latérales suivie de deux autres internes, puis de deux externes, puis de deux internes qui se dichotomisent. Enfin apparaît une côte médiane.

c) Sur le bourrelet. Aucune formule n'a pu être établie avec certitude.

6. *Microsculpture* — a) Sur les valves. La microsculpture est fort mal conservée. Les côtes sont couvertes de bases d'épines très petites, disposées irrégulièrement en quinconce. Pas de traces de microcostules pseudoradiaires qu'il ne faut pas confondre avec les fibres du test qui apparaissent après décortication partielle. Il est possible que les espaces intercostaux étaient également garnis de bases d'épines.

b) Sur l'aréa. L'aréa ventrale ne montre guère de microcostules longitudinales de croissance. Les microcostules transversales sont mal marquées et le détail de leur arrangement est difficilement observable. Elles paraissent se réunir par deux ou trois pour former une costule plus grosse. Leur jonction est très irrégulière. Les espaces marginaux généralement unicostulés sont ici pratiquement lisses et particulièrement larges.

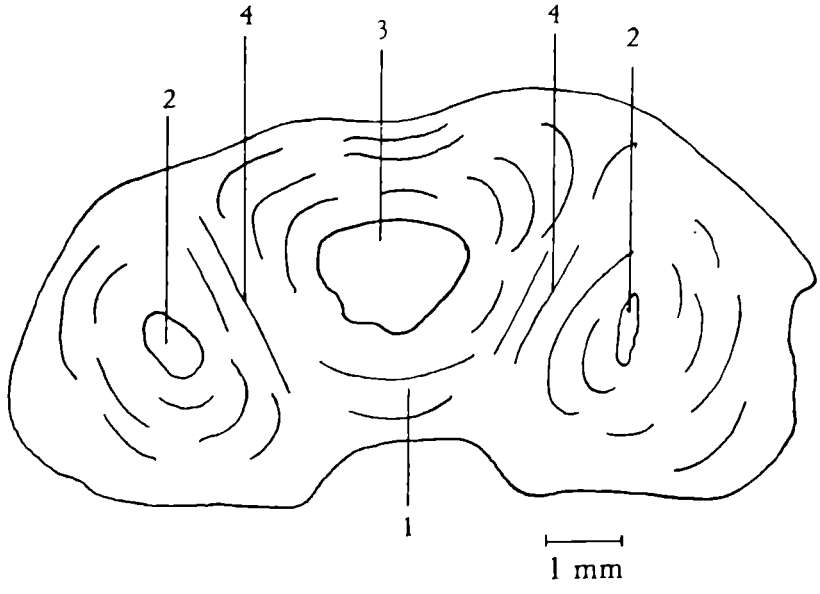

Fig. 2. - *Cyrtospirifer pamiricus* (C. Reed).
Section polie perpendiculaire au plan de symétrie bilatérale dans la région du crochet d'une valve ventrale (n. 1765). 1: plaque delthyriale; 2: cavité apicale latérale; 3: cavité post-delthyriale; 4: prismotest.

MORPHOLOGIE INTERNE

1. *Plaque delthyriale* — La plaque delthyriale est nette et généralement plan-concave, avec une cavité post-delthyriale qui se colmate très rapidement surtout dans la Forme II. Elle est plutôt courte mais profondément située dans le delthyrium.

2. *Lamelles dentaires* — Les lamelles dentaires sont plutôt courtes,

épaisses dans la région voisine du crochet et subsinales tellement elles sont proches et parallèles aux bords du sinus. Leur longueur estimée est d'environ 1/3 de la longueur de la valve ventrale. Elles restent un peu divergentes même dans les Formes II, font entre-elles un angle d'environ 45° et n'enserrent pas le myoglyphe.

3. *Apophyses articulaires* — Dans un spécimen qui a été préparé spécialement (Forme I) on voit une apophyse articulaire allongée avec un épaississement de raccord au plateu cardinal pratiquement inexistant. Elle est engagée dans une cavité glénoïde ouverte à sa base. Les cavités glénoïdes n'ont pu être observées sauf en coupe et sur un seul individu.

4. *Brachiophores* — Non observables.

5. *Myoglyphes* — a) Ventral. Par suite de la décortication du test, le myoglyphe ventral apparaît souvent entre les lamelles dentaires. Son contour est piriforme et il n'est pas excavé; il entre presque entièrement dans le sillon

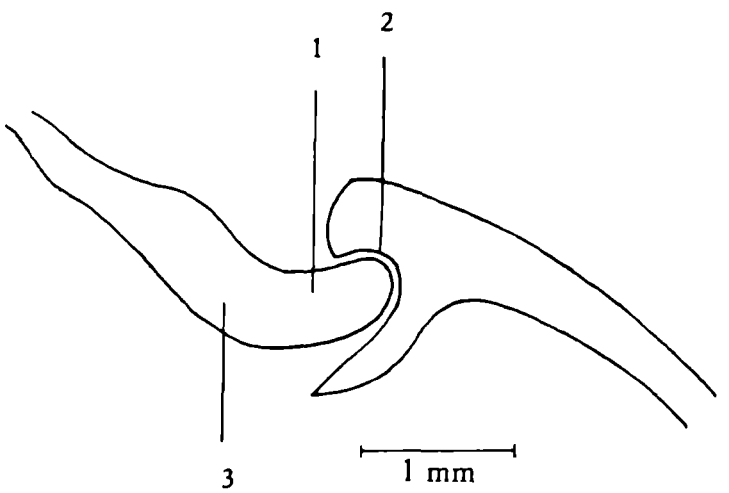

Fig. 3. - *Cyrtospirifer pamiricus* (C. Reed).
Section polie parallèle au plan de symétrie bilatérale dans la région de l'articulation (n. 1766). 1: apophyse articulaire; 2: cavité glénoïde; 3: épaississement de raccord au plateau cardinal, ici très réduit.

du sinus. On y reconnaît notamment les grosses côtes du pédonculaire ventral et le chevelu des diducteurs principaux, le centre est parcouru par les côtes médianes des adducteurs. La conservation est insuffisante et ne permet pas une analyse de détail.

b) Dorsal. Le myoglyphe dorsal n'est guère discernable si ce n'est par un myophragme peu élevé médian et les quatre lobes des adducteurs à peine marqués.

c) Notothyrial. Le processus cardinal est bifide et constitué par deux massifs callotestaires qui se soudent après une courbe sigmoïde en surplomb dans le notothyrium.

d) Brachiophorien. Non observable.

6. *Empreintes génitales* — Aucune visible.

7. *Empreintes vasculaires* — Les côtes radiaires laissent souvent leur empreinte dans le moule interne, mais le fait n'est pas constant et certains individus ont des moules internes lisses dans lesquels on remarque des traces de tubercules (empreintes génitales ?) et de costules sinueuses comparables à des empreintes vasculaires.

8. *Appareil brachial* — Non observable.

Rapports et différences

L'espèce a, par sa variabilité intraspécifique, de multiples affinités avec les espèces voisines recueillies en même temps. Elle paraît différer cependant de *Cyrtospirifer mastujensis* (C. Reed) par l'aspect plus trapu, plus gibbeux, par la formule sinale et sa microsculpture moins accentuée (ou moins bien conservée ?). Elle diffère de *Cyrtospirifer* cf. *verneuili* (R. I. Murchison) par sa taille un peu inférieure, sa forme carrée gibbeuse et une hauteur moindre de son aréa.

La variété *parilis* créée par C. Reed est en réalité la Forme I ailée du *pamiricus*, avec des prolongements cardinaux (mucrorations brisées ?) et un sinus mieux marqué que dans la Forme II.

La variabilité de *Cyrtospirifer pamiricus* est très étendue et si on ne dispose pas d'un grand nombre de représentants on est tenté d'assimiler certains individus, au moins par leur aspect général, à des espèces frasniennes. C'est le cas, vraisemblablement pour *Spirifer orbelianus*, *Spirifer anossofi* signalés par C. Reed (1922, p. 55 et p. 61) et qui ne sont représentés chacun que par un seul individu.

Répartition stratigraphique

Cyrtospirifer pamiricus a été découvert dans les gisements de Shogran 55 PD – 70, 71, Kuragh 54 PD – 77, 78 et a été considéré par C. Reed comme d'âge dévonien supérieur et vraisemblablement frasnien. Une comparaison avec les *Cyrtospirifer* d'Europe occidentale semble confirmer cette assertion bien que la microsculpture pustuleuse rappelle plutôt celle de certains spirifères famenniens de Belgique (non encore étudiés).

D. Nalivkin (1947, pl. 29, fig. 2) a reproduit la fig. 8 de C. Reed (1922, pl. 16) et une autre forme beaucoup plus ailée provenant de la même localité. L'auteur place l'espèce dans le Famennien et lui donne une valeur stratigraphique.

En 1959 M. S. Abramian (p. 81 et tableau p. 15) précise la position du *pamiricus* dans le Famennien supérieur et lui donne une valeur de fossile de niveau, au moins en Arménie.

Cyrtospirifer mastujensis (C. Reed, 1922)

Pl. 7, Fig. 19-21

1922 *Cyrtospirifer Verneuili* var. *mastujensis* C. Reed. *Chitral and Pamirs*, p. 63, pl. 12, fig. 6-10.

Diagnose et description — Voir C. Reed, 1922, p. 63.

Remarque — On peut rapporter à l'espèce quatre spécimens reconnaissables principalement à leur contour aliforme, un sinus profond, une formule sinale différente de celle de *pamiricus* et une microsculpture identique à celle figurée par C. Reed (1922, pl. 12, fig. 7 et 8).

Cyrtospirifer mastujensis a été considéré par son auteur comme une variété du *verneuili* et a été trouvé à Shogran 55 PD - 71.

Cyrtospirifer cf. **verneuili** (R. I. Murchison, 1840)

Pl. 7, fig. 22

Remarque — Cette espèce paraît représentée par trois blocs contenant quelques valves ventrales bombées à aréa élevée et quelques valves dorsales. Toutes sont décortiquées et réduites à des moules internes de sorte que l'ornementation a disparu. Un essai de dégagement dans le but d'y découvrir la microsculpture serait vraisemblablement fatal pour les individus. La forme générale rappelle celle du *verneuili* mais l'attribution reste cependant douteuse.

Les spécimens proviennent de Kuragh 55 PD - 76.

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Manuscript revised February 1964

PERMIAN FOSSILS

A NEW PERMIAN EPIMASTOPORA (CALCAREOUS ALGA) FROM HUNZA VALLEY (WESTERN KARAKORUM)

by

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INTRODUCTION (1)

While examining samples coming from a section made in the Permian of Hunza valley (right side of Chapursan river: on the way Khudabad-Raminj) during Prof. A. Desio's expedition, I recognized the presence of an algal form belonging to genus *Epimastopora*, unknown until now in this region. The specimens we examined have been taken from the samples of Gircha Formation with a thickness of 6000 m, whose upper part is formed by brown and black arenaceous layers with small interpositions of dolomitic limestone, while lower part is formed by light – coloured quartz – sandstones. Our specimens are coming from the calcareous layers in between the inferior and superior member of the formation.

Epimastopora forms are rather frequent and their presence has been noted by several authors in Upper Paleozoic of Asia, America and Europe. It has to be remembered, by the way, that the nearest geographic finding is given by the species *Epimastopora alpina* Herak, coming from the Darvasian of Darvas (central Tajikistan — NW Pamir). This species, in opposition to the one I have examined, has been found in association with some other species of calcareous Algae.

(1) I am herein thanking Prof. M. B. Cita who encouraged me in this work, and Dr. K. B. Korde for the valuable information she gave me.

Notwithstanding the fact that it has frequently been noted, genus *Epimastopora* is still not very well known as we are not in possession of sure data to recognize it exactly.

From stratigraphical point of wiew it has a great importance, having a limited vertical distribution: its oldest forms appear in Upper Carboniferous and most recent ones are not going over Permian; each species occurs even shortest intervals (see table 1). For what concerns ecology, *Epimastopora* testifies warm marine environment such as a littoral sea.

Genus **Epimastopora** Pia 1922

Discussion — Authors now all agree in admitting the vegetal nature of this fossil and in its location in the family of *Dasycladaceae*. Discussions are rising with regard to the generic name, as forms very similar among them have been differently named.

Pia (1922) has in fact called with name *Epimastopora* some specimens which Gortani (1906) had illustrated as *Gyroporella*? and coming from Carnic Alps, while Lee (1912), on his behalf, has named *Koninckopora* specimens of the same type studied by de Koninck (1842) who gave them the name of *Calamopora inflata*. Times afterwards the supposition has been made of the identity of the two genus mentioned before (Johnson 1946, Herak 1960); these authors anyhow preferred to defer temporarily any solution awaiting for the finding of better and more significant specimens. Wood (1942) and Maslov (1956) have instead resolutely rejected genus *Epimastopora* and, even maintaining the specific names, have referred all species described under this name to genus *Koninckopora*.

To give a better idea on the debated question I think it rather suitable to report briefly the descriptions of the two genus in the reports respectively corrected by Wood (1942) for what concerns genus *Koninckopora*, and by Pia himself (1937) for what concerns genus *Epimastopora*. I am beside enclosing two recapitulatory outlines giving the species known up to now and referred to one or the other of the two mentioned genus.

a)	Class	*Chlorophyceae*
	Fam.	*Dasycladaceae*
	Tribe	*Cyclocrinae*
	Subtribe	*Mastoporinae*
	Genus	*Epimastopora* Pia 1922

The fragments are straight, sometimes bended, rarely in the form of an « S ». These fragments are crossed by numerous pores generally of large dimension, either round or irregularly poligonal. The species can be distinguished on the ground of wideness and form of pores.

TABLE I

Species	Thickness	Diameter of pores	Interval between pores	Age and occurrence
	mm	mm	mm	
E. kansasensis Johnson 1946	?	0,04-0,05 min. 0,07-0,11 max.	0,04	Pennsylv.-Permian USA
E. jewetti Johnson 1946	?	0,11-0,14	0,05-0,10	Pennsylv.-Permian USA
E. regularis Johnson 1946	?	0,07-0,09	0,029-0,033	Pennsylv.-Permian USA
E. sp. A-B-C Johnson 1946	?	0,059-0,08 (C)	?	Pennsylv.-Permian USA
E. japonica Endô 1951 [1]	0,23-0,31	0,15 (1951) 0,095 (1960)	0,26 ? (1951) 0,027-0,041 (1960)	Lower Permian Japan
E. piai Korde 1951	0,23	0,084	0,021	Upper Carboniferous: Ural Mountains. Lower Permian: Carnia
E. yoshimurai Konishi 1953	0,35-0,55	0,015-0,060	0,015-0,050	Permian Siam
E. iwaizakiensis Endô 1953	?	0,06-0,10	0,13-0,20	Upper Permian Japan
E. sp. Endô 1953	?	0,05	0,26	Lower Permian Japan

[1] Afterwards (1960) new genus *Pseudoepimastopora* was established by Endô who referred to it even the species *E. japonica*. I think there are not determinant elements for this attribution and therefore prefer to maintain the first denomination.

(to be followed) TABLE I

Species	Thickness	Diameter of pores	Interval between pores	Age and occurrence
	mm	mm	mm	
E. kanumai Endô 1954	?	0,09-0,19 (Hida Massif) 0,08-0,16 (Hokkaido)	0,027-0,08 (Hida Massif) 0,041-0,135 (Hokkaido)	Upper Carboniferous Japan
E. kosakiensis Konishi 1954	0,3-0,5	0,081-0,190	0,14-0,25	Permian Japan
E. sp. Konishi 1954	?	0,065-0,16	0,11-0,14	Upper Permian Japan
E. minima Elliott 1956	0,182	0,065	0,25	Upper Permian Iraq
E. longituba Endô 1957	(0,54-1,08)?	0,054-0,081	?	Permian Japan
E. hinomatensis Horiguchi 1958	?	0,09-0,16	0,09-0,19	Lower Permian Japan
E. sp. Rezak 1959	0,156-0,175	0,034-0,052	?	Permian Arabia
E. alpina Herak 1960 (1)	0,32-0,38	0,07-0,19 max.	0,018-0,09	Middle Permian Yugoslavia
E. likana Herak 1960	0,20-0,30	0,04-0,10	variable	Carb.-Permian: Carnia. Lower Permian: Croatia
E. sp. Herak 1960	0,25-0,40	0,10-0,20	?	Upper Carboniferous: Croatia (Yugoslavia)
E. sp. Herak 1963	?	?	?	Upper Paleozoic Northern Hungary

b) Class *Chlorophyceae*
Fam. *Dasycladaceae*
Subfam. *Cyclocrinae*
Genus *Koninckopora* Lee 1912

(1) This species will probably be put in synonymy with *Epimastopora piai* Koide 1951, as both of them refer to the specimens of Carnia studied by Pia (1937).

Wood is giving the following description:

« A dasycladacean, with the terminal branches polygonal in form, closely pressed together, and forming a continuous external layer. Radial walls of terminal branches coated with a delicate deposit of calcareous matter. Terminal branches extremely numerous; probably the primary branches divided several times. Thallus elongate, circular in cross section, widening very gradually; annulation and fissuration unknown. Terminal branches usually constricted about their middle length in a somewhat irregular manner and narrowing towards the exterior ».

TABLE II

Species	Thickness of the calcareous wall	Diameter of pores	Interval between pores	Age and occurrence
	mm	mm		
K. inflata de Koninck 1842	?	0,18-0,20	4-7 μ	Carboniferous Belgium
K. tenuiramosa Wood 1942	0,5	0,12-0,14	7-8 μ at centre 20-30 μ on sides	Carboniferous Ireland
K. macropora Maslov 1956	0,200	0,10	?	Carboniferous ? URSS
K. micropora Maslov 1956	0,06-0,10	0,05-0,06	?	Middle Carboniferous URSS

The specimens coming from Hunza valley, although presenting some variations in respect of the species described up to now, do not add any new significant element for the solution of the still opened discussion on the denomination and nature of this fossil.

I could anyhow note a greatest number of affinities with the specimens described as *Epimastopora*, than with the ones Wood refers to genus *Koninckopora*, as there is not any circular cross section that can make you think to a cilindric or claviform thallus.

Waiting that authors studying this problem will come to a solution, I shall herein only describe the new form under the name *Epimastopora* and underline the characters for which it is differing from the species already known.

Epimastopora hunzaensis sp. n.

Pl. 8, 9

Description — The examined specimens consist of thallus fragments either in longitudinal or cross section. In longitudinal section we can see some very small straight or slightly bended fragments, having at most a length of 2,2 mm and a thickness of 0,16-0,45 mm; they consist in a single series of small tubes almost constant in diameter, as high as the thickness of the calcareous wall, generally parallel among them, perpendicular or slightly oblique in respect of external wall and disposed normally to the lengthening of the thallus. In a specimen only, the small tubes seem to have conical form being each of them upside down in respect of the precedent one.

We can occasionally find, when the section becomes slightly oblique, a disposition on two alternate series; in this case the small branches are not as long as the calcareous little fragment, but short and stocky.

Generally the disposition in series of the small tubes is regular enough; the interval is not always constant but its sizes are, as a rule, rather low (17-30 μ); we can observe different sizes when recrystallization is occurring.

Particular interest is given by a section presenting one of the small tubes dichotomycally bifurcated; for the rest this specimen is very similar to the other ones. Being this the only case, although rather a good number were the studied specimens, I think the fact has a sporadic significance.

In cross sections we can observe some small little masses prevalently formed by dark pores very near one another, circular or slightly elliptical in section, separated from thin white calcite walls. These pores generally have uniform dimensions (33-71 μ) and are roughly disposed in alternate way; the reticulate deriving from this disposition has altogether irregular look. Interpores have slightly variable sizes according to different directions. Oblique sections are formed by a thin and very irregular lozenge reticulate and pores occupying the webs have a lengthened and fusiform look with often sinuous contour line.

Dimensions — We are here relating a table with dimensions and most characteristic elements of each examined specimen (p. 91).

Remarks — It is interesting to underline the fact that longitudinal sections always appear as isolated and never coupled small little fragments; it is therefore impossible to see the form of a hollow cilinder, neither mesure its external and internal diameters. This observation would give credit to Maslov hypothesis (1956); this author is considering thallus as a flattened small bladder formed by alternate cells.

TABLE III

N. Slide	Dimensions of Alga l × h	Diameter of pores (1)	Interval between pores	Form of pores	Disposition of pores
PM 44/1 long.	(2,2 × 0,20-0,27) mm	49-66 μ	65-85 μ	cilindric	oblique in respect of the wall
PM 44/6 long.	(1,5 × 0,16-0,26) mm	?	?	?	two alternate rows partly in monoseries
PM 44/7 ob.	(3 × 0,4-0,6) mm	48-51 μ	18-35 μ	irregular and lenghtened	irregular
PM 44/9 a long.	(1,5 × 0,25-0,45) mm	50-66 μ	(24-48) ?μ	cilindric and bifurcated	monoserial
PM 44/9 b long.	(1,35 × 0,3-0,4) mm	50-62 μ	17-33 μ	cilindric	monoserial, uniform and regular
PM 44/10 cross	(2 × 0,5) mm	50-66 μ	12-17 μ	circular or elliptical	alternate
PM 44/11 a cross-ob.	?	33-63 μ	20-35 μ	circular or elliptical	alternate
PM 44/11 b cross	(2,5 × 1,3) mm	40-42 μ	?	circular	alternate ?
PM 44/12 cross-ob.	(1,2 × 0,8) mm	46-71 μ	17-40 ? μ	circular or elliptical	in irregular alternation
PM 44/13 cross	(1,9 × 0,4) mm	50-70 μ	20-30 μ	circular	alternate
PM 44/16 long.	(2 × 0,19-0,29) mm	35-65 μ	?	cilindric or conical	monoserial
PM 46/4 long.	(2,1 × 0,21-0,28) mm	50 μ	18-28 μ	cilindric	monoserial
PM 46/9 cross	(1,7 × 1,2) mm	40-50 μ	19-29 μ	circular	irregular

(1) Some authors prefer to consider pores in cross sections and branches in longitudinal section.

Affinities and differences — The species in exam is characteristic enough and can be easily distinguished from other species described up to now, for the small dimensions of its pores and the cilindric form of the branches.

Other species most similar with the new one are:

Epimastopora yoshimurai Konishi 1953 (p. 106, pl. 11, fig. 16, 18 and 19 c) which can be easily distinguished having a thicker thallus, pores elliptical in their contour line, and branches forming a sort of a small bladder in the centre of the calcareous sheath and suddenly narrowing themselves towards the edges.

Epimastopora sp. Endô 1953 (p. 121, pl. XI, fig. 6), presenting an undulating thallus and the small tubes swollen in their centre.

Epimastopora minima Elliot 1956 (p. 327, pl. 1, fig. 1, 3), differing from our species for its undulating branches with variable diameter, at a good distance one another.

Epimastopora sp. Rezak 1959 (p. 536, pl. 72, fig. 7, 11), which can be distinguished for its thinner and largely bended thallus and its pores with smaller medium diameter.

Koninckopora micropora Maslov 1956 (p. 251, pl. 84, fig. 4), which has its branches in the form of a small barrel and the calcareous sheath much thinner and pores with a more uniform diameter.

I had lastly notice of *Epimastopora ferganica* Miklukho-Macklay found in the Karachiatirian of Fergana. Its geographical position rather near to our place and the same stratigraphical position could make us think of an identity of the two forms. But the overmentioned species is only named in a collection and no particular description has been made up to now; therefore it has to be considered as a « *nomen nudum* ».

Derivatio nominis — Specific name *hunzaensis* is an adjective derived from the name of the place where specimens have been collected (Hunza Valley).

Holotype — Specimen represented in pl. 8, fig. 6, sample PM 46/4, collected by Dr. E. Martina in date 14-8-1962 and deposited at the Micropaleontological Laboratory in the Institute of Paleontology — University of Milan — Coll. nº 1447.

Age — Limit between Karachiatirian-Darvasian (middle of Lower Permian).

Type-level — Gircha formation, limestone with Fusulinids of Lower Permian. It is found in association with *Bryozoa*, *Nankinella*, *Pseudofusulina*, *Globivalvulina*, fragments of Echinoids. 62 PM 46/4.

Type-locality — Chapursan valley (affluent of Hunza river — Pakistan).

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PERMIAN FORAMINIFERA FROM THE UPPER HUNZA VALLEY

by

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INTRODUCTION

The samples examined were collected in 1962 by E. Martina and R. Galimberti, in the upper basin of the Hunza River in the Western Karakorum (Pakistan), during the Geological Expedition led by prof. A. Desio.

Since these samples are limestone, the examination was made on thin sections; the microfacies are very rich in Foraminifera.

Very few works have been written on the Foraminifera from this region and, in particular, nobody studied the Foraminifera from the upper Hunza Valley before.

The most important paper dealing with the Foraminifera from Chitral is that of Reed (1925). This author studied the Fusulinid faunas collected by Hayden (1916) from the *Fusulina* limestone of Baroghil Ailak, Chitral. This locality is only about 150 kilometers far from the Hunza Valley.

Reed figured *Fusulina* (*Schellwienia*) *verneuili* var., *Fusulina* (*Schell.*) *verneuili* var. *yarkunensis* n. var., *Fusulina* (*Schell.*) *moelleri* var. *chitralensis* n. var., *Fusulina* (*Schell.*) cf. *kraffti*, *Fusulina* (*Schell.*) *uralica* var., *Valvulina* sp., *Endothyra* sp. This association is considered of Upper Carboniferous to Permian age, but we believe that it is younger than so.

Among those who have examined the Foraminifera from the Karakorum in general, Merla must be mentioned. In 1934 this author examined the fauna collected by the De Filippi Expedition, but he limited his contri-

bution to the study of Foraminifera, establishing a new variety only, *Schellwienia erucaria* (Schwager) *caracorumensis* n. v., probably of Upper Permian age. Even today nothing is known about the other microfossils of the Expedition mentioned.

A year later (1935), Silvestri illustrated a number of Fusulinids found in some samples collected during the 1929 Italian Geographic Expedition to the Karakorum Range.

In 1938 a noteworthy contribution by M. Reichel was issued on the Fusulinid faunas from the Shaksgam Valley, where it was possible to identify 3 Fusulinid horizons: the lowest one of Upper Uralian age and the other two respectively of Lower and Upper Artinskian age. According to the author, these faunas could be compared with those from Darvas and Salt Range, described by Schwager (1887) and Dunbar (1933).

Dunbar (1940) described two new species of *Parafusulina* from the Upper Permian calcareous sandstones in the same locality.

The fossils collected in 1951 by the Expedition in the Gilgit region studied and illustrated by Dickins in 1956, come from a region much closer to that in which the samples studied were collected. However, this author only mentions the presence of *Fusulina* gen. and sp. at Kaibor Village, near the Hunza Valley, without mentioning of which genera and species the fauna consists.

In 1955, Desio and Cita mentioned a Permian fauna with *Neoschwagerina craticulifera*, contained in a sample which is part of the right moving moraine of the High Baltoro glacier (Karakorum).

Many works deal with the finding of foraminiferal associations in the neighbouring regions. Hayden in 1909 reported a study on Afghanistan Fusulinids. The *Fusulina* Limestone is referred by the author to the Upper Carboniferous, but we think that it is probably of Permian age, and may be Artinskian; this interpretation is chiefly based on the evolution stage of the fauna.

Also Furon's work of 1927 deals with Afghanistan Fusulines. Rich Fusulinid faunas were found in the Bamian Limestone in many localities of North Afghanistan. Thompson (1946) after having examined the same formation, established some new genera and species.

Some microfacies of Afghanistan Paleozoic were illustrated by F. Villa in 1961; these come from the Northern side of the Hindu Kush Range.

The Fusulinids illustrated by F. and G. Kahler (1940) come from Tienshan. The authors think this fauna to be coeval with that of the Upper *Schwagerina* Horizon of the Carnic Alps.

The most detailed works from the stratigraphical as well as micropaleontological point of view concern the regions North of Pakistan, that is Fergana, Darvas and chiefly the Pamir regions. These works were written by geologists and micropaleontologists from the USSR, from 1936 onwards. Among the most important ones, mention must be made of those by Miklukho-Maclay, who gave a detailed stratigraphy of those regions.

In his last work on the Upper Paleozoic of Central Asia (1963), this author subdivides the Permian in two parts: Lower and Upper Permian. According to his studies, the Karachiatirian and Darvasian stages belong to the Lower Permian; these stages include respectively three and two paleontological horizons. The Upper Permian is divided in Murgabian and Pamirian; the latter one can be subdivided into two horizons. The monograph reported is also noteworthy inasmuch as the author tries to correlate the instituted subdivisions here with those of the rest of Asia, European Russia, Caucasus, Europe, and America. For this reason we will adopt in the present work the same subdivisions and stages which were used for Central Asia.

Besides, the faunal assemblages described from the Karachiatirian and Darvasian, are more similar to ours than the faunas of other known Permian stages, as Sakmarian, Artinskian etc.

Description of the samples

The samples examined come from the Low Chapursan Valley, and belong to the Gircha Formation, described by Desio (1963). This formation mostly consists, in the upper part, of arenaceous slates, brown to black, with thin intercalations of dark-grey dolomitic limestone in well distinct beds; the lower part is chiefly formed by light-coloured quartz-sandstone. The samples examined come from the dark-grey dolomitic limestones. They were been collected on the right slope of Chapursan Valley, along the road which leads from Khudabad towards Raminj. Approximately at the second mile the road rises up to a terrace situated at about 80 m above the river, in Hajashitk locality.

Sample 62 PM – 44 was collected at the beginning of the ascent, Sample 62 PM – 46 comes from the base of the outcrops located along the way at the northern end of the above-mentioned terrace. Both samples were collected in situ. The stratigraphic location of the two samples is not clear; it seems however more probable that Sample 62 PM – 46 overlay Sample 62 PM – 44. The series presents a normal order of succession.

Also a third sample, 62 PM – 45, has been examined. This sample is particularly rich in Brachiopods, which have been studied by N. Fantini Sestini, and illustrated in the present volume, but it has no significant micropaleontological content. Sample 62 PM – 45 comes from a block not in situ, found on the above-mentioned terrace, at the base of the outcrops.

Samples 62 PM – 44 and 62 PM – 46 are, on the contrary, particularly rich in microfossils. The fossils are not well preserved and often recrystallized.

62 PM-44: Bryozoan dolomitic biosparite, with numerous fragments of Echinoids, Foraminifera, Algae and Corals (?). The recrystallization is very remarkable; many dolomite crystals can be noticed, as well as a number of calcite veins crossing the rock.

The foraminiferal assemblage is rich in Fusulinids, among them the following genera should be mentioned: *Nankinella*, *Pseudofusulina*, *Monodiexodina* (?) and *Schubertella* (?). Also the genera *Globivalvulina*, *Hemigordius*, *Lasiodiscus* are rather frequent, and usually also the *Lagenidae*. Some specimens belong to the genera *Nodosaria*, *Geinitzina* and *Pachyphloia*.

We were able to identify a certain number of species, some other unidentified specimens have been described and figured, and others have merely been figured in order to present a more complete and clearer picture of the composition of the fauna. The species present are rather numerous, but they are usually represented by a few classifiable specimens. Since it was impossible, in many cases, to find several sections of the same species, an accurate identification was not always sure.

The species identified are, as follows:

Foraminifera
Nankinella aff. *quasihunanensis* Sheng
Nankinella sp.
Pseudofusulina cf. *paraconfusa* Rauser-Chernoussova
Monodiexodina? sp.
Schubertella? sp.
Climacammina sp. 1
Climacammina sp. 2
Textularia sp.
Tetrataxis conica Ehrenberg
Tetrataxis conica v. *lata* Spandel
Globivalvulina bulloides (Brady)

Globivalvulina biserialis Cushman & Waters
Globivalvulina graeca Reichel
Globivalvulina sp. 1
Hemigordius? *pakistanus* sp. n.
Hemigordius? sp. n.
Lasiodiscus cf. *planus* Miklukho-Maclay
Lasiodiscus cf. *sellieri* Dessauvagie
Lasiodiscus tenuis Reichel
Lasiodiscus sp. 1
Aghatammina?
Lagenidae: Geinitzina, Nodosaria, Pachyphloia
Algae
Epimastopora hunzaensis Zanin Buri

Among the species mentioned above, some were found in the Lower Permian: *Nankinella quasihunanensis* and *Pseudofusulina paraconfusa* definitely come from Permian formations, from China and Bashkiria respectively. Other forms, such as *Lasiodiscus tenuis*, *L. planus*, *Globivalvulina graeca* have been found in the Upper Permian and sometimes in the Middle Permian. The genus *Monodiexodina*, if it is really present, would be indicative of the Permian. Among the Algae, the presence of *Epimastopora* would confirm the Permian age. In the neighbouring regions, this genus is found only in the Lower Permian.

Consequently, this association cannot be older (Carboniferous). The presence of forms which have been found in the Upper Permian, as well as the lack of the typical « *Schwagerinae* » would indicate that the above-mentioned faunas do not belong to the Lowermost Permian. The lack of more evolute forms, such as *Verbeekininae*, *Neoschwagerininae* and real Parafusulines, which are usually found in Darvasian beds, would indicate that the fauna in question does not belong to this stage.

We may conclude that our association probably belongs to the transitional period from Karachiatirian to Darvasian.

62 PM-46: Fusulinid dolomitic biosparite. The other fossils are less numerous than Pseudofusulines. It has often been named Fusulinid dolomitic Limestone. The rock is veined by frequent calcite of various sizes and has recrystallized to a certain extent; small crystals of dolomite are often present.

Other fossils are present: frequent Bryozoans, some spines of *Productidae*, fragments of Echinoids, Algae, however less frequent than in the

previously mentioned sample, and rare Ostracods. Among the small Foraminifera, *Globivalvulinae*, *Lasiodiscus* and *Lagenidae* occur rather frequently.

The species identified are:

Foraminifera
Eostaffella sp. 1
Eostaffella sp. 2
Millerella? sp.
Pseudofusulina cf. *buranchini* Rauser-Chernoussova
Pseudofusulina cf. *tschernyschewi* v. *ellipsoidalis* Chen
Pseudofusulina sp. 1
Pseudofusulina sp. 2
Pseudofusulina sp. 3
Globivalvulina bulloides (Brady)
Globivalvulina biserialis Cushman & Waters
Globivalvulina graeca Reichel
Lasiodiscus sp. 1
Lasiodiscus sp. 2
Geinitzina sp.
Algae
Epimastopora hunzaensis Zanin Buri

It must be mentioned that the species of Fusulinids identified and described are relatively few. Great difficulties have been met in the identification of Fusulinids owing to the recent splitting of genera and species in highly specialized studies.

Regarding the age of Sample 62 PM – 46, we remember that *Pseudofusulina buranchini* and *Ps. tschernyschewi* v. *ellipsoidalis* have been both found in the Lower Permian of Bashkiria and Southern China respectively. *Globivalvulina graeca* is known in the Upper Permian. The genus *Epimastopora*, as previously mentioned, has been found only in the Lower Permian of the neighbouring regions.

By a more detailed examination of the *Pseudofusulina* fauna (about 80 per cent of the total fauna) it can be noticed that this mostly consists of rather big forms, with weakly developed chomata, limited to the first whorls, or even quite absent. Some very big specimens, about 1 cm in size, present a net-like subdivision, and sometimes cuniculi; these are limited, at most, to three chambers. They are specimens of a rather evolute *Pseudofusulina*

fauna, closed to the following stage, or *Parafusulina*. However, specimens, definitely belonging to this last genus, have not been recognized.

Schwagerinae, *Pseudoschwagerinae*, *Orientoschwagerinae*, *Triticites*, etc. are absent, as well as *Nankinellae*; the latter ones are present in Sample 62 PM – 44. Also *Verbeekininae* and *Neoschwagerininae* are absent. We can conclude that, as for Sample 62 PM – 44, the fauna of the sample in question belongs to an age included between the Uppermost Karachiatirian and the Lowermost Darvasian.

The only anomalous finding in this chronologically well-defined assemblage is that of *Millerella*, a genus which is known to disappear at the end of the Middle Carboniferous.

Comparison between the associations examined

The species which belong to both samples examined are few indeed. The affinities are limited to the presence of: three species of *Globivalvulina*, in particular *Gl. bulloides*, *Gl. biserialis* and *Gl. graeca*, the genus *Lasiodiscus* with an indetermined species, some *Lagenidae*, however not determined, and an Alga, *Epimastopora hunzaensis*. No Fusulinids are represented in both samples.

From the discussion about the age of each sample, it resulted that both samples belong to the Lower Permian, and approximately to the same faunal zone.

Comparison with other microfaunas

Though the faunas contained in the samples studied are various and rich, it is very difficult to compare these with the associations described in the neighbouring regions.

A great part of the Fusulinid associations studied by the authors [see Hayden (1909), Reed (1917), Furon (1927), Silvestri (1935), Reichel (1939), Dunbar (1940), Thompson (1946), Desio & Cita (1955)] belong to a more recent age; after their evolution stage, we can say that they are at least Darvasian (= Artinskian), if not more recent. Consequently, they have no species in common with the associations from the Hunza Valley.

A comparison with the faunas studied by the Russian paleontologists must be limited to the Fusulinid faunas, for at the present time, the small Foraminifera have not been carefully examined. The Fusulinid associations from Fergana, Darvas, and Pamir seem to be rather different from the Pakistan ones: no species in common have been found in the two regions.

We could, therefore, say that we are faced with a particular fauna found only in our region.

Regarding to the small Foraminifera and Algae, these fossils coming from Fergana, Darvas, and Pamir were not studied in detail. Literature on the subject only mentions small Foraminifera at the beginning of *Parafusulina* zone (Darvasian): these fossils were not recorded in the beds belonging to the lower zones. However it seems that the genus *Epimastopora* is common to the region, including the Hunza Valley.

From the few discussions referred to above, we can deduce that our associations may belong to the base of the *Parafusulina* zone or to an age immediately preceding it.

ACKNOWLEDGMENTS

The author sincerely thanks profs. M. B. Cita and M. Reichel for their assistence and valuable advice, drs. A. Forti and M. Pasini for having enabled her to consult some publications on Permian Foraminifera, dr. C. Loriga for her critical remarks.

Also, the author wishes to thank prof. O. S. Vialov for sending very rare Russian literature.

PALEONTOLOGICAL DESCRIPTIONS

In the present work we have adopted the classification used in the USSR, published in 1959 in « Oznovij paleontologij » (Foundamentals of Paleontology), since it concerns almost all the genera belonging to the Paleozoic.

FORAMINIFERA

Family OZAWAINELLIDAE Thompson & Foster 1937

Subfamily STAFFELLINAE M.-Maclay 1949

Genus **Nankinella** Lee 1934

Nankinella aff. quasihunanensis Sheng 1963

Pl. 10, fig. 1 (n); Pl. 12, fig. 2, 3, 5, 6

1963 *Nankinella quasihunanensis* Sheng. *Permian Fusulinids*, p. 156, pl. 3, fig. 7-15.

Some specimens in axial section, slightly oblique, not always well preserved, are attributed to this species. The down-reported measurements are therefore approximate.

The characteristics observed are: test lenticular, planispiral, involute; periphery subacute; inflate at the centre. Umbilicus absent. Central part re-

crystallized in most of the specimens. 6 whorls visible. Proloculus not well visible: apparently spherical and small-sized. Spire gradually increasing, with the greatest increase only in the last whorl. Septa straight. Wall and chomata recrystallized. Wall seemingly thin; chomata small, extending laterally to the polar parts; tunnel, however, not well outlined.

Sizes — width 1,90 mm
axial length 1,12 mm
proloculus 0,05 mm
chomata thickness 0,037 mm
wall thickness 0,015 mm

	Axial length	Width	Ratio
1st	0,062	0,15	0,41
2nd	0,13	0,30	0,43
3rd	0,25	0,46	0,54
4th	0,375	0,75	0,50
5th	0,62	1,00	0,62
6th	1,00	1,50	0,66

Remarks — Our specimens would correspond to the smaller sized paratypes having few whorls. Some differences have, however, been noticed; among them we point out the presence of a slight depression in the umbilical region, which is not noticeable in the Pakistan specimens. Also the tunnel seems to be broader than in the holotype.

It differs from *Nankinella ovata* M.-Maclay for it is smaller, and it has more developed chomata and more increase in spiral pitch.

Some transversal sections, somewhat oblique, might be attributed to the same species.

Occurrence — *Nankinella quasihunanensis* was found in China (Province of Kucichow) in the bottom of the Wuchiaping Limestone (Upper Permian).

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Nankinella sp.

Pl. 12, fig. 1, 4

A poorly-preserved specimen, in axial section, is attributed to this genus. It shows the following characteristics: test small-sized, lenticular, planispiral,

involute; periphery subacute, inflate at the centre. Umbilicus absent. Wall recrystallized and the first whorls quite obliterated by recrystallization. Only the three outest whorls visible. Spiral pitch gradually increasing. In axial section, the chambers appearing triangular. Septa straight. Chomata, though recrystallized, apparently having a certain thickness. Tunnel not visible.

Sizes — width 0,90 mm
axial length 0,475 mm
chomata thickness ? 0,035 mm

Axial length	Width	Ratio
0,19	0,375	0,51
0,315	0,59	0,54
0,475	0,90	0,53

Remarks — It is similar to *Nankinella* aff. *quasihunanensis*, but it differs from this in its slightly different ratio, thinner chomata and smaller size.

Occurrence — The genus *Nankinella* is common in the Permian of Caucasus, Crimea, Ussuri province, Pamir, China and Indo-China, and North-America.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Subfamily Ozawainellinae Thompson & Foster 1937

Genus **Eostaffella** Rauser-Chernoussova 1948

Eostaffella sp. 1
Pl. 12, fig. 11

The axial section of a specimen is attributed to this genus. Its characteristics are: test nautiloid, planispiral, involute; periphery rounded, very wide. Umbilicus wide, not very deep. Spire rather rapidly increasing. The two most exterior whorls visible; inner whorls and proloculus recrystallized. Secondary deposits consisting of pseudochomata, becoming chomata in the last chamber, being very thin and not well developed. Wall thin and simple.

Sizes — width 0,19 mm
maximum length 0,12 mm
axial length (umbilicus) 0,10 mm
chomata thickness 0,01 mm

The above-described characteristics correspond to the genus diagnosis; the lack of other specimens does not permit a more exact and definite identification.

Occurrence — The genus *Eostaffella* was found in the Carboniferous and in the Lower Permian of USSR, North-America, China and Central Asia (?).

Locality — Hajashitk, Chapursan Valley. 62 PM – 46.

Eostaffella sp. 2

Pl. 12, fig. 10

Another specimen may be attributed to the genus *Eostaffella*. One axial section of it was found very different from the above-described species. In this case too, the lack of other specimens does not permit a more exact identification.

Test lenticular, flattened, planispiral; periphery subacute. Umbilicus small, slightly depressed. 3 whorls visible. Spire width almost constant; heigth very rapidly increasing. Last chamber thightening towards the perifery, assuming a flask-shape. Proloculus spherical, medium-sized. Tunnel not visible. From the second whorl, chomata, rather well developed in their central part, are present. Wall thin and simple.

Sizes — width 0,375 mm
maximum length 0,095 mm
axial length (umbilicus) 0,075 mm
last chamber height 0,125 mm
penultimate chamber height 0,07 mm
proloculus 0,051 mm
chomata thickness 0,022 mm

Occurrence — (The same as *Eostaffella* sp. 1).

Locality — Hajashitk, Chapursan Valley. 62 PM – 46.

Genus **Millerella** Thompson 1942

Millerella ? sp.

Pl. 12, fig. 9

An axial section is attributed to this genus; its characteristics are: test planispiral, discoidal, slightly asymmetrical. Last chamber displaced towards

one of the lateral faces; concave in both sides. Periphery rounded. 4 whorls. The first whorls involute, the outer ones evolute. Proloculus spherical, small sized. Spire of constant sizes in the first whorls, rapidly increasing in the others; in the last whorl its sizes being twice those of the precedent whorl. Tunnel not visible. Secondary deposits evident in the last two whorls: in the first as pseudochomata, in the last one as chomata. Wall thin and simple.

Sizes — width 0,52 mm
maximum length 0,14 mm
axial length (centre) 0,05 mm
proloculus 0,025 mm
last chamber { height 0,15 mm / width 0,13 mm
penultimate chamber { height 0,11 mm / width 0,075 mm
chomata thickness 0,025 mm

Remarks — Our form is very similar to *Millerella marblensis* Thompson, but it can be distinguished for its clearer evolute last whorls, more rapidly increasing spiral pitch, and more reduced number of whorls.

It can be distinguished from *Millerella carbonica* (Grozdilova & Lebedeva) for its more rounded periphery, smaller proloculus, more rapidly increasing spiral pitch, and bigger sizes.

Occurrence — All micropaleontologists agree with the fact that the genus *Millerella* appears in the Lower Carboniferous, reaching its highest development in the Lower-Middle Carboniferous boundary, and disappearing at the end of the Middle Carboniferous. It has been found in various localities in USSR, North America; in Asia probable *Millerella* have been indicated in the Doshi (Afghanistan) Middle-Upper Carboniferous grey limestones.

The presence of the form described herein, which agrees as well with *Millerella* (this can be easily checked by comparing the characters of the described species with the genus diagnostic characteristics), as with more evolute and quite definitely Permian forms is thus extraordinary.

The hypothesis that it might be question of a reworked form is worthy of mention, but this seems to be invalidated by the rock type in which this form was found, since the detrital elements of that rock are few.

Locality — Hajashitk, Chapursan Valley. 62 PM – 46.

Family SCHWAGERINIDAE Dunbar & Henbest 1930

As previously reported, sample 62 PM – 46 contains many specimens belonging to this family. We tried to identify some specimens, whose characteristics are very clear. As for other forms, we only give a generic identification, but sometimes this is not also absolutely reliable.

Many difficulties arise when we want to define more exactly the classification regarding the *Schwagerinidae*. During the last few years many new genera have been created, having intermediate characteristics regarding to those already existing, merging gradually one into the other. One must also take into account the discussed problems of synonymy and the different opinions on the taxonomical value of certain characters.

With regard to species, the number of instituted new species is very considerable.

However, a total sistematic revision of this family has been made by Kahler and is now in press.

Subfamily SCHWAGERININAE Dunbar & Henbest 1930

Genus **Pseudofusulina** Dunbar & Skinner 1931

Pseudofusulina cf. **buranchini** Rauser-Chernoussova 1949

Pl. 11, fig. 1

1949 *Pseudofusulina buranchini* Rauser-Chernoussova. *Bashkirian Pre-Urals*, p. 134, pl. 5, fig. 3-4. (Fide Ellis & Messina).

We have studied an incomplete specimen, in axial section, showing the following characteristics.

Test subcylindrical, slightly convex in its middle part. Inner whorls inflated with pointed poles, outer whorls subcylindrical with obtusely pointed poles. Length/width ratio in the first whorls about = 2,2, then rapidly increasing. Rather large-sized: 7,4 mm, specimen incomplete. 5 whorls visible. Proloculus spherical 0,25 in diameter. Wall of keriothecal type, thin in the first whorl, then rapidly increasing; thickness in the 4th whorl about 0,09 mm. Septa rather thin, thicker in the middle part. Flutings pronounced, high and narrow along the whole test; irregular and broader in the outer whorls. Tunnel low and broad, not always well visible. Chomata absent. Supplementary deposits in the form of irregularly spread thickenings.

		Axial length	Width	Ratio	Spirotheca
Sizes —	1st	1,25	0,55	2,28	0,027
	2nd	2,00	0,93	2,20	0,050
	3rd	2,72	1,26	2,16	0,062
	4th	5,50	1,57	3,54	0,090

Proloculus 0,25 mm.

Remarks — Our specimen is very similar to the holotype. We think it more correct to determine our form only by comparison, the fossils found being scanty, the section incomplete and axial fillings, even incipient, absent.

Occurrence — The holotype comes from the Lower Permian of the Yuzhny Massif (Burtsevka horizon) in Bashkiria. It seems never to have been found in Asia before.

Locality — Hajashitk, Chapursan Valley. 62 PM – 46.

Pseudofusulina cf. **paraconfusa** Rauser-Chernoussova 1949
Pl. 13, fig. 7

1949 *Pseudofusulina paraconfusa* Rauser-Chernoussova. *Bashkirian Pre-Urals*, p. 127, pl. 3, fig. 7; pl. 4, fig. 1. (Fide Ellis & Messina).

Test inflated, fusiform, with obtusely acuminate poles. The specimen here examined is an incomplete axial section, not perfectly centered; visible only from the first whorl forward. Length/width ratio in the first whorls about $\leqq 1$, then rather rapidly increasing, in the three last whorls ratio almost constant. Rather large-sized: over 8 mm; 6 whorls visible. Wall of keriothecal type, thin in the first whorls; thicker in the last ones. Septa thin to moderately thick, rather fluted (flutings high and narrow). Tunnel rather large and low. Pseudochomata not well developed, visible as far as the 3rd whorl. Axial fillings absent or very thin.

		Axial length	Width	Ratio	Spirotheca
Sizes —	1st	0,35	0,32	1,07-1,08	0,035-37
	2nd	1,25	0,75	1,66-1,67	0,05
	3rd	2,25	1,07	2,09	0,05-6
	4th	4,70	1,80	2,66	0,070-75
	5th	6,70	2,60	2,57	0,075-87
	6th	8,20	3,40	2,40	0,075

Remarks — An accurate identification is impossible, because a single incomplete axial section is not diagnostic, and because only a very reduced number of specimens has been observed. Also, the holotype has a much more regular tunnel, and axial fillings slightly more developed than the specimen we are considering.

The latter one shows remarkable affinities with the two following species. It differs from *Pseudofusulina confusa* Rauser-Chernoussova for its less lengthened first whorls, more reduced number of whorls, thinner septa and spirotheca, smaller tunnel.

It differs from *Pseudofusulina* gr. *urdalensis* Rauser-Chernoussova for the lack of chomata and much broader and irregular tunnel.

Occurrence — The holotype comes from the Lower Permian Tastuba horizon in ASSR Bashkiria. It has never been found in Asia before.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Pseudofusulina cf. **tschernyschewi** (Schellwien) v. **ellipsoidalis** Chen 1934

Pl. 13, fig. 1

1934 *Pseudofusulina tschernyschewi* v. *ellipsoidalis* Chen. *South China*, p. 55, pl. X, fig. 13-14.

One specimen, in axial section, is attributed to this species, by comparison. Its characteristics are: test ellipsoidal; poles rounded. Constituted of 5 whorls constantly ellipsoidal. Proloculus spherical, medium-sized. Spirotheca, of keriothecal type, thin in the two first whorls, then gradually increasing. Septa thin, with rather accentuated, but regular, flutings. Chomata well visible in the 1st whorl, then absent. Tunnel not always well outlined, generally low and narrow.

		Axial length	Width	Ratio	Spirotheca
Sizes —	1st	0,7	0,35	2,00	0,017
	2nd	1,25	0,55	2,28	0,017
	3rd	1,70	0,85	2,00	0,037
	4th	2,65	1,25	2,10	c,05
	5th	3,60	1,60	2,25	0,067

Proloculus 0,17 mm

Chomata thickness 0,031 mm.

Remarks — The form described herein presents some differences in respect of Chen's variety: our specimen has a greater whorl width and more

accentuated septa fluting. For these reasons, it has been determined by comparison.

Occurrence — The type-variety occurs in Southern China Swine Limestone (Upper Uralian); it has never been indicated elsewhere.

On the contrary, *Pseudofusulina tschernyschewi* Schellwien was found in USSR, Asia — particularly in the Darvas basin —, always belonging to the Permian.

Locality — Hajashitk, Chapursan Valley. 62 PM - 46.

Pseudofusulina sp. 1

Pl. 13, fig. 5

One specimen incomplete, in axial section. Test fusiform with rather pointed poles. Only 4 whorls visible. Length/width ratio = 2 about in the first whorl, then rather rapidly increasing. Proloculus spherical, medium-sized. Spirotheca of keriothecal type very thin in the first whorls, then slightly increasing. Septa thin with regular flutings, high but wide, more accentuated in the apical parts. Chomata not distinct, apparently limited to the first whorls. Tunnel low and narrow, but not well outlined.

		Axial length	Width	Ratio	Spirotheca
Sizes —	1st	0,55	0,275	2	0,012
	2nd	1,20	0,45	2,66	0,018
	3rd	2,00	0,70	2,85	0,025
	4th	3,30	1,02	3,24	0,037

Proloculus 0,16 mm.

Occurrence — The genus *Pseudofusulina* ranges from the Upper Carboniferous to the Permian. It is diffused all over the world.

Locality — Hajashitk, Chapursan Valley. 62 PM - 46.

Pseudofusulina sp. 2

Pl. 13, fig. 3

One specimen in axial section not centered, showing the following characteristics: test cylindrical, incomplete. Inner whorls inflated sub-rhombic, poles broadly rounded. Length/width ratio in the first whorl visible = 1,45, then rapidly increasing. Large-sized form, reaching 6,5 mm in length, though the fifth whorl being incomplete. 4 whorls visible. Proloculus not visible. Wall of ke-

riothecal type thin in the first visible whorl, then rapidly increasing up to the fourth whorl; in the last one thickness strongly decreasing. Septa thin with irregular high and narrow flutings in the middle part; much fluting in the apical part. Tunnel low and broad, medium-sized. Chomata well developed as far as the third visible whorl.

		Axial length	Width	Ratio	Spirotheca
Sizes —	1st	0,45	0,32	1,45	0,025
	2nd	1,15	0,575	2,00	0,037
	3rd	3,10	1,10	2,81	0,05
	4th	5,00	1,65	3,00	0,09
	5th (incomplete)	6,50	2,10	—	0,05

Chomata thickness 0,075 mm.

Occurrence — (See what recorded for *Pseudofusulina* sp. 1).
Locality — Hajashitk, Chapursan Valley. 62 PM - 46.

Pseudofusulina sp. 3
Pl. 11, fig. 2

One specimen, incomplete, in slightly oblique centered section, next to the axial; it shows the following characteristics: test ellipsoidal with rounded poles. Length/width ratio = 1,5 in the first whorl, then very gradually increasing. 4 and a half whorls visible. Proloculus spherical, medium-sized. Wall of keriothecal type, thin in the inner whorls, increasing very gradually in the outer whorls. Septa thin with high and narrow flutings. Tunnel low, broad, not always located at the same place. Chomata not always visible, appearing to be present only in the first whorls.

		Axial length	Width	Ratio	Spirotheca
Sizes —	1st	0,375	0,25	1,5	0,019
	2nd	0,775	0,40	1,93	0,025
	3rd	1,38	0,62	2,22	0,027
	4th	2,25	0,94	2,38	0,044
	4th 1/2 (incomplete)	2,75	1,12	—	0,050

Proloculus 0,15 mm.

Occurrence — (See what recorded for *Pseudofusulina* sp. 1).
Locality — Hajashitk, Chapursan Valley. 62 PM - 46.

Subfamily Polydiexodininae M.-Maclay 1953

Genus **Monodiexodina** Sosnina 1956

Monodiexodina? sp.

Pl. 10, fig. 1 (m)

One specimen, cylindrical, large sized, in oblique axial section: it would appear to have the same characteristics as the genus *Monodiexodina*. As far as it could be measured, length/width ratio in the first visible whorl = 1,6, then very rapidly increasing; in the outer whorls, width less than 1/4 of length. 4 whorls visible. Proloculus not visible. Wall of keriothecal type, very thick. Septa much fluted at the poles, at the middle part flutings less accentuated, eventually limited to the lowest part of septum.

	Axial length	Width	Ratio	Spirotheca
Sizes — 1st	0,8	0,5	1,6	—
2nd	3,75	1,0	3,75	0,075/80
3rd	6,50	1,62	4,05	0,080/90
4th	9,4	2,30	4,08	0,09/0,10

Occurrence — The genus *Monodiexodina* was found in the Upper Permian of Primori, Japan, and Indo-China; exceptionally in the Lower Permian (Darvasian).

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Family Textulariidae d'Orbigny 1846

Subfamily Palaeotextulariinae Galloway 1933 [1]

Genus **Climacammina** Brady, emend. Cummings 1956

Climacammina sp. 1

Pl. 16, fig. 1

The specimen examined by us is broken: it is in oblique section. 9 chambers biserially arranged visible, tending to become uniserial. Aperture simple in the first stages, then cribrate. Proloculus crossed by a fissure. Wall constituted by two layers: outer layer dark, microgranular, with agglutinated material, thin, measuring 0,012 mm in thickness; inner layer calcareous, hyaline, radiate, much thicker (thickness 0,06 to 0,09 mm).

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[1] Cummings (1956) ranged the family *Palaeotextulariidae*, erected by himself, in the superfamily *Endothyridea*, on the basis of the text structure.

Sizes — length 1,25 mm
width 0,875 mm
width at apex 0,30 mm
last chamber height 0,225 mm

It has not been possible to classify this species.

Occurrence — The genus *Climacammina* has been found in the Middle-Upper Carboniferous-Middle Permian of England, USSR, America, East and Indonesia; some specimens were found in the Permian limestones of the Bulola Gorge (Afghanistan) and in Pakistan at Murgo and Shaksgam.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Climacammina sp. 2
Pl. 10, fig. 1 (c)

Two specimens, one of which complete, in section almost parallel to the axis, but not cut through the biserial part, are attributed to this genus. The following characteristics may be observed: test large-sized, conical, constituted of 11 chambers apparently uniserial, transversally very rapidly increasing. Proloculus not visible; first chamber almost spherical; second and third chambers having trapezoidal shape; other chambers wider then long, arch-shaped with convexity rather accentuated towards the apertural face. Chamber height, after the third one, almost constant. Sides almost straight, but with rather deep depressions in respect of the sutures. Aperture not visible in the two first chambers, hardly visible in the third and fourth ones; in the others, cribrate, occupying about two thirds of the apertural face. Wall constituted of two distinct layers: outer layer thin, dark, microgranular, sometimes with agglutinated elements (maximum thickness 0,02 mm); inner layer calcareous, hyaline, radiate, much thicker, with maximum thickness in the first chambers: 0,08 mm, decreasing towards the last until 0,05 mm.

Sizes — length 3,50 mm
width 2,00 mm
apex angle 42°
1st chamber 0,44 mm

Remarks — Many species could be compared with ours, but the comparisons are very difficult, because of the type of the section studied.

It differs from *Climacammina* sp. 1 in its size, being twice as large, and by its more numerous chambers, of which only the uniserial arrangement can be seen.

Occurrence — (See that recorded for *Climacammina* sp. 1).

Locality — Hajashitk, Chapursan Valley. 62 PM-44.

Subfamily TEXTULARIINAE d'Orbigny 1846

Genus **Textularia** Defrance 1824

Textularia sp.

Pl. 16, fig. 2

One incomplete axial section is attributed to this genus: the initial portion is missing. 4 pairs of biserially arranged chambers can be seen. Septa mostly slightly incurved, increasingly flexing next to the aperture. Sides almost parallel, sutures depressed. Chamber sizes almost constant; height varying between 0,10 mm and 0,12 mm. Wall constituted of a dark, arenaceous layer, rich in agglutinated elements; thickness 0,03 mm (0,05 mm near the aperture).

Sizes — length 0,62 mm
width (end) 0,37 mm
width (base) 0,32 mm
aperture 0,015 mm

Remarks — The species most similar to ours is *Textularia multilocularis* Reuss, for its slow chamber increase in the terminal part, almost parallel sides, and shape of chambers. Our species differs from the mentioned one for its smaller sizes.

Occurrence — This genus ranges from the Lower Carboniferous to the Recent. It is found all over the world.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Family TETRATAXIDAE Galloway 1933

Genus **Tetrataxis** Ehrenberg 1854

Tetrataxis conica Ehrenberg 1854

Pl. 16, fig. 4

1854 *Tetrataxis conica* Ehrenberg. *Mikrogeol.*, p. 24, pl. 37, fig. 12.
1879 *Tetrataxis conica* Moeller. *Russ. Kohlenkalks*, p. 71, pl. 2, fig. 3 a-g; pl. 7, fig. 1-2; p. 72, fig. 30.
1927 *Tetrataxis conica* Harlton. *Penn. Foram. Oklahoma*, p. 22, pl. 4, fig. 5 a-d.
1933 *Gallataxis conica* Galloway. *Manual Foram.*, p. 161, pl. 14, fig. 17-18.

One well preserved specimen in slightly oblique axial section is attributed to this species. Its characters are: test conical large-sized, apex angle broad (77°). Sides almost straight, tending to slight convexity towards test terminal part. Umbilicus rather wide. 8 visible chambers. Section, slightly oblique, only grazing proloculus; thus the proloculus cannot be described. Chamber sizes greatly varying, according to how they have been cut. Last chamber 0,125 mm high. Wall constituted of two layers: outer dark, microgranular, about 0,027 mm thick; inner calcareous, hyaline, radiate, 0,02 to 0,075 mm thick. This rather considerable thickness chiefly depending on how the examined specimen has been cut.

Sizes — width 1,00 mm
height 0,9 mm
apex angle 77°

Remarks — The holotype is poorly illustrated and not described. Moeller studying Ehrenberg's specimens, has widely obviated such a lack.

Our form corresponds rather well to the above-mentioned examples.

Occurrence — The holotype comes from Tula Kohlen Formation (USSR). It has been found from the Pennsylvanian to the Upper Permian in USSR, North America, the Farthest East, and Central Asia (Pakistan: Murgo).

Locality — Hajashitk, Chapursan Valley. 62 PM-44.

Tetrataxis conica v. lata Spandel 1901
Pl. 16, fig. 5

1901 *Tetrataxis conica* v. *lata* Spandel. *Permo-Carb. Kansas*, pp. 186-187, fig. 6a-b.

Some specimens are attributed to this variety, among them an axial section, which will be here described: test small-sized, conical, sides almost straight, apex angle 90°. Umbilicus rather large: about 0,09 mm. 6 chambers visible. At the apex, proloculus indistinctly visible. Chamber sizes gradually increasing, last chamber 0,0375 mm high. Wall constituted of a dark, microgranular layer 0,0125 mm thick; only in few spots an inner layer, calcareous, hyaline, visible.

Sizes — width 0,28 mm
height 0,125 mm
apex angle 90°

Remarks — Our form is of a smaller size than the type, but the broad apex angle, as well as the shape of the chambers, are similar to those of Spandel's form.

Occurrence — This type comes from the Permo-Carboniferous of Kansas. After this, the var. *lata* was found by Vlasov & M.-Maclay (1959) in the Permian of Northern Pamir.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Family Biseriamminidae Chernyscheva 1941

Genus **Globivalvulina** Schubert 1920

Forms referable to this genus are rather frequent, but well oriented sections are scanty, and do not permit any accurate comparisons.

However, based chiefly on Reichel's (1945) and Loriga's (1960) works, we tried to proceed to specific identifications.

Globivalvulina bulloides (Brady) 1876

Pl. 14, fig. 2, 4, 5, 9; Pl. 15, fig. 1-5, 20

1876 *Valvulina bulloides* Brady. *Carb. Permian Foraminifera*, p. 89, pl. 4, fig. 12-15.
1920 *Globivalvulina bulloides* Schubert. *Protozoen*, p. 153.
1927 *Globivalvulina bulloides* Harlton. *Penn. Foram. Oklahoma*, p. 23, pl. 5, fig. 2a-c.
1948 *Globivalvulina bulloides* Plummer. *Morph. Globivalvulina*, p. 39, fig. 4-5.
1949 *Globivalvulina bulloides* Morozova. *Pré-Oural Bachkir*, p. 13, pl. II, fig. 10, 14.
1960 *Globivalvulina bulloides* Loriga. *Permiano Dolomiti*, p. 53, pl. 3, fig. 6; pl. 7, fig. 1c; text-fig. 6.

Some specimens, from both the studied samples, may be referred to Brady's species. Chambers globular, showing the typical shape, rapidly increasing in size; outline almost circular. Wall generally thin, thicker in one of the specimens. All sections oblique in respect of coiling plane.

Sizes — 0,30 × 0,37 mm

Occurrence — The holotype comes from the Carboniferous of Southern Iowa (USA). It has been indicated in the Permo-Carboniferous of USSR and North America, in the Permian of Australia, Central Asia, Cyprus and Northern Italy.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44, 62 PM – 46.

Globivalvulina biserialis Cushman & Waters 1928
Pl. 14, fig. 6, 8; Pl. 15, fig. 6-11, 14, 15

1928 *Globivalvulina biserialis* Cushman & Waters. *Penns. Permian Texas*, p. 64, pl. 8, fig. 7a-c.
1930 *Globivalvulina biserialis* Cushman & Waters. *Cisco Group Texas*, p. 70, pl. 8, fig. 1-5.
1948 *Globivalvulina biserialis* Plummer. *Morph. Globivalvulina*, p. 171, fig. 1a-b.
1960 *Globivalvulina biserialis* Loriga. *Permiano Dolomiti*, p. 52, text-fig. 4.

The sections referring to this species are oblique. Test medium-sized. 6 chambers in each section, globular and rapidly increasing. One specimen showing last chamber much developed. Wall relatively thick; sutures depressed.

Sizes — 0,45-0,50 mm

Sizes, chamber shape and increase permit a sure attribution of these specimens to Cushman & Waters' species.

This species occurs most frequently in our samples.

Occurrence — The holotype comes from the Upper Carboniferous of Texas. This species was also found in the Permian of North America and in the Upper Permian of Northern Italy (Dolomites).

Locality — Hajashitk, Chapursan Valley. 62 PM - 44, 62 PM - 46.

Globivalvulina graeca Reichel 1945
Pl. 14, fig. 3; Pl. 15, fig. 16-19

1945 *Globivalvulina graeca* Reichel. *Foram. Permien méditerr.*, p. 550, fig. 36, 38, pl. XIX, fig. 15-17.
1960 *Globivalvulina graeca* Loriga. *Permiano Dolomiti*, p. 54, pl. 3, fig. 7-8, text-fig. 8.

Some specimens, in differently oriented sections, are very similar to Reichel's species in their size and shape. Chambers — moderately globular — gradually increasing; sutures slightly depressed. Transversal outline circular or subcircular. Wall rather thin.

Sizes — 0,9-1,00 mm

Occurrence — The holotype comes from the Permian of Chios Island (Aegean Sea). Numerous specimens were found in the Upper Permian of Northern Italy (Dolomites). It has also been found in the Upper Permian of North Caucasus.

Locality — Hajashitk, Chapursan Valley. 62 PM - 44, 62 PM - 46.

Globivalvulina sp. 1
Pl. 14, fig. 1

1960 *Globivalvulina* sp. Loriga. *Permiano Dolomiti*, p. 57, text-fig. 10.

One specimen examined seems to correspond to *Globivalvulina* sp. described by Loriga in the Permian of Dolomites. The section examined is oblique. At most 6 chambers, rather rapidly increasing. Sutures slightly depressed. Wall probably thick. Very small-sized: only 0,225 mm. Outline similar to that of *Globivalvulina bulloides*, but our form differs chiefly for its smaller size.

The section found is not sufficient to erect a new species. We agree with Loriga in deeming it necessary to have — for this — a greater number of forms. We regret that the significant name *Globivalvulina parva* suggested by the author for this small species has already been employed by Tschernyschew for a Visean form occurring from the Southern Urals.

Occurrence — The species described by Loriga (1960) occurs in the *Bellerophon* Limestones (Upper Permian) of the Dolomites (Northern Italy). This form has been found by us for this first time abroad.

Locality — Hajashitk, Chapursan Valley. 62 PM - 44.

Family CORNUSPIRIDAE Reuss 1861
Genus **Hemigordius** Schubert 1908

Hemigordius ? pakistanus sp. n.
Pl. 17, fig. 1-3, 7

Test discoidal, surfaces parallel or only slightly convex; periphery rounded. Sizes slightly varying from one specimen to the other: diameter/height ratio about 2/1. Proloculus almost spherical, of rather remarkable sizes: 0,087 × 0,10 mm; second chamber tubular, undivided, 2-3 whorls coiled on different planes, the three last whorls planispiral or nearly so; last, sometimes also the penultimate, whorl evolute. In axial section, the 2nd chamber gradually increasing in sizes. Chamber lights slice-shaped, with convexity outwards, point-ending with a slight and short prolongation towards the centre, almost embracing the preceeding whorl. In the last whorl this prolongation almost inexistent. Chamber wall recrystallized, thickening in the middle part of the test, being constituted by the fusion of wall of subsequent whorls. The wall of the most exterior evolute whorls however does not extend over the centre.

Holotype sizes — maximum diameter 0,475 mm
height 0,20 mm
proloculus 0,087 × 0,10 mm

Remarks — Since we suppose that the original wall may have been calcareous imperforate, we think this specimen to be a *Hemigordius*. Recrystallization is more frequent in calcareous imperforate tests than in other test types. This supposition appears to be supported by the presence — in our material — of almost always recrystallized structures (chomata etc.) which should have the same composition as the *Hemigordius* test.

Though the attribution to this genus is not sure, nevertheless, the erection of a new species is justified, inasmuch as proloculus, coiling type, and second chamber increase are clearly visible, as well as the diameter/height ratio: all these characteristics have a specific value in this genus.

The holotype as well as the three paratypes are in axial, slightly oblique section, therefore not perfectly oriented.

Also two specimens in sections parallel to the axis may be attributed to the species described herein, as they have the same sizes and ratios. At the centre can be noticed, though not very clearly, the coiling on different planes; the following plane spire is, on the contrary, clearly visible (Pl. 17, fig. 7).

Comparison — Our species is distinguished from *Hemigordius schlumbergeri* (Howchin) by its more reduced size, different ratio, more accentuated prolongations, more crushed form of tubular chamber, and for having the last whorl evolute.

It is closely similar to *Hemigordius longus* Grozdilova, from which it is distinguished by its different ratio, more accentuated initial axial deviation, the last whorl evolute, higher more crescentic and embracing chamber lights.

It is distinguished from *Hemigordius permicus* Grozdilova by its much more reduced size, different ratio, a greater axial deviation in the first whorls and narrower spiral pitch.

Name derivation — The name derives from Pakistan, the country of the type-locality.

Holotype — Pl. 17, fig. 1; deposited at the Micropaleontological Laboratory of the Paleontological Institute, University of Milan. Coll. No. 1448.

Type-level — Gircha Formation, Lower Permian Fusulinids Limestone. 62 PM-44.

Type-locality — Hajashitk, Chapursan Valley (Pakistan).

Hemigordius? sp. n.
Pl. 17, fig. 4, 6

In sample 62 PM – 44 was found a specimen in subaxial section; it cannot be classified among any of the species described till now. It is doubtless a new species: however we cannot give it a specific name, for lack of specimens; the mere description will be here down given: test discoidal, rather large-sized; lateral surfaces almost convex; periphery rounded. Proloculus not visible. Second chamber tubular, undivided, coiled as a ball («pelotonned») in the early whorls, then planispiral or almost so. Height of chamber lights very rapidly increasing; exceeding the width by about 4 times. Last whorls apparently evolute. In the outer whorls, chamber section of axial plane crescent-shaped. Prolongations towards the centre not much developed. Spiral pitch, on the contrary, very slowly increasing. Wall very thin near the perifery; thicker in the middle part of the test, being there constituted of a fusion of the wall of subsequent whorls. The test wall is recrystallized. The original test may have been calcareous imperforate. For this reason we attribute — though doubtfully — our specimen to the genus *Hemigordius*.

Sizes — maximum diameter 0,85 mm
height 0,25 mm

Some horizontal sections have been attributed to this species, chiefly for their sizes and spiral pitch.

Holotype — Pl. 17, fig. 4; deposited at the Micropaleontological Laboratory of the Paleontological Institute, University of Milan. Coll. No. 1449.

Type-level — Gircha Formation, Lower Permian Fusulinids Limestone. 62 PM – 44.

Type-locality — Hajashitk, Chapursan Valley (Pakistan).

Family Lasiodiscidae Reitlinger 1956

Genus **Lasiodiscus** Reichel 1945

Test planispiral, evolute, with surfaces differently concave, periphery usually rounded. The test consists of a proloculus and of a second tubular chamber. Wall structure microgranular, appearing dark in transmitted light. A clear hyaline layer, consisting of calcareous pillars, covers the central part of one of the discoidal surfaces, which is conventionally considered the «upper»

one. On the other or « lower » face, adventiv chamberlets, more or less developed in the different species, are visible, communicating with the second chamber by means of small apertures or pores.

Lasiodiscus cf. **planus** M.-Maclay 1954
Pl. 18, fig. 5; text-fig. 1 c

1954 *Lasiodiscus planus* M.-Maclay. *Permien sup. Nord Caucase*, p. 22, pl. I, fig. 7-9.
1963 *Lasiodiscus planus* Dessauvagie & Dager. *Lasiodiscidae Anatolia*, p. 82, text-fig. 11, pl. III, fig. b.

Some specimens in variously oriented sections were found, attribuable to a unique species. Their state of preservation not being perfect, only one of them will be here described and figured.

Test discoidal, planispiral, evolute; periphery rounded; both faces concave. One half of the test not well visible. 8 whorls visible. Spire lights subsquare in the first whorls; subrectangular-arcuate in the last ones. Spiral pitch almost constant; height gradually, but rather rapidly, increasing. Proloculus not visible. Wall structure microgranular. Upper face of spire covered by a hyaline layer, consisting of pillars about 0,025 mm thick. Surface of pillars not always visible. Adventiv chamberlets well developed on the lower face: maximum length 0,07 mm near the periphery.

Sizes — diameter 0,362 mm
thickness 0,05 mm
1st chamber light 0,012 × 0,012 mm
last chamber light 0,025 × 0,05 mm

Our specimen, though incomplete, agrees rather well with M.-Maclay's. However the adventiv chamberlets are less developed in the Pakistan specimen.

Occurrence — The holotype occurs in the Upper Permian of North Caucasus; it was found also in the Middle Permian of Ankara Region (Turkey).

Locality — Hajashitk, Chapursan Valley. 62 PM-44.

Lasiodiscus cf. **sellieri** Dessauvagie 1963
Pl. 18, fig. 3; text-fig. 1 e

1963 *Lasiodiscus sellieri* Dessauvagie. In Dessauvagie & Dağer: *Lasiodiscidae Anatolia*, p. 79, text-fig. 4-9, pl. I, fig. a-b; pl. II, fig. a-d.

One specimen only, in axial section. Its characteristics are: test discoidal, planispiral, evolute; periphery rounded, faces subparallel, edges fluted for a

slight displacement of the last whorl in respect of the general coiling plane: outline slightly sinuous. First whorls not visible. Last three whorls showing very slow increase (both in height and width). Chamber lights subrectangular to arcuate. Wall microgranular. A clear hyaline layer, consisting of pillars, may

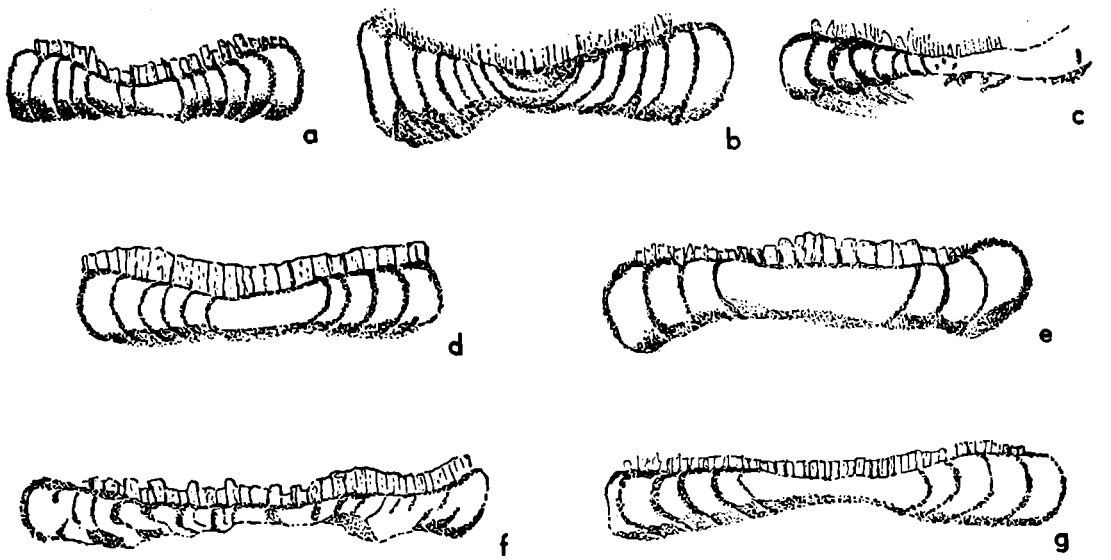

Fig. 1 - a = *Lasiodiscus* sp. 1, Chapursan Valley, S. 62 PM-46.
b = *Lasiodiscus* sp. 1, Chapursan Valley, S. 62 PM-44.
c = *Lasiodiscus* cf. *planus* M.-Maclay, Chapursan Valley, S. 62 PM-44.
d = *Lasiodiscus* sp. 2, Chapursan Valley, S. 62 PM-44.
e = *Lasiodiscus* cf. *sellieri* Dessauvagie, Chapursan Valley, S. 62 PM-44.
f = *Lasiodiscus* sp., Chapursan Valley, S. 62 PM-46.
g = *Lasiodiscus tenuis* Reichel, Chapursan Valley, S. 62 PM-44.
All figures × 130.

be observed on the upper face of the spire, except on the last whorl. Thickness 0,034 mm in the middle part, 0,012 mm near the periphery. Adventiv chamberlets very short are hardly visible on the lower face.

Sizes — diameter 0,41 mm
thickness 0,088 mm
centre thickness 0,062 mm
spire maximum pitch 0,043 mm

Remarks — We think that the characteristics of our specimen show remarkable affinity with those of Dessauvagie's form. However, the incompleteness of our section and the lack of further specimens do not allow a more certain identification.

Occurrence — The holotype occurs in the Middle Carboniferous of West Anatolia.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Lasiodiscus tenuis Reichel 1945
Text-fig. 1 g

1945 *Lasiodiscus tenuis* Reichel. *Foram. Permien méditerr.*, p. 530, text-fig. 3, pl. XIX, fig. 3.
1954 *Lasiodiscus tenuis* M.-Maclay. *Permien sup. Nord Caucase*, p. 18, pl. I, fig. 3.

One specimen sectioned parallel with the axis, but not centered. Its characteristics are: test discoidal, both faces — differently — slightly concave; periphery arcuate. Proloculus not visible. 6 whorls visible, arranged in plane spiral. Spiral pitch gradually increasing, height slightly more rapidly increasing. On the upper face, a hyaline layer, consisting of pillars, covers all the whorls except the last one; thickness 0,03 mm at the middle part to 0,02 at the periphery. Adventiv chamberlets weakly developed. Wall microgranular.

Sizes — diameter 0,47 mm
thickness 0,025 to 0,07 mm
pillars 0,02/0,03 mm
last spire pitch 0,034 mm
penultimate spire pitch 0,026 mm

Our specimen corresponds well to Reichel's species.

Occurrence — The holotype occurs in the Upper Permian of Tatoi (Greece); it was found also in the Upper Permian of North Caucasus.

Locality — Hajashitk, Chapursan Valley. 62 PM – 44.

Lasiodiscus sp. 1
Pl. 18, fig. 1; text-fig. 1 a, b

Our material consists of some axial or slightly oblique sections. Test discoidal: upper face concave, lower face slightly concave. Periphery subsquare to arcuate. Centre never well visible. 8 whorls visible in one specimen, always arranged in plane spiral. Spiral pitch gradually increasing; height much more rapidly increasing. On the upper face hyaline layer, consisting of pillars, developed also in the last volution. Thickness 0,02 mm near the periphery to 0,032 mm in the middle part. On the lower face, adventiv chamberlets very short, hardly visible. Pores or secondary apertures not well visible. Wall microgranular.

Sizes — diameter 0,31/0,362 mm
thickness 0,075/0,10 mm
centre thickness 0.035/0,037 mm
last spire pitch 0,030 mm
penultimate spire pitch 0,025 mm
pillars 0,02/0,032 mm

Remarks — Another specimen was found, in tangential oblique section, doubtless belonging to the above-described species. Other sections, more oblique, may also be attributed to this species.

It differs from *Lasiodiscus ovoides* M.-Maclay by its greater number of whorls, less gradually increasing spire-width. Also, the species from Caucasus has much more developed adventiv chamberlets.

It differs from *Lasiodiscus tenuis* Reichel in its smaller size, a greater spiral pitch in the last whorl, and less developed chamberlets.

It differs from *Lasiodiscus minor* Reichel in its larger size, a greater spiral pitch in the last whorl, and less developed chamberlets.

The spire ratio is very similar to that of *Lasiodiscus insecta* M.-Maclay, but this last species has much developed adventiv chamberlets, and more divergent from the centre.

No form described is similar to *Lasiodiscus* sp. 1.

Occurrence — The genus *Lasiodiscus* is found in the Upper Carboniferous to the Lower Permian of Russian Platform and Central Asia; in the Upper Permian of Greece, Caucasus and Cyprus.

Locality — Hajashitk, Chapursan Valley. 62 PM-44, 62 PM-46.

Lasiodiscus sp. 2
Text-fig. 1 d

One specimen sectioned parallelly with the axis, but not centered. Its characteristics are: test discoidal, both faces slightly concave. Periphery arcuate to subsquare. Proloculus not visible. 5 whorls visible, arranged in plane spiral. Spiral pitch gradually increasing, height more rapidly increasing. Hyaline layer, consisting of pillars, much developed: thickness 0,025 mm near the periphery to 0,035 in the middle part, covering also the last whorl. Adventiv chamberlets not much developed. Wall microgranular.

Sizes — diameter 0,35 mm
thickness 0,062 mm

centre thickness 0,037 mm
pillars 0,025/0,034 mm
last chamber light 0,031 × 0,05 mm

Remarks — This specimen is similar to *Lasiodiscus* sp. 1, but it is distinguished by its much more developed hyaline layer, and more rapidly increasing spiral pitch.

It differs from *Lasiodiscus tenuis* Reichel in its smaller size, less rapidly increasing spiral pitch, and more increasing whorl height. Moreover the Pakistan specimen presents a more developed hyaline layer.

Occurrence — (See that recorded for *Lasiodiscus* sp. 1).

Locality — Hajashitk, Chapursan Valley. 62 PM - 46.

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SUR QUELQUES FORAMINIFERES PERMIENS D'ASIE CENTRALE

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Le matériel étudié dans cette note nous a été aimablement communiqué par M. le Professeur Ardito Desio, Directeur de l'Institut géologique de Milan. Il provient pour une partie, (55 AD – 98 et 98 bis) des gorges de la Bulola, à une centaine de kilomètres au N.NO de Kabul, pour une autre, de la vallée de la Shaksgam (29 KD – 252, 253, 257) et du bassin du glacier Baltoro (54 PZ – 160) dans la partie centrale de la chaîne du Karakorum.

Divers auteurs ont déjà eu l'occasion de décrire des microfaunes de ces régions.

A. Silvestri, en particulier, a donné en 1935 une étude des Fusilinidés recueillis dans le Karakorum par l'Expédition géographique italienne organisée en 1929.

H. H. Hayden en 1909, puis M. L. Thompson en 1946 ont fait connaître, de leur côté, les faunes à Fusulinidés de la vallée de la Bulola.

C. O. Dunbar, enfin, a décrit de la vallée de la Shaksgam une nouvelle espèce de *Parafusulina*.

Le plupart des Fusulinidés que nous avons rencontrés dans nos échantillons se rapportent aux formes signalées par nos devanciers. Certains cependant nous ont paru mériter une figuration et un commentaire. En outre, un calcaire blanc cristallin du Karakorum nous a fourni en abondance un Miliolidé: *Hemigordiopsis renzi* Reichel.

Divers facteurs ont rendu les déterminations spécifiques parfois difficiles.

La recristallisation et la tectonisation qui ont affecté une partie du matériel ont souvent fait disparaître, en effet, les fines structures des restes fossiles et les ont amenés à l'état de « fantômes ».

Par ailleurs, certains échantillons ayant déjà été utilisés par A. Silvestri pour son travail de 1935, étaient de taille réduite et ne nous ont livré qu'un très petit nombre de spécimens utilisables.

Dans la brève analyse qui va suivre nous procéderons par gisements.

1) Gisements des gorges de la Bulola

a) ECHANTILLON 55 AD – 98 (Gorges de la Bulola. Hindu Kush) — Calcaire marneux noir, pétri de Fusulinidés de grande taille appartenant tous à la même forme, malheureusement en mauvais état de conservation. Les caractères observables permettent de les rattacher à:

Polydiexodina afghanensis Thompson 1946

1909 *Fusulina elongata* Hayden. *Fusulinidae Afghanistan*, pp. 247-248, pl. 17, fig. 3-5.
1946 *Polydiexodina afghanensis* Thompson. *Afghanistan*, pp. 150-152, pl. 24, fig. 1-6; pl. 26, fig. 1-7.

Coquille allongée suivant l'axe d'enroulement, sensiblement cylindrique, aux extrémités arrondies. Chez les formes jeunes, elle est renflée dans sa partie centrale, les extrémités étant plus aigües.

Nombre de tours égal à 10; la longueur d'un spécimen moyen est de 16 mm pour un diamètre de 4,4 mm. La hauteur des tours est constante à partir du second.

Proloculum très grand, atteignant jusqu'à 1 mm. Sphérique chez certains individus, il est le plus souvent de forme extrêmement irrégulière, provoquant corrélativement une déformation du premier tour, dont les cloisons sont peu nombreuses et peu ondulées. La déformation peut être encore sensible dans le second tour où, toutefois, les cloisons montrent une régularité beaucoup plus grande. L'ondulation des cloisons est très poussée et régulière dans les tours suivants, déterminant un grand nombre de tunnels.

b) ECHANTILLON 55 AD – 98 bis (Entre les gorges de la Bulola et le col de Shibar) — Calcaire organodétritique à nombreux débris d'organismes (Algues du genre *Mizzia*, *Cribrostomum*) et une riche faune de Fusulinidés,

dont *Neoschwagerina craticulifera*. Thompson (1946) a décrit dans ces niveaux *N. craticulifera haydeni* Doutkevitch et Khabakov. La seule coupe que nous possédions étant mal orientée, il nous est impossible de dire si nous avons affaire ici à la même variété.

Yangchienia haydeni Thompson 1946

Pl. 19, fig. 4

1946 *Yangchienia haydeni* Thompson. *Afghanistan*, pp. 146-147, pl. 23, fig. 5-11.

Individus très abondants, dont nous avons rencontré de nombreuses sections obliques. La seule coupe centrée que nous ayons obtenue montre les caractères suivants:

Coquille de petite taille, allongée suivant l'axe d'enroulement, de forme sensiblement losangique en coupe axiale.

Nombre de tours égal à 7, pour un diamètre de 0,82 mm.

Proloculum de petite taille. Les deux premiers tours, constituant le *juvenarium*, ont un enroulement extrêmement serré, dont l'axe est pratiquement perpendiculaire à l'axe d'enroulement des tours adultes suivants. La hauteur de ces derniers croît régulièrement.

Chomatas très développés, doublant pratiquement la spirothèque sur toute sa longueur; notre forme se rapproche ainsi beaucoup plus de l'échantillon fig. 7 de Thompson que de l'holotype. Les chomatas encadrent à partir du troisième tour un tunnel unique, bien visible jusqu'au dernier tour.

Afghanella schencki Thompson 1946

Pl. 19, fig. 1, 2.

1909 *Neoschwagerina annae* Hayden. *Fusulinidae Afghanistan*, pp. 250-251, pl. 22, fig. 8-14.
1946 *Afghanella schencki* Thompson. *Afghanistan*, pp. 153-155, pl. 25, fig. 1-12.

Coquille de petite taille, allongée suivant l'axe d'enroulement, la longueur étant le double de la hauteur. La forme générale est assez convexe, à extrémités arrondies.

Les trois seuls exemplaires que nous ayons observés comptent 7 tours seulement; ils correspondent donc à des individus n'ayant pas atteint leur complet développement pour lequel ce nombre est de 9 à 10. La hauteur de ces tours va en croissant régulièrement.

Endosquelette très important. Les septulas transverses sont bien développés dès le début de l'enroulement, alors que les septulas axiaux n'apparaissent qu'avec la fin du deuxième tour, de même que les septulas transverses secondaires. Ceux-ci sont en alternance assez régulière avec les septulas transverses de premier ordre. Dans les derniers tours, toutefois, on rencontre fréquemment deux septulas secondaires intercalés entre les septulas transverses primaires.

Verbeekina verbeeki (Geinitz) 1876

Pl. 19, fig. 3

? 1909 *Schwagerina princeps* Hayden. *Fusulinidae Afghanistan*, pl. 19, fig. 1-6.

Coquille sphérique mesurant au huitième tour 2,5 mm de diamètre.

Proloculum très petit. L'enroulement est d'abord très serré jusqu'au troisième tour, puis la hauteur croît régulièrement jusqu'au huitième. La portion conservée du neuvième tour a, par contre, la même hauteur que le huitième.

Test mince. L'épaisseur peut cependant varier, croître ou décroître dans des proportions allant du simple au double, dans le même tour. Cette particularité peut être observée sur la figure 3, pl. 19 en ce qui concerne le sixième tour (le deuxième à partir de l'extérieur).

Chomatas petits, bien développés à partir du septième tour.

Des diverses espèces reconnues dans l'échantillon 55 AD - 98 bis, certaines: *Neoschwagerina craticulifera*, *Yangchienia haydeni*, *Afghanella schencki* ont déjà été citées dans la même région par Thompson. *Verbeekina verbeeki*, par contre, ne figure sur sa liste qu'avec un point d'interrogation et au titre de récolte antérieure (Hayden). Notre savant confrère, en revanche, a décrit, des mêmes gisements que nos espèces, *Polydiexodina afghanensis* que nous n'avons pas retrouvée.

L'association *Neoschwagerina-Verbeekina* est propre au domaine mésogéen où elle caractérise le Permien supérieur. Les Polydiexodines, elles, sont des formes nord-américaines du Capitanien. La découverte d'un représentant de ce genre dans les mêmes horizons que des faunes typiquement mésogéennes constitue donc un élément de corrélation important pour l'étude comparée du Permien américain et asiatique. Nos observations ne nous permettent pas, malheureusement, d'apporter à ce sujet des arguments positifs nouveaux.

2) Gisements du Karakorum

a) ECHANTILLON 29 KD – 252 (Moraine près du camp V Concordia - Glacier du Baltoro) et 54 PZ – 160 (Moraine à droite de l'Alto Baltoro) — Calcaires blancs très recristallisés. Les fines structures des fossiles ont le plus souvent disparu.

Hemigordiopsis renzi Reichel 1945

Pl. 19, fig. 10

1945 *Hemigordiopsis renzi* Reichel. *Île de Chypre*, pp. 524-528, fig. 1-2.

Coquille grossièrement sphérique, de 2,6 mm de diamètre, présentant quelques irrégularités aux extrémités de l'axe d'enroulement. La recristallisation a effacé la plupart des limites entre les divers tours. Seule subsiste, bien visible, la lumière de la coquille colorée en noir par de la matière organique.

L'embryon montre 6 tours au moins, enroulés en peloton. L'enroulement se fait ensuite autour d'un axe. En même temps, le test très homogène, formé de petits cristaux de calcite, prend une grande épaisseur. Dans les parties observables, la lumière n'occupe alors que le sixième de l'épaisseur de chaque tour, la couche externe du test en représentant à elle seule la moitié.

Dans le gisement type, à Chypre, l'espèce est associée à des Fusulinidés de la partie supérieure du Permien moyen.

b) ECHANTILLON 29 KD – 253 (Camp face au glacier Staghar - Vallée de la Shaksgam) — Calcaire sublithographique de couleur crème, contenant quelques Fusulinidés, appartenant tous à la même espèce:

Paraschwagerina sp.

Pl. 19, fig. 5-7

? 1935 *Fusulina uralica* Silvestri. *Caracorum*, pp. 87-91, pl. I, fig. 1-4; pl. II, fig. 2, 3.

Coquille d'assez grande taille, globuleuse chez le jeune, devenant beaucoup plus fusiforme au fur et à mesure de la croissance.

Nombre de tours égal à 6,75 chez l'individu le plus développé que nous possédions (fig. 5). Comme l'indiquent les valeurs ci-dessous, la hauteur des

tours croît régulièrement, pour diminuer à partir de la deuxième moitié du sixième tour, ce qui laisse entendre que la coquille atteint alors un stade sénile:

Dimensions — Hauteur du Ier tour 0,100 mm
2me — 0,216
3me — 0,391
4me — 0,458
5me — 0,641
6me — 0,525
7me — 0,341.

Proloculum de grande taille (0,308 mm).

Ouverture buccale médiane, bien visible dans les deux premiers tours. Sa hauteur est environ la moitié de la hauteur totale de la loge.

Lame spirale mince, augmentant lentement et progressivement d'épaisseur. Cloisons assez fortement ondulées.

Le petit nombre d'individus que nous avons eu à notre disposition – 4 au total – ne nous a pas permis une étude détaillée de cette forme dont l'attribution générique, elle-même, peut prêter à discution.

Par la forme générale, la minceur de la lame spirale, le mode d'enroulement régulier et lent des tours, le plissement assez accentué des cloisons, nos coquilles offrent, en effet, des caractères de Paraschwagérines. Mais leur proloculum de grande taille et leur juvenarium massif à tours peu nombreux les rapprochent étroitement des Pseudoschwagérines. Suivant, en somme, que l'on considère séparément l'adulte ou le jeune on peut être tenté de ranger nos fossiles dans l'un ou l'autre de ces deux genres, ou d'en faire un genre nouveau. N'ayant pas des éléments suffisants pour trancher, nous avons admis provisoirement qu'il s'agissait d'une *forme macrosphérique de Paraschwagerina.*

c) ECHANTILLON 29 KD – 257 (Un peu en amont de l'embouchure de la Bya Lungma). Calcaire gréseux.

Parafusulina shiptoni Dunbar 1940

Pl. 19, fig. 8, 9

1935 *Fusulina wanneri* Silvestri. *Caracorum*, pp. 96-97, pl. III, fig. 1-3.
1940 *Parafusulina shiptoni* Dunbar. *Karakorum*, pp. 1-4, pl. I, fig. 1-7.

Coquille très allongée, cylindrique, aux extrémités arrondies.

Axe d'enroulement assez irrégulier. Le spécimen figuré montre sept tours, correspondant à un diamètre de 2,6 mm pour une longueur de 16 mm.

Proloculum de petite taille (0,25 mm), à partir duquel la hauteur des tours croît régulièrement.

Cloisons très plissées sur toute la longueur de la coquille. Des cuniculi ont pu être observés en coupe tangentielle. Tunnel unique. Axial filling extrêmement développé, débutant dès le deuxième tour. De forme irrégulière, son extension va dans l'ensemble en augmentant, au fur et à mesure qu'on se rapproche des extrémités.

Les Parafusulines se rencontrent, en Amérique, du Permien moyen à la partie inférieure du Permien supérieur (Wordien). Dunbar quant à lui, voit dans son espèce une forme évoluée qu'il rattache soit à la partie supérieure du Permien moyen, soit au Wordien. Le contexte stratigraphique étant mal connu, il est impossible à l'heure actuelle de fixer un âge plus précis.

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Manuscript revised 30 January 1964.

PERMIAN FOSSILS OF THE UPPER HUNZA VALLEY

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INTRODUCTION

The paleontologic material which forms the subject of this study was collected in 1962 by E. Martina and R. Galimberti during the geologic exploration conducted by Prof. A. Desio in the upper basin of the Hunza River, north of the Batura Glacier in the Western Karakorum (1).

The fossils are represented by Brachiopods, Pelecypods and Bryozoans and by Foraminifera, which were examined by I. Premoli Silva (2).

So far as we are aware no paleontologic studies of the area under examination exist and geologic data are also very limited. The first to carry out studies of this kind was MacMahon who, in 1900 elaborated the notes submitted to him by Officers of the Indian Army and also studied a few samples of rock.

In 1916 Hayden, after having explored the region, put forward a rather superficial description of the types of rock met with along the route. On page 299 of his work the author refers to the limited area in which the fossils now being studied were found, and points out that 3 miles before reaching

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(1) I would like to thank Prof. C. Rossi Ronchetti, director of the Institute of Paleontology of Milan University, for her constant help during the preparation of this work.

(2) I. Premoli Silva, *Permian Foraminifera of the Upper Hunza Valley*, p. 89 to 125 of this volume.

Misgar the hills are formed by limestones which can certainly be attributed to Upper Paleozoic since they seem to correspond extremely well to those of the Chinese Turkestan and Russian Pamirs. In the vicinity of the above mentioned village he also came across limestone with *Spirifer* and small Bryozoans.

Later, in 1928, Kuenen illustrated the samples of rock collected in 1925 by the Visser expedition and recently, 1957, Schneider worked on the geological problems of this region which he explored during 1954 when following the Austro-German expedition.

In 1956, following an exploration which took place in Pakistan during 1951, Ivanac, Traves and King published a geological report on the region situated north-west of Gilgit. In this connection they also mention the information given by Clark the American geologist, who in 1948 more or less followed the same route taken by Hayden and collected fossils at Khaibar, Misgar and Shimsal. These fossils were examined by the United States National Museum and, although no list was published, they have been considered as belonging to the Upper Carboniferous or Lower Permian.

The fossils collected in 1951 have on the other hand been studied by Dickins and according to the above-mentioned Authors they have confirmed the Darband and Khaibar Nala localities as being Permian whilst for the Sandhi locality they suggest the Upper Carboniferous or Permian.

Appendix B to the forementioned study in fact contains J. M. Dickins's report on the results of his studies; he specifies: *Fusulinidae* gen. et. sp., *Fenestella* sp. C, *Streblotrypa*? sp., *Rugosa* gen. B sp., *Orthotetidae* gen. ind., *Pelecypoda*? gen. ind. as having been identified at Khaibar Village at the junction of Khaibar Nala and the Hunza River.

The fauna « would suggest that the beds are of a Lower Permian age, possibly older than those of Locality 1 ». This latter locality is in correspondence to Darband Village, 3 miles north of Darkot, Yasin Valley.

The data collected during the above-mentioned Desio expedition are the subject of detailed and exhaustive study at the Institutes of Geology and Paleontology of Milan University.

Detailed examination of the fossiliferous localities

The fossils which have been examined come from the lower Chapursan Valley and from the lower Abgarch Valley where the Gircha Formation was

individualized. This is a formation which is mostly formed of arenaceous schists, brown and black clayey schists with slight dark grey dolomitic limestone intercalations in rather thin but well defined layers especially in the higher zone and light quartz sandstone in the lower zone.

The macrofossils come from only two localities; one in the Abgarch Valley and the other in the Chapursan Valley between Khudabad and Raminj, where the two localities which produced *Foraminifera* are also situated.

1. *Abgarch Valley* — The fossiliferous samples found in this locality were not collected in situ but from the right hand side of the stream running through the Abgarch Valley, approximately 300 m east of Mor Khun; they come from the Gircha Formation. Although the fossils are numerous, the fauna does not appear to be particularly rich in species; however, specially amongst the Brachiopods, each species is represented by a good number of specimens. On the other hand the Pelecypods and the Bryozoans are generally represented by a single specimen per species. The species identified are as follows:

Fenestrellina cf. *perelegans* (Meek)
Cancrinella cancriniformis (Tschernyschew)
Neospirifer fasciger nitiensis (Diener)
Elivina tibetana (Diener)
Edmondia sp. ind.
Parallelodon desioi sp. n.
Pseudomonotis sp. ind.
Schizodus sp. ind.
Ditomopyge ? *middlemissi* (Diener)

If one excludes those forms which have been identified only generically, those determined by comparison, and also the newly established species, only the following can be utilized in establishing the age of the samples: *Cancrinella cancriniformis* (Tschernyschew), *Neospirifer fasciger nitiensis* (Diener), *Elivina tibetana* (Diener) and *Ditomopyge* ? *middlemissi* (Diener). The first three of these species have a fairly extensive distribution as they have been recorded in the Permian, in the « Permo-Carboniferous » and also in the Uralian. It is however important to note in this respect that the genus *Elivina*, according to Sarytcheva's Russian treatise (page 270), schould belong exclusively to the

Lower Permian. Lastly *Ditomopyge ? middlemissi* (Diener) has been recorded only in the Chitichun Permian and in the Upper Artinskian in the Shaksgam Valley. It is therefore quite probable that the outcrop in which these fossils appear can be attributed to the Permian and more precisely to the Lower Permian.

2. *Chapursan Valley* — This second locality is to be found in the Chapursan Valley, on the right slope along the road which leads from Khudabad towards Raminj. After 3 or 4 miles the road rises up to a terrace situated at approximately 80 m above the river, in Hajashitk locality. At the northern end of this terrace big fossiliferous blocks are to be found which originate from the outcrops higher up.

The species here identified are the following:

Neochonetes carboniferus (Keyserling)
Linoproductus lineatus (Waagen)
Elivina tibetana (Diener)

Distribution of these three species extends from the « Permo-Carboniferous » to the Permian. However, here too we meet with a representative of the genus *Elivina, Elivina tibetana* (Diener), and one can make the same remarks as made for the previously described locality. One may therefore conclude that this outcrop can be attributed to the Permian and perhaps to the Lower Permian.

The most frequent species appears to be, without doubt, the *Neochonetes carboniferus* (Keyserling); only three specimens have in fact been referred to *Elivina tibetana* (Diener) and two to *Linoproductus lineatus* (Waagen).

Only eleven species have been identified, and for three of these a specific identification has not been possible. For this reason it is obvious that comparison with faunas from other localities has a very limited significance. Certain affinities seem however to link the fauna here examined with the fauna from the Murgo region and Sasir Pass which was collected by the Visser expedition and studied by Renz during 1939/1940. The localities mentioned have the following species in common with ours: *Fenestrellina perelegans* (Meek), *Cancrinella cancriniformis* (Tschernyschew), *Neospirifer fasciger nitiensis* (Diener) and *Elivina tibetana* (Diener).

Renz has recorded in the Shaksgam Valley these forms too: *Fenestrellina perelegans* (Meek), *Cancrinella cancriniformis* (Tschernyschew), *Elivina tibetana* (Diener) and *Ditomopyge ? middlemissi* (Diener).

Renz places the age of all the outcrops in which the species mentioned here are found from the Lower Uralian to the Upper Artinskian; these are considered by A. as corresponding to the Lower and Middle Permian.

Merla, who studied the fossils collected by the De Filippi expedition, describes a very rich fauna which, however, has only the following in common with ours: *Elivina tibetana* (Diener) (named by him *Spirifer tibetanus* var. *lata* Merla and *Spirifer tibetanus* var. *occidentalis* Schellwien) and *Cancrinella cancriniformis* (Tschernyschew), both from the Rimu region.

A comparison can be also made with the fauna from Baroghil Ailak I (Chitral), which was examined in 1925 by Reed. This fauna presents a greater number of species than ours. Species in common with ours: *Cancrinella cancriniformis* (Tschernyschew), *Linoproductus lineatus* (Waagen) (named by the author *Productus cora* d'Orbigny var. *lineatus* Waagen) and some forms of *Spirifer*, such as *Spirifer* (*Spiriferella*) *rajah* Salter, similar to our *Elivina tibetana* (Diener).

PALEONTOLOGICAL DESCRIPTIONS

BRYOZOANS

Family FENESTRELLIDAE King 1850

Gen. **Fenestrellina** d'Orbigny 1849

Fenestrellina cf. perelegans (Meek) 1872

1872 *Fenestella shumardi* Meek. *Nebraska*, p. 153, pl. 7, fig. 3.
1872 *Fenestella perelegans* Meek. *Ibidem*, p. 153.
1885 *Fenestella perelegans* Waagen. *Salt Range*, p. 777, pl. 87, fig. 1-3.
1939 *Fenestrellina* cf. *perelegans* Renz. *Karakorum*, p. 10.
1940 *Fenestrellina perelegans* Renz. *Karakorum*, p. 123.
1948 *Fenestrellina perelegans* Branson. *Index Permian Invertebrates*, p. 246, *(cum syn.)*.

Small fragment of a not very well preserved colony. Thin branches of constant thickness; dissepiments thinner than the branches.

Rectangular fenestrules, with rounded corners: numbering 8 on a 5 mm transversal direction. The state of preservation prevents us from seeing the apertures, however a keel seems to be visible.

Occurrence — The *F. perelegans* (Meek) has been found in the Upper Carboniferous and Lower Permian of Nebraska; in the Middle *Productus* Limestone of the Salt Range; in the *Fusulina* Limestone of Japan and in the Upper Uralian of the Karakorum Range.

Locality — Abgarch Valley. 62 PG - 30.

BRACHIOPODS

Family CHONETIDAE Hall & Clarke 1895

Subfamily CHONETINELLIDAE Muir-Wood 1962

Gen. **Neochonetes** Muir-Wood 1962

Neochonetes carboniferus (Keyserling) 1846

1846 *Chonetes sarcinulatus* var. *carbonifera* Keyserling. *Petschoraland*, p. 215.
1928 *Chonetes carboniferus* Chao. *China*, p. 13, pl. 1, fig. 19-22.
1931 *Chonetes sarcinulata* Ozaki. *China*, p. 97, pl. 9, fig, 17, 18.
1948 *Chonetes carboniferus* Branson. *Index Permian Invertebrates*, p. 306 (*cum syn.*).
1962 *Neochonetes carboniferus* Muir-Wood. *Chonetoidea*, p. 87.

Several small sized specimens, preserved as external moulds, more or less embedded in the rock.

Pedicle valve, more wide than long, semi-circular in outline, fairly convex in both directions, never depressed in the centre. Straight hinge, equal to the greatest width. Well developed umbo, projecting slightly beyond the hinge.

Semi-circular brachial valve, almost flat or slightly convex.

Ornaments of capillae increasing in number by bifurcation.

Dimensions — length 10,5 mm; 11 mm; 15,5 mm
width 13 mm; 15,5 mm; 16,5 mm

Remarks — Muir-Wood, in his recent study (page 87) on the *Chonetoidea* also includes *Ch. carbonifera* Keyserling in his new genus *Neochonetes*.

Occurrence — The *N. carboniferus* (Keyserling) has been found in the Permian of Petschoraland, Donetz Basin (Russia); in the Permo-Carboniferous of China and in the Auernig Beds of the Carnic Alps.

Locality — Hajashitk. Chapursan Valley. 62 PM - 45.

Family LINOPRODUCTIDAE Stehli 1954

Gen. **Linoproductus** Chao 1927

Linoproductus lineatus (Waagen) 1884

Pl. 20, fig. 6,7

1884 *Productus lineatus* Waagen. *Salt Range*, p. 673, pl. 66, fig. 1, 2; pl. 67, fig. 3.
1897 *Productus lineatus* Diener. *Chitichun*, p. 14, pl. 4, fig. 2-5.
1903 *Productus lineatus* Diener. *Central Himalayas*, p. 138, pl. 7, fig. 1.

1927 *Linoproductus lineatus* Chao. *Productidae of China*, p. 129, pl. 15, fig. 27, 28.
1939 *Linoproductus lineatus* Renz. *Karakorum*, p. 25, pl. 3, fig. 8, 9.
1948 *Linoproductus lineatus* Branson. *Index Permian Invertebrates*, p. 392 (*cum syn.*).

2 pedicle valves, one of which is well preserved.

Pedicle valve, suboval in outline; high and extremely curved umbo, slightly projecting beyond the hinge; poorly developed and slightly flattened ears; venter hardly convex. Ornaments of thin costellae separated by slightly wider intercostal sulci.

Occurrence — The *L. lineatus* (Waagen) has been found in many localities, in the *Productus* Limestones of the Salt Range, Laos, Indochina; in the Permian of Chitichun Pass (India), Russia, Sumatra; in the Permo-Carboniferous of Tianschan Range, Iran and Karakorum Range; in the Jisu-Honguer Limestone (Mongolia) and in the Auernig Beds of the Carnic Alps.

Locality — Hajashitk, Chapursan Valley. 62 PM – 45.

Gen. **Cancrinella** Fredericks 1928

Cancrinella cancriniformis (Tschernyschew) 1889
Pl 20, fig. 8

See following study, page 190 for synonymy and description.

8 specimens, sometimes slightly deformed, always incomplete, represented by 5 pedicle valves and 3 brachial valves, besides numerous fragments.

Locality — Abgarch Valley. 62 PG – 30.

Family SPIRIFERIDAE King 1846

Subfamily SPIRIFERINAE King 1846

Gen. **Neospirifer** Fredericks 1924

Neospirifer fasciger nitiensis (Diener) 1897
Pl. 20, fig. 1

1897 *Spirifer nitiensis* Diener. *Kumaon and Gurhwal*, p. 41, pl. 4, fig. 4, 5.
1903 *Spirifer nitiensis* Diener. *Central Himalayas*, pp. 106, 188, pl. 4, fig. 6, 7.
1931 *Spirifer fasciger* var. *nitiensis* Reed. *Salt Range*, p. 20, pl. 4, fig. 10,11.
1939 *Spirifer fasciger* var. *nitiensis* Renz. *Karakorum*, p. 35.
1948 *Neospirifer fasciger nitiensis* Branson. *Index Permian Invertebrates*, p. 427 (*cum syn.*).

2 pedicle valves and some fragments, doubtfully attributable to the species under examination.

Rather large-sized; the only almost complete valve has a hinge approximately 70 mm wide.

Pedicle valve more wide than long, extremely convex in the longitudinal direction. Umbo slightly projecting beyond the hinge; median sulcus narrow and deep posteriorly; very wide and hollowed out anteriorly; the front of the sulcus is 14 mm wide.

Very characteristic ornaments, consisting of fascicles, each with 3-4 plications; the central plication is always more prominent than the lateral plications, except in the two fascicles which border the median sulcus. At the two wings the plications are all alike and the fascicles are no longer distinguishable. A rather weak plication can be seen at the centre of the median sulcus, accompanied by two plications which soon part by dichotomy.

Interarea, visible in only one specimen, sub-rectangular, with a large delthyrium.

Occurrence — The *N. fasciger nitiensis* (Diener) has been found in the Permian of Niti Pass, Spiti, Kashmir, Johar, Punjab (India) and Siberia; in the Uralian of the Karakorum Range.

Locality — Abgarch Valley. 62 PG - 30.

Gen. **Elivina** Fredericks 1924

Elivina tibetana (Diener) 1897
Pl. 20, fig. 2-5

1897 *Spirifer tibetanus* Diener. *Chitichun*, p. 45, pl. 6, fig. 1-7.
1900 *Spirifer occidentalis* Schellwien. *Trogkofel*, p. 76, pl. 2, fig. 10-13.
1902 *Spirifer tibetanus* Tschernyschew. *Ural und Timan*, p. 539, pl. 7, fig. 2-6.
1903 *Spirifer tibetanus* Diener. *Central Himalayas*, pp. 17, 81.
1934 *Spirifer tibetanus occidentalis* Merla. *Caracorum*, p. 229, pl. 21, fig. 20-22.
1934 *Spirifer tibetanus* var. *lata* Merla. *Ibidem*, p. 230, pl. 21, fig. 25.
1939 *Spirifer tibetanus* Renz. *Karakorum*, p. 36.
1940 *Spirifer tibetanus occidentalis* Renz. *Karakorum*, p. 187, pl. 6, fig. 4, 8.
1940 *Elivina tibetana* Branson. *Index Permian Invertebrates*, p. 356 (*cum syn.*).

A number of specimens, always more or less incomplete, sometimes fairly large, represented by the pedicle valves only.

Pedicle valve, more long than wide. The best preserved specimen is 29 mm wide and 44 mm long. Shorter forms can also be found as Diener

has already mentioned. A pointed umbo very projecting beyond the hinge, interarea not visible; hinge short. Median sulcus extended from the umbo's apex to the front, starting narrow and deep, wide and slightly hollow anteriorly.

Ornaments of plications very prominent posteriorly, less prominent along the front and the flanks. At the centre of the median sulcus there is a very thin plication and a wide furrow on each side. The median sulcus is delimited by two strong plications, which part by dichotomy once in the apex region and secondly near the front. The valve's lateral regions are ornamented by 6 plications which anteriorly continue to widen and become further apart and less prominent. These plications very seldom separate.

Occurrence — The E. *tibetana* (Diener) has been found in many localities; in the Permian of Chitichun Pass (India), Malla Sangcha, Karakorum Range, China, Timor; in the *Schwagerina* Limestone of Russia; in the *Fusulina* and Trogkofel Limestone of the Karawanken Range and in the Permo-Carboniferous of the Tianschan Range.

Localities — Abgarch Valley. 62 PG – 30. – Hajashitk, Chapursan Valley. 62 PM – 45.

PELECYPODS

Family GRAMMYSIIDAE Fischer

Gen. **Edmondia** de Koninck 1842

Edmondia sp. ind.

Pl. 20, fig. 12

An only specimen exists, represented by the right valve only, with traces of shell.

A very inequilateral valve, transversally elliptical, more long than high, with a height/length ratio = 0,51. Prominent umbo, placed approximately at 1/4 of the length of valve, prosogyral, with a not preserved apex. Anterior margin, short, very convex; ventral margin very wide, regularly curved, slightly off pitch at the anterior top; posterior margin convex and postero-dorsal margin long and rectilineal.

The ornaments seem to consist only of thin growth lines.

Dimensions — height 11 mm
length 21,3 mm
thickness 4,5 (?) mm

Remarks — The specimen examined may be compared with *Edmondia unioniformis* Phillips, as given by Rakusz (1932, p. 96, pl. IV, fig. 25). However, such affinity cannot be remarked if we examine the specimen figured at pl. V, fig. 9 of the same work and referred to the same species.

Edmondia unioniformis Phillips usually is more rounded in outline, in particular anteriorly, and somewhat higher in posterior part.

Locality — Abgarch Valley. 62 PG – 30.

Family PARALLELODONTIDAE Dall

Gen. **Parallelodon** Meek & Worthen 1866

Parallelodon desioi sp. n.

Pl. 20, fig. 9, 10

2 specimens, one represented by a well preserved left valve (holotype), the other by a very incomplete right valve.

Holotype — Strongly inequilateral valve, elongated, sub-trapezoidal in outline. Considerable convexity with maximum curvature placed at 1/3 of the valve's length. Stocky umbo, wide and short, sufficiently projecting beyond the hinge, with apex at approximately 2/5 of the length. Anterior margin short and convex; ventral margin very long and not very curved, meeting at an acute angle with the posterior margin, almost straight and strongly inclined towards the hinge. Dorsal margin long and straight, less than the maximum length of the valve. Cardinal area not visible.

Ornaments of radial riblets, approximately 44 near the ventral margin, roundish, rather infrequent, increasing by intercalation, separated by wider intervals. A few concentric rugae, wide and flat, appear in the posterior region near the margin. In certain limited zones very faint growth lines passing over the riblets can also be seen.

Dimensions — height 13,5 mm
length 25 (?) mm
thickness 8,3 mm
length of the hinge line 21,5 (?) mm

Comparison — The specimens examined differ from the Permian species, attributed to the same genus, by their ornaments, and by absence of ventral sinus. The concentric ornament is in fact very accentuated in the other species and one often notices a reticulation. The *Parallelodon multistriatus* Girty seems

to be somewhat similar and in particular the specimen Reed referred to for comparison to this species (1927, p. 157, pl. 15, fig. 11). However the specimens of this species appear higher anteriorly, with the posterior portion more distinct from the rest of the valve and also much less convex.

Holotype — Collected by R. Galimberti (12/8/1962) and preserved in the Paleontology Institute of Milan University. Register-number P 1780.

Derivation of name — The specific name comes from the name of the Director of the expedition: Prof. A. Desio.

Horizon and locality — Gircha Formation — Lower Permian. Right hand side of the stream running through the Abgarch Valley, approximately 300 m east of Mor Khun.

Family PTERIIDAE Meck

Gen. **Pseudomonotis** Beyrich 1862

Pseudomonotis sp. ind.

Only one badly preserved specimen.

Very flat valve, probably more long than high, almost equilateral. Hinge line long and straight, equal to the valve's major length. The assembly of the other margins seems to form a semi-ellipsis. Umbo small and not very prominent.

Ornaments of radial costae, thin and slightly undulating, increasing by intercalation, separated by wider and flat intervals. Infrequent, well defined concentric rugae are visible along the margins.

Remarks — Our specimen can be compared with that described by Diener as *Pseudomonotis* sp. ind. (1915, p. 59, pl. VI, fig. 1), which, however, is more elliptical in outline and presents more developed concentric ornaments.

Locality — Abgarch Valley. 62 PG - 30.

Family TRIGONIIDAE Lamarck

Gen. **Schizodus** King 1848

Schizodus sp. ind.

Pl. 20, fig. 11

A small specimen, represented by the left valve only.

Slightly inequilateral valve, sub-triangular in outline, slightly more long than high. Roundish umbo, not very prominent, placed approximately at mid-length. Anterior margin rectilineal, meeting the ventral margin almost at

right angle; ventral margin moderately wide, but very convex; posterior margin almost entirely missing. Convexity displaced dorsally and anteriorly; posterior region more sloping.

The ornaments seem to consist of rather indistinct growth lines.

Remarks — Our specimen differs from the other species of the same genus in having the umbo almost central, rounded and not very projecting, and not very developed posterior part.

It can be compared with *Schizodus sandimanensis* Dickins from Western Australia (1963, p. 101, pl. 17, fig. 1-9), which however is distinguished by its more quadrate shape, more acute umbo, and more prominent posterior carina. Also *Schizodus wheeleri* Swallow as given by Tschernyschew (1914, p. 39, pl. 1, fig. 5) shows some similarities, however its umbo is more acute, and its posterior part is more elongate.

Locality — Abgarch Valley. 62 PG - 30.

TRILOBITES

Family PHILLIPSIIDAE Oehlert 1886

Gen. **Ditomopyge** Newell 1931

Ditomopyge? middlemissi (Diener) 1897

Pl. 20, fig. 13

1897 *Phillipsia middlemissi* Diener. *Chitichun*, p. 3, pl. 1, fig. 3.
1940 *Phillipsia* cf. *middlemissi* Renz. *Karakorum*, p. 241, pl. 13, fig. 4.

Only one pygidium, not complete.

Pygidial axis broad, convex, but flattened on top, projecting beyond the pleural fields, with 11 segments. Only one pleural field is visible, with 8 segments and with the large border defined by the wide border furrow. The surface shows smooth.

Remarks — The species under examination was originally attributed to the *Phillipsia* genus, the distribution of which results to be at present limited to the Lower Carboniferous. After a careful examination of the few genera present in the Permian, the Diener species has been referred, in this study, to the genus *Ditomopyge* Newell 1931. The attribution however remains uncertain because of this species, only the *pygidium* is known.

Occurrence — The *D. ? middlemissi* (Diener) has been found in the Permian of Chitichun Pass (India) and in the Upper Artinskian of Shaksgam Valley (Karakorum).

Locality — Abgarch Valley. 62 PG - 30.

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Manuscript revised 20 April 1964.

PERMIAN FOSSILS OF THE SHAKSGAM VALLEY

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INTRODUCTION

The fossils that have been examined were collected by Prof. A. Desio along the Shaksgam Valley, during the 1929 Italian expedition to the Karakorum and were previously the subject of a short preliminary note by G. Merla (1935).

This work is dedicated to the complete description of the fauna, after careful examination of all material in hand. Determinations have been brought up to date after perusal of recent texts, whilst new determinations have been added, some of which have corrected determinations which proved to be imperfect and others based on specimens which at first were not taken into consideration (1).

PREVIOUS STUDIES

The first geological data regarding the Shaksgam Valley were collected by A. Desio, who in a paper written during 1930 re-wrote a series of geological and geographic notes which he had collected during the Karakorum expedition. He described the territory he had then visited and mentioned the localities in which the fossils which are now being described had been collected, indicating the outcrop as belonging to the Permo-Carboniferous period. The

(1) I should particularly like to acknowledge my debt to Dr. H. M. Muir-Wood for her much valued advice and to Prof. C. Rossi Ronchetti for her constant help during the preparation of this study.

fossils collected by Desio, as I have mentioned, were later examined by G. Merla, who in a preliminary note written in 1935 gave the following separate lists of determinated species for the 4 fossiliferous localities (1):

I – CAMP STAGHAR GLACIER FRONT — *Schizophoria* sp. ind., *Productus cancriniformis*? Tschernyschew, *Marginifera typica* Waagen var. *elongata* Huang, *Marginifera* cf. *gobiensis* (Chao), *Krotovia* cf. *pustulata* Keyserling, *Productus* cf. *humboldti* d'Orbigny, *Productus semireticulatus* Martin, *Productus spiralis* Waagen, *Productus fasciatus* Kutorga, *Productus mongolicus* Diener, *Productus* aff. *fasciatus* Kutorga and *elegans* Mc Coy, *Uncinulus timorensis* Beyrich, *Camarophoria purdoni* Davidson, *Camarophoria* aff. *crumena* Martin, *Camarophoria* cf. *pinguis* Waagen, *Terebratuloidea* cf. *davidsoni* Waagen, *Reticularia lineata* Martin, *Spirifer fasciger* Keyserling (or *musakeilensis* Davidson), *Spirifer* n. sp. aff. *siculus* Gemmellaro, *Enteletes* aff. *contractus* Gemmellaro, *Enteletes* cf. *waageni* Gemmellaro, *Enteletes tschernyscheffi* Diener, *Enteletes* cf. *acuteplicatus* Waagen, *Enteletes* cf. *subaequivalvis* Gemmellaro, *Enteletes meridionalis* Gemmellaro, *Orthotichia morgani* Derby, *Dielasma* n. sp. aff. *biplex* Waagen.

II – SHAKSGAM VALLEY, east side, approximately 4 km below Kyagar glacier — Forms similar to *Geinitzella columnaris* (Schlotheim), *Derbyia regularis* Waagen.

III – SLIGHTLY ABOVE THE SINGHIÉ GLACIER — *Productus* aff. *abichi* var. *punjabiensis* Cowper Reed, *Spinomarginifera* sp. ind., *Spirifer* aff. *trigonalis* Martin, *Chonetes* aff. *Chonetes* sp. ind. Cowper Reed.

IV – NEAR TO THE GASHERBRUM GILGA « SIGNAL CAMP » — *Productus cancriniformis* Tschernyschew, *Productus pseudoirginae* Huang, *Productus gratiodentalis* Grabau, *Productus rimuensis* Merla, *Marginifera typica* Waagen var. *septentrionalis* Tschernyschew, *Chonetes trapezoidalis* Waagen, *Spirifer sokolowi* Tschernyschew, *Spirifer psittacus* Merla, *Spirigerella* cf. *derbyi* Waagen var. *kweichowensis* Grabau, *Martinia uralica* Tschernyschew, *Martinia subtriquetra* Merla, *Martinia frechi*? Schellwien, *Martinia* cf. *semiconvexa* Chao, *Barrandeophyllum* sp. ind.

Based on the determined forms Merla concluded briefly with the following sentence « The series of Permian beds encountered is on the whole complete. In other words we are faced with a zone of uninterrupted sedimentation which stretches from the Uralian to the Lopingian ».

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(1) In this and the following schedule the various species are listed with the names given by the various Authors.

A few years later (1939) Renz and Reichel, presented the results obtained from their studies of the Paleozoic and Mesozoic fauna collected by the Visser expedition to the Karakorum and in the bordering territories during 1929/30 and 1935. We are particularly interested in the paleontologic data supplied for those parts of the Shaksgam Valley previously mentioned by Desio, which the Aa's believe to be of an age between the Lower Uralian and Upper Artinskian. The forms that they defined, subdivided as to age and locality, are the following:

LOWER URALIAN

XXXII locality, « Nordfuss P. 6252 m (20512 f) E Shaksgam-Pass » — *Productus semireticulatus* Martin, *Productus uralicus* Tschernyschew, *Productus* (*Linoproductus*) *simensis* Tschernyschew.

XXXV locality, « W Shaksgam-Pass » — *Productus uralicus* Tschernyschew, *Marginifera himalayensis* Diener, *Martinia nucula* Rothpletz, *Euomphalus* sp. Enderle.

XXXVI locality, « Shaksgam-Tal, bei der Schlucht » — *Marginifera himalayensis* Diener, *Martinia semiglobosa* Tschernyschew, *Spirifer tibetanus* Diener, *Temnocheilus* (*Metacoceras*) sp. ind.

XXXVIII locality, « E-Seite Kyagar-Gletscher » — *Productus intermedius* Abich var. *minor* Schellwien, *Productus* (*Krotovia*) sp. aff. *pustulatus* Keyserling, *Productus* (*Linoproductus*) *cora* d'Orbigny, *Productus* (*Linoproductus*) *simensis* Tschernyschew, *Productus* (*Linoproductus*) *cancriniformis* De Terra, *Productus* (*Echinoconchus*) *elegans* McCoy, *Productus* (*Horridonia*) *incisus* Schellwien, *Marginifera schellwieni* Tschernyschew, *Camarophoria purdoniformis* Grabau, *Pugnax elegans* Girty var., *Pugnax* cf. *elegans* Girty, *Pugnax* cf. *swallowiana* (Shumard ?), *Terebratuloides* sp. aff. *triplicata* (Kutorga), *Hustedia remota* Eichwald, *Athyris* sp. aff. *planosulcata* (Phillips), *Terebratula* (*Dielasma*) *elongata* (Schlotheim).

XXXIX locality, « Shaksgam Tal, zwischen Singhi-und Kyagar Gletscher » — *Productus* (*Linoproductus*) *cora* d'Orbigny, *Productus* (*Linoproductus*) *cancriniformis* De Terra [non Tschernyschew], *Productus* (*Echinoconchus*) *elegans* McCoy, *Marginifera himalayensis* Diener, *Spirifer tibetanus* Diener.

UPPER URALIAN

XXXIII locality, « Tal E Shaksgam Pass » — *Polypora* cf. *sykesi* (De Koninck).

XXXIV locality, « Tal E Shaksgam Pass » — *Derbyia senilis* (Phillips), *Derbyia*

cf. *eusarkos* (Abich), *Productus semireticulatus* Martin, *Productus* (*Linoproductus*) *cancriniformis* Tschernyschew, *Marginifera intermedia helica* (Abich) var. *shaksgamensis* nov. var. Renz, *Marginifera spinosocostata* (Abich), *Aviculopecten* (*Deltopecten*) sp. aff. *barboti* Licharew, *Aviculopecten*? sp. ind., *Allorisma* sp. aff. *sulcata* (Phillips), *Bakewellia antiqua* (Muenster), *Parallelodon* sp. ind., *Bellerophon* sp. aff. *jonesianus* Mansuy (de Koninck?), *Bellerophon* sp. ind., *Cylindritopsis* sp. aff. *ovalis* Gemmellaro, *Naticopsis* sp. ind.

XL locality, « E-Ufer Singhi-Gletscher » — *Polypora biarmica* Keyserling, *Polypora transiens* Waagen & Pichl, *Polypora* sp. ind., *Derbyia senilis* (Phillips), *Chonetes variolata* (d'Orbigny), *Chonetes* sp. ind. aff. *vishnu* Salter, *Productus* sp. ind., *Spirifer* sp. ind., *Dielasma timanicum* Tschernyschew, *Allorisma* sp. aff. *sulcata* (Phillips), *Pleurophorus*? sp. ind., *Sanguinolites*? sp. ind., *Allorisma* sp. ind., Gastropods ind., Pelecypods ind.

LOWER ARTINSKIAN

XXXII locality, « Nordfuss P. 6252 m (20512 f), E Shaksgam Pass » — *Parafusulina eurucaria* Schwager var. *karakorumensis* Merla.

UPPER ARTINSKIAN

XXXVII locality, « Shaksgam Tal, SE Kyagar Tso » — *Parafusulina visseri* n. sp. Reichel, *Parafusulina visseri* var. *lata* n. var. Reichel, *Parafusulina shaksgamensis* n. sp. Reichel, *Parafusulina japonica cincta* n. subsp. Reichel, *Parafusulina japonica* var. *densa* n. var. Reichel, *Parafusulina* cf. *kaerimizensis* (Ozawa), *Pseudofusulina* (? *Triticites*) aff. *subobsoletus* (Ozawa), *Parafusulina* aff. *chihsiaensis* (Lee), *Palaeofusulina* aff. *delicata* (Colani var.), *Yanchienia iniqua* Lee, *Schubertella simplex* Lange, *Endothyra* sp. ind., *Glomospira pusilla* Geinitz, *Calzitornella*, *Geinitzina*, *Pachyphloia* sp. ind., *Fenestella elusa* Reed, *Polypora* sp. ind., *Rhipidomella cora* (d'Orbigny), *Rhipodomella michelini* (Léveillé) mut. *orientalis* (Mansuy), *Schizophoria* cf. *supracarbonica* Tschernyschew, *Schizophoria juresanensis* Tschernyschew, *Enteletes obesa* Grabau, *Enteletes oehlerti* Gemmellaro, *Enteletes tschernyscheffi* Diener, *Enteletes tschernyscheffi* var. *darvasica* n. var. Renz, *Enteletes meridionalis* Gemmellaro var. *karakorumensis* n. var. Renz, *Meekella striatocostata* (Cox), *Meekella* (*Orthothetina*) *baschkirica* Tschernyschew, *Chonetes uralica* Moeller, *Chonetes sinuosa* Schellwien, *Chonetes* cf. *latesinuata* Schellwien, *Chonetella nasuta* Waagen, *Productus semireticulatus* Martin var. *transversalis* Tschernyschew, *Productus semireticulatus* Martin, *Pro-*

ductus uralicus Tschernyschew, *Productus inflatus* Tschernyschew (not Mc Chesney), *Productus gratiosus* Waagen, *Productus moelleri* Stuckenberg, *Productus moelleri* Stuckenberg var. *latus* Tschernyschew, *Productus pseudomedusa* Tschernyschew, *Productus* (*Linoproductus*) *cora* d'Orbigny var. *waagenianus* Girty, *Productus* sp. a (aff. *P. mexicanus* (Shumard?) White), *Productus* (*Linoproductus*) *koninckianus* Verneuil, *Productus* (*Linoproductus*) *keideli* n. sp. Renz, *Productus* (*Linoproductus*) *kayseri* (Chao), *Productus* (*Linoproductus*) *cancriniformis* Tschernyschew, *Productus* (*Echinoconchus*) *punctatus* Martin, *Productus* (*Echinoconchus*) *punctatiformis* (Chao), *Productus* (*Waagenoconcha*) *abichi* Waagen, *Productus* (*Waagenoconcha*) *abichi* Waagen mut. *cambodgiensis* Mansuy, *Productus* (*Juresania*) *juresanensis* Tschernyschew, *Productus* (*Dictyoclostus*) *margaritatus* Mansuy, *Productus* (*Striatifera*) *mytiloides* Waagen, *Productus* (*Horridonia*) *incisus* Schellwien, *Marginifera juresanensis* Tschernyschew, *Marginifera sintanensis* Chao, *Marginifera* cf. *involuta* Tschernyschew, *Marginifera spinosocostata* (Abich), *Aulosteges* cf. *dalhousii* Davidson, *Camarophoria superstes* (Verneuil), *Camarophoria mutabilis* Tschernyschew, *Camarophoria* sp. aff. *affinis* Gemmellaro, *Uncinulus* (*Uncinunellina*) *timorensis* (Beyrich), *Uncinulus* (*Uncinunellina*) cf. *timorensis* Broili (? Beyrich), *Rhynchonella hustediaformis* n. sp. Renz, *Rhynchonella*? n. sp. aff. *hoffmani* Krotow, *Spirifer liraeformis* Tschernyschew, *Spirifer liraeformis* Tschernyschew var. *elegantulus* n. var. Renz, *Spirifer fasciger* Keyserling var. *moosakhailensis* Davidson, *Spirifer* (*Neospirifer*) *wynnei* Waagen, *Spirifer tibetanus* Diener var. *occidentalis* Schellwien, *Squamularia asiatica* Chao, *Squamularia inaequilateralis* (Gemmellaro), *Squamularia rostrata* (Kutorga), *Squamularia dieneri* Gemmellaro, *Squamularia waageni* (Loczy), *Squamularia transversalis* n. sp. Renz, *Martinia corculum* (Kutorga), *Martinia semiplana* Waagen, *Martinia elegans* Diener, *Martinia sinuloba* n. sp Renz, *Martinia squamularioides* Huang var. *shaksgamensis* n. var. Renz, *Martiniopsis aschensis* Tschernyschew, *Ambocoelia planoconvexa* (Shumard), *Ambocoelia* n. sp. Renz, *Spiriferina multiplicata* (Sowerby), *Spiriferina cristata* Schlotheim var. *octoplicata* (Sowerby), *Spiriferina toulai* Gemmellaro, *Spiriferina margaritae* var. *dilatata* Gemmellaro, *Hustedia remota* (Eichwald), *Hustedia indica* (Waagen), *Athyris acutomarginalis* Waagen, *Terebratula* (*Dielasma*) *elongata* (Schlotheim), *Terebratula* (*Dielasma*) sp. ind., *Hemiptychina dieneri* Gemmellaro var. *quinqueplicata* n. var. Renz, *Notothyris nucleolus* (Kutorga), *Notothyris nucleolus* (Kutorga) var. *simplex* Waagen, *Notothyris*? *taveli* n. sp. Renz, *Notothyris*? *wyssi* n. sp. Renz, *Aviculopecten karakorumensis* n. sp. Renz, *Aviculopecten tristriatus* n. sp. Renz, *Aviculopecten* cf. *hiemalis* Mansuy (? Salter), *Aviculopecten* cf. *alternoplicatus* Chao, *Aviculopecten* n. sp. Renz, *Aviculopecten* sp. ind. a (aff.

samarensis Stuckenberg), *Aviculopecten* sp. ind. b, *Conocardium uralicum* (Verneuil), *Euchondria* (?) *engelhardti* Etheridge & Dunbar, *Streblopteria magnini* Mansuy, *Lima* cf. *striatoplicata* Chao, *Allorisma* cf. *elegans* King, *Edmondia* cf. *nyströmi* Chao, *Euomphalus* (*Phymatifer*) cf. *sumatrensis* Roemer, *Strobeus* cf. *elegans* Gemmellaro, *Capulus abundans* Wanner, *Luciella huangi* n. sp. Renz, *Trachydomia tubercolato-lineata* n. sp. Renz, *Phillipsia* cf. *middlemissi* Diener, *Phillipsia* sp. ind.

Critical examination of the fossil localities

Many problems are encountered in establishing the age of the outcrops from which the fossils under examination originate.

Firstly there is the old but not as yet definitely resolved problem of the Carboniferous-Permian boundary and of the position of the equally controversial Uralian. Previous studies of the Shaksgam Valley place the Uralian in the Lower Permian, following the proposition of Grabau (1931), whereas subsequent authors favour its inclusion in the Upper Carboniferous.

The problem of the Carboniferous-Permian boundary may have no direct bearing on the present paleontological study; there are however many other problems which arise when trying to establish the age of the various outcrops on the basis of correlation and comparison with similar previously described formations. In fact the age of these latter has often been disputed and is still unsettled on account of the discordant opinions of the various authors who have dealt with the subject. The general longevity of the species found in the formations constitutes the main obstacle to the solution of these problems. In this connection it must however be noted that the vast stratigraphical range attributed to many of the species is due to the incomplete knowledge of the identified fossils consequent upon their imperfect state of preservation. These fossils, mostly Brachiopods, are frequently incomplete with respect to trail, ears and internal structures, characters of paramount importance in reaching an accurate specific and generic identification. On the other hand, this point has already been made by Chao (1927), in connection with the widely distributed *Productus semireticulatus* Martin. This species, occurring in badly damaged condition, has now assumed a more limited stratigraphical meaning. In view of these remarks it is evident what difficulties are involved in distinguishing between the Upper Carboniferous and the Permian in the Shaksgam Valley on the basis of the fossils discovered.

I. CAMP STAGHAR GLACIER FRONT — This locality yielded the richest and best preserved fauna and in fact 42 of the 70 species completely identified were obtained from here.

These forms are embedded in a white aphanitic limestone, with fractures infilled by calcite.

The identified species are as follows:

Schizophoria sp., *Orthotichia morganiana* (Derby), *Enteletes dieneri* Gemmellaro, *E. dieneri darvasicus* Renz, *E.* cf. *elegans* Gemmellaro, *E. meridionalis* Gemmellaro, *E. subaequivalvis* Gemmellaro, *E. waageni* Gemmellaro, *Enteletina* cf. *acuteplicata* (Waagen), *Tschernyschewia typica typica* Stoyanow, *Marginifera* cf. *typica* Waagen, *M.* cf. *typica elongata* Huang, *Paramarginifera* cf. *gobiensis* (Chao), *P.* cf. *himalayensis* (Diener), *Echinoconchus fasciatus* (Kutorga), *E. punctatus* (Sowerby), *Waagenoconcha* cf. *abichi* (Waagen), *W. humboldti* (d'Orbigny), *Chaoiella gruenewaldti* (Krotow), *Costiferina spiralis* (Waagen), *Reticulatia moelleri* (Stuckenberg), *R.* cf. *transversalis* (Tschernyschew), *Linoproductus* sp., *Compressoproductus* sp., *Cancrinella cancriniformis* (Tschernyschew), *Uncinunellina timorensis* (Beyrich), *Terebratuloidea davidsoni* Waagen, *Stenoscisma biplicata* (Stuckenberg), *S. pinguis* (Waagen), *S. purdoni* (Davidson), *Stenoscisma* sp., *Neophricodothyris asiatica* (Chao), *Elivina* cf. *tibetana tenuisulcata* (Merla), *Purdonella merlai* sp. n., *Neospirifer fasciger* (Keyserling), *Martinia* cf. *glabra* (Sowerby), *M.* cf. *semiplana* (Waagen), *Martinia* sp. II, *Whitspakia* cf. *biplex* (Waagen), *Hemipthychina* cf. *carniolica* Schellwien, *Gastrioceras*? sp.

The range of each species listed is rather wide, if all of the identifications made are considered to be valid.

A sufficiently precise indication of the age of this fauna can be deduced from the distribution pattern of the genera to which the respective species belong. According to Sarytcheva et al. (1960) the genera *Tschernyschewia*, *Neophricodothyris*, *Elivina* and *Purdonella* would be exclusively Permian. Similar ranges can be observed also for the genera *Paramarginifera* and *Costiferina* which appear in the treatise on *Productoidea* by Muir-Wood and Cooper (1960) but are however not mentioned in the Russian work. Also Stehli's new genus *Whitspakia* — to which belong some species from the *Productus* Limestone of the Salt Range (Pakistan) — is an exclusively Permian genus. The genus *Marginifera* would appear in the Lower Permian according to Muir-Wood and Cooper but Sarytcheva et al. contend that it would already be present in the Middle Carboniferous. It can therefore be deduced that eight of twenty-five genera identified are exclusively Permian. Hence, solely from the exami-

nation of the occurrence of the genera, the outcrops in question can be referred to the Permian.

It is now pertinent to consider the possibility of subdividing the Permian on the grounds of the species identified. Unfortunately, with the exception of the species determined by comparison, only few species offer useful data in this respect. Some species were found only in Permian beds, they are: *Enteletes dieneri darvasicus* Renz, *E. meridionalis* Gemmellaro, *E. subaequivalvis* Gemmellaro, *E. waageni* Gemmellaro, *Tschernyschewia typica typica* Stoyanow, *Costiferina spiralis* (Waagen), *Stenoscisma biplicata* (Stuckenberg), *S. pinguis* (Waagen) and *Neophricodothyris asiatica* (Chao).

Only *Enteletes dieneri darvasicus* appears to be exclusively Artinskian, for it was found in the Upper Artinskian of the Karakorum and in the Darvasian of Darvas. Also, *Tschernyschewia typica typica* is present in the Upper Permian; it was also recognized in the Middle *Productus* Limestone of the Salt Range. *Stenoscisma pinguis* was found only in the Middle *Productus* Limestone of the Salt Range.

On account of the presence of these last species, the fauna studied can be attributed either to the top of the Lower Permian or more probably, to the base of the Upper Permian. This uncertainty is due to the still disputed location of the Lower-Upper Permian boundary (Likharew 1962).

II. SHAKSGAM VALLEY, EAST SIDE, APPROXIMATELY 4 KM BELOW KYAGAR GLACIER — *Derbyia regularis minor* Waagen and *Rhombopora* sp. have been identified in a dark marbled limestone. These, recognized for the first time in the Upper *Productus* Limestone of the Salt Range, were also subsequently identified in the Uralian (Lower Permian) of the Karakorum.

From these few points it is impossible to specify the age of the locality, which however can at least be confidently allocated to the Permian.

III. SLIGHTLY ABOVE SINGHIÉ GLACIER — *Juresania* sp. and *Neochonetes variolatus* (d'Orbigny) have been identified in a green grey sandstone, with abundant calcite cement. *Schizodus* cf. *dubiiformis* Waagen, *Janeia biarmica* (Verneuil) and also numerous indeterminate Pelecypods were found in a grey-brown very fine feldspathic sandstone with clay calcite matrix. Probably *Neochonetes variolatus* and *Janeia biarmica* are not exclusively Permian species.

The limited amount of data available permits the attribution of the outcrop only to the Permian, without more precise classification.

IV. NEAR TO THE GASHERBRUM GILGA « SIGNAL CAMP » — The following species have been identified in slightly argillaceous grey-brown limestone containing very fine organic calcite fragments in an argillaceous limonitic matrix:

Amplexocarinia sp., *Marginifera* ? *altimontana* (Merla), *M. gratiodentalis* (Grabau), *M. gratiosa* (Waagen), *M.* ? *rimuensis* (Merla), *M. septentrionalis* (Tschernyschew), *Waagenoconcha pseudoirginae* (Huang), *Cancrinella cancriniformis* (Tschernyschew), *Chonetinella* ? *latesinuata* (Schellwien), *Chonetinella* sp., *Neochonetes* sp., *Spirifer* ? *psittacus* Merla, *Crurithyris tschernyschewi* (Likharew), *Brachithyrina* cf. *sokolowi* (Tschernyschew), *Spirigerella derbyi kweichowensis* Grabau, *Martinia orbicularis* Gemmellaro, *M. subtriquetra* Merla, *M.* cf. *uralica* Tschernyschew, *Martinia* sp. I, *Notothyris exilis* (Gemmellaro), *Straparollus* (*Euomphalus*) cf. *oldhami* (Reed), *Straparollus* (*Euomphalus*) cf. *parvus* (Waagen).

A consideration of the genera identified indicates that the fauna studied does not comprise typically Permian forms, in fact most of the genera, twelve out of fourteen, are present in the Upper Carboniferous as well as in the Permian. Only the genera *Marginifera* and *Spirigerella* yield information useful for the determination of the age of the outcrop. The genus *Marginifera* would be exclusively Permian according to Muir-Wood and Cooper as already indicated; according to the Russian authors it would have a wider range, being already present in the Middle Carboniferous. According the same Russian authors, the genus *Spirigerella* would be exclusively Permian.

It may be concluded that the fauna studied is referable to the Lower Permian, taking into account also that the genus *Chonetinella* disappears in the lower part of this period.

This age is confirmed also by the examination of the distribution of only some species. Most of the species identified are not stratigraphically defined. *Marginifera* ? *altimontana* (Merla) and *M.* ? *rimuensis* (Merla) were found only one time in the Uralian (Lower Permian) of the Karakorum; *Waagenoconcha pseudoirginae* (Huang) and *Spirigerella derbyi kweichowensis* Grabau are cited only in the Lower Permian of Kweichow (China). The other species are all already present at the base of the Permian.

The outcrop may therefore probably be attributed to the base of the Lower Permian.

Composition of the fauna

The fauna examined, which is mostly all Brachiopods, consists of 164 specimens divided between Corals (5), Bryozoans (1), Brachiopods (146), Pelecypods (5), Gastropods (6) and Cephalopods (1). Among these, 70 species have been identified and divided as follows: 1 Corals, 1 Bryozoans, 63 Brachiopods, 2 Pelecypods, 2 Gastropods and 1 Cephalopod.

Here follows the list in the systematic order suggested in the «Treatise on Invertebrate Palaeontology» by R. C. Moore for the Corals, Bryozoans, Gastropods and Cephalopods. On the other hand the classification used for the Brachiopods is that used by H. M. Muir-Wood in 1955 and, in as far as the suborders *Productoidea* and *Chonetoidea* are concerned, modified during 1960 and 1962. Furthermore the Pelecypods have been classified according to the system adopted by Piveteau in 1952.

Coelenterata
Class **Anthozoa**

Order RUGOSA
Suborder STREPTELASMATINA Wedekind 1927
Family AMPLEXIDAE Chapman 1893
Genus *Amplexocarinia* Soshkina 1928
Amplexocarinia sp. ind.

Bryozoa
Class **Gymnolaemata**

Order CRYPTOSTOMATA
Family RHABDOMESIDAE Vine 1883
Genus *Rhombopora* Meek 1872
Rhombopora sp. ind.

Brachiopoda
Class **Articulata**

Suborder DALMANELLOIDEA Moore 1952
Superfamily DALMANELLACEA Schuchert & Cooper 1931
Family SCHIZOPHORIIDAE Schuchert & Le Vene 1929
Subfamily SCHIZOPHORIINAE Schuchert & Le Vene 1929

Genus *Schizophoria* King 1850
Schizophoria sp. ind.
Genus *Orthotichia* Hall & Clarke 1892
Orthotichia morganiana (Derby)
Subfamily ENTELETINAE Waagen 1884
Genus *Enteletes* Fischer de Waldheim 1825
Enteletes dieneri Gemmellaro
Enteletes dieneri darvasicus Renz
Enteletes cf. *elegans* Gemmellaro
Enteletes meridionalis Gemmellaro
Enteletes subaequivalvis Gemmellaro
Enteletes waageni Gemmellaro
Genus *Enteletina* Schuchert & Cooper 1931
Enteletina cf. *acuteplicata* (Waagen)
Suborder STROPHOMENOIDEA Mailleux 1932 emend.
Superfamily ORTHOTETACEA Williams 1953
Family ORTHOTETIDAE Mc Evan 1939
Subfamily ORTHOTETINAE Waagen 1884
Genus *Derbyia* Waagen 1884
Derbyia regularis minor Waagen
Derbyia sp. ind.
Suborder PRODUCTOIDEA Mailleux 1940 emend.
Superfamily STROPHALOSIACEA Muir-Wood & Cooper 1960
Family TSCHERNYSCHEWIIDAE Muir-Wood & Cooper 1960
Genus *Tschernyschewia* Stoyanow 1910
Tschernyschewia typica typica Stoyanow
Superfamily PRODUCTACEA Waagen 1883
Family OVERTONIIDAE Muir-Wood & Cooper 1960
Subfamily OVERTONIINAE Muir-Wood & Cooper 1960
Genus *Krotovia* Fredericks 1928
Krotovia sp. ind.
Family MARGINIFERIDAE Stehli 1954
Subfamily MARGINIFERINAE Stehli 1954
Genus *Marginifera* Waagen 1884
Marginifera? *altimontana* (Merla)
Marginifera gratiodentalis (Grabau)
Marginifera gratiosa (Waagen)
Marginifera? *rimuensis* (Merla)

Marginifera septentrionalis Tschernyschew
Marginifera cf. *typica* Waagen
Marginifera cf. *typica elongata* (Huang)
Genus *Paramarginifera* Fredericks 1916
Paramarginifera cf. *gobiensis* (Chao)
Paramarginifera cf. *himalayensis* (Diener)
Family ECHINOCONCHIDAE Stehli 1954
Subfamily ECHINOCONCHINAE Stehli 1954
Genus *Echinoconchus* Weller 1914
Echinoconchus fasciatus (Kutorga)
Echinoconchus punctatus (Sowerby)
Subfamily WAAGENOCONCHINAE Muir-Wood & Cooper 1960
Genus *Waagenoconcha* Chao 1927
Waagenoconcha cf. *abichi* (Waagen)
Waagenoconcha humboldti (d'Orbigny)
Waagenoconcha pseudoirginae (Huang)
Family BUXTONIIDAE Muir-Wood & Cooper 1960
Subfamily JURESANIINAE Muir-Wood & Cooper 1960
Genus *Juresania* Fredericks 1928
Juresania sp. ind.
Family DICTYOCLOSTIDAE Stehli 1954
Subfamily DICTYOCLOSTINAE Stehli 1954
Genus *Chaoiella* Fredericks 1933
Chaoiella gruenewaldti (Krotow)
Genus *Costiferina* Muir-Wood & Cooper 1960
Costiferina spiralis (Waagen)
Genus *Reticulatia* Muir-Wood & Cooper 1960
Reticulatia moelleri (Stuckenberg)
Reticulatia cf. *transversalis* (Tschernyschew)
Family LINOPRODUCTIDAE Stehli 1954
Subfamily LINOPRODUCTINAE Stehli 1954
Genus *Linoproductus* Chao 1927
Linoproductus sp. ind.
Genus *Compressoproductus* Sarytcheva 1960
Compressoproductus sp. ind.
Genus *Cancrinella* Fredericks 1928
Cancrinella cancriniformis (Tschernyschew)
Suborder CHONETOIDEA Muir-Wood 1955

Superfamily CHONETACEA Shrock & Twenhofel 1953
Family CHONETIDAE Bronn 1862
Subfamily CHONETINELLINAE Muir-Wood 1962
Genus *Chonetinella* Ramsbottom 1952
Chonetinella? *latesinuata* (Schellwien)
Chonetinella sp. ind.
Genus *Neochonetes* Muir-Wood 1962
Neochonetes variolatus (d'Orbigny)
Neochonetes sp. ind.
Suborder RHYNCHONELLOIDEA Moore 1952
Superfamily RHYNCHONELLACEA Schuchert 1896
Family CAMAROTOECHIIDAE Schuchert & Le Vene 1929
Genus *Uncinunellina* Grabau 1932
Uncinunellina timorensis (Beyrich)
Genus *Terebratuloidea* Waagen 1883
Terebratuloidea davidsoni Waagen
Superfamily STENOSCISMATACEA Shrock & Twenhofel 1953
Family STENOSCISMATIDAE Muir-Wood 1955
Subfamily STENOSCISMATINAE Muir-Wood 1955
Genus *Stenoscisma* Konrad 1839
Stenoscisma biplicata (Stuckenberg)
Stenoscisma pinguis (Waagen)
Stenoscisma purdoni (Davidson)
Stenoscisma sp. ind.
Suborder SPIRIFEROIDEA Allen 1940 emend.
Superfamily SPIRIFERACEA Waagen 1883
Family SPIRIFERIDAE King 1846
Subfamily PHRICODOTHYRINAE Caster 1939
Genus *Neophricodothyris* Likharew 1934
Neophricodothyris asiatica (Chao)
Subfamily SPIRIFERINAE Schuchert 1913
Genus *Spirifer* Sowerby 1819
Spirifer? cf. *psittacus* Merla
Genus *Elivina* Fredericks 1919
Elivina cf. *tibetana tenuisulcata* (Merla)
Genus *Purdonella* Reed 1944
Purdonella merlai sp. n.
Genus *Neospirifer* Fredericks 1919

Neospirifer fasciger (Keyserling)
Subfamily AMBOCOELIINAE George 1931
Genus *Crurithyris* George 1931
Crurithyris tschernyschewi (Likharew)
Subfamily BRACHYTHYRINAE Fredericks 1924
Genus *Brachythyrina* Fredericks 1929
Brachythyrina cf. *sokolowi* (Tschernyschew)
Superfamily PUNCTOSPIRACEA Cooper 1944
Family ATHYRIDAE Phillips 1841
Subfamily ATHYRINAE Waagen 1883
Genus *Spirigerella* Waagen 1883
Spirigerella derbyi kweichowensis Grabau
Family SPIRIFERINIDAE Davidson 1884
Subfamily MARTINIINAE Waagen 1883
Genus *Martinia* Mc Coy 1844
Martinia cf. *glabra* (Sowerby)
Martinia orbicularis Gemmellaro
Martinia cf. *semiplana* Waagen
Martinia subtriquetra Merla
Martinia cf. *uralica* Tschernyschew
Martinia sp. I
Martinia sp. II
Suborder TEREBRATULOIDEA Muir-Wood 1955
Superfamily TEREBRATULACEA Waagen 1883
Family DIELASMATIDAE Schuchert & Le Vene 1929
Subfamily DIELASMATINAE Schuchert 1913
Genus *Whitspakia* Stehli 1964
Whitspakia cf. *biplex* (Waagen)
Genus *Hemiptychina* Waagen 1882
Hemiptychina cf *carniolica* Schellwien
Genus *Rostranteris* Gemmellaro 1899
Rostranteris exilis Gemmellaro

Mollusca
Class **Lamellibranchiata**

Order TAXODONTA Neumayr 1883
Suborder CTENODONTA Douvillé 1912
Family SOLENOMYIDAE Gray

Genus *Janeia* King 1850
Janeia biarmica (Verneuil)
Order PREHETERODONTA Douvillé 1912
Family TRIGONIIDAE Lamarck
Genus *Schizodus* King 1844
Schizodus cf. *dubiiformis* Waagen

Class **Gastropoda**
Subclass **Prosobranchia**

Order ARCHAEOGASTROPODA Thiele 1925
Suborder MACLURITINA Cox & Knight 1960
Superfamily EUOMPHALACEA de Koninck 1881
Family EUOMPHALIDAE de Koninck 1881
Genus *Straparollus* de Montfort 1810
Subgenus *Euomphalus* Sowerby 1814
Straparollus (*Euomphalus*) cf. *oldhami* (Reed)
Straparollus (*Euomphalus*) cf. *parvus* (Waagen)

Class **Cephalopola**

Order AMMONOIDEA
Suborder GONIATITINA
Superfamily GONIATITACEA de Haan 1825
Family NEOICOCERATIDAE Hyatt 1900
Genus *Gastrioceras* Hyatt 1884
Gastrioceras? sp. ind.

As we already stated, the fauna consists of Corals, Bryozoans, Brachiopods, Pelecypods, Gastropods and Cephalopods. Of these the most numerous are undoubtedly the Brachiopods which represent 89% of the total fauna examined if considered in relation to the number of the specimens. These are followed by the Corals, Pelecypods and Gastropods, each of which represent 3% of the fauna. Percentages do not vary even if one takes into consideration the number of the species instead of the number of the specimens.

The 63 determined species of Brachiopods are grouped into 35 genera, distributed between 16 families of *Brachiopoda Articulata*, divided amongst the suborder *Dalmanelloidea*, *Strophomenoidea*, *Productoidea*, *Chonetoidea*, *Rhynchonelloidea*, *Spiriferoidea* and *Terebratuloidea*.

Suborder *Productoidea*, with 7 out of 16 families examined, is the best represented as to number. The *Spiriferidae* family, with 4 subfamilies, has the greatest frequency of genera which in fact amount to 7. These are followed by *Schizophoriidae* with 2 subfamilies and 4 genera; *Dielasmatidae*, *Dictyoclostidae* and *Linoproductidae* with 1 subfamily and 3 genera. On the other hand the families *Marginiferidae*, *Echinoconchidae*, *Chonetidae*, *Camarotechiidae*, are represented by 2 genera and the families *Orthotetidae*, *Tschernyschewiidae*, *Overtoniidae*, *Buxtoniidae*, *Stenoscismatidae*, *Athyridae* and *Spiriferinidae* by only one. The best represented genera as to the number of species, are *Marginifera* and *Martinia* with 7; then follows genus *Enteletes* with 6, *Stenoscisma* with 4, *Waagenoconcha* with 3, *Derbyia*, *Paramarginifera*, *Echinoconchus*, *Reticulatia*, *Chonetinella*, *Neochonetes* with 2.

The other genera are represented by only one species each.

In the majority of cases specimens are not very frequent in the various species: one or two specimens have been mentioned; only *Neophricodothyris asiatica* is represented by 16 specimens, *Martinia subtriquetra* by 13, *Neochonetes variolatus* by 11, *Orthotichia morganiana* by 9, *Marginifera gratiosa* by 4, *Enteletes meridionalis*, *E. subaequivalvis*, *E. dieneri* and *Stenoscisma pinguis* by 3.

The Pelecypods and the Gastropods are represented by only 2 species each, whilst the Cephalopods are represented by one specimen only. Finally Corals and Bryozoans are represented by one genus, with only one species each.

In as far as possible we have used the nomenclature suggested in Moore's « Treatise on Invertebrate Palaeontology » and in Muir-Wood's and Cooper's studies on the *Productoidea* (1960) and *Chonetoidea* (1962), when describing the species.

Observations on previous studies of the Shaksgam Valley

As mentioned in the introduction, the fossils of the Shaksgam Valley have already been the subject of a short preliminary note by Merla in 1935. The object of the present investigation was the complete re-examination of the forms already considered and of those not yet dealt with. Any variations in respect of previous identifications are discussed at the end of each description. Meanwhile it has been considered advisable to summarize the results obtained in a double list, placing Merla's data on the left and the results of

the present investigation on the right. In some case, as will be noted, the generic attributions have been altered and the specific determinations have remained, whilst in others the determinations of the species have also been changed.

Merla 1935	Fantini Sestini 1964
I. CAMP STAGHAR GLACIER FRONT.	
Schizophoria sp. ind.	*Schizophoria* sp. ind.
Productus cancriniformis? Tschern.	*Cancrinella cancriniformis* (Tschern.)
Marginifera typica Waagen var. *elongata* Huang	*Marginifera typica elongata* (Huang)
Marginifera cf. *gobiensis* Chao	*Paramarginifera* cf. *gobiensis* (Chao)
Krotovia cf. *pustulata* Keys.	*Krotovia* sp. ind.
Productus cf. *humboldti* d'Orb.	*Waagenoconcha humboldti* (d'Orb.)
Productus semireticulatus Martin	*Reticulatia* cf. *transversalis* (Tschern.)
Productus spiralis Waagen	*Costiferina spiralis* (Waagen)
Productus fasciatus Kut.	*Echinoconchus fasciatus* (Kut.)
Productus mongolicus Diener	*Compressoproductus* sp. ind.
Productus aff. *fasciatus* Kut. and *elegans* Mc Coy	*Echinoconchus punctatus* (Sow.)
Uncinulus timorensis Beyrich	*Uncinunellina timorensis* (Beyrich)
Camarophoria purdoni Davidson	*Stenoscisma purdoni* (Davidson)
Camarophoria aff. *crumena* Mart.	*Stenoscisma biplicata* (Stuck.)
Camarophoria cf. *pinguis* Waagen	*Stenoscisma pinguis* (Waagen)
Terabratuloidea cf. *davidsoni* Waag.	*Terebratuloidea davidsoni* Waagen
Spirifer fasciger Keys.	*Neospirifer fasciger* (Keys.)
Spirifer n. sp. aff. *siculus* Gemm.	*Purdonella merlai* sp. n.
Enteletes aff. *contractus* Gemm.	*Enteletes* cf. *elegans* Gemm.
Enteletes cf. *waageni* Gemm.	*Enteletes waageni* Gemm.
Enteletes tschernyscheffi Diener	*Enteletes dieneri* Gemm.
Enteletes cf. *acuteplicatus* Waagen	*Enteletina* cf. *acuteplicata* (Waagen)
Enteletes cf. *subaequivalvis* Gemm.	*Enteletes subaequivalvis* Gemm.
Enteletes meridionalis Gemm.	*Enteletes meridionalis* Gemm.
Orthotichia morgani Derby	*Orthotichia morganiana* (Derby)
Dielasma n. sp. aff. *biplex* Waagen	*Whitspakia* cf. *biplex* (Waagen)

On the basis of the fossils identified, Merla attributed this outcrop either to the Lopingian or to the Upper Permian, listing: *Marginifera elongata* Huang, *M.* cf. *gobiensis* Chao, *Productus mongolicus* Diener and *Productus spiralis* Waagen as characteristic species of the asiatic Lopingian. He also referred the *Enteletes* group to the Lopingian and listed as Neopermian forms: *Uncinulus timorensis* Beyrich, *Camarophoria purdoni* Davidson, *C.* cf. *pinguis* Waagen and *Terebratuloidea davidsoni* Waagen.

In the light of our present knowledge, it is possible to reach similar conclusions. In fact this outcrop can be referred to the top of the Lower Permian or to the base of the Upper Permian (p. 155).

II. SHAKSGAM VALLEY, EAST SIDE, 4 KM BELOW KYAGAR GLACIER —

Geinitzella columnaris (Schloth.)	*Rhombopora* sp. ind.
Derbyia regularis Waagen	*Derbyia regularis minor* Waagen

Merla states « in all probability even in this case it is Upper Permian ». It seems pointless to discuss the age only from these fossils. One can only record that *Derbyia regularis minor* Waagen has been found in the Upper *Productus* Limestone of the Salt Range (Pakistan) and also in the Karakorum Uralian (Lower Permian), and that *Derbyia regularis* also, as was mentioned by Merla, extends from the «Permo-Carboniferous» to the Middle Permian.

III. SLIGHTLY ABOVE THE SINGHIÉ GLACIER —

Productus aff. *abichi* var. *punjabensis* Reed	*Juresania* sp. ind.
Spinomarginifera sp.	—
Spirifer aff. *trigonalis* Martin	*Spirifer ?*
Chonetes sp. ind. Reed	*Neochonetes variolatus* (d'Orbigny)
Pelecypods	*Janeia biarmica* (Verneuil)
	Schizodus cf. *dubiiformis* Waagen

Although Merla attributed this outcrop with doubt to the Upper Permian, he in fact notes the similarity between the remains of the *Chonetes* and the *Chonetes* sp. ind. identified by Reed amongst the Ta-li-shao fauna, then considered probably of the Lopingian age. On the other hand, these *Chonetes* may well correspond to *Neochonetes variolatus*, «Permo-Carboniferous» and Permian species. Therefore the age of this outcrop cannot be more precisely determined.

IV. NEAR TO THE GASHERBRUM GILGA « SIGNAL CAMP » —

Productus cancriniformis Tschern.	*Cancrinella cancriniformis* (Tschern.)
Productus pseudoirginae Huang	*Waagenoconcha pseudoirginae* (Huang)
Productus gratiodentalis Grabau	*Marginifera gratiodentalis* (Grabau)
Productus rimuensis Merla	*Marginifera ? rimuensis* (Merla)
Marginifera typica var. *septentrionalis* Tschern.	*Marginifera septentrionalis* Tschern.
Chonetes trapezoidalis Waagen	*Chonetinella* sp. ind.
Spirifer sokolowi Tschern.	*Brachithyrina* cf. *sokolowi* (Tschern.)
Spirifer psittacus Merla	*Spirifer ? psittacus* Merla
Spirigerella cf. *derbyi* Waagen var. *kweichowensis* Grabau	*Spirigerella derbyi kweichowensis* Grabau
Martinia uralica Tschern.	*Martinia* cf. *uralica* Tschern.
Martinia subtriquetra Merla	*Martinia subtriquetra* Merla
Martinia frechi ? Schellwien	*Crurithyris tschernyschewi* (Likharew)
Martinia cf. *semiconvexa* Chao	*Martinia* sp. I
Barrandeophyllum sp.	*Amplexocarinia* sp. ind.

According to Merla the Uralian (Lower Permian) character of the fauna is clearly proved by the presence of *Spirifer sokolowi* Tschernyschew, *Martinia subtriquetra* Merla, *M. uralica* Tschernyschew, *Marginifera typica* var. *septentrionalis* Tschernyschew, *Productus rimuensis* Merla and *Spirifer psittacus* Merla. The present conclusions also tend to confirm its attribution and to refer the outcrop to the base of the Lower Permian.

The fauna from the Shaksgam Valley was also the object of a study by Renz (1939-40), who identified a number of species which are listed — subdivided as to locality — at p. 151 of the present work. Renz recognized the presence of the Uralian and Artinskian, which, in his own subdivision of the Permian, form respectively the lower and middle part of this period. The fossils from the youngest beds, preserved in white limestone, may indeed belong to the Middle Permian. However, their age is certainly more recent than the Artinskian, in that they seem referable also to the lowest part of the Upper Permian, if the close affinity of this fauna with that of the Middle *Productus* Limestone of the Salt Range is taken in to account.

As regards the Permian macrofauna of the Shaksgam Valley, we observe that Renz did not find the following species: *Amplexocarinia* sp., *Rhombopora*

sp., *Enteletes* cf. *elegans* Gemmellaro, *E. meridionalis* Gemmellaro, *E. subaequivalvis* Gemmellaro, *E. waageni* Gemmellaro, *Enteletina* cf. *acuteplicata* (Waagen), *Tschernyschewia typica typica* Stoyanow, *Marginifera* ? *altimontana* (Merla), *Marginifera gratiodentalis* (Grabau), *M.* ? *rimuensis* (Merla), *M.* cf. *typica* Waagen, *M.* cf. *typica elongata* (Huang), *M. septentrionalis* Tschern., *Paramarginifera* cf. *gobiensis* (Chao), *Waagenoconcha humboldti* (d'Orbigny), *W. pseudoirginae* (Huang), *Chaoiella gruenewaldti* (Krotow), *Costiferina spiralis* (Waagen), *Chonetinella* sp., *Neochonetes* sp., *Terebratuloidea davidsoni* (Waagen), *Stenoscisma biplicata* (Stuckenberg), *S. pinguis* (Waagen), *S. purdoni* (Davidson), *Spirifer* ? cf. *psittacus* Merla, *Elivina* cf. *tibetana tenuisulcata* (Merla), *Purdonella merlai* sp. n., *Brachithyrina* cf. *sokolowi* (Tschernyschew), *Spirigerella derbyi kweichowensis* Grabau, *Martinia* cf. *glabra* (Sowerby), *M. orbicularis* Gemmellaro, *M. subtriquetra* Merla, *M.* cf. *uralica* Tschernyschew, *Hemiptichyna* cf. *carniolica* Schellwien, *Notothyris exilis* Gemmellaro, *Janeia biarmica* (Verneuil), *Schizodus* cf. *dubiiformis* Waagen, *Straparollus* (*Euomphalus*) cf. *oldhami* (Reed), *S.* (*Euomphalus*) cf. *parvus* (Waagen) and *Gastrioceras* ? sp.

The fauna recorded in the present work shows also a great affinity with that collected by De Filippi's expedition to the Karakorum in 1914 and studied by Merla (1934).

A significant comparison can be made with the fauna from the locality « Rimu front » (unit 1 to 3), which was referred by Merla to the Uralian (Lower Permian). The species from this locality which correspond are the following: *Echinoconchus punctatus* (Sowerby) (= *P. punctatus* Martin), *Chaoiella gruenewaldti* (Krotow) (= *P. gruenewaldti* Krotow), *Marginifera rimuensis* (Merla) (= *P. rimuensis* Merla), *M. altimontana* (Merla) (= *P. altimontanus* Merla), *Spirifer* ? *psittacus* Merla, *Martinia uralica* Tschernyschew, *M. subtriquetra* Merla, *Neophricodothyris asiatica* (Chao) (= *Reticularia lineata* Martin) and *Stenoscisma biplicata* (Stuckenberg) (= *Camarophoria biplicata* Stuck.).

According to Merla, among these species only *Martinia subtriquetra* can be regarded as a typical Uralian species. Numerous specimens of this species were found in our locality « Signal Camp of Gasherbrum Gilga ». From the « Rimu front » (unit 5), referred to the Lopingian (Upper Permian), occur also *Cancrinella cancriniformis* (Tschernyschew) (= *P. cancriniformis* Tschern.), *Marginifera typica elongata* (Huang) (= *P. typicus* Waagen var. *elongatus* Huang) and *Waagenoconcha abichi* (Waagen) (= *P. abichi* Waagen). Other species in common are: *Costiferina spiralis* (Waagen) (= *P. spiralis* Waagen) occurring from the Upper Jarkand Valley (Lopingian); *Marginifera gratiosa* (Waagen) (= *P.* aff. *gratiosus* Waagen), *Marginifera typica elongata* (Huang)

and *Cancrinella cancriniformis* (Tschernyschew) from the Dèpsang Valley (Lopingian); *Marginifera himalayensis* (Diener) (= *P. himalayensis* Diener) and *Elivina tibetana tenuisulcata* (Merla) (= *Spirifer tibetanus* Diener var. *tenuisulcata* Merla) from moraine of Camp IV of Rimu (Lopingian) and *Marginifera typica elongata* (Huang) from Upper Sciàiok (Lopingian).

PALEONTOLOGICAL DESCRIPTIONS

Amplexocarinia sp. ind.

Pl. 21, fig. 1, 2, 3

Numerous specimens, not well preserved, always incomplete, height up to 36 mm, only two of them still preserving the internal morphology, though not perfectly.

Solitary, ceratoid corallite, with sub-circular section of 9-21 mm of diameter. Major septa, little developed, nearly always present. Inner tabellae horizontal, outer tabellae inclined. Very thick epitheca. The lateral surface of corallite is vertically grooved, with growth wrinklings.

Remarks — These specimens were referred by Merla to the similar genus *Barrandeophyllum*, which is now considered exclusive of Devonian.

The genus *Amplexocarinia* Soshkina 1928 is placed by Hill in Moore (1956, p. 258) in the Family *Laccophyllidae* Grabau 1928, while subsequently, Schouppé and Stacul, contrary to what was said by Hill, placed it in the Family *Amplexidae* Chapman 1893 having as Family-type the genus *Amplexus* Sowerby 1814.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 456.

Rhombopora sp. ind.

Small fragments, the longest one is about 30 mm. Zoarium cilindrical, branched. Zoecia with oval apertures aligned in regular, oblique rows.

Remarks — Merla (1935, p. 157) considers these small fragments are similar to *Geinitzella columnaris* (Schlotheim), but after a more accurate examination, we were able to attribute them to the genus *Rhombopora* Meek 1872.

Locality — Shaksgam Valley, east side, approximately 4 km below Kyagar glacier. 29 KD - 409.

Schizophoria sp. ind.

Only one bivalve specimen, badly preserved, longer than wide. Pedicle valve with sharp umbo, slightly projecting beyond the hinge. Interarea triangular, rather high and not very wide. The convexity is not very pronounced and

is more accentuated on the posterior part. The brachial valve on the other hand is more convex with thick but stocky umbo, not projecting beyond hinge.

The whole surface seems to be ornamented by very fine costellae.

Locality — Camp Staghar glacier front. 29 KD – 288.

Orthotichia morganiana (Derby) 1874

Pl. 21, fig. 12, 13, 14

1874 *Orthis*? *morganiana* Derby. *Brasil*, p. 29, pl. III, fig. 1-7, 9, 11, 34; pl. IV, fig. 6, 14, 15.
1902 *Orthotichia morgani* Tschernyschew. *Ural und Timan*, p. 594, pl. XXVI, fig. 8-10; pl. XLVIII, fig. 1-3.
1939 *Orthotichia* cf. *morganiana* Renz. *Karakorum*, p. 12, pl. I, fig. 8.
1944 *Orthotichia morgani* Reed. *Salt Range*, p. 9, pl. 1, fig. 11.
1948 *Orthotichia morganiana* Branson. *Permian Invert.*, p. 445 (*cum syn.*).
1954 *Orthotichia morganiana* Dresser. *Brasil*, p. 24, pl. I, fig. 8-11, 13.
1958 *Orthotichia morganiana* Ivanova. *Moscow*, p. 97.

Numerous specimens, bivalve, all but one more or less incomplete.

Shell very convex, sub-circular in outline. Pedicle valve slightly less convex than brachial; one median sulcus starts at half the length of valve and is accentuated anteriorly, producing the emargination of the brachial valve; umbo sharp, moderately curved. Brachial valve with umbo slightly curved and projecting beyond hinge. Interarea not visible. Ornament, not well preserved, of very fine capillae and occasional growth lines. On the eroded surface of the pedicle valve two dental lamellae are visible, parallel to the median septum long about one third of the valve length. On the brachial valve there are two brachiophore lamellae, very large and divergent, and the low median septum. In one transverse section (fig. 1) cut near the hinge, can be seen the two very divergent dental lamellae of the pedicle valve as well as the thin median septum. On the brachial valve, the well-spaced crural lamellae give a broad curve, keeping almost parallel to the outer face of the valve; near the hinge, they flex strongly towards the plane of symmetry; the median septum is very short. These inner structures are outlined by darker lines, among which is a grey calcite. The secondary calcite filling the lateral cavities located between shell and the lamellae is lighter-coloured.

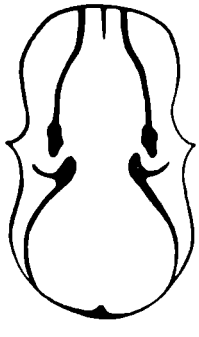

Fig. 1

A strong similarity is between the specimens examinated and those of the *Schwagerina* Limestone described by Tschernyschew.

Dimensions —			
	length	33,3 mm	40,3 mm
	width	40,5 mm	43,5 mm
	thickness	24,3 mm	30 mm

Occurrence — The *O. morganiana* (Derby) has been found in the Limestone with *Schwagerina* of the Ural, in the Lower Permian of China; in the Lower *Productus* Limestone of the Salt Range, in the Upper Uralian of the Karakorum, in the C3 of Moscow basin and in the Pennsylvanian of Brazil.

Locality — Camp Staghar glacier front. 29 KD - 271, 289, 321, 324, 360, 365, 366, 367, 368.

Enteletes dieneri Gemmellaro 1899

Pl. 21, fig. 15, 16

1897 *Enteletes tschernyscheffi* Diener. *Chitichun*, p. 67, pl. V, fig. 7-10 (not 11).
1932 *Enteletes tschernyscheffi* De Terra. *K'un lun und Karakorum*, p. 159, pl. XV, fig. 1.
1940 *Enteletes tschernyscheffi* Renz. *Karakorum*, p. 129.
1948 *Enteletes dieneri* Branson. *Permian Invert.*, p. 357 (*cum syn.*).

Some specimens, one perfectly preserved, the others incomplete.

The valves somewhat wider than long are highly convex. Umbo of the brachial valve projecting, curved, much more developed than the pedicle umbo. Brachial valve ornamented by 4 plications well developed at the two sides of the large central plication. On the pedicle valve there are 5 or 6 plications on each side of the median sulcus, which is not very wide, but quite deep. The plications are sharp projecting and nearly reach the umbo. Plication furrows sharp and deep. Capillae present on the whole surface.

Dimensions —		
	length	23,2 mm
	width	25,5(?) mm
	thickness	27,3 mm

Occurrence — The *E. dieneri* Gemmellaro has been found in the Artinskian of the Karakorum, in the Permian of Chitichun and Malla Sangcha (Central Himalaya).

Locality — Camp Staghar glacier front. 29 KD - 290, 298, 299.

Enteletes dieneri darvasicus Renz 1940

Pl. 21, fig. 17

1914 *Enteletes tschernyscheffi* var. Tschernyschew. *Darvas*, p. 60, pl. X, fig. 7-8.
1940 *Enteletes tschernyscheffi* var. *darvasica* Renz. *Karakorum*, p. 130, pl. I, fig. 11a-c.

Only one specimen, incomplete.

Valves very convex. Pedicle valve slightly less developed than the brachial one. Umbo of the brachial valve, highly rounded, a bit higher than the opposite one, which is only slightly less projecting but more pointed. Ornament of brachial valve of plications which are present rather near the umbo and at half-length they become projecting and pointed. At the sides of the central plication there are always 3 plications well developed and fourth one rounded and not very visible.

All that is visible of the pedicle valve is the umbo, without plications. Fine capillae are visible here and there.

Dimensions — length 26 (?) mm
width —
thickness 29,5 mm

Occurrence — The *E. dieneri darvasicus* Renz has been found in the Artinskian of the Karakorum and in the Permian of Darvas.

Locality — Camp Staghar glacier front. 29 KD – 30c.

Enteletes cf. **elegans** Gemmellaro 1898-99

1898-99 *Enteletes elegans* Gemmellaro. *Sosio*, p. 277, pl. XXIX, fig. 6-10.
1903 *Enteletes* cf. *elegans* Diener. *Central Himalayas*, p. 89, pl. III, fig. 19.
1914 *Enteletes elegans* Tschernyschew. *Darvas*, p. 26, pl. VII, fig. 8.
1930 *Enteletes elegans* Gregorio. *Sicilia*, p. 22, pl. IV, fig. 7-20.
1938 *Enteletes elegans* Heritsch. *Trogkofelkalkes*, p. 81, pl. III, fig. 10-14.

Only one brachial valve not complete, very like the specimen illustrated by Diener, much less like the Sosio specimens.

Brachial valve much convex; venter rounded; flanks steep; umbo much curved and projecting. Hinge line not visible. Ornaments of plications, which do not appear to affect the umbo. Plications rather projecting, but not sharp, 5 on each side of the central plication, which is slightly more developed than the others. The last lateral plication is just visible.

Remarks — This specimen is cited in the list given by Merla (1935, p. 155) as *Enteletes* aff. *contractus* Gemmellaro, species now considered synonym of *E. oehlerti* Gemmellaro, because the differences between the two species are too slight.

I prefer to compare our specimen, although it is incomplete, to the other species of Gemmellaro, *E. elegans*, in view of the considerable similarity found between the fossil we are examining and the one illustrated by Diener and referred by him tentavely to *E. elegans*.

Occurrence — The *E. elegans* Gemmellaro has been found in the Permian of Sosio, Himalaya and Darvas, and in the Trogkofel Beds of the Carnic Alps.

Locality — Camp Staghar glacier front. 29 KD - 294.

Enteletes meridionalis Gemmellaro 1898-99

Pl. 21, fig. 4, 5, 6, 7

1898-99 *Enteletes meridionatis* Gemmellaro. *Sosio*, p. 279, fig. 19, pl. XXVIII, fig. 10-12; pl. XXIX, fig. 1-5.
1911 *Enteletes meridionalis* Frech. *Obercarbon Chinas*, p. 121, pl. XXVII, fig. 4, 5.

Some specimens of small dimensions, sub-equivalve, slightly wider than long. Valves very convex, slightly asymmetrical inasmuch as the position of the maximum plication is not central, but slightly to one side.

Pedicle valve slightly less convex than the brachial valve. Umbo sharp and curved. Interarea buried in limestone in all specimens. Plications are present at about half-length, irregular, sometimes flat and wide, sometimes sharp and highly projecting, divided by plication furrows of different widths. The median sulcus of pedicle valve is slightly asymmetrical. This irregularity is well visible anteriorly. Fine capillae on the whole surface, growth lines parallel to the commissure.

Dimensions —			
	length	12,4 mm	18,2 mm
	width	13,3 mm	—
	thickness	10,4 mm	13,6 mm

Occurrence — The *E. meridionalis* Gemmellaro has been recognized in the Permian of Sosio and China.

Locality — Camp Staghar glacier front. 29 KD - 297, 308, 312.

Enteletes subaequivalvis Gemmellaro 1898-99

Pl. 21, fig. 8, 9, 10, 11

1898-99 *Enteletes subaequivalvis* Gemmellaro. *Sosio*, p. 276, pl. XXVIII, fig. 25-32.
1903 *Enteletes subaequivalvis* Diener. *Central Himalayas*, p. 29, pl. I, fig. 8.

Some specimens, sometimes well preserved, small dimensions, subequivalve, wider than long.

Pedicle valve slightly less convex than the brachial one; umbo slightly shorter than the brachial valve but not less pointed; interarea large, concave; median sulcus short.

Brachial valve with maximum convexity posteriorly; umbo well developed curved and sharp at apex. At about half-length there are some plications divided by wide plication furrows: six on the pedicle valve and seven on the brachial one. Fine capillae are present on the whole surface.

On pedicle valve of some internal moulds, dental lamellae, very long, closed, parallel visible; median septum, on the contrary, not visible. On brachial valve, brachiophore lamellae visible, very long, divergent, spaced; median septum thin.

Dimensions —				
length	11,3(?) mm	13 mm	13,5 mm
width	12,5(?) mm	14,8 mm	15,5(?) mm
thickness	9 mm	10,2 mm	11 (?) mm

Occurrence — The *E. subaequivalvis* Gemmellaro has been found in the Permian of Sosio and Chitichun (Himalaya).

Locality — Camp Staghar glacier front. 29 KD - 307, 309, 322.

Enteletes waageni Gemmellaro 1898-99

Pl. 21, fig. 18, 19, 20

1898-99 *Enteletes waageni* Gemmellaro. *Sosio*, p. 280, pl. XXVIII, fig. 13-15; pl. XXIX, fig. 16-17.
1903 *Enteletes waageni* Diener. *Central Himalayas*, p. 28.
1944 *Enteletes waageni* Reed. *Salt Range*, p. 15, pl. II, fig. 6,7.
1948 *Enteletes waageni* Branson. *Permian Invert.*, p. 360 (*cum syn.*).
1957 *Enteletes waageni* Termier. *Djebel Tebaga*, p. 197, pl. I, fig. a-e.

Only one specimen bivalve, not complete.

Pedicle valve slightly less convex than the brachial one; umbo rounded, slightly projecting; interarea very high and wide, concave. The left part of the valve, not completely preserved, is less developed than the right one. Therefore the median sulcus is not where the symmetry plane should be, but more towards the right, and the anterior edge projects on this side, while it recedes towards the left. At the sides of the median sulcus there are four pointed plications; the last of these plications is just visible.

Brachial valve very convex with maximum convexity posteriorly; umbo highly projecting beyond hinge, wide, quadrate, posteriorly flattened, much

curved. At the sides of the large central plication there are four plications of decreasing sizes.

Ornament of capillae characterising this genus.

On the posterior surface of the pedicle valve can be hardly seen the median septum and slightly divergent dental lamellae. Umbonally, on the brachial valve are visible the long lamellae of the brachiophore and the weak median septum.

Occurrence — The *E. waageni* Gemmellaro has been found in the Permian of Tunisia, Sosio (Sicily), Chitichun, and in the Middle and Upper *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD - 296.

Enteletina cf. **acuteplicata** (Waagen) 1884

Pl. 21, fig. 21

1884 *Enteletes acuteplicatus* Waagen. *Salt Range*, p. 562, pl. XLIX, fig. 10.
1948 *Enteletina acuteplicata* Branson. *Permian Invert.*, p. 361.

Fragment belonging to one brachial valve.

Numerous plications acute, very projecting, divided by wide and deep plication furrows, cover practically all the surface. Fine capillae are visible more or less everywhere.

Occurrence — The *E. acuteplicata* (Waagen) has been found in the Upper *Productus* Limestone of the Salt Range

Locality — Camp Staghar glacier front. 29 KD - 302.

Derbyia regularis minor Waagen 1882

Pl. 22, fig. 1

1882 *Derbyia regularis* var. *minor* Waagen. *Salt Range*, p. 597.
1939 *Derbyia regularis* var. *minor* Renz. *Karakorum*, p. 12.

Only one pedicle valve incomplete and concave, about 15 mm long, ornamented by radial, regular and flat costellae (about 18 in 10 mm anterior to the umbo) increasing by bifurcation. Intercostal sulci capillary. Umbo not preserved. Straight hinge width about 18 mm. In view of the concavity of the pedicle valve and its small dimensions, it is possible to refer this specimen to the var. *minor* Waagen.

Occurrence — The *D. regularis minor* Waagen has been found in the Upper *Productus* Limestone of the Salt Range and in the Upper Uralian of Kiwas (Karakorum).

Locality — Shaksgam Valley, east side, approximately 4 km below Kyagar glacier. 29 KD - 455.

Derbyia sp. ind.

Only one specimen very badly preserved, represented by only one incomplete and deformed valve, highly convex, especially in the posterior side. All the surface is ornamented by fine and rather dense costellae. Rugae concentric and irregular both in disposition and development occurring mainly in the central part of the valve.

Locality — A little above the Staghar glacier. 29 KD - 299.

Tschernyschewia typica typica Stoyanow 1910

Pl. 21, fig. 22, 23, 24

1878 *Productus scabrisculus* Abich. *Djoulfa*, p. 33, pl. V, fig. 3.
1879 *Strophalosia horrescens* Moeller. *Djoulfa*, p. 233.
1900 *Productus abichi* Arthaber. *Djulfa*, p. 252, pl. XX, fig. 1.
1910 *Tschernyschewia typica* Stoyanow. *Neue Brachiopodenart*, p. 853.
1915 *Tschernyschewia typica* Stoyanow. *Armenia*, p. 77, pl. I, fig. 1-5; pl. II, fig. 1-12; pl. IV, fig. 1.
1933 *Tschernyschewia typica* Simić. *Westserbien*, p. 95, pl. I, fig. 15-18.
1944 *Productus* (*Tschernyschewia*) *typica* Reed. *Salt Range*, p. 83, pl. XII, fig. 13; pl. XIII, fig. 7; pl. XVIII, fig. 6.
1958 *Tschernyschewia typica* Ramovs. *Skofja Loka*, p. 524, pl. IX, fig. 3, 4.
1960 *Tschernyschewia typica* Muir-Wood & Cooper. *Productoidea*, p. 127, pl. 25, fig. 1-9.
1963 *Tschernyschewia typica typica* Schréter. *Nordungarn*, p. 109, pl. III, fig. 9-17; pl. IV, fig. 1, 2.

One specimen, bivalve, well preserved, small-sized.

Shell transversally elliptical, with very short hinge; maximum width at about half-length. Pedicle valve strongly convex longitudinally, flattened transversally with steep flanks. Median sulcus shallow; ears not preserved; umbo apex truncate; interarea triangular, about 6 mm in width. Behind hinge, terminal part of cardinal process of brachial valve projecting, divided in two lobes, between them large median septum of pedicle valve visible in section. This septum visible also on outer surface, on 2/5 of length of pedicle valve.

Brachial valve almost flat posteriorly, concave anteriorly and laterally, with median part slightly prominent. Near umbo, small elliptical node visible; interarea linear.

Ornament of spine bases very closed, rounded posteriorly, and of thin spine ridges anteriorly.

Dimensions — length 14,7 mm
width 17,5 mm
height 7 mm
thickness 5 mm

Occurrence — The *T. typica typica* Stoyanow has been found in the Permian of Djoulfa (Armenia), in the Upper Permian of West Serbia and North Hungary and in the Middle and Upper *Productus* Limestone of the Salt Range (Pakistan).

Locality — Camp Staghar glacier front. 29 KD - 333.

Krotovia sp. ind.

One pedicle valve, incomplete, somewhat wider than long. Venter rounded and flanks rather steep. Umbo tapering. The whole surface is ornamented by numerous elongate or subrounded spine bases. Not other peculiarities observed.

Remarks — I think that having regard to the state of preservation and the small dimensions, about 15 mm of length, it is only possible to give a generical attribution. I should not accept the last determination of Merla (1935, p. 155), who referred the specimen examined to the species *K. pustulata* Keys. In fact it is possible to point out, by a careful examination, that the specimens of this latter have invariably different proportions and a wider umbo than my specimen.

Locality — Camp Staghar glacier front. 29 KD - 332.

Marginifera ? altimontana (Merla) 1934

Pl. 22, fig. 8, 9, 10

1934 *Productus altimontanus* Merla. *Caracorum*, p. 223, pl. XX, fig. 27-32, 36-41.

Pedicle valve of small dimensions, not complete. Visceral disc convex; trail short; umbo slightly projecting beyond hinge, much recurved; ears not preserved; hinge straight; median sulcus narrow and deep. Ornament of

highly defined costae, 6 per side, with few spine bases. Rugae present only on the visceral disc.

Remarks — The *Productus altimontanus* Merla, like *P. rimuensis* Merla which it resembles, has to be attributed, almost certainly, to the genus *Marginifera* Waagen like it had already been said by the Author of the two species. But they are always specimens incomplete; in fact, for istance, we cannot observe on the pedicle valve « two rows of spines on flanks, one extending from anterior margin to umbo and second shorter row ». Therefore the generical attribution always presents some doubts.

Occurrence — The *M.* ? *altimontana* (Merla) has been found in the Uralian stage of Rimu (Karakorum).

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 389.

Marginifera gratiodentalis (Grabau) 1934

Pl. 22, fig. 6, 7

1927 *Productus gratiosus* var. *occidentalis* Chao. *China*, p. 47, pl. IV, fig. 11-16.
1934 *Productus gratiodentalis* Grabau. *China*, p. 36, pl. X, fig. 7, 8.
1948 *Dictyoclostus gratiodentalis* Branson. *Permian Invert.*, p. 334 (*cum syn.*).
1957 *Marginifera gratiodentalis* Coleman. *Australia*, p. 79, pl. 9, fig. 1-14.

Only one pedicle valve, rather well preserved. Visceral disc very convex, but posteriorly flat; flanks sub-steep; ears projecting, well demarcated from visceral disc. High geniculation. Trail with median sulcus, rather wide, but not very deep. Umbo not projecting beyond the hinge.

Ornament of sub-equal, strong costae, with intercostal sulci, slightly narrower. Costae not converging in median sulcus. Visceral disc presents some rugae that together with the costae make a reticulate ornamentation well visible. On the flanks there are some spines.

Occurrence — The *M. gratiodentalis* (Grabau) has been found in the Carnic *Fusulina* Limestone and in the Permian of China and Australia.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 390.

Marginifera gratiosa (Waagen) 1884

1884 *Productus gratiosus* Waagen. *Salt Range*, p. 691, pl. LXXII, fig. 3-7.
1934 *Productus* aff. *gratiosus* Merla. *Caracorum*, p. 261.
1935 *Productus* aff. *gratiosus* Reichardt. *Nassfeldschichten*, p. 979, pl. 100, fig. 8.

1939 *Productus gratiosus* Renz. *Karakorum*, p. 148.
1944 *Marginifera gratiosa* Reed. *Salt Range*, p. 98, pl. XIX, fig. 6, 7, 7a.
1948 *Dictyoclostus gratiosus* Branson. *Permian Invert.*, p. 334 (*cum syn.*).
1961 *Productus* (*Dictyoclostus*) *gratiosus* Shimizu. *Maizuru Group*, p. 323, pl. 15, fig. 19-21.
1961 *Dictyoclostus gratiosus* Zhang & Ching. *Jinxian*, p. 411, pl. IV, fig. 12-18.

Four specimens all represented by the pedicle valve only, some rather well preserved, but incomplete. About 15-17 mm of length and 15-16 mm of width. The visceral disc highly convex, flanks steep, umbo wide, not projecting beyond hinge. The hinge and the apex of the umbo are never visible. High geniculation. Median sulcus from umbo to the trail.

The ornament consists of costae wich begin thin and become broad rounded, unequal with intercostal sulci of varying widths. They are bifurcated at the beginning of the trail. Central costae converging on the median sulcus, which is the most important characteristic of the species. The rugae are over the costae on the visceral disc. On one specimen it is possible to distinguish one row of spine bases on the flanks.

Remarks — The *P. gratiosus* Waagen has been attributed by different authors sometimes to the genus *Marginifera* Waagen, sometimes to the genus *Dictyoclostus* Muir-Wood. The question is still open today, in fact even in the latest works one finds this species cited either as *Marginifera gratiosa* by Reed for istance, in 1944, or as *Productus* (*Dictyoclostus*) *gratiosus* by Shimizu, in 1961.

My specimens are not sufficiently well preserved to enable me to decide, but I think that this species presents the most important characteristics of the genus *Marginifera* Waagen. It is also to be noted that the genus *Dictyoclostus* would be exclusive of the Lower Carboniferous.

Occurrence — The *M. gratiosa* (Waagen) has been recognized in the Upper Uralian, Lower Artinskian and Lopingian of the Karakorum, in the Permian of Sosio, China, Chitichun, Central Himalaya, in Indo-China, in the Trogkofel Beds and in the Upper and Middle *Productus* Limestone of the Salt Range.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 387.

Marginifera ? rimuensis (Merla) 1934

1934 *Productus rimuensis* Merla. *Caracorum*, p. 221, pl. XXIV, fig. 7-16, 20.

Pedicle valve, not complete, wider than long; visceral disc not very convex; umbo slightly projecting; ears not preserved; flanks steep; trail with wide,

shallow median sulcus. Poorly defined costae, about 10 on each side, occur on visceral disc with rugae well visible at sides of umbo.

Remarks — As regards the genus see remarks on the *Marginifera*? *altimontana* (Merla).

Occurrence — The *M.* ? *rimuensis* (Merla) has been recognized in the Uralian of the Karakorum.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 389, 391, 392.

Marginifera septentrionalis Tschernyschew 1902

1902 *Marginifera typica* var. *septentrionalis* Tschernyschew. *Ural und Timan*, p. 646, pl. XXXVI, fig. 10-12; Pl. LVIII, fig. 13-16.
1931 *Marginifera typica* var. *septentrionalis* Grabau. *Mongolia*, p. 306, pl. XXX, fig. 6-9.
1948 *Marginifera septentrionalis* Branson. *Permian Invert.*, p. 407 (*cum syn.*).
1955 *Marginifera septentrionalis* Dunbar. *Central East Greenland*, p. 80, pl. 5, fig. 5-6.

Pedicle valve, badly preserved, wider than long, rather quadrate in outline. Visceral disc wide, umbo strongly curved, and projecting much beyond hinge. Strong geniculation. Median sulcus not very deep, only on trail. Ears well developed, quite demarcated from visceral disc. Flanks sub-steep. Ornaments of costae, sub-equal, fairly well defined, on the venter. On the contrary it is not possible to observe the ornaments of the ears and of the umbo.

Occurrence — The *M. septentrionalis* Tschernyschew has been found in the Permian of China, Mongolia and Greenland and in the *cora* and *Schwagerina* Beds of the Ural and Timan and Trogkofel Beds of the Carnic Alps.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 285.

Marginifera cf. **typica** Waagen 1884

1862 *Productus longispinus* Davidson. *India*, p. 31, pl. I, fig. 19.
1884 *Marginifera typica* Waagen. *Salt Range*, p. 717, pl. LXXVI, fig. 4-7; pl. LXVIII, fig. 1.
1897 *Marginifera typica* Diener. *Chitichun*, p. 32, pl. IV, fig. 11-13.
1903 *Marginifera typica* Diener. *Central Himalayas*, p. 74.
1906 *Marginifera typica* var. *genuina* Gortani. *Col Mezzodì*, p. 23, pl. II, fig. 4-13.
1911 *Marginifera typica* Frech. *Obercarbon Chinas*, p. 168.
1916 *Marginifera typica* Broili. *Timor*, p. 22, pl. CXVII, fig. 6-8.
1924 *Marginifera typica* Fredericks. *Ussuriland*, p. 23.
1931 *Marginifera typica* Ozaki. *China*, p. 135, pl. XII, fig. 21.
1934 *Marginifera typica* var. *genuina* Simić. *Belerofonska fauna*, p. 34, pl. 1, fig. 10.
1960 *Marginifera typica* Muir-Wood and Cooper. *Productoidea*, p. 206, pl. 60, fig. 1-10.

Only one specimen, which is partially in the rock. Only the visceral disc of the pedicle valve is clearly visible. Visceral disc very convex; trail slightly incurved; median sulcus wide, but not very deep, already present on the umbo, continues to the trail.

The specimen is quite decorticate.

Remarks — Muir-Wood and Cooper (1960, p. 206) consider as type-species of the genus *Marginifera* Waagen 1884, the *M. typica* Waagen designated by Oehlert in 1887 (p. 1277) among the species for which Waagen had created the genus without indicating the type-species.

Occurrence — The *M. typica* Waagen has been found in the Permian of Chitichun, Timor, Russia and in the Middle and Upper *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD - 338.

Marginifera cf. **typica elongata** (Huang) 1932

1932 *Productus* (*Marginifera*) *typicus* var. *elongatus* Huang. *China*, p. 23, pl. I, fig. 14.
1934 *Productus typicus* var. *elongatus* Merla. *Caracorum*, p. 268, pl. XXV, fig. 16-23.

Only one specimen, not complete, which is partially in the limestone, but the visceral disc can be seen, very convex, narrow, with flanks sub-steep. Median sulcus just visible. Umbo projecting much beyond hinge. Costae sub-equal and rounded.

Occurrence — The *M. typica elongata* (Huang) has been recognized in the Permian of Kweichow (China) and in the Lopingian of the Karakorum.

Locality — Camp Staghar glacier front. 29 KD - 372.

Paramarginifera cf. **gobiensis** (Chao) 1927

Pl. 22, fig. 3

1927 *Marginifera gobiensis* Chao. *China*, p. 165, pl. XVI, fig. 29-33.
1931 *Marginifera gobiensis* Grabau. *Mongolia* p. 308, pl. XXX, fig. 1-5.
1948 *Paramarginifera gobiensis* Branson. *Permian Invert.*, p. 448.

Brachial valve, rather well preserved, not complete, slightly convex. Umbo flat, wide, not very prominent. The median sulcus, narrow and not very deep, begins at about half-length. Anteriorly ornament of costae thin, divided by intercostal sulci of the same width. Posteriorly some rugae, well defined, irregular covering all the visceral disc.

Occurrence — The *P. gobiensis* (Chao) has been found in Jisu Honguer Limestone (Mongolia).

Locality — Camp Staghar glacier front. 29 KD - 293.

Paramarginifera cf. **himalayensis** (Diener) 1899

1899 *Marginifera himalayensis* Diener. *Kashmir and Spiti*, p. 39, pl. II, fig. 1-7; pl. VI, fig. 1, 2.
1903 *Marginifera himalayensis* Diener. *Central Himalayas*, p. 104, pl. V, fig. 5, 6, 27.
1915 *Marginifera himalayensis* Diener. *Kashmir, Kanaur and Spiti*, p. 79, pl. VIII, fig. 9.
1934 *Productus himalayensis* Merla. *Caracorum*, p. 266.
1940 *Marginifera himalayensis* Renz. *Karakorum*, p. 169, pl. V, fig. 6, 7.
1941 *Marginifera himalayensis* Muir-Wood. *North Sikkim*, p. 19, pl. I, fig. 1-3.
1948 *Paramarginifera himalayensis* Branson. *Permian Invert.*, p. 448 (*cum syn.*).

Only one pedicle valve without ears, not complete either posteriorly or anteriorly. Valve wider than long, highly convex, with the greatest convexity at about half-length. Trail subflat, with wide median sulcus, which is already present near umbo and is deepest halfway along its length and becomes progressively wider towards the front. Flanks steep. A sulcus separates the venter of the shell from the ears in this specimen. Surface decorticated, therefore ornamented only by capillae.

Occurrence — The *P. himalayensis* (Diener) has been recognized in the Permian of India and Russia, in the Lopingian and Uralian of the Karakorum.

Locality — Camp Staghar glacier front. 29 KD - 327.

Echinoconchus fasciatus (Kutorga) 1844

Pl. 22, fig. 13, 14, 15

1902 *Productus fasciatus* Tschernyschew. *Ural und Timan*, p. 631, pl. XXXI, fig. 7; pl. XXXIV, fig. 5, 6.
1939 *Productus* (*Echinoconchus*) *fasciatus* Renz. *Karakorum*, p. 23.
1948 *Echinoconchus fasciatus* Branson. *Permian Invert.*, p. 353 (*cum syn.*).
1958 *Echinoconchus fasciatus* Ivanova. *Moscow*, p. 108.

Pedicle valve, not complete, large (length mm 51(?) and width about mm 55), highly convex and, in spite of the fact that it is incomplete, one can see that it must have been longer than wide. Umbo massive, very rounded and curved, projecting beyond hinge, flanks steep; strong geniculation.

Ornaments of very fine spine bases very thick umbonally. At 25 mm from the beak there are some flattened bands narrowing on flanks and anteriorly. In fact measuring from the centre of one band to the other the difference is about from 6 mm to 2 mm.

Occurrence — The *E. fasciatus* (Kutorga) has been found in the Upper Carboniferous of the Ural and Timan and the Tian-Shan, in the Permian of Mongolia and China, and in the Upper Uralian of Kiwas (Karakorum) and in K'un-lun, in C_2 and C_3 of the Moscow basin.

Locality — Camp Staghar glacier front. 29 KD - 343.

Echinoconchus punctatus (Sowerby) 1822

Pl. 22, fig. 11, 12

1809 *Anomites punctatus* Martin. *Petrif. Derb.*, pl. XXXVII, fig. 6 (not fig. 7-8).
1927 *Echinoconchus punctatus* Chao. *China*, p. 67, pl. VI, fig. 7, 8, 15, 16.
1934 *Productus punctatus* Merla. *Caracorum*, p. 218, pl. XXIV, fig. 20.
1935 *Pustula* (*Echinoconchus*) *punctatus* Reichardt. *Nassfeldschichten*, p. 987.
1940 *Productus* (*Echinoconchus*) *punctatus* Renz. *Karakorum*, p. 158, pl. IV, fig. 5.
1943 *Productus* (*Echinoconchus*) *punctatus* Délépine. *Asturies*, p. 65, pl. III, fig. 5-7.
1948 *Echinoconchus punctatus* Branson. *Permian Invert.*, p. 354 (*cum syn.*).
1949 *Echinoconchus punctatus* Kostić-Podgorska. *Lika, Croatie*, p. 88, pl. II, fig. 6.
1958 *Echinoconchus punctatus* Ivanova. *Moscow*, p. 107, pl. VIII, fig. 3; pl. XIX, fig. 5.
1960 *Echinoconchus punctatus* Muir-Wood and Cooper. *Productoidea*, p. 243, pl. 66, fig. 1-2; pl. 82, fig. 8-10; pl. 83, fig. 1-4; pl. 88, fig. 11; pl. 125, fig. 5.

Only one specimen, bivalve, fractured and deformed particularly near the umbo.

Pedicle valve with visceral disc slightly convex. Trail just medianly sulcate. Corresponding with this median sulcus the brachial valve projects slightly for almost the whole length. Pedicle valve ornamented by bands flattened towards the umbo, more developed anteriorly, separated by narrow grooves. Brachial valve ornament of small bands, rather regular, on which concentrical rows of spine bases, not always preserved, visible. Along the anterior margin of each band are distributed spine bases small and frequent, behind them spine bases larger and more rare visible.

Brachial valve, partially eroded at centre as well as umbonally, thus showing presence of long median septum, joining perpendicularly with well developed lateral ridges running parallelly with hinge.

Under the partially absent umbo of pedicle valve, cardinal process of brachial valve, well developed, very prominent hardly visible.

Remarks — The specimen examined has been identified by Merla (1935, p. 155) in his preliminary note as *Productus* aff. *fasciatus* Kutorga and *elegans* Mc Coy. Now, although it is deformed, I think that the ornament makes it different from *Echinoconchus elegans* (Mc Coy) which presents in fact some very narrow and projecting bands, separated by wide and smooth intervals. *Echinoconchus fasciatus* (Kutorga) on the contrary is characterized by very rounded, but posteriorly flattened venter and by steep flanks. Our pedicle valve is not very convex and poorly developed posteriorly. The deformation which has occurred can certainly not account for such a considerable reduction of the median-posterior part.

As regards the species *Echinoconchus punctatus* (Martin) should point out that Muir-Wood and Cooper (1960, p. 243) note that *Anomites punctatus* Martin 1809, proposed by Weller as type species of its genus *Echinoconchus* was «declared nomenclatorially invalid in 1948 by the International Commission on Zoological Nomenclature, and 12 species including *Anomites punctatus* have been referred to subsequent authors, in the case of *punctatus* to J. Sowerby, 1822».

Dimensions — length 26,5 mm
width 28,5 mm
thickness 15,5 mm

Occurrence — The *E. punctatus* (Sowerby) is a species, wich is found in several localities, in Europe and in Asia, from Visean to Permian. It has been recognized in the Uralian and Artinskian of the Karakorum, in the Uralian of Indo-China, in the Taiyuan Series of China, in the *Omphalotrochus* and *Schwagerina* Limestones of the Ural, in the Carboniferous of the Carnic Alps and the Asturias and in C_2 and C_3 of the Moscow Basin.

Locality — Camp Staghar glacier front. 29 KD – 287.

Waagenoconcha cf. **abichi** (Waagen) 1884

1884 *Productus abichi* Waagen. *Salt Range*, p. 697, pl. LXXIV, fig. 1-7.
1934 *Productus abichi* Merla. *Caracorum*, p. 263.
1940 *Productus* (*Waagenoconcha*) *abichi* Renz. *Karakorum*, p. 161, pl. IV, fig. 6.
1948 *Waagenoconcha abichi* Branson. *Permian Invert.*, p. 552 (*cum syn.*).
1960 *Waagenoconcha abichi* Muir-Wood and Cooper. *Productoidea*, p. 254, pl. 89, fig. 1-5.

One pedicle valve, badly preserved, highly convex. Venter wide with median sulcus wide, but almost superficial. Flanks sub-steep. Umbo curved,

well projecting beyond hinge. Ears well defined. Ornaments of spine ridges regularly placed.

Occurrence — The *W. abichi* (Waagen) has been found in the Artinskian and in the Lopingian of the Karakorum, in the Permian with *Oldhamina* and *Lyttonia* of China, in the Permian of Chitichun, in the Middle and Upper *Productus* Limestone of the Salt Range, in the Uralian with *Schwagerina princeps* of Indo-China.

Locality — Camp Staghar glacier front. 29 KD - 329.

Waagenoconcha humboldti (d'Orbigny) 1842

1842 *Productus humboldti* d'Orbigny. *Amérique méridionale*, p. 54, pl. V, fig. 4-7.
1927 *Waagenoconcha humboldti* Chao. *China*, p. 86, pl. XV, fig. 2-3.
1948 *Waagenoconcha humboldti* Branson. *Permian Invert.*, p. 553 (*cum syn.*).
1953 *Waagenoconcha humboldti* Chronic. *Peru*, p. 86, pl. 15, fig. 4-7.
1958 *Waagenoconcha humboldti* Ivanova. *Moscow*, p. 105.
1960 *Waagenoconcha humboldti* Muir-Wood and Cooper. *Productoidea*, p. 253, pl. 89, fig. 6-10.

Two specimens, one bivalve and one pedicle valve, unfortunately both incomplete.

Shell wider than long. Pedicle valve with visceral disc convex and flanks sub-steep. One wide median sulcus from the umbo to the anterior commissure divides the valve in two lobes, which widen anteriorly and narrow towards the umbo. Ears flattened, triangular, wide. Umbo sharp, slightly projecting beyond hinge. Brachial valve slightly concave, with median fold. Ornaments of spine ridges fine, elongate and very dense, and rugae flattened, very short at the sides.

Occurrence — The *W. humboldti* (d'Orbigny) has been recognized in the *Schwagerina* Limestone of the Ural, in the C_3 of the Moscow Basin and in the Permian of Peru, Bolivia and Jisu Honguer (Mongolia).

Locality — Camp Staghar glacier front. 29 KD - 330, 331, 334.

Waagenoconcha pseudoirginae (Huang) 1932

1932 *Pustula* (*Waagenoconcha*) *pseudoirginae* Huang. *Southwestern China*, p. 52, pl. III, fig. 23; pl. IV, fig. 1, 2.

Only one pedicle valve incomplete, with a small fragment of brachial valve.

Pedicle valve very convex; venter projecting; umbo large curved, highly projecting beyond the hinge wide and straight. Brachial valve sub-flat, slightly concave. Ornaments of spine ridges, pronounced up to 1,5 mm long, subquincun-

cially arranged. These spine ridges are in fact more developed in this specimen than in those of Huang. Irregular rugae on flanks, not very visible in the centre.

Occurrence — The *W. pseudoirginae* (Huang) has been recognized in the Permian of China.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 403.

Juresania sp. ind.

Pedicle valve, not well preserved. Shell subtriangular in the outline. Venter projecting and umbo much curved and projecting beyond the hinge. Surface ornamented by spine ridges concentrically arranged and rugae irregularly placed.

Remarks — This specimen has been noted by Merla (1935, p. 157) as *Productus* aff. *abichi* var. *punjabensis* Cowper Reed. However there are not the characteristics of the genus *Waagenoconcha*, to which the species now belongs. The ornament is comparable instead to those of *Juresania* Fredericks 1928.

However in the recent treatise of the Russian Sarytcheva (1960, p. 229) the genus *Juresania* has been considered synonymous with the genus *Buxtonia* Thomas 1914, while Muir-Wood & Cooper (1960, p. 266) regard it as available.

Locality — Slightly above Singhié glacier. 29 KD - 428.

Chaoiella gruenewaldti (Krotow) 1888

1888 *Productus gruenewaldti* Krotow. *Tscherdyn und Solikamsk*, p. 546, pl. I, fig. 9-11.
1931 *Productus gruenewaldti* Ozaki. *China*, p. 120, pl. XI, fig. 4-9.
1935 *Productus gruenewaldti* Reichardt. *Nassfeldschichten*, p. 979, pl. 100, fig. 1 a-c.
1943 *Productus* (*Dictyoclostus*) *gruenewaldti* Délépine. *Asturies*, p. 70, pl. VI, fig. 9, 10.
1944 *Productus* (*Dictyoclostus*) cf. *gruenewaldti* Reed. *Salt Range*, p. 51, pl. X, fig. 7.
1948 *Chaoiella gruenewaldti* Branson. *Permian Invert.*, p. 305 (*cum syn.*).
1949 *Productus gruenewaldti* Kostić-Podgorska. *Like, Croatie*, p. 85.
1958 *Dictyoclostus gruenewaldti* Ivanova. *Moscow*, p. 112, pl. II, fig. 3.
1960 *Chaoiella gruenewaldti* Muir-Wood and Cooper. *Productoidea*, p. 275, pl. 54, fig. 1-11.

Only one pedicle valve incomplete, sub-quadrate in outline. Visceral disc slightly convex, umbo not very projecting beyond hinge, but much incurved; ears well developed but incomplete; trail very elongate; weak median sulcus; flanks steep.

The ornament is well preserved on the ears and on the trail. On the ears the rugae are well visible as are also the costae on the trail. On the visceral

disc there is just visible the reticulation due to the superposition of the two types of ornaments.

Remarks — Muir-Wood and Cooper (1960, p. 275) note that the *Productus gruenewaldti* Krotow has been designated as type species by Fredericks in 1933 (p. 27 and 32) for his new genus *Chaoiella* and they agree with his designation.

Occurrence — The *C. gruenewaldti* (Krotow) has been recognized from Moscovian to Permian; in the Carboniferous of China, in the C_2 and C_3 of the Moscow Basin, in the limestones with *Schwagerina princeps* of Indo-China, in the *cora* and *Schwagerina* Limestones of the Ural and in the Middle *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD - 338.

Costiferina spiralis (Waagen) 1884

1884 *Productus spiralis* Waagen. *Salt Range*, p. 681, pl. LXVII, fig. 6; pl. LXVIII, fig. 3; pl. LXIX, fig. 1-3.
1915 *Productus spiralis* Diener. *Kashmir, Kanaur and Spiti*, p. 67, pl. VI, fig. 16; pl. VII, fig. 1, 2.
1934 *Productus spiralis* Merla. *Caracorum*, p. 260.
1948 *Dictyoclostus spiralis* Branson. *Permian Invert.*, p. 339 (*cum syn.*).
1960 *Costiferina spiralis* Muir-Wood and Cooper. *Productoidea*, p. 277.

Only one pedicle valve not complete, large. Visceral disc highly convex; umbo very wide, projecting beyond hinge. Ears well defined and elongated on the sides. Ornaments of strong costae in the centre. Irregular rugae on the ears. The ornament of visceral disc is not preserved.

Remarks — According to Muir-Wood and Cooper (1960, p. 277) the *Productus spiralis* Waagen has to be referred to new genus *Costiferina* Muir-Wood and Cooper 1960.

Occurrence — The *C. spiralis* (Waagen) has been found in the Lopingian of the Karakorum, in the Kashmir, in the Lower *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD - 282.

Reticulatia moelleri (Stuckenberg) 1898

Pl. 22, fig. 5

1898 *Productus moelleri* Stuckenberg. *Russland*, p. 340, pl. II, fig. 15.
1939 *Productus moelleri* Renz. *Karakorum*, p. 148, pl. III, fig. 1.
1948 *Dictyoclostus moelleri* Branson. *Permian Invert.*, p. 336 (*cum syn.*).

1958 *Dictyoclostus moelleri* Ivanova. *Moscow*, p. 112, pl. III, fig. 3.
1960 *Reticulatia moelleri* Muir-Wood and Cooper. *Productoidea*, p. 285.

Only one pedicle valve partially in the limestone. Visceral disc highly convex; trail flat with median sulcus wide, but not deep. Flanks slightly spreading. Ears wide, flat, well delimited from umbo, which is acute, slightly projecting beyond hinge.

Ornaments of fine costae, which together with slightly more pronounced rugae produce a weak reticulation.

Remarks — According to Muir-Wood and Cooper (1960, p. 285) the *Productus moelleri* Stuckenberg may belong to the new genus *Reticulatia* Muir-Wood and Cooper 1960. See also the remarks of the *Reticulatia* cf. *transversalis* (Tschernyschew).

Occurrence — The *R. moelleri* (Stuckenberg) has been recognized in the Upper Artinskian of the Karakorum, in the *cora* and *Sckwagerina* Beds of the Ural and in the C_2 and C_3 of the Moscow Basin.

Locality — Camp Staghar glacier front. 29 KD – 332.

Reticulatia cf. **transversalis** (Tschernyschew) 1902

Pl. 22, fig. 4

1897 *Productus semireticulatus* Diener. *Chitichun*, p. 18, pl. II, fig. 1, 3, 5; pl. III, fig. 1, 3.
1902 *Productus transversalis* Tschernyschew. *Ural und Timan*, p. 611, pl. XXIX, fig. 4-6.
1939-40 *Productus semireticulatus* var. *transversalis* Renz. *Karakorum*, p. 22 and 145.
1943 *Productus* (*Dictyoclostus*) *transversalis* Délépine. *Asturies*, p. 67, pl. III, fig. 3, 4.
1944 *Productus* (*Dictyoclostus*) cf. *transversalis* Reed. *Salt Range*, p. 50, pl. VIII, fig. 9.
1948 *Dictyoclostus transversalis* Branson. *Permian Invert.*, p. 340 (*cum syn.*).
1960 *Reticulatia transversalis* Muir-Wood and Cooper. *Productoidea*, p. 285.

Specimen bivalve, very incomplete. All that is visible of the pedicle valve is a small part near the umbo. It is only possible to observe that the visceral disc is convex and from the respective positions of the two valves, that the body cavity is very narrow. The brachial valve is better preserved, although incomplete, and is geniculated, flattened at ears, concave. The hinge, which is long and straight, is buried in the limestone.

Ornaments of costae numerous, very strong, rounded, becoming wider anteriorly, frequently bifurcated and of rugae numerous, fine, progressively broader, not developed anteriorly. The rugae crossing the costae become wider and form a very evident reticulation.

Remarks — We have to observe that although the specimen that we are examining is incomplete, it is very similar to the specimens of the Permian, particularly of Chitichun, originally referred to the *Productus semireticulatus* Martin and later included in the synonymy of *Productus transversalis* Tschernyschew.

Otherwise the presence of *P. semireticulatus* Martin in the Permian had already been debated by Chao in 1927 (p. 29) who had also pointed out that the specimens of the Permian are distinguished by « a tendency of the shells to become much more transverse and regularly inflated, the radiating costae are coarser and the reticulation covers a much larger space ».

Muir-Wood (1928, p. 96) in her revision of the species *Productus semireticulatus* Martin had also established the distribution from the Visean to the superior half of the Tournaisian. Therefore we must exclude all the specimens of the Permian described by Diener (1897, p. 18), Broili (1916, p. 8), Merla (1934, p. 219), Renz (1939, 1940, pp. 21 and 144, pl. II, fig. 8) and others.

We have also to point out about this debated species that Fredericks (1933, p. 40) considers either the *Productus semireticulatus* of Chitichun, Kashmir and Spiti, described by Diener or the *Productus uralicus* Tschernyschew and *Productus transversalis* Tschernyschew synonymous with *Productus moelleri* Stuckenberg, because these forms could be fully developed specimens of the *P. moelleri* Stuckenberg. But this opinion has not been accepted by subsequent authors or to be more precise it has been debated, to my knowledge.

The *Productus moelleri* Stuckenberg might represent a young form, but as I have only one incomplete specimen of both forms, I can only speak very briefly about the question and accept the opinion of the majority of the authors.

As regards the genus the species examined, previously referred to the genus *Dictyoclostus* Muir-Wood, now limited to the Lower Carboniferous, because the ornament and the reticulation are very accentued and developed on both the valves, it might be referred to the new genus of the Permian, *Reticulatia* Muir-Wood and Cooper (1960 p. 284). But since it has not been possible to establish the presence of the « *ginglymus* » and of the anterior lamellae of the pedicle valve, the reference is doubtful.

Occurrence — The *R. transversalis* (Tschernyschew) has been recognized in the Moscovian of the Asturias, in the beds with *Schwagerina princeps* of Indo-China, in the *Schwagerina* Limestone of the Ural, in the Permian of Chitichun and the Himalaya, in the Uralian and Artinskian of the Karakorum, in the Middle *Productus* Limestone of the Salt Range, in the Chitral and K'un-lun.

Locality — Camp Staghar glacier front. 29 KD - 325.

Linoproductus sp. ind.

Only one specimen of median sizes, represented by only one incomplete pedicle valve.

Visceral disc convex; geniculation rather accentuated with steep flanks. Ornaments of costellae separated by slightly wider intercostal sulci. Since these are the only characteristics it has been possible to observe, it is evident that a specific attribution is impossible. Nevertheless the fragment may be referred to the *Linoproductus lineatus* (Waagen) group.

Locality — Camp Staghar glacier front. 29 KD - 339.

Compressoproductus sp. ind.

Pl. 22, fig. 2

Only one pedicle valve, incomplete and decorticated.

Visceral disc very convex. Probable geniculation. Trail not preserved. Ears well developed, flattened and demarcated. Flanks sub-steep. Hinge hardly wider than maximum width of the valve. Umbo acute, slightly projecting and slightly incurved. As the specimen is decorticated, the surface is finely costellate and, on the visceral disc, the rugae are not well developed and irregular.

Remarks — This specimen was listed by Merla (1935, p. 155) as *Productus mongolicus* Diener. This species was referred by Chao to the genus *Striatifera*. But after having compared the above mentioned specimen with many illustrations of this species, we think that it can be referred to the genus *Compressoproductus* Sarytcheva, because of the ornaments; in fact the costellae are finer and the rugae of the visceral disc are stronger than those of the genus *Striatifera*.

Locality — Camp Staghar glacier front. 29 KD - 327.

Cancrinella cancriniformis (Tschernyschew) 1889

1889. *Productus cancriniformis* Tschernyschew. *Central Ural*, p. 373, pl. VII, fig. 32, 33.
1934 *Productus cancriniformis* Merla. *Caracorum*, p. 261, pl. XXV, fig. 24-26; pl. XXVI, fig. 5-10.
1939 *Productus cancriniformis* Renz. *Karakorum*, p. 18, pl. III, fig. 6-7 and p. 158.
1948 *Linoproducts cancriniformis* Branson. *Permian Invert.*, p. 387 (*cum syn.*).
1957 *Linoproductus cancriniformis* Coleman. *Australia*, p. 69, pl. VIII, fig. 1-9.
1960 *Cancrinella cancriniformis* Muir-Wood and Cooper. *Productoidea*, p. 301.

Two pedicle valves, incomplete, one without umbo, the other one partially deformed, lacking the anterior part; but the ornaments are quite well preserved. Pedicle valve very convex, umbo highly curved, flanks steep. All the surface is ornamented by thin costellae; numerous spines sub-quincuncially arranged, less developed posteriorly. Rugae irregular are present on the whole surface.

Remarks — The *Productus cancriniformis* Tschernyschew already assigned to the genus *Cancrinella* Fredericks by Dunbar and Condra (1932, p. 257) has been retained in this genus by Muir-Wood and Cooper (1960, p. 301).

Occurrence — The *C. cancriniformis* (Tschernyschew) has been found in all the Permian of Europe, Asia and Australia.

Locality — Camp Staghar glacier front. 29 KD - 301. Signal Camp of Gasherbrum Gilga. 29 KD - 415.

Chonetinella ? latesinuata (Schellwien) 1892

Pl. 23, fig. 1

1892 *Chonetes latesinuata* Schellwien. *Karnischen Fusulinenkalk*, p. 30, pl. I, fig. 4-7.
1931 *Chonetes latesinuata* Ozaki. *North China*, p. 95, pl. 11, fig. 19, 20.
1935 *Chonetes latesinuata* Reichardt. *Nassfeldschichten*, p. 978.
1939 *Chonetes* cf. *latesinuata* Renz. *Karakorum*, p. 143.
1943 *Chonetes latesinuata* Délépine. *Asturies*, p. 64, pl. VII, fig. 3-5.
1949 *Chonetes latesinuata* Kostić-Podgorska. *Lika, Croatie*, p. 79, pl. I, fig. 12.
1952 *Chonetes* (*Chonetes*) *latesinuatus* Sarytcheva and Sokolskaja. *Index palaeozoic Brachiopods*, p. 57, pl. 11, fig. 64.
1958 *Chonetes* (*Mesolobus*) *latesinuatus* Ivanova. *Moscow*, p. 103.
1962 *Chonetinella ? latesinuata* Muir-Wood. *Chonetoidea*, p. 86.

Only one pedicle valve, incomplete, convex, with a median sulcus limited to the anterior part. Hinge long and straight, equal to the maximum width. Ears flattened and umbo wide, projecting slightly beyond hinge. Shell ornamented by well developed costellae, separated by narrow and deep intercostal sulci, increasing by bifurcation at 1/3 of the length, but very often at 2/3.

Dimensions — length 11(?) mm
hinge width 20(?) mm

Remarks — According to Muir-Wood (1962, p. 86) this species must be attributed, though with some doubts, to the genus *Chonetinella* Ramsbottom 1952.

Occurrence — The *C. ? latesinuata* (Schellwien) has been found in several localities, in the Carnic *Fusulina* Limestone, in the Carboniferous of the Astu-

rias, in the Taiyuan series of North China, in the Upper Artinskian of the Karakorum and in the C_2 and C_3 of the Moscow basin.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 281

Chonetinella sp. ind.

Pl. 23, fig. 2

Two pedicle valves, small sizes, incomplete. Umbo acute, slightly recurved and projecting beyond the hinge, straight and very wide. The median sulcus is present, but once it has passed the umbo, it becomes very deep. Steep flanks. Ears very developed, well demarcated.

Remarks — The above-mentioned specimens had been identified by Merla (1935, p. 155) as *Chonetes trapezoidalis* Waagen; now this species has been attributed to the genus *Waagenites* Muir-Wood 1962. A more detailed examination allowed to attribute the specimens to the genus *Chonetinella* Ramsbottom 1952, however without any specified identification.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 387.

Neochonetes variolatus (d'Orbigny) 1842

Pl. 23, fig. 4, 5

1842 *Leptaena variolata* d'Orbigny. *Amérique mérid.*, p. 49, pl. IV, fig. 10-11.
1940 *Chonetes variolata* Renz. *Karakorum*, p. 139, pl. II, fig. 4; pl. V, fig. 8.
1948 *Chonetina variolata* Branson. *Permian Invert.*, p. 315 (*cum syn.*).
1962 *Neochonetes variolatus* Muir-Wood. *Chonetoidea*, p. 87.

Numerous internal moulds of brachial and pedicle valves, small-sized.

Shell much wider than long; hinge widest part of shell. Pedicle valve very convex at median part with median sulcus shallow; umbo slightly projecting beyond hinge; ears large. Brachial valve very concave. Ornament of capillae poorly preserved.

Interior of pedicle valve with median septum short and anteriorly two vascolar trunks parallel, separated by a narrow groove.

Adductor scars small, oval, adiacent to septum; diductor scars large, extending anteriorly as far as end of vascolar trunks. Small papillae ranged near margins, coarser papillae irregularly distributed posteriorly.

Interior of brachial valve with median septum very long and thin, and lateral septa very short, not very divergent. Posteriorly, socket ridges accentuated and well defined. Alveolus and cardinal process not visible. Papillae like those on pedicle valve.

Dimensions — length 9 mm
width 13,5 mm
thickness 3,4 mm

Remarks — These numerous specimens had been listed as *Chonetes* sp. ind. in Merla's preliminary note. This Author had also stated that they are similar to the *Chonetes* sp. ind. illustrated by Reed among the fauna from Tali-shao (p. 132). On the basis of an examination of all the specimens however we were able to refer these forms to the species of d'Orbigny. In fact they correspond well to this species, even though they are all preserved as internal moulds.

In accordance with what proposed by Muir-Wood (1962, p. 87) the abovementioned species is assigned to the genus *Neochonetes* Muir-Wood 1962.

The two valves present similar curve. In fact the brachial one is not flat, as it was erroneously written by some authors. Only this valve shows the median septum long and thin.

Occurrence — The *N. variolatus* (d'Orbigny) has been found in the Permo-Carboniferous of Bolivia, Peru and India; in the *cora* Beds, in the Permian and Artinskian of Russia, in the *Schwagerina* Limestone of Indochina, in the Auernig Beds of the Carnic Alps.

Locality — Slightly above Singhié glacier. 29 KD - 421, 422, 433.

Neochonetes sp. ind.

Pl. 23, fig. 3

Two small pedicle valves, deprived of the ears tops.

Wide shell, subtrapezoidal in outline, not very strongly convex. Flattened ears, well demarcated. The umbo is not very developed, being young forms; it is acute and projects very little beyond the hinge. A median sulcus is already present near the umbo.

Surface of pedicle valve posteriorly smooth and with irregular lamellae anteriorly.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 387.

Uncinunellina timorensis (Beyrich) 1865

Pl. 23, fig. 6, 7

1865 *Rhynchonella timorensis* Beyrich. *Timor*, p. 72, pl. I, fig. 10.
1933 *Uncinunellina timorensis* Huang. *China*, p. 61, pl. IX, fig. 12-13; pl. X, fig. 30-36.
1940 *Uncinulus* (*Uncinunellina*) *timorensis* Renz. *Karakorum*, p. 176, pl. V, fig. 12a-d.

1948 *Uncinunellina timorensis* Branson. *Permian Invert.*, p. 550 (*cum syn.*).
1961 *Uncinunellina timorensis* Zhang & Ching. *Jingxian*, p. 404, pl. I, fig. 9-16.

Only one specimen bivalve, pentagonal in outline.

Pedicle valve sub-flat, median sulcus wide and not very deep posteriorly; umbo wide, but only slightly projecting. Brachial valve highly convex. The greatest width is a little anterior to the middle.

Ornament of plicae very thin near umbo, but wider, flat and uniform laterally and anteriorly, divided by very fine intercostal sulci.

Remarks — Reed cites in his work about the fossils of Salt Range (1944, p. 126) the *Uncinunellina theobaldi* (Waagen), collected from the Middle *Productus* Limestone, which previous authors, for instance Huang, had considered inseparable from the species *Uncinunellina timorensis* (Beyrich) and therefore had listed among the synonyms of this species.

Dimensions — length 20(?)mm
width 24,5 mm

Occurrence — The *U. timorensis* (Beyrich) has been recognized in the Artinskian of the Karakorum and in the Permian of China, Chitichun, Central Himalaya and Timor.

Locality — Camp Staghar glacier front. 29 KD - 313.

Terebratuloidea davidsoni Waagen 1883

1862 *Rhynchonella pleurodon* Davidson. *India*, p. 29.
1883 *Terebratuloidea davidsoni* Waagen. *Salt Range*, p. 416, pl. XXXIII, fig. 1-5.
1906 *Terebratuloidea davidsoni* Gortani. *Col Mezzodì*, p. 38.
1944 *Terebratuloidea davidsoni* Reed. *Salt Range*, p. 143, pl. XXIII, fig. 2.

2 specimens bivalve, without umbo, and one without the anterior part. Valves very convex. Median sulcus with 3 or 4 sharp plications. The fold is regularly convex and highly prominent. Lateral parts short and sloping, with plicae divergent, well developed anteriorly.

Dimensions — width 15,3(?) mm
thickness 10,3 mm

Occurrence — The *T. davidsoni* Waagen has been recognized in the Middle *Productus* Limestone and in the Permo-Carboniferous of the Carnic Alps.

Locality — Camp Staghar glacier front. 29 KD - 314, 318.

Stenoscisma biplicata (Stuckenberg) 1898

1862 *Camarophoria plicata* Moeller. *Uralgebirges*, p. 169, pl. VIII, fig. 2a.
1898 *Camarophoria biplicata* Stuckenberg. *Russland*, p. 343, pl. III, fig. 18.
1902 *Camarophoria biplicata* Tschernyschew. *Ural und Timan*, p. 494, pl. L, fig. 8-10.
1934 *Camarophoria biplicata* Merla. *Caracorum*, p. 244.
1944 *Camarophoria biplicata* Reed. *Salt Range*, p. 137, pl. XXII, fig. 11, 11a; pl. XXIII, fig. 9, 9a-b; pl. XXIV, fig. 10, 10a-b.

A small specimen bivalve, well preserved, slightly wider than long. Pedicle valve sub-flat; umbo sharp, projecting, and median sulcus very wide and deep, delimited by two plications sub-equal. Brachial valve highly convex, umbo not very developed and median fold slightly prominent whith three large plications. There are also three plications on each side: the last one is just visible.

Dimensions — length 11,9 mm
width 13,6 mm
thickness 9,6 mm

Occurrence — The *S. biplicata* (Stuckenberg) has been found in the Uralian of the Karakorum, in the *Schwagerina* Limestone of the Ural and in the Middle *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD - 319.

Stenoscisma pinguis (Waagen) 1883

Pl. 23, fig. 8, 9, 10, 11

1883 *Camerophoria pinguis* Waagen. *Salt Range*, p. 441, pl. XXXII, fig. 10, 11.

Three specimens bivalve, small sized, slightly wider than long. Pedicle valve sub-flat with wide sulcus. Umbo sharp, projecting, not much curved. Brachial valve highly convex with umbo sharp, but slightly projecting beyond hinge.

Ornaments of sharp plications which occur in the centre at about 1/3 of the length and at the sides half-way along the valve. There are 5 plications on the fold and 4 on the sulcus sub-equal or slightly more developed centrally.

At the sides there are wide plane and triangular surfaces; at sides of valves, 3 or 4 plications, slightly curved towards the edges, becoming progressively shorter.

Dimensions —			
length	11,8 mm	10,4(?) mm
width	13 mm	10,4 mm
thickness	8,6 mm	8,4 mm

Occurrence — The *S. pinguis* (Waagen) has been recognized in the Middle *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD – 315, 317.

Stenoscisma purdoni (Davidson) 1862

Pl. 23, fig. 12, 13.

1862 *Camerophoria purdoni* Davidson. *India*, p. 30, pl. III, fig. 4.
1883 *Camerophoria purdoni* Waagen. *Salt Range*, p. 437, pl. XXXII, fig. 1-7.
1897 *Camarophoria purdoni* Diener. *Chitichun*, p. 71, pl. XII, fig. 6, 8, 9.
1944 *Camarophoria purdoni* Reed. *Salt Range*, p. 133.
1948 *Stenoscisma purdoni* Branson. *Permian Invert.*, p. 526 (*cum syn.*).

Only one specimen bivalve, nearly complete, medium dimensions. Pedicle valve convex, laterally sub-flat, with umbo prominent and sharp, without apex. Median sulcus shallow and wide. Brachial valve rounded with the greatest width a little anterior to the middle; umbo wide and slightly projecting.

Ornament of plications very projecting, acute, 5 on the sulcus, 2 of them start from the umbo, the others appear at different distances. They are all present at half-length. Lateral plications less developed are present only in the anterior half. On the brachial valve the 6 plications of the fold are all present at about 1/3 of the length.

Dimensions —	
length	16,7(?) mm
width	—
thickness	10,5 mm

Occurrence — The *S. purdoni* (Davidson) has been recognized in the Permian of Chitichun, India, Timor and Russia and in the Middle and Upper *Productus* Limestone of the Salt Range.

Locality — Camp Staghar glacier front. 29 KD – 337.

Stenoscisma sp. ind.

Only one specimen bivalve, left part missing, slightly asymmetrical owing to deformation. This specimen might be referred to *S. mutabilis* Tschernyschew, but it differs from the latter inasmuch as the posterior part of both valves is quite smooth. In fact the plications are present at about 1/3 of the length.

Owing to this difference and to the poor state of preservation I am unable to make a specifical identification.

Locality — Camp Staghar glacier front. 29 KD - 320.

Neophricodothyris asiatica (Chao) 1927

Pl. 24, fig. 1-6

1927 *Squamularia asiatica* Chao. *China*, p. 91, pl. XI, fig. 12-14.
1939-40 *Squamularia asiatica* Renz. *Karakorum*, pp. 38, 189, pl. VII, fig. 2.
1944 *Squamularia* (*Neophricodothyris*) *asiatica* Reed. *Salt Range*, p. 233, pl. XXXI, fig. 6.
1948 *Neophricodothyris asiatica* Branson. *Permian Invert.*, p. 424 (*cum syn.*).
1961 *Neophricodothyris asiatica* Zhang & Ching. *Jingxian*, p. 405, pl. II, fig. 5-8.

Numerous specimens well preserved, nearly always bivalve, small and medium dimensions. Shell more or less transversally elliptic. Valves almost uniformly rounded, umbo of the pedicle valve more developed and much curved, highly projecting beyond the hinge. Ornaments of bands regular, narrowing posteriorly.

Remarks — Two of our specimens are asymmetrical, one bivalve and one pedicle valve, similar to those illustrated by Renz (1940, pl. VII, fig. 3) as *S. inaequilateralis* Gemmellaro. But the specimens illustrated by Gemmellaro differ from the forms, which we are examining, which rather resemble really some asymmetrical specimens of *N. asiatica* (Chao). Furthermore this asymmetry has already been observed by previous authors, for instance by Merla.

E. Ivanova in the Russian Treatise of Palaeontology (1960, p. 277) limits the occurrence of the genus *Neophricodothyris* Likharew 1934 to the Permian; she also remarks that the species identified in Russia in older beds are surely to be referred to other genera.

Dimensions —	lenght	11,2 mm	20(?) mm	22,3 mm
	width	14,2 mm	23(?) mm	28,5 mm
	thickness	7,3 mm	14,7 mm	18,4 mm

Occurrence — The *N. asiatica* (Chao) has been recognized in several Permian localities of Europe and Asia.

Locality — Camp Staghar glacier front. 29 KD - 292, 306, 321, 341, 342, 344, 345, 348, 349, 350, 351, 352, 353, 354, 356, 359, 361.

Spirifer ? cf. **psittacus** Merla 1934

1934 *Spirifer psittacus* Merla. *Caracorum*, p. 227, pl. XXI, fig. 26-29.

A small fragment of pedicle valve, highly projecting in the middle, sloping at the sides. Umbo sharp, prominent; median sulcus already present starting from the umbo. Ornaments of fine plications divided by furrows of uniform width.

Occurrence — The *S. psittacus* Merla has been found in the Uralian of the Karakorum.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 387.

Elivina cf. **tibetana tenuisulcata** (Merla) 1934

1934 *Spirifer tibetanus* var. *tenuisulcata* Merla. *Caracorum*, p. 273, pl. XXVI, fig. 14-21.
1948 *Elivina tibetana tenuisulcata* Branson. *Permian Invert.*, p. 356.

A small fragment of pedicle valve without edges. Median sulcus as wide as the double plications which flank it.

This characteristics in Merla's opinion would differentiate this form from typical *Spirifer tibetanus* Diener with a very wide sulcus. Laterally on the sulcus there are two wide plications, very flat, anteriorly bifurcated. On the sides of these at least four plications can be counted, they are rounded and become progressively shorter. There is not any other peculiarity.

Occurrence — The *E. tibetana tenuisulcata* (Merla) has been recognized in the Lopingian of the Karakorum.

Locality — A little above Staghar glacier. 29 KD - 434.

Purdonella merlai sp. n.

Pl. 24, fig. 10-13

Only one specimen, perfectly preserved, bivalve. Shell sub-pentagonal in outline, wider than long.

Pedicle valve very convex; umbo acute, strongly projecting, slightly incurved; short hinge; interarea concave, triangular; ratio between width and

length about 2.6. Lateral edges very arcuate, the maximum of its curve is at about 1/3 of the length. Lateral edges anteriorly converging towards the front which is about 15 mm wide and continues with a short and arcuate expansion. Median sulcus already present on the umbo, beginning narrow and deep, becoming wider and shallower.

Brachial valve rather convex, with umbo wide, slightly projecting. Fold absent until about 2/3 of the length, anteriorly very little relieved.

Ornaments of plications acute, often rounded by erosion, starting from the beak, very thin, then more and more pronounced, separated by deep and acute plication furrows. These plications multiply very rarely by bifurcation, and have a fairly constant width, decreasing towards the lateral commissures. The seven plications situated in the median sulcus show different widths. In the middle there is only one thin plication, flanked by plication furrows which are twice as wide as the others. There follow three plications on both sides, separated by plication furrows, which are only a little wider than the ones situated on the flanks. Of the three left lateral plications the middle one is filiform and weakly marked, the other two are regular. On the fold the plications are similar to the others, but anteriorly the 3 central plications become wider and the same can be said of the plication furrows.

Dimensions —	length of pedicle valve	29,7	mm
	length of brachial valve	26	mm
	mid - width	30,5	mm
	thickness	21	mm
	width of interarea	12 (?)	mm
	length of interarea	4,5(?)	mm

Remarks — This specimen was referred by Merla (1935, p. 155) to *Spirifer* n. sp. aff. *siculus* Gemmellaro, but Gemmellaro's species differs above all by the greater width of its interarea. For this reason, the whole shape is different. *Purdonella nikitini* (Tschernyschew) shows a narrow hinge and a similar outline; but the plications are flat, bifurcating very frequently. Moreover, the umbo is bigger, less projecting, but more incurved.

Also *P. nikitini tschernyschewi* (Ozaki) shows a very projecting umbo on the pedicle valve, though less acute, but it has a more prominent fold which is present already posteriorly; its sulcus is narrow, anteriorly nearly absent. Furthermore, the plications, weakly rounded and separated by thin furrows, bifurcate very often anteriorly.

No other species of this genus, exclusively Permian, presents analogies with the specimen we are examining. For this reason, this certainly represents a new species for Science and I denominate it specifically although we have only one specimen, because it is perfectly preserved.

Holotype — Collected by A. Desio (24-6-1929) and preserved in the Paleontology Institute of Milan University. Register-number P 1781.

Derivation of name — The specific name « *merlai* » is dedicated to the first Italian author (G. Merla) to study the Permian Brachiopods of this region.

Horizon and locality — Upper Permian. Camp Staghar glacier front. 29 KD - 280.

Neospirifer fasciger (Keyserling) 1846

Pl. 24, fig. 9

1846 *Spirifer fasciger* Keyserling. *Petschoraland*, p. 231, pl. VIII, fig. 3.
1939 *Spirifer* (*Neospirifer*) *fasciger* Renz. *Karakorum*, p. 33.
1943 *Spirifer* (*Neospirifer*) *fasciger* Délépine. *Asturies*, p. 91, pl. V, fig. 12-17.
1948 *Neospirifer fasciger* Branson. *Permian Invert.*, p. 427 (*cum syn.*).
1949 *Neospirifer fasciger* Kostić-Podgorska. *Lika, Croatie*, p. 92, pl. II, fig. 17.

Only one specimen bivalve, but very incomplete. All that is visible of the pedicle valve is a small anterior fragment with a small part of the median sulcus which seems to be very wide and not very deep. Brachial valve slightly convex in the middle, flattened laterally with umbo wide and slightly projecting beyond hinge. Median fold nearly flat.

Ornament of plications already defined near the umbo, multiplied either by bifurcation or intercalation, at different widths, some of plications much developed, but always projecting.

Remarks — Renz (1939, p. 33) lists in synonymy of the *S.* (*Neospirifer*) *fasciger* (Keyserling) the *S. moosakhailensis* Davidson and (1940, p. 185) considers the *S. moosakhailensis* one variety of the *S. fasciger*. Reed (1944, p. 196) however considers the *S. musakheylensis* Davidson separately.

Occurrence — The *S.* (*Neospirifer*) *fasciger* (Keyserling) has been found in the Permo-Carboniferous and Permian of Asia, Eurcpe and Australia.

Locality — Camp Staghar glacier front. 29 KD - 336.

Crurithyris tschernyschewi (Likharew) 1939

Pl. 24, fig. 8

1900 *Spirifera* (*Martinia*) *planoconvexa* Arthaber. *Djulfa*, p. 266.
1902 *Ambocoelia planoconvexa* Tschernyschew. *Ural und Timan*, p. 575, pl. XX, fig. 1; pl. XLIX, fig. 7.
1912 *Ambocoelia planoconvexa* Yakowlew. *Donetz Bassin*, p. 31, pl. V, fig. 4-7, 14.
1933 *Ambocoelia planoconvexa* Simić. *Westserbien*, p. 100, pl. IV, fig. 2-4.
1939 *Ambocoelia* (*Crurithyris*?) *tschernyschewi* Likharew. *Fauna SSSR*, p. 114, pl. XXV, fig. 11.
1940 *Ambocoelia planoconvexa* Renz. *Karakorum*, p. 202, pl. VIII, fig. 12.
1960 *Crurithyris planoconvexa* Ramovs. *Slovenia*, p. 202.
1963 *Ambocoelia* (*Crurithyris*) *tschernyschewi* Schréter. *Nordungarn*, p. 134, pl. VII, fig. 7-11.

Only one pedicle valve, which has some small fractures that make it flat along the edges slightly deforming it. High posterior convexity, umbo well projecting beyond hinge and much curved. Interarea high and narrow, poorly visible. Hinge wide and straight, nearly perpendicular to the lateral edges which are very quickly incurved towards the front which is short and nearly straight.

Remarks — This specimen was described by Merla in his preliminary note (1935, p. 158) as *Martinia frechi*? Schellwien. The identification was doubtful. In fact the specimen illustrated by Schellwien presents an umbo much more developed and prominent. As only the posterior part of our specimen is well preserved since it is the only part without fractures, we are of the opinion that the characteristics mentioned above are those which can best be compared. Therefore we have referred the specimen that we are examining to *C. tschernyschewi* (Likharew), which presents the greatest similarity and differs only in convexity of the valve, more visible anteriorly. However the flatness of the valve can be explained by the numerous fractures occurring in our specimen.

Occurrence — The *C. tschernyschewi* (Likharew) has been recognized in the Artinskian of the Karakorum, in the *Schwagerina* Limestone of the Ural, in the Permian of Djoulfa (Armenia) and Donetz Basin (Russia) and in the Upper Permian of W. Serbia and North Hungary.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 387.

Brachythyrina cf. **sokolowi** (Tschernyschew) 1902

1902 *Spirifer sokolowi* Tschernyschew. *Ural und Timan*, p. 552, pl. VIII, fig. 3a-c; pl. XXXIX, fig. 4.
1913 *Spirifer sokolowi* Mansuy. *Indochine*, p. 70, pl. VII, fig. 5; pl. VIII, fig. 11.
1948 *Brachythyrina sokolowi* Branson. *Permian Invert.*, p. 301.

Only one specimen badly preserved, deformed and incomplete. It is in fact one pedicle valve of large dimensions, without the anterior part and the ears. At about 1/2 of length there is a median sulcus very wide and deep anteriorly. Umbo big, much curved, and projecting beyond hinge.

Occurrence — The *B. sokolowi* (Tschernyschew) has been found in the *Schwagerina* Limestone of the Ural and Indochina.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 396.

Spirigerella derbyi kweichowensis Grabau 1934

Pl. 23, fig. 18, 19

1934 *Spirigerella derbyi* var. *kweichowensis* Grabau. *China*, p. 113, pl. VII, fig. 12.

Only one specimen incomplete, rather large dimensions. Shell sub-pentagonal in outline. Pedicle valve longer than wide, highly convex, with the greatest height at about half-length. Umbo well developed, very prominent and curved. Flanks slightly sloping. Anteriorly there is a median sulcus not very deep, which nearly reaches the anterior edge, and continues in a little tongue nearly at right angles to the plane of the valves. Brachial valve preserved only posteriorly, highly convex with umbo wide and not projecting beyond hinge. Surface smooth with only few growth lines. Along the anterior edge there are some rugae, wide and flat.

Dimensions —	length	34,2	mm
	width	26,5(?)	mm
	thickness	24,5	mm

Occurrence — The *S. derbyi kweichowensis* Grabau has been recognized in the Permian of Kweichow (China).

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 399.

Martinia cf. **glabra** (Sowerby) 1820

Pl. 23, fig. 14, 15, 16

1809 *Conchyliolithes Anomites glaber* Martin. *Petrif. Derbiens*, p. 11, pl. 48, fig. 9-10.
1897 *Martinia glabra* Diener. *Kumaon and Gurhwal*, p. 44, pl. V, fig. 4.
1931 *Martinia* cf. *glabra* Ozaki. *China*, p. 79, pl. IX, fig. 6.
1943 *Martinia glabra* Délépine. *Asturies*, p. 93, pl. III, fig. 22-23.
1948 *Martinia glabra* Branson. *Permian Invert.*, p. 413 (*cum syn.*).

One specimen, bivalve, incomplete. Shell sub-pentagonal in outline. Pedicle valve about wider than long, highly convex posteriorly and sloping anteriorly. Umbo prominent and curved. Median sulcus wide and shallow at half length and more visible near the anterior commissure which becomes undulating. Brachial valve wider than long with a wide fold well visible only anteriorly and umbo poorly projecting. Interarea not visible.

Dimensions — lenght 24,3(?) mm
width 27,5(?) mm
thickness 16,3 mm

Occurrence — The *M. glabra* (Sowerby) has been found frequently in the Carboniferous and Permian of Europe, Asia and America.

Locality — Camp Staghar glacier front. 29 KD - 355.

Martinia orbicularis Gemmellaro 1898-99

1898-99 *Martinia orbicularis* Gemmellaro. *Sosio*, p. 301, pl. XXXIII, fig. 16-22.
1933 *Martinia* cf. *orbicularis* Huang. *China*, p. 52, pl. VIII, fig. 12-15.
1948 *Martinia orbicularis* Branson. *Permian Invert.*, p. 414 (*cum syn.*).
1961 *Martinia orbicularis* Zhang & Ching. *Jingxian*, p. 405, pl. II, fig. 20-23.

One pedicle valve with edges not complete, large. Valve sub-circular in outline, with umbo large, prominent and highly curved. Hinge nearly straight rather more than half as long as the mid - width. Surface smooth with some very rare rugae.

Dimensions — length —
width 39(?) mm

Occurrence — The *M. orbicularis* Gemmellaro has been recognized in the Permian of Sosio, Mongolia and China and in the *Schwagerina* Limestone of the Ural.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 398.

Martinia cf. **semiplana** Waagen 1882

1882 *Martinia semiplana* Waagen. *Salt Range*, p. 536, pl. XLIII, fig. 4.
1931 *Martinia* cf. *semiplana* Ozaki. *China*, p. 81, pl. IX, fig. 11-13.
1939-40 *Martinia semiplana* Renz. *Karakorum*, p. 40, 197.
1948 *Pseudormartinia semiplana* Branson. *Permian Invert.*, p. 471 (*cum syn.*).
1949 *Martinia semiplana* Kostić-Podgorska. *Lika, Croatie*, p. 97, pl. II, fig. 16.
1961 *Martinia semiplana* Zhang & Ching. *Jingxian*, p. 406, pl. II, fig. 16-19.

Specimen bivalve badly preserved being very incomplete. Shell subpentagonal in outline. Pedicle valve with umbo very wide and projecting beyond hinge. The apex is not preserved. Brachial valve slightly convex in the middle, flattened along the edges. Lateral commissures straight, anterior commissure wide with weak central sinuosity.

Dimensions — length 26,3 mm
width 29 (?) mm
thickness 16,8(?) mm

Occurrence — The *M. semiplana* (Waagen) is a species largely recognized in the Permian, but also in the Upper Carboniferous, for instance, of China. It has been found in the Middle *Productus* Limestone of the Salt Range, in the Uralian and Artinskian of the Karakorum, in the Permian of Chitichun, Russia and Yunnan, China and the Carnic Alps, in the *Schwagerina* Limestone of the Ural.

Locality — Camp Staghar glacier front. 29 KD - 369.

Martinia subtriquetra Merla 1934

Pl. 23, fig. 17

1902 *Martinia triquetra* Tschernyschew. *Ural und Timan*, p. 562, pl. XVI, fig. 1-6.
1933 *Martinia triquetra* Huang. *China*, p. 48, pl. VI, fig. 5,6; pl. IX, fig. 6-10.
1934 *Martinia subtriquetra* Merla. *Caracorum*, p. 236, pl. XXI, fig. 1.

Numerous specimens rather well preserved, sometimes large (occasionally exceeding 50 mm in width). They are nearly all pedicle valves. Only one is bivalve, but incomplete.

Shell rounded in outline, never triangular. Umbo curved and projecting. Median sulcus, just visible already near the umbo, becomes very wide but

always not very deep anteriorly. Growth lines sinuous, irregular, more developed anteriorly. Brachial valve, transversally sub-elliptical in outline, slightly convex with a large fold in the centre.

Dimensions —	length	37(?) mm	44(?) mm
	width	36(?) mm	52(?) mm

Occurrence — The *M. subtriquetra* Merla has been found in the Uralian of the Karakorum, in the *Schwagerina* Limestone of the Ural and in the Permian of China.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 286, 378, 379, 380, 382, 384, 395, 400.

Martinia cf. **uralica** Tschernyschew 1902

1900 *Martinia contracta* Schellwien. *Trogkofelschichten*, p. 87, pl. XIII, fig. 8.
1902 *Martinia uralica* Tschernyschew. *Ural und Timan*, p. 566, pl. XVIII, fig. 1-4
1934 *Martinia uralica* Merla. *Caracorum*, p. 235.

Some pedicle valves badly preserved and incomplete. Valve longer than wide, highly convex with umbo much developed and curved. Median sulcus weak in the middle-anterior part.

Occurrence — The *M. uralica* Tschernyschew has found in the Uralian of the Karakorum, in the *Schwagerina* Limestone of the Ural and in the Trogkofel Limestone of the Carnic Alps.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 284, 393.

Martinia sp. I

A large specimen: length about 54 mm, width 52 mm, thickness 36 mm. In fact it is not possible to give the exact dimensions because the specimen is incomplete. Pedicle valve highly convex, median sulcus wide, very deep anteriorly. Umbo projecting highly beyond hinge and curved so that it covers nearly the whole of the interarea which is very narrow. It is evident that all the posterior part has been deformed. Brachial valve wider than long, highly convex in the centre. Anteriorly it presents a triangular fold shallow and very wide. The surface seems to be quite smooth with the exception of the some large irregular growth lines along the edges.

Remarks — This large specimen, incomplete and a little deformed, had been referred by Merla to *Martinia* cf. *semiconvexa* Chao. But in one of his

handwritten notes, which was inclosed with the fossil, Merla had already pointed out that the hinge, which is much more narrow in the specimen examined, produced another outline, and that there were no plications on the brachial valve. But we would point out that these plications are not always present in *M. semiconvexa* Chao.

Merla thought that probably it was a new species, which is very likely. But we prefer to make only a generical identification because we have only one specimen, which is badly preserved.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 376.

Martinia sp. II

Only one specimen bivalve, but incomplete. Shell sub-elliptical in outline. Pedicle valve wider than long, very convex in the centre, flattened along the edges. Umbo curved and projecting beyond hinge. Interarea slightly wider than long. Brachial valve is very convex posteriorly and seems to be flattened along the edges. Umbo well developed.

Locality — Camp Staghar glacier front. 29 KD - 357.

Whitspakia cf. **biplex** (Waagen) 1882

Pl. 24, fig. 14-16

1882 *Dielasma biplex* Waagen. *Salt Range*, p. 349, pl. XXV, fig. 3-5.
1897 *Dielasma biplex* Diener. *Chitichun*, p. 74, pl. XI, fig. 5, 6, 7?
1911 *Dielasma biplex* Diener. *Shan States*, p. 38, pl. V, fig. 25.
1915 *Dielasma biplex* Diener. *Kashmir, Kanaur and Spiti*, p. 98, pl. X, fig. 10, 11.
1928 *Dielasma biplex* Hamlet. *Timor*, p. 69, pl. X, fig. 15, 16.

Two specimens bivalve, one rather well preserved, the other one very incomplete. Probably both have been slightly deformed.

Shell sub-rectangular in outline. Pedicle valve very elongate and regularly convex. Umbo prominent much curved but without apex. Two strong folds starting from the umbo and widening up to half-way along the valve, becoming sub-parallel thereafter. Anterior edge narrow and sulciplicate. The interspace between the folds is not preserved, therefore it is not possible to see the anterior central fold, illustrated by Waagen. Brachial valve with umbo poorly developed, flanks steep. Two central folds begin slightly posteriorly at the half-length. They are divided by a narrow, deep sulcus, and become wider

apart anteriorly. Lateral commissures nearly semi-circular. Surface smooth with only slight growth lines.

Dimensions — length 47,6(?) mm
width 25,7 mm
thickness 22,3 mm

Remarks — Our specimens compared with those illustrated by Waagen are longer and narrower and appear to be posteriorly thinner and prominent, with the flanks of the brachial valve more sloping. But it does not seem necessary to divide them specifically.

The species *D. biplex* Waagen was designated by Stehli (1961) as type species of his new genus *Pakistania*. In 1964, however, Stehli changed the generic name *Pakistania* with the name *Whitspakia*, in order to remove a homonymy case.

Occurrence — The *W. biplex* (Waagen) has been found in the Middle *Productus* Limestone of the Salt Range and in the Permian of Chitichun, Timor and Kashmir.

Locality — Camp Staghar glacier front. 29 KD - 346, 347.

Hemiptychina cf. **carniolica** Schellwien 1900

1900 *Hemiptychina carniolica* Schellwien. *Trogkofelschichten*, p. 106, pl. XV, fig. 20.
1906 *Hemiptychina carniolica* Gortani. *Col Mezzodì*, p. 43, pl. III, fig. 5.

Only two specimens bivalve, one badly preserved, the other a little better preserved, but incomplete. Pedicle valve longer than wide, highly convex. Umbo sharp, much projecting beyond hinge and much curved. Brachial valve sub-flat, preserved only anteriorly. Two folds wide, well projecting, divided in the centre by a rather deep sulcus and laterally by sulci of the same width, but shallower. These folds start at 2/3 of the length of the pedicle valve. Surface smooth with only very thin growth lines. Along the anterior commissure there are some strong growth lines.

Occurrence — The *H. carniolica* Schellwien has been recognized in the Trogkofel Beds and in the *Fusulina* Limestone of the Carnic Alps.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 281.

Rostranteris exilis Gemmellaro 1898-99

Pl. 24, fig. 7

1898-99 *Rostranteris exilis* Gemmellaro. *Sosio*, p. 243, pl. XXV, fig. 63-70; pl. XXVII, fig. 60; pl. XXX, fig. 42.

1900 *Notothyris exilis* Schellwien. *Trogkofelschichten*, p. 103, pl. XV, fig. 13-17.
1903 *Notothyris exilis* Diener. *Central Himalayas*, p. 39, pl. II, fig. 1.
1906 *Notothyris exilis* Gortani 1906. *Col Mezzodì*, p. 46, pl. III, fig. 13-16.

Specimen bivalve, well preserved, although the right part is missing.

Shell sub-oval in outline. Pedicle valve longer than wide, regularly convex with umbo sharp and prominent. Anteriorly there are two wide and flat folds about 3 mm long. Brachial valve slightly convex with three small anterior folds sharp, not very prominent, particularly the two lateral ones. Lateral commissures straight, anterior commissure undulating to correspond with the small folds we have described. Surface smooth, except for growth lines, sometimes very evident.

Dimensions — length 11,5 mm
thickness 6,2(?) mm

Remarks — Stehli (1962, p. 98) states that the genus *Rostranteris* Gemmellaro 1899 should not be regarded as synonymous of *Notothyris* Waagen, because the two genera, though being very similar internally, differ significantly in external characteristics. *Rostranteris* includes forms in which the pedicle valve bears only two folds, and the brachial valve three. Stehli records between the species assigned to the genus *Rostranteris* also *Rostranteris exilis* Gemmellaro.

Occurrence — The *R. exilis* Gemmellaro has been found in the Permian of Sosio and Chitichun and in the Trogkofel Beds of the Carnic Alps.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 401.

Janeia biarmica (Verneuil) 1845

Pl. 24, fig. 17

1845 *Solemya biarmica* Verneuil. *Géol. de la Russie*, p. 295, pl. 19, fig. 4.
1903 *Solemya* (*Janeia*) *biarmica* Diener. *Central Himalayas*, p. 173, pl. VIII, fig. 7-8.
1948 *Janeia biarmica* Branson. *Permian Invert.*, p. 614 (*cum syn.*).

Only one large specimen, well preserved, and several small specimens poorly preserved. These latter specimens must also be referred to this species. All are preserved as internal moulds.

Right valve: sub-elliptic in outline, strongly inequilateral, much longer than high. The ratio between height and length is about 36%. Umbo prosogyre, incomplete, situated anteriorly at about 1/5 of the length. Anterior margin short, concave under the umbo, then strongly arcuate; dorsal margin

long and rectilineal; ventral margin weakly arcuate forming a very wide curve. The dorsal furrow is very well delineated. Irregular, rather accentuated growth lines run parallelly to the margins and they are particularly visible anteriorly.

Dimensions — length 48,5 mm
height 17,5(?) mm

Occurrence — The *J. biarmica* (Verneuil) has been recognized in the Permian of Russia, in the Middle Magnesian Limestones of England, in the Kupperschiefer of Germany, in the Upper Carboniferous and Lower Permian of Kansas and Nebraska, in the Kuling shales of Spiti (India) and in the Lower Permian of China.

Locality — Slightly above Singhié glacier. 29 KD - 541, 546, 547.

Schizodus cf. **dubiiformis** Waagen 1881

1881 *Schizodus dubiiformis* Waagen. *Salt Range*, p. 238, pl. 19, fig. 15-16.
1906 *Schizodus dubiiformis* Gortani. *Strati a Bellerophon Carnia*, p. 115, pl. 4, fig. 19.
1925 *Schizodus dubiiformis* Likharew. *Onega-Dwina*, p. 130, pl. II, fig. 11.

An only internal mould of left valve, transversally elliptic, with acute, projecting umbo, not well preserved.

Anterior margin regularly arcuate, ventral margin weakly arcuate, dorsal margin at first nearly rectilineal, then angle-folded, to correspond with the posterior area which is delimited by a rounded carina starting from the umbo, flattening rapidly before reaching the margin.

Dimensions — length 28,5 mm
height 23 mm

Occurrence — The *S. dubiiformis* Waagen has been found in the Upper *Productus* Limestone, in the *Bellerophon* Limestone of the Carnic Alps and in the Permian of Russia.

Locality — Slightly above Singhié glacier. 29 KD - 546.

Straparollus (Euomphalus) cf. **oldhami** (Reed) 1944

1944 *Euomphalus* (*Schizostoma*) *oldhami* Reed. *Salt Range*, p. 346, pl. LVIII, fig. 16.

Two specimens, rather small, partially inclosed in the limestone. Maximum diameter 9-11 mm, with sub-trapezoidal section. Angulation at outer-upper edge well developed, very visible even also at the first whorls. In fact it is particularly defined by reason of the inclination of the surface of the whorls towards

the suture. Suture very deep. The first whorls are not so deep as in the specimen illustrated by Reed. I cannot say whether this is due to deformation or whether it represents a different characteristic.

Ornaments of fine, collabral growth lines.

Remarks — In « Treatise on Invertebrate Paleontology » (p. 192) we note that the sub-genus *Schizostoma* Bronn 1834 is to be considered a synonym of *Euomphalus* Sowerby 1814, which is no longer considered as a genus, but as a sub-genus of the genus *Straparollus* de Montfort 1810.

Occurrence — The *S.* (*Euomphalus*) *oldhami* (Reed) has been recognized in the Middle *Productus* Limestone of the Salt Range.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 396.

Straparollus (Euomphalus) cf. **parvus** (Waagen) 1880

1880 *Euomphalus parvus* Waagen. *Salt Range*, p. 89, pl. IX, fig. 2.

Numerous specimens all incomplete, partially enclosed in the rock. Maximum diameter 6 to 9 mm. The first whorls are never visible, therefore we cannot say certainly whether the spire grows bigger rapidly. From the fragments examined it appears to do so. The angulation at outer-upper edge is present at about 2/3 from suture. For these characteristics I think it is possible to refer our specimens to this species.

Occurrence — The *S.* (*Euomphalus*) *parvus* (Waagen) has been found in the Middle *Productus* Limestone of the Salt Range.

Locality — Signal Camp of Gasherbrum Gilga. 29 KD - 397.

Gastrioceras ? sp. ind.

Pl. 24, fig. 18

Small fragment represented by two whorls, incomplete, preserved in pale-grey limestone.

In the most internal whorl there are ornaments of ribs triangular, wider and more projecting externally than near the umbilical seam. The most external whorl presents some nodes elongate and projecting beyond the umbilical seam. From these nodes start some little bundles of fine ribs, 3 or 4, that seem to be bifurcated. Sometimes some ribs appear in the intervals between the nodes. These small ribs sub-equal, divided by fine interspaces, go on the whorls sides towards the venter. There is not any other peculiarity.

Locality — Camp Staghar glacier front. 29 KD - 323.

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Manuscript revised 20 February 1964.

MESOZOIC FOSSILS

CORALS OF THE UPPER JURASSIC OF THE SHAKSGAM VALLEY

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Introduction

This study describes the small fauna, mainly consisting of Corals and a few remains of Bryozoans, collected by Prof. A. Desio during the scientific-alpinistic expedition to the Karakorum in the summer of 1929.

These fossils come from a small saddle in the ridge at the confluence of the Sarpo Laggo Valley with the Shaksgam Valley, having the following geographical co-ordinates 36° 05' 00" Lat. N, 76° 24' 45" Long. E Greenwich.

Many other fossils were collected in the same locality and in its immediate neighbourhood. These fossils, possibly either of the same or of different age, were lost during their removal to Italy. Together with the above-mentioned forms, articles of Crinoids and specimens of *Ostrea* were also present.

The fossils under examination are preserved in a marly-arenaceous limestone, greybrown in colour, slightly laminated and scaly, with clastic elements of limestone, quartz and subordinate feldspar, angular in shape and less than 0.10 mm in average size.

These fossils had already been briefly examined, though not described, many years ago by Zuffardi-Comerci, who carried out polished sections on a large part of the material. For this reason I have not always been in the position of observing the calices, which could have supplied further useful indications for the determination. Furthermore the walls of the corallites appear smooth and show only unfrequent traces of ornament. Better elements are given, on the contrary, from the polished sections which were made previously

and have been now completed, making it possible to determine most of the specimens examined.

Previous works

There exist no paleontological studies dealing with the Jurassic of the locality examined in this occasion. However, the presence of Jurassic beds in other areas of the region had already been mentioned. In 1929 Mason, observed the Jurassic in the Aghil Range, about 130 km from our locality, in the upper part of the Sa Lungpa Valley. The biofacies of these outcrops is nevertheless different from that existing in the Shaksgam Valley, in that it is characterized by Ammonites of the «Perisphinctidi» group, that is by a different fauna, perhaps contemporary to the fauna here described.

There have been various references to Jurassic outcrops even further to the east. Renz (1940) studied the eastern side of the Aghil Range and neighbouring territories. The presence of Lias, Dogger and Malm, always characterized by an Ammonites and Pelecypods biofacies, was recognized in this area. Only Renz mentioned a Coral, coming from the district of the Karakorum Pass (range NW of Polu) and referred it to the *Astrocoenia* genus, without any specific determination; however, having observed some characters similar to those of the *Astrocoenia dubia* Koby, he suggested the possible presence of Malm.

In the Chitral district, Tipper (1923) described Jurassic beds, with different facies, possibly older than those outcropping in the locality under examination.

Locality and meaning of the fossils

The specimens examined amounted to about 50. Among these 8 species have been identified, 7 belonging to *Scleractinia* and 1 to *Bryozoa*.

The Corals are mostly represented by colonial forms; in fact the solitary forms are infrequent. Among the colonial specimens the fasciculated forms, of phaceloid type, prevail, but the massive specimens, of cerioid type, are not absent. Some of the coralla must have reached considerable dimensions, as some fragments are over 12 cm in height. The following species were identified:

Macgeopsis cf. *subcylindrata* Alloiteau
Isastraea explanata (Goldfuss)
Thecosmilia costata Fromentel
Thecosmilia magna Thurmann & Etallon

Thecosmilia dichotoma Koby
Thamnoseris froteana Thurmann & Etallon
Dermosmilia sp.
Ceriopora? sp.

It results from the stratigraphical distribution that the forms identified are rather longeval as they range over a good part of the Middle-Upper Jurassic and are generally found from Callovian up to Tithonic. The only exception is represented by *Macgeopsis subcylindrata* Alloiteau, which is, however, identified only by comparison in this study. This species has been created quite recently by Alloiteau for the Upper Bathonian of Madagascar; nevertheless it is not improbable that it may have survived in Asia until the Upper Jurassic. No interesting conclusion can be drawn from the Bryozoans, which are referred with some uncertainty to the *Ceriopora* genus, ranging from Triassic to Miocene. Therefore taking into account the elements resulting from the wide range of the species examined and from the poverty of the fauna, the outcrop which has supplied the fossils under study can be safely assigned, in my opinion, to the Upper Jurassic, without further specification.

PALEONTOLOGICAL DESCRIPTIONS

SCLERACTINIA

Family STYLOPHYLLIDAE Volz 1896

Genus **Macgeopsis** Alloiteau 1957

Macgeopsis cf. **subcylindrata** Alloiteau 1958
Pl. 25, fig. 1

1958 *Macgeopsis subcylindrata* Alloiteau. *Madrép. Madagascar*, p. 8, pl. III, fig. 7-10; pl. XXVI, fig. 7.

Fragment of solitary corallum, 24.5 mm high, subcylindrical, with subcircular section, 22 mm in diameter. Thick theca, with irregularly scattered rather deep transversal furrows and longitudinal costae corresponding to the outer margin of the septa.

About 60 laminar septa; the long ones belonging to the early cycles, however, do not reach the centre and only a few of them join each other by means of their internal margin. The septa of the 5th cycle are rudimentary. Endotheca developed in the outer part. No evidence of structure in the centre.

As only one incomplete specimen is at my disposal, I cannot but refer it, with uncertainty, to the species described by Alloiteau.

Occurrence — The *M. subcylindrata* Alloiteau has been found till now only in the Upper Bathonian of Tongobory (Madagascar).

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 475.

Family ISASTRAEIDAE Alloiteau 1952

Genus **Isastraea** M. Edwards & Haime 1851

Isastraea explanata (Goldfuss) 1829

Pl. 25, fig. 2

1826 *Astrea helianthoides* (pars) Goldfuss. *Petrefacta Germaniae*, p. 65, pl. 22, fig. 4 b (not 4 a).
? 1826 *Astrea oculata* Goldfuss. *Ibidem*, p. 65, pl. 22, fig. 2.
1829 *Astrea explanata* Goldfuss. *Ibidem*, p. 112, pl. 38, fig. 14.
1851 *Isastraea explanata* Edwards & Haime. *Corals Oolitic*, p. 94, pl. 17, fig. 1.
1857 *Isastraea explanata* Edwards & Haime. *Histoire des Corall.*, p. 527.
1857 *Isastraea goldfussiana* Edwards & Haime. *Ibidem*, p. 532.
1861 *Isastraea explanata* Fromentel. *Polypiers fossiles*, p. 228.
1867 *Isastraea goldfussiana* Bölsche. *Norddeutsch. Jura-Kreidegebirg.*, p. 21.
1875 *Isastraea explanata* (pars) Becker & Milaschewitsch. *Nattheim*, p. 162, pl. 39, fig. 9, 11 (not fig. 10).
1881 *Astrea helianthoides* (pars) Quenstedt. *Röhren und Sternkorallen*, p. 785, pl. 173, fig. 41 (not fig. 32).
1885 *Isastraea explanata* Koby. *Polyp. Jurass. Suisse*, p. 269, pl. 80, fig. 1-4; pl. 81, fig. 1, 2.
1887 *Isastraea explanata* Solomko. *Krim*, p. 101, pl. 4, fig. 6.
1900 *Isastraea exserta* Gregory. *Cutch*, p. 128, pl. 17, fig. 1.
1905 *Isastraea explanata* Koby. *Portugal*, p. 80, pl. 20, fig. 13.
1926 *Isastraea goldfussiana* Speyer. *Nordwestdeutsch. Jura*, p. 256.
1954 *Isastraea explanata* Geyer. *Württemberg*, p. 186, pl. 15, fig. 6.
1957 *Isastraea explanata* Alloiteau. *Madrép. fossiles*, p. 162.

Fragment of colonial corallum, sub-thamnasterioid, with a convex upper surface. Thick calices, subcircular, more or less deep at the centre according to the degree of erosion. The diameter of the calices varies from 5 to 8 mm. The distance between the centres of adjacent calices is 4-9 mm.

Laminar, confluent, often parallel septa. In a transversal polished section there is evidence of about 40 septa per calice which occasionally appear laterally ridged.

Occurrence — The *I. explanata* (Goldfuss) has been found in the Upper Jurassic of Germany, Switzerland, England and Cutch (India).

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 485.

Family MONLTLIVALTIIDAE Dietrich 1926

Genus **Thecosmilia** M. Edwards & Haime 1848

Thecosmilia costata Fromentel 1861

Pl. 25, fig. 3

1861 *Thecosmilia costata* Fromentel. *Introd. Polyp. fossiles*, p. 143.
1864 *Thecosmilia costata* Fromentel. *Polyp. corall. Gray*, pl. 6, fig. 1.
1884 *Thecosmilia costata* Koby. *Polyp. Jurass. Suisse*, p. 169, pl. 45, fig. 3, 4; pl. 55, fig. 9-17; pl. 59, fig. 4-7.

Several short subcylindrical fragments. Elliptical section of the corallites with major axis 11-12.5 mm and minor axis 9-11.5 mm in length with a ratio between the axes of 0.80. In a horizontal polished section are observed about 60 septa, alternatively thin and very thick, especially in the outer part. The septa of the first two cycles extend to the centre but do not join. The septa of the last cycle, which is incomplete, are very short. The endotheca is well developed.

Theca ornamented by costae, not always preserved, of variable thickness, a little knotty, alternatively thin and very strong, corresponding internally to the septa.

Occurrence — The *Th. costata* Fromentel has been found in the French Upper Jurassic and in the Oxfordian of Switzerland.

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 460, 466, 469, 474, 486.

Thecosmilia dichotoma Koby 1884

Pl. 25, fig. 4, 5

1884 *Thecosmilia? dichotoma* Koby. *Polyp. Jurass. Suisse*, p. 175, pl. 46, fig. 4-8.
1886 *Dermoseris dichotoma* Koby. *Ibidem*, p. 345.
1896 *Thecosmilia koniakensis* Ogilvie. *Stramberg. Schichten*, p. 201, pl. 14, fig. 1.
1954 *Thecosmilia dichotoma* Geyer. *Württemberg*, p. 182, pl. 14, fig. 15.
1955 *Thecosmilia dichotoma* Geyer. *Stramberger Tithon*, p. 200.

Phaceloid corallum almost completely enclosed in the rock; the theca of the corallites, ornamented by granulous, badly preserved costae, outcrops only limitedly. On a vertical polished section the corallites appear to change orientation and part by dichotomy. The septa, alternatively thick and very thin, are joined together by numerous dissepiments.

In a horizontal polished section are observed round or elliptical corallites, with a diameter varying from 5 to 8.5 mm, limited by a thin theca. There are 60 straight laminar septa per corallite. Those of the early cycles reach the centre, while those of the last order are very short. The endotheca is well developed. The columella is never evident.

Occurrence — The *Th. dichotoma* Koby has been found in the Oxfordian stage of Switzerland, in the Upper Jurassic of Germany and in the Tithonian stage of Stramberg.

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 476.

Thecosmilia magna Thurmann & Etallon 1864

Pl. 26, fig. 2, 3

1864 *Thecosmilia magna* Thurmann & Etallon. *Lethea bruntrutana*, p. 385, pl. 54, fig. 11.
1881 *Lithodendron longimanum* Quenstedt. *Petrefacta Germaniae*, p. 698, pl. 170, fig. 17.
1881 *Lithodendron cylindratum* Quenstedt. *Ibidem*, p. 699, pl. 170, fig. 18.
1884 *Thecosmilia magna* Koby. *Polyp. Jurass. Suisse*, p. 166, pl. 44, fig. 1-3.
1896 *Thecosmilia longimana* Ogilvie. *Stramberg. Schichten*, p. 203, pl. 14, fig. 2.
1955 *Thecosmilia magna* Geyer. *Stramberger Tithon*, p. 199.

Phaceloid corallum, of considerable dimensions; the incomplete colony reaches 121 mm in length and about 70 mm in maximum width. Very thick corallites parting by dichotomy under a rather acute angle with subparallel development. The diameter of the corallites, circular or subelliptical, is about 20-22 mm. In some sections the septa are numerous, subequal and thin, while in others they appear irregularly thickened. Four complete cycles and perhaps a 5th rudimental one are present.

A well developed endotheca, constituted by thin and numerous elements, distributed all over calice. No evidence of columella. The outer surface of the corallites is extremely worn out and is undulating.

Occurrence — The *Th. magna* Thurmann & Etallon has been found in the Upper Jurassic of Germany, in the Tithonian stage of Stramberg Beds, in the Oxfordian of Switzerland.

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 470, 472, 480, 481.

Family THAMNASTERIIDAE Vaughan & Wells 1943

Genus **Thamnoseris** Thurmann & Etallon 1864

Thamnoseris froteana Thurmann & Etallon 1864

Pl. 26, fig. 1

1864 *Thamnoseris froteana* Thurmann & Etallon. *Lethea bruntrutana*, p. 406, pl. 57, fig. 10.
1887 *Thamnoseris frotei* Koby. *Polyp. Jurass. Suisse*, p. 385, pl. 101, fig. 17.
1957 *Thamnoseris froteana* Alloiteau. *Madrép. fossiles*, p. 208.

This specimen has already been studied and polished by Zuffardi-Comerci. Its section is the only part which can be observed at the moment. As I am not in the position of examining the calices and I ignore the height at which the specimen was sectioned, I cannot but accept the indicative determination of Zuffardi-Comerci, that appears, nevertheless, to be quite reliable. Small fragment of cerioid corallum showing in the section some polygonal corallites, of very different dimensions. In the large corallites the major axis can reach 15 mm or more, in the small ones about 5 mm.

About 30 straight septa are present; those of the first two cycles extend to the centre, those of the third are only a little shorter, while the fourth cycle is incomplete. At the lens the septa appear discontinuous owing to large scattered pores. Thin but always continuous theca. No evidence of columella.

Occurrence — The *T. froteana* Thurmann & Etallon has been found in the Oxfordian stage of Switzerland and in the Upper Jurassic of Germany.

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 465.

Family DERMOSMILIIDAE Koby 1887

Genus **Dermosmilia** Koby 1884

Dermosmilia sp.

Pl. 26, fig. 4, 5

Some short fragments of cylindrical corallites, sub-elliptical in section, with major axis ranging from 14.4 to 20.9 mm, minor axis from 12.6 to 14.6

mm, the ratio between the axes being 0.78. Calices never preserved. In a horizontal polished section appear 38 very strong septa, with a strongly variable thickness, regularly alternating with as many very thin septa, well developed in length but not always evident. The septa of the early cycles become twisted at about 2/3 of their total length and continue twisted for the remainder 1/3 ending either with a small expansion or joining those opposite; this junction takes place in correspondence to the foci of the elliptical section. Large pores, visible to the naked eye, are present in the outer part of the septa. These perforations are evident also in longitudinal section.

Strong theca preserved only on a small part, ornamented by knotty, very badly preserved costae not corresponding to the internal septa. The outer surface is elsewhere covered by weaker, irregular and alternatively thick and thin costae, generally corresponding to the septa.

The examined specimens do not resemble any species of *Dermosmilia* already described by the previous Authors; their state of preservation allows only a generical determination.

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 468

BRYOZOANS

Family HETEROPORIDAE Waters 1880

Genus **Ceriopora** Goldfuss 1827

Ceriopora? sp. ind.

Several fragments, of small dimensions. These colonial forms are constituted by several small poligonal tubes which are closely packed, subequal and separated by a thick theca with frequent pores. The tube diameter is about 0,4 mm.

Locality — Confluence of the Sarpo Laggo Valley with the Shaksgam Valley. 29 KD - 461, 467, 471, 487.

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Manuscript received 10 October 1961.

RUDISTE E NERINEE DEL CRETACEO DI YASIN (PAKISTAN NORD-OCCIDENTALE)

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Introduzione

Si riferiscono i risultati definitivi dello studio paleontologico della collezione di Rudiste e Nerinee raccolta dal Prof. A. Desio durante l'estate 1955, in occasione della sua spedizione scientifico-alpinistica al Karakorum, nella zona di Yasin, situata in una valle confluente di sinistra del F. Gilgit affluente dell'Indo.

I risultati preliminari di tale studio sono stati presentati al Congresso Internazionale di Geologia tenuto a Città del Messico nel 1956 e pubblicati nei resoconti della sezione VII nel 1958. Quasi contemporaneamente (1959) apparivano, tradotti in inglese, sulla Rivista Italiana di Paleontologia, dato il ritardo nella stampa delle comunicazioni al Congresso. Gli esemplari descritti sono depositati presso l'Istituto di Paleontologia dell'Università di Milano, con relativo numero d'inventario (1).

Conoscenze precedenti

La scoperta del giacimento fossilifero di Yasin si deve a H. H. Hayden (1914), il quale segnalò nel suo rapporto del 1915 la presenza in detta località

(1) Desidero porgere i miei sinceri ringraziamenti al prof. L. R. Cox del Department of Geology del British Museum di Londra per le osservazioni fornitemi sulla classificazione delle *Nerineacea*.

di arenarie e calcari con *Hippurites* e Orbitoline, che attribuì al Cretaceo superiore. Il materiale raccolto da Hayden fu in seguito esaminato da H. Douvillé (1926) che vi riconobbe *Orbitolina bulgarica*, *O.* cf. *discoidea*, *Horiopleura haydeni* n. sp., *Praeradiolites gilgitensis* n. sp., *Nerinea coquandi* d'Orbigny, *Rhabdophyllia* cf. *gracilis* de Fromentel, *Eugyra neocomiensis* de Fromentel, *Isastrea* cf. *regularis* de Fromentel. Secondo l'A. la fauna presenta affinità marcate con quella del Cretaceo inferiore della Mesogea europea e potrebbe essere attribuita al Barremiano superiore o all'Aptiano; con questi nuovi elementi paleontologici la datazione di Hayden viene quindi ad essere rettificata.

Ad analoghe conclusioni circa l'età barremiano-aptiana del giacimento di Yasin giunse molto tempo dopo anche R. O. Brunnschweiler (1956) in base all'esame dei fossili raccolti nel 1951 nella stessa località di Hayden da I. Ivanac, D. Traves e D. King. Le forme da lui identificate e solo elencate sono le seguenti: *Eugyra* cf. *E. neocomiensis* de Fromentel, *Calamophyllia* cf. *C. gracilis* Blainville, *Thecosmilia* sp., *Isastrea* cf. *I. regularis* de Fromentel, *Montastrea* sp., *Horiopleura haydeni* Douvillé, *Horiopleura* cf. *H. haydeni* Douvillé, *Horiopleura* cf. *H. lamberti* (Munier-Chalmas), *Nerinea* cf. *N. coquandi* d'Orbigny, *Ptygmatis* n. sp.

Nel 1955 la spedizione italiana al Karakorum percorse la regione e il prof. A. Desio studiò la geologia della zona e raccolse abbondante materiale paleontologico che sottopose al nostro studio e a quello di altri suoi collaboratori. Da tali ricerche derivarono alcune comunicazioni presentate al Congresso Internazionale di Geologia di Città del Messico del 1956, ad opera dello stesso A. Desio, di M. B. Cita e M. A. Ruscelli, oltre che della scrivente in collaborazione con A. Farioli Mirelli, comunicazioni che furono stampate solo due anni dopo (1958) nella sezione VII (Paleontología, Taxonomía y Evolución).

Nello stesso 1956 ad opera di A. Farioli Mirelli è stata pubblicata la diagnosi in lingua latina di una nuova specie di Nerineide, identificata nel materiale in oggetto, e denominata *Nerinea desioi* n. sp.

L'anno successivo nella monografia sulle Orbitoline trovate nel Continente Indiano, nel Tibet e a Burma M. R. Shani (1957) descrisse una *Orbitolina* cf. *chitralensis* n. sp. determinata nel calcare ad *Hippurites* di Yasin, da lui attribuito ancora al Cenomaniano riprendendo la vecchia datazione di Hayden, senza tener conto né di quella di Douvillé né di quelle più recenti.

Successivamente A. Desio (1959) presentò una rassegna degli affioramenti cretacei del Karakorum e dell'Hindu Kush in lingua inglese. In tale rassegna egli fornì notizie anche sul giacimento di Yasin, riportando una successione

stratigrafica riassuntiva della sequenza fossilifera ed elencando i fossili ivi identificati, in base ai quali veniva proposta l'attribuzione dell'affioramento all'Aptiano.

Nello stesso anno M. B. Cita e M. A. Ruscelli (1959) illustrarono alcune microfacies cretacee del Pakistan occidentale e dell'Afghanistan; in quella ricavata dai calcari scistosi grigio-nerastri di Yasin era presente una caratteristica associazione oligotipica ad Orbitoline, tra le quali fu riconosciuta *Orbitolina discoidea*.

C. Rossi Ronchetti e A. Farioli Mirelli (1959) da parte loro fornirono i risultati dello studio preliminare delle Rudiste, Nerinee e Coralli di Yasin, che aveva permesso l'identificazione delle forme seguenti: *Horiopleura haydeni* Douvillé, *Praeradiolites gilgitensis* Douvillé, *Adiozoptyxis coquandiana* d'Orbigny, *A. renauxiana* d'Orbigny, *Nerinea vogtiana* de Mortillet, *Nerinea desioi* Farioli Mirelli, *Rhabdophyllia* cf. *R. gracilis* de Fromentel, *Isastrea* cf. *I. regularis* de Fromentel. In base a considerazioni sulla fauna e a confronti con faune analoghe di altre regioni attribuirono all'Aptiano probabilmente inferiore l'affioramento di Yasin.

Rimangono infine da segnalare le considerazioni di carattere geologico fornite da A. Desio nel 1963 sul gruppo di Yasin nell'ambito della rassegna delle formazioni geologiche del Karakorum occidentale.

Considerazioni sulla fauna

L'analisi completa del materiale ha consentito il riconoscimento delle seguenti forme di Rudiste e Nerinee [1]:

Horiopleura desioi n. sp.
Horiopleura haydeni Douvillé
Eoradiolites? gilgitensis (Douvillé)
Cossmannea (*Eunerinea*) *vogtiana* (de Mortillet)
Adiozoptyxis coquandiana (d'Orbigny)
Plesioptyxis desioi (Farioli Mirelli)
Plesioptyxis yasinensis n. sp.

Le Rudiste sono costituite nella quasi totalità da rappresentanti del genere *Horiopleura*, per lo più di grandi dimensioni ed abbastanza ben conservati con le due valve, tanto che si è riusciti a mettere in evidenza sia le strut-

[1] I Coralli indicati nelle nostre note preliminari, che completano la fauna, sono stati inviati per lo studio a J. Alloiteau del C.N.R.S. francese.

ture interne sia anche la struttura microscopica del guscio. L'unica forma di Radiolitidi presente è invece piuttosto piccola e molto deformata, per cui lo studio ne risulta meno favorito.

Delle Nerineidi i più frequenti sono gli esemplari appartenenti al genere *Plesioptyxis*, che predominano nettamente nella fauna di Gasteropodi. Si tratta di individui di medie dimensioni, con strutture delle pieghe interne spirali molto complicate. Gli altri rappresentanti di questo gruppo, che hanno dimensioni maggiori, sono invece molto scarsi di numero (uno o due esemplari per specie).

Nel suo complesso quindi la fauna, che è in massima parte composta di specie esclusive della zona, può essere considerata come un'associazione ad *Horiopleura* e *Plesioptyxis*; associazione poco variata come numero di forme, ma ricca di individui, come accade spesso in questi gruppi di habitat di scogliera.

Delle 7 specie sopra elencate solo 3 erano già note nella zona grazie agli studi di Douvillé (1926) (*Horiopleura haydeni*, *Eoradiolites? gilgitensis*, *Adiozoptyxis coquandiana*); le altre portano un ulteriore contributo alla conoscenza della fauna cretacea di Yasin. Di esse solo *Cossmannea* (*Eunerinea*) *vogtiana* era già stata segnalata in altre regioni, mentre le rimanenti sono nuove per la scienza.

Nell'elenco fornito da Brunnschweiler (1956) figurano *Horiopleura* cf. *H. lamberti* (Munier-Chalmas), di cui non ho riscontrato la presenza nel materiale in esame pur ricco di esemplari, ed *Horiopleura* cf. *H. haydeni*. Mi sembra probabile che almeno una delle due segnalazioni sia assimilabile con la nuova specie da me istituita, *Horiopleura desioi*. Considerazioni analoghe forse si possono fare anche per *Ptygmatis* n. sp., pure elencata da Brunnschweiler, che potrebbe presumibilmente essere identificabile con una delle due specie di *Plesioptyxis* di nuova istituzione. Tuttavia in base al solo nome e senza almeno una illustrazione degli esemplari non è possibile giudicare in merito.

Considerazioni sull'età

L'età della fauna di Yasin è stata già discussa nelle note preliminari prima citate (Desio 1958, 1959; Rossi Ronchetti e Farioli Mirelli 1958, 1959) e la discussione ha portato a riferire il giacimento all'Aptiano. Questa datazione è risultata oltre che da confronti con associazioni analoghe presenti in altre regioni, anche ed in modo particolare dalla distribuzione stratigrafica del genere *Horiopleura* e delle poche specie che lo rappresentano.

Nuovi elementi sono emersi nel frattempo relativamente a tale distribuzione ed è quindi necessario riaprire la discussione sull'età della fauna di Yasin. La base per tale disanima è fornita da recenti ricerche di carattere stratigrafico sulla regione pirenaica, la quale costituisce la zona di massimo sviluppo del gen. *Horiopleura*; provengono infatti da tale regione 3 delle 4 specie sicuramente appartenenti al genere in esame, ossia *H. lamberti* (Munier-Chalmas), *H. baylei* Coquand, *H. almerai* Paquier. La posizione stratigrafica dei livelli ad *Horiopleura*, ed in particolare ad *H. lamberti*, è sempre stata piuttosto discussa ed ha subito nel tempo diverse modificazioni. Considerati infatti originariamente albiani da Douvillé (1888), tali livelli sono stati attribuiti successivamente al Barremiano superiore-Aptiano inferiore da Kilian e Paquier. In seguito Jacob (1939) ha collocato nell'Aptiano superiore le faune pirenaiche a *Polyconites verneuili*, *Horiopleura lamberti* e *Pseudotoucasia santanderensis*, diffuse anche in Spagna, Algeria, Tunisia, Libano, Eraclea e fino all'Himalaya.

In tempi più recenti, nella memoria di G. Astre (1954) relativa alle Radiolitidi nord-pirenaiche, si trovano riferiti alla parte alta dell'Aptiano superiore gli strati ad *Horiopleura* di Pech de Foix nei Pirenei del bacino dell'Ariège; mentre all'Aptiano superiore-Albiano sono attribuiti i calcari con *Horiopleura baylei*, *H. lamberti*, *Polyconites verneuili*, *Toucasia seunesi*, *Sphaerulites cantabricus*, *Orbitolina conoidea-discoidea*. Ulteriori ricerche sulla stratigrafia del Cretaceo inferiore, i cui risultati sono stati presentati al Colloquio sul Cretaceo inferiore tenuto a Lione nel settembre 1963, hanno permesso di precisare la posizione dei livelli ad *Horiopleura*. A. Poignant (1963) ha infatti distinto nei Bassi Pirenei (dintorni di Orthez) un Aptiano superiore calcareo con *Toucasia seunesi*, *Horiopleura baylei*, *Radiolites cantabricus* (= *Sphaerulites cantabricus*), *Terebratula delbosi* ecc., da un Albiano inferiore pure calcareo a *Horiopleura lamberti*, *Polyconites verneuili*, *Radiolites cantabricus* (= *Sphaerulites cantabricus*) ecc.

La distribuzione del genere *Horiopleura* viene dunque ristretta da questi studi all'Aptiano superiore-Albiano inferiore.

Se ci si riporta ora alla fauna di Yasin, si trovano in essa due specie di questo genere (*H. haydeni* e *H. desioi*); la prima segnalata finora solo nella zona in questione, la seconda nuova per la scienza. Delle altre forme ad esse associate, *Eoradiolites? gilgitensis* è pure una specie locale, *Adiozoptyxis coquandiana* e *Cossmannea* (*Eunerinea*) *vogtiana* hanno la massima diffusione nel Barremiano superiore-Aptiano e possono giungere fino all'Albiano, mentre le due specie del gen. *Plesioptyxis* sono di nuova istituzione.

Con questi soli elementi a disposizione è quindi difficile stabilire se la

fauna di Yasin debba essere attribuita all'Aptiano superiore piuttosto che all'Albiano inferiore. Mi sembra tuttavia di poter propendere per un'attribuzione all'Aptiano superiore, in quanto delle poche specie del gen. *Horiopleura* solo *H. lamberti* è indicata anche nell'Albiano inferiore, mentre *H. baylei*, già citata sopra, e *H. almerai* sono per ora segnalate soltanto nell'Aptiano. Anche la distribuzione delle specie già conosciute di Nerineidi sembra accordarsi con tale conclusione, perché esse hanno la massima diffusione nel Barremiano superiore-Aptiano ed i riferimenti all'Albiano sono ancora piuttosto scarsi e da controllare. Infine la struttura delle pieghe interne di *Plesioptyxis desioi* e *Pl. yasinensis* mostra notevoli analogie con quella di diverse specie aptiane, come « *Nerinea* » *prefleuriaui* Delpey, « *Nerinea* » *galatea* Coquand, *Nerinea* (*Diozoptyxis*) *baconica* Benkö-Czabalay, ecc.

DESCRIZIONI PALEONTOLOGICHE

LAMELLIBRANCHI

RUDISTAE [1]

Fam. CAPROTINIDAE Douvillé 1887

Gen. **Horiopleura** Munier-Chalmas (in litteris) 1882

Il nome generico *Horiopleura* è stato proposto nel 1882 da Munier-Chalmas per *Monopleura lamberti* del Cretaceo inferiore della regione pirenaica; l'A. si è però limitato alla proposta del nome, senza indicare i caratteri diagnostici né del genere, né della specie-tipo. Le caratteristiche di *Horiopleura* sono state invece messe in luce più tardi, seppure solo parzialmente, da Douvillé nel 1889, ed in seguito da Paquier con maggior completezza nel 1905. Le osservazioni fornite in proposito da Palmer nel 1928 non hanno aggiunto nulla di nuovo a quanto già si conosceva. Notizie e discussioni sulle caratteristiche e sui rapporti di *Horiopleura* con generi vicini si ritrovano infine nei lavori di Mac Gillavry (1937) e di Jacob (1939), che presentano entrambi qualche elemento contrastante con le osservazioni precedenti.

Allo scopo di risolvere le incertezze determinate da questo stato di fatto sono state studiate in dettaglio per mezzo di sezioni lucidate trasversali e lon-

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[1] Per la sistematica di questo ordine di Lamellibranchi mi sono attenuta, in mancanza di altre classificazioni complete, a Bobkova e Pčelincev (Osnovi Paleontologii, vol. III, 1960).

gitudinali della conchiglia e di sezioni sottili del guscio le due specie di *Horiopleura* presenti nel materiale pakistano. I risultati di questo studio, completati da un esame analitico accurato della letteratura, permettono di precisare nel modo seguente le caratteristiche del gen. *Horiopleura* Munier-Chalmas.

Diagnosi — Conchiglia di grandi dimensioni, inequivalve, con valva destra lunga e conica, diritta oppure leggermente ritorta all'apice, provvista di coste longitudinali e di lamelle e linee di accrescimento; percorsa sul lato ventrale da due depressioni longitudinali separate da una interbanda debolmente rigonfia e sul lato postero-dorsale da un solco legamentare longitudinale; esso si estende per tutta la lunghezza della valva e interessa l'intero spessore della parete della conchiglia. Valva sinistra capuliforme, più o meno convessa, liscia o con lamelle e linee di accrescimento; umbone marginale, incurvato verso il basso; debole rigonfiamento submediano, limitato lateralmente da due depressioni radiali poco profonde.

Microstruttura del guscio — Valva sinistra. In sezione trasversale si possono distinguere nel guscio, a partire dall'esterno, tre strati nettamente separati tra loro (tav. 27, fig. 1; tav. 28, fig. 1) (1).

1) Strato fibroso (tav. 28, fig. 2) di spessore da 1,5 a 2 mm, formato da fibre di calcite (dimensioni intorno a 10 μ) disposte obliquamente rispetto alla superficie esterna e con inclinazione variabile; sempre perpendicolari però alle linee di accrescimento.

La superficie esterna dello strato presenta rughe e solchi, sottolineati da un orlo bruno scuro, formato da una sostanza isotropa indefinibile.

2) Strato intermedio a struttura incrociata (tav. 29, fig. 1), di spessore 0,3-0,5 mm. Esso consta di fibre di calcite allungate quasi parallelamente alla superficie del guscio e associate in più ordini sovrapposti, con piani di allungamento delle fibre poco inclinati tra loro.

3) Strato interno a struttura prismatica (tav. 27, fig. 2; tav. 29, fig. 2), di spessore da 4 a 8 mm. Risulta formato da grossi granuli bruni di calcite cristallina (dimensioni intorno a 1 mm), separati da aggregati di calcite microgranulare. Nelle sezioni esaminate lo strato mostra per lo più struttura a mosaico e larghe zone di calcite limpida totalmente ricristallizzate. Solo di rado è possibile osservare una struttura prismatica: sono visibili infatti prismi affiancati di calcite (dimensioni di 0,1-0,3 mm in sezione trasversale), allungati obliquamente rispetto alla superficie del guscio e perpendicolarmente alle linee di accrescimento. Lo strato è ulteriormente suddiviso da 2 o 3 super-

(1) Desidero ringraziare la dott. P. Spadea per l'aiuto gentilmente prestatomi in questa fase della ricerca.

fici di discontinuità, sottolineate da aggregati di calcite microgranulare e dalla presenza di impurità.

Valva destra. Sono riconoscibili solo due strati: uno esterno, fibroso, con struttura analoga a quella del I strato della valva sinistra, di spessore intorno a 1 mm, ed uno strato interno formato attualmente da un mosaico di cristalli di calcite.

Strutture interne — Valva destra con cavità principale piuttosto ampia ed elementi mio-cardinali ben sviluppati: impronta muscolare anteriore superficiale, impronta muscolare posteriore su di una lamina miofora più o meno eretta verticalmente, sporgente nella cavità principale. Dente cardinale submediano, lungo e conico, arcuato in sezione, delimitato dalle due fossette per l'articolazione dei due denti anteriore e posteriore della valva sinistra. Cavità legamentare parallela al margine postero-dorsale, situata tra la fossetta del dente posteriore e la lamina miofora posteriore, la quale è disposta ad angolo subretto rispetto agli altri elementi dell'apparato mio-cardinale.

Valva sinistra con cavità principale ridotta; impronta muscolare anteriore su una lunga superficie di inserzione parallela al margine della valva; impronta muscolare posteriore su di una lamina miofora, subtriangolare in sezione, lunga e ben sviluppata, disposta ad angolo subretto rispetto agli altri elementi dell'apparato mio-cardinale; tale lamina sporge nella cavità principale ed è situata di lato ed esternamente rispetto alla lamina miofora corrispondente della valva destra, da cui è separata da un breve intervallo. La lamina miofora posteriore è separata dal margine della valva da una cavità accessoria posteriore marginale, ampia e per lo più di forma semilunare. Apparato cardinale costituito da due denti cardinali divergenti, l'anteriore più robusto del posteriore, separati da una fossetta cardinale arcuata. Cavità legamentare molto piccola, posta tra il dente posteriore e la lamina miofora posteriore.

Da quanto è stato esposto si può notare come le caratteristiche generiche messe in evidenza sul materiale pakistano concordino nelle linee generali con quelle indicate dai vecchi AA., come Douvillé e Paquier. Tale materiale ha consentito inoltre di fornire completamenti e precisazioni rispetto alle loro indicazioni più generalizzate.

Le osservazioni più recenti fornite da Jacob e da Mac Gillavry sul genere in questione non concordano invece del tutto con quelle degli AA. precedenti e con le nostre; è quindi necessario discutere i punti controversi.

Nella sua analisi della vita e dell'opera di H. Douvillé, Jacob (1939) ha preso in esame tra l'altro anche il gen. *Horiopleura* (p. 490), fornendo dati sui

caratteri generici, sulla distribuzione e sulla sua probabile origine. Mi soffermo qui a considerare solo i caratteri generici, che concordano in massima parte sia con quelli indicati dagli AA. precedenti, sia con le mie personali osservazioni. L'unica discordanza riguarda il numero delle cavità accessorie della valva sinistra. Jacob afferma infatti che in *Horiopleura baylei* Coquand [1] « une apophyse myophore *mp*, dressée est separée du limbe par une cavité accessoire *O* et une autre plus petite *O'* ». Dalle ricerche bibliografiche da me eseguite non sono risultate presenti in tale specie due cavità accessorie posteriori, ma una sola e piuttosto piccola. Del resto anche nelle poche altre specie finora attribuite al gen. *Horiopleura* è sempre presente una sola cavità accessoria posteriore. L'unico accenno ad una seconda cavità accessoria si trova in Pervinquière (1912, p. 299) per *H. lamberti* (Munier-Chalmas). Si tratterebbe però in questo caso di una cavità accessoria anteriore che circonderebbe « l'apofisi miofora » corrispondente. È piuttosto dubbio tuttavia che si tratti di una vera cavità accessoria, poiché una cavità accessoria in tale posizione non è mai stata segnalata né prima né dopo dagli AA. che si sono occupati del gen. *Horiopleura*. Inoltre sulla fig. 6 (p. 298) di Pervinquière, che rappresenta il contromodello del « birostre », *O''* è segnato su di un rigonfiamento marginale che sovrasta l'area d'inserzione del muscolo anteriore; non ha quindi l'aspetto di una cavità.

Mac Gillavry (1937) ha impostato le sue ricerche relative al gen. *Horiopleura* ed alle sue probabili derivazioni da altri generi sull'area muscolare posteriore della valva destra e sul suo modo d'inserzione. A p. 96 del suo lavoro di revisione delle Rudiste di Cuba egli fornisce alcune sezioni tangenziali oblique (figg. 1-4), che vogliono illustrare lo sviluppo progressivo dell'area muscolare posteriore in due specie del gen. *Polyconites*, in *Horiopleura lamberti* (Munier-Chalmas) e in *H. haydeni* Douvillé. Secondo l'A., la « sezione radiale » eseguita su di un esemplare di *H. lamberti* mostra che l'inserzione muscolare posteriore è più simile ad un ispessimento della parete della conchiglia che sporge nella cavità principale, che ad una vera lamina miofora. In *H. haydeni*, in base alla sezione ripresa da Douvillé, riconosce che l'area muscolare posteriore sarebbe limitata verso l'interno da una parete verticale.

Le osservazioni fatte su *H. lamberti* non ci sembrano però del tutto esatte, in quanto la sezione prossimo-distale passa fuori della regione muscolare, vi-

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[1] Jacob ha citato questa specie come presente oltre che nella regione pirenaica anche in Sicilia, probabilmente in base a Douvillé 1889 (p. 644). L'esemplare illustrato da Douvillé come *Horiopleura* sp. (figg. 14, 15) è stato però successivamente determinato da Di Stefano 1899 (p. 39) come *Polyconites douvillei* Di Stefano.

cino al fondo della valva, ed in questo caso sembra difficile stabilire se si tratti di un ispessimento della parete della conchiglia, piuttosto che di una vera lamina miofora. D'altra parte tutti gli AA. che hanno descritto *H. lamberti*, a partire da Douvillé, hanno segnalato la presenza di una lamina miofora posteriore tanto sulla valva destra quanto sulla sinistra. Paquier (1905) ha anzi sottolineato l'importanza di questo carattere nei confronti con la sua nuova specie, *H. almerai* (1), la quale, a detta dell'A., dovrebbe possedere una lamina miofora quasi orizzontale o leggermente inclinata verso l'interno della conchiglia.

Da quanto è stato esposto mi sembra quindi piuttosto discutibile l'avvicinamento di *Horiopleura* al gen. *Polyconites* e la riunione dei due generi nella sottofam. *Polyconitinae* proposta da Mac Gillavry, con la conseguente derivazione comune dalle Monopleuridi. L'area miofora posteriore della valva destra ha infatti caratteri meglio correlabili con quelli del gen. *Gyropleura*, il quale è pure provvisto di una lamina miofora posteriore. Allo stato attuale delle conoscenze sembra quindi più rispondente alle relazioni filogenetiche la probabile derivazione di *Horiopleura* dalle Gyropleuridi, derivazione del resto già sostenuta dalla maggior parte degli AA.

Differenziazione dai generi vicini — Dopo aver esposto le caratteristiche del gen. *Horiopleura* e discusso le varie interpretazioni, ritengo utile mettere in evidenza i caratteri differenziali tra detto genere ed i generi affini. Va premesso prima di tutto che la differenziazione si fonda esclusivamente sui caratteri interni della conchiglia; la forma esterna infatti, essendo spesso somigliante in organismi appartenenti a generi diversi (come *Monopleura*, *Gyropleura*, *Caprotina*, *Polyconites* ecc.), non offre alcun elemento sicuro per un riconoscimento generico. Anche i caratteri interni della valva destra non sono sempre determinanti a questo riguardo, poiché in generi diversi si trovano notevoli concordanze strutturali, soprattutto per quanto concerne l'apparato mioforo che ha molta importanza nella sistematica di questo gruppo di Lamellibranchi. Sono quindi le sole strutture interne della valva sinistra che consentono una classificazione sicura e permettono di conseguenza la discriminazione dai generi vicini.

I primi due generi sopra citati, *Monopleura* Matheron e *Gyropleura* Douvillé, si distinguono facilmente dal gen. *Horiopleura* per la mancanza di cavità

(1) *H. almerae* Paquier deve essere chiamata più propriamente *H. almerai*, poiché Paquier l'ha dedicata al canonico J. Almera di Barcellona.

accessorie nella valva sinistra. Per quanto riguarda l'apparato mioforo va fatto rilevare che in *Monopleura* s. str. le impronte muscolari, sia anteriori che posteriori, sono superficiali su tutte due le valve. Nel sottogenere *Himeraelites* Di Stefano si ha invece una modificazione a questo riguardo, nel senso che la valva sinistra possiede una forte apofisi miofora posteriore, cui corrisponde sulla valva destra una lamina miofora spessa e bassa. Questo sottogenere si avvicina quindi di più al genere in esame da cui tuttavia si differenzia per i motivi generali sopra riportati. Il gen. *Gyropleura* da parte sua, che corrisponde a *Monopleura* s. str. nell'andamento dell'apparato mioforo della valva sinistra, presenta invece una lamina miofora posteriore trasversale sulla valva destra; carattere che tende a ravvicinarlo al gen. *Horiopleura.*

Tra i generi che sono provvisti di cavità accessorie sulla valva sinistra quelli che si avvicinano di più al genere in oggetto sono *Caprotina* d'Orbigny e *Polyconites* Roulland. Il gen. *Caprotina* possiede infatti come *Horiopleura* sulla valva sinistra una lamina miofora posteriore raddrizzata e prominente; se ne differenzia però per la presenza di più di una cavità accessoria. Si osservano infatti una cavità accessoria anteriore e due cavità posteriori. La prima è situata tra l'impronta muscolare anteriore e la parete della conchiglia, le altre due sono comprese tra il dente cardinale posteriore, la lamina miofora posteriore e la parete della conchiglia.

Il gen. *Polyconites* si distingue da *Horiopleura* per avere il muscolo posteriore della valva destra inserito su di un ispessimento del guscio, mentre quello della valva sinistra è portato da una lamina miofora trasversale parallela alla commissura. Si distingue inoltre per la presenza di più di una cavità accessoria; si riscontrano infatti oltre a due cavità accessorie posteriori, una cavità accessoria anteriore tra l'inserzione del muscolo relativo e la parete della conchiglia ed una quarta cavità situata dietro il dente cardinale anteriore.

Horiopleura desioi n. sp.

Tav. 30, 31, 32, 33, 34, 35; Figg. 1-5 nel testo

Materiale — L'olotipo costituito da una conchiglia bivalve (55 DP-108), e 5 paratipi pure bivalvi, alcuni abbastanza ben conservati, altri più o meno deformati, di grandi dimensioni.

Descrizione dell'olotipo (tav. 30, figg. 1-2; tav. 31, figg. 1-3) — Conchiglia inequivalve con valva destra grande, conica, allungata, spessa e robusta, quasi diritta, solo un poco ritorta all'apice, con piccola area di attacco, espandentesi abbastanza rapidamente verso l'alto; lato dorsale leggermente concavo, lato

ventrale poco convesso. Angolo di accrescimento, misurato in direzione dorso-ventrale = 20°, in direzione antero-posteriore = 25°. Lato dorsale lungo circa il 50% di quello ventrale, per cui la commissura è molto obliqua. La sezione trasversale è sub-ellittica, poiché il diametro massimo (dorso-ventrale) misura 76 mm e quello minimo (antero-posteriore) 73 mm. Parete della conchiglia piuttosto spessa, con faccia esterna alquanto corrosa, ornata di lamelle e linee di accrescimento strettamente ravvicinate e ondulate e di rare tracce di coste longitudinali. Sul lato ventrale, presso l'apice, si vedono tracce delle due depressioni longitudinali, corrispondenti alle fasce sifonali, leggermente ritorte, separate da una interbanda larga e poco rigonfia, che scompaiono rapidamente a causa delle deformazioni subite dalla conchiglia. Sul lato postero-dorsale si nota un solco legamentare longitudinale arcuato, che si estende per tutta la lunghezza della valva fin presso l'area di attacco, interessando l'intero spessore della parete della conchiglia.

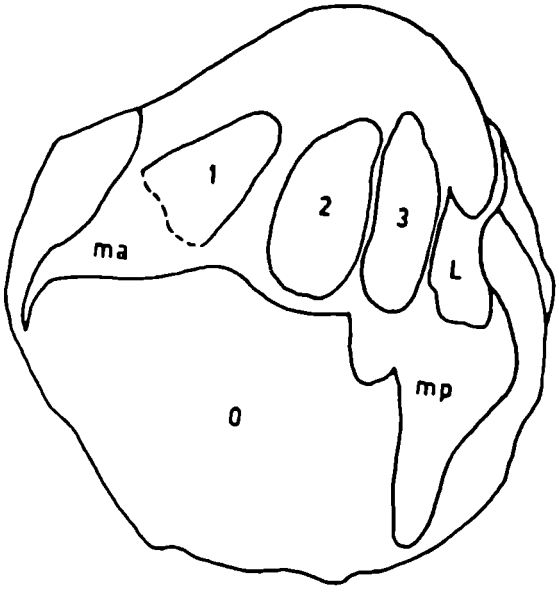


Fig. 1 - Sezione trasversale della valva destra dell'olotipo di *Horiopleura desioi* n. sp. Gr. nat.

Valva sinistra piuttosto piccola, alquanto erosa, poco convessa, capuliforme, incastrata obliquamente nella valva destra, inclinata verso l'apice dal lato ventrale, con umbone marginale (postero-dorsale), incurvato verso il basso. Dalla sommità dell'umbone parte un rigonfiamento arrotondato e poco sporgente, delimitato lateralmente da due depressioni appena accennate, che corrispondono alle fasce sifonali della valva destra e che rendono sinuoso il margine ventrale; questi seni corrispondono al passaggio delle correnti respiratorie. Parete della conchiglia più sottile di quella della valva destra, con faccia esterna quasi liscia.

Strutture interne. Valva destra. Una sezione trasversale dell'olotipo tagliata a livello della commissura (tav. 31, fig. 2; fig. 1 nel testo) mostra la parete della conchiglia molto ispessita nella regione cardinale (9 mm), molto più sottile in quella ventrale (6 mm); un solco legamentare sul lato posteriore che attraversa tutto lo strato interno della parete, aprendosi all'interno in una cavità legamentare (*L*) abbastanza ampia (mm 19 × 8), disposta

parallelamente al margine postero-dorsale, di forma irregolarmente ovale, appuntita all'estremità cardinale, arrotondata a quella ventrale; si osserva inoltre la cavità principale (*O*) alquanto ristretta (mm 57×32), di forma irregolare, limitata alla parte medio-ventrale della sezione, con margine interno irregolarmente sinuoso a livello dei denti. Gli elementi cardinali sono robusti e molto sviluppati, hanno sezione ovale ed occupano la metà dorsale della valva. Si riconoscono le sezioni del dente cardinale (2) ([1]) e della fossetta che lo contiene, allungate in direzione dorso-ventrale (lunghezza 26 mm, larghezza 14 mm) e situate centralmente; esse sono delimitate dalle sezioni dei denti cardinali della valva sinistra (1 e 3) divergenti ad angolo di circa 45°, l'anteriore (1) più sviluppato del posteriore (3), il quale è delimitato posteriormente dalla cavità legamentare. Ventralmente rispetto alla sezione del dente anteriore, si nota l'area d'inserzione dell'adduttore anteriore (*ma*) che ha forma triangolare ben definita e che raggiunge con estremità acuta la faccia interna della parete della conchiglia. Ventralmente rispetto alla cavità legamentare, si trova la sezione della lamina miofora posteriore (*mp*), di forma irregolarmente triangolare, che si spinge con l'estremità acuta fino alla faccia interna della parete della conchiglia.

Valva sinistra. Una sezione trasversale tagliata a livello della commissura (tav. 31, fig. 3) ha un poco danneggiato la valva sinistra nella parte posteriore; inoltre essa comprende nella parte anteriore anche una porzione della valva destra. La sezione mostra la parete della conchiglia molto più sottile di quella della valva destra (massimo 3 mm), elementi strutturali meno marcati e cavità principale abbastanza vasta; sul lato posteriore si intravede inoltre un accenno di solco legamentare accompagnato da una piccolissima cavità legamentare. Apparato cardinale costituito dei due denti cardinali, 1 e 3, divergenti ad angolo di 45°, l'anteriore più robusto del posteriore, separati da una fossetta arcuata di forma ovoidale, per l'articolazione del dente 2, allungata in direzione dorso-ventrale. Impronta muscolare anteriore su una superficie d'inserzione lunga e parallela al margine della valva; impronta muscolare posteriore inserita su di una lamina miofora triangolare, assai prolungata ventralmente, disposta ad angolo subretto rispetto alla direzione degli altri elementi miocardinali, separante la cavità principale dalla cavità accessoria posteriore. Questa cavità accessoria ben distinta e vasta è allungata parallelamente alla faccia interna della parete della conchiglia che la delimita esternamente (lunghezza della cavità accessoria posteriore 26 mm, larghezza 12 mm); ha forma grosso

([1]) La formula cardinale è ripresa dal « Traité de Paléontologie » di Piveteau (p. 334).

modo semilunare, con margine esterno regolarmente convesso e margine interno un poco concavo.

Paratipi — I 5 paratipi (tav. 30, fig. 3; tav. 32, figg. 1-3; tav. 33, figg. 1, 2; tav. 34, figg. 1,2; tav. 35, figg. 1,2), che concordano bene con l'olotipo nei caratteri morfologici generali, hanno dimensioni ancora più grandi. La valva destra è quasi diritta o leggermente convessa, con angolo di accrescimento misurato in direzione dorso-ventrale costantemente di 20° ed in direzione antero-posteriore variabile tra 30° e 33°; il lato dorsale è concavo e quello ventrale è convesso, con rapporti di lunghezza del primo rispetto al secondo variabili tra il 37% e il 50% circa. La commissura tra le due valve è quindi molto obliqua e la valva destra ha sezione ellittica, con diametro dorso-ventrale variante tra 123 mm e 83 mm e diametro antero-posteriore tra 76 mm e 72 mm.

Faccia esterna della parete della conchiglia più o meno erosa, provvista di rughe di accrescimento grosse e arrotondate e di lamelle e linee di accrescimento disposte strettamente ed ondulate; qua e là nelle parti meglio conservate si vedono coste longitudinali irregolari granulose, più o meno discontinue, in numero di 2-3 per cm, separate da intervalli relativamente stretti. Sul lato ventrale sono visibili le due depressioni longitudinali leggermente ritorte (tav. 33, figg. 1, 2), che si attenuano e si allargano avvicinandosi alla commissura; hanno andamento arcuato in direzione dorsale e sono separate da un'interbanda rigonfia, che si allarga sempre più verso la commissura (larghezza all'apice 14 mm, presso il margine postero-ventrale 31 mm). Solco legamentare longitudinale (tav. 34, fig. 2; tav. 35, fig. 1) corrispondente come posizione, andamento e profondità a quello dell'olotipo.

Valva sinistra sempre piccola e capuliforme, distintamente anche se non fortemente convessa, con umbone o marginale o molto vicino al margine dorsale, sporgente sulla commissura. Il rigonfiamento arrotondato, che parte dalla sommità dell'umbone, è sempre poco sporgente e va a raggiungere, con andamento arcuato sul margine ventrale l'interbanda sporgente tra le due fascie sifonali della valva destra; è pure limitato da due depressioni poco profonde. Faccia esterna della parete della conchiglia provvista solo di linee di accrescimento, che diventano più lamellose e più marcate verso la periferia.

Le sezioni trasversali della valva destra e della sinistra mostrano strutture interne più o meno corrispondenti a quelle dell'olotipo; le variazioni sono soprattutto dovute a deformazioni subite dai vari esemplari. La sezione trasversale della valva sinistra di un paratipo più completo, mette meglio in evidenza le strutture interne (tav. 32, fig. 3; fig. 3 nel testo), soprattutto le im-

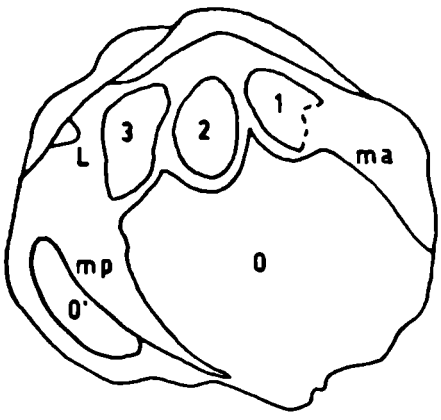


Fig. 2

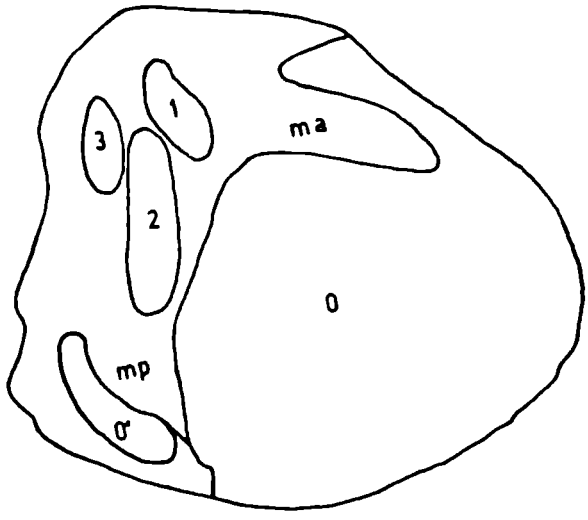


Fig. 3

Figg. 2, 3 - *Horiopleura desioi* n. sp. Sezioni trasversali di valva sinistra di due paratipi. Gr. nat.

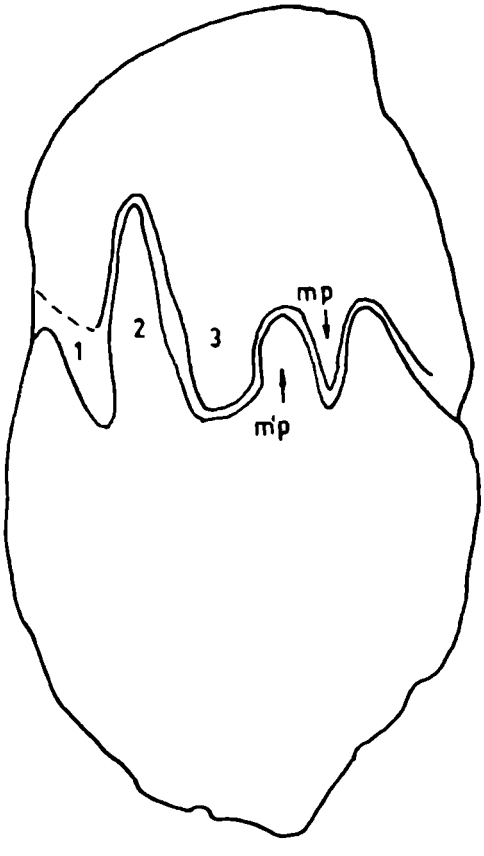


Fig. 4 - *Horiopleura desioi* n. sp. Sezione longitudinale di un paratipo, eseguita presso il margine dorsale. Gr. nat.

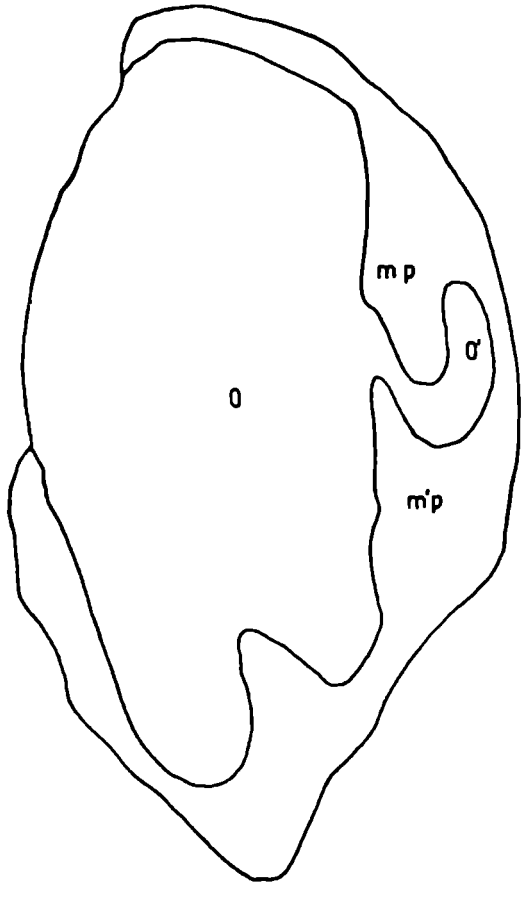


Fig. 5 - *Horiopleura desioi* n. sp. Sezione longitudinale dello stesso paratipo, eseguita presso il margine ventrale. Gr. nat.

pronte muscolari (*ma*, *mp*) e la cavità accessoria posteriore (*O'*). Questa appare ben formata e delimitata, con caratteristica forma semilunare, nettamente marginale, localizzata al raccordo postero-ventrale (lunghezza 25 mm, larghezza 8 mm).

Un paratipo bivalve è stato sezionato longitudinalmente presso il margine dorsale e presso il margine ventrale. La sezione longitudinale tagliata presso il margine dorsale (tav. 32, fig. 2; fig. 4 nel testo) mostra il forte e lungo dente conico (2) della valva destra (lungo 32 mm, largo alla base 12 mm e alla sommità 5 mm circa), delimitato da due fossette contenenti i due denti 1 e 3 della valva sinistra: l'anteriore conica meno profonda e più stretta, la posteriore di forma quasi subrettangolare, larga circa 11 mm. Dietro la fossetta posteriore si osserva la lamina miofora posteriore (*m'p*) della valva destra, affiancata alla quale si trova la lamina miofora posteriore (*mp*) della valva sinistra non molto lunga e stretta (16,5 mm di lunghezza, 6 mm di larghezza), un poco irregolare di forma, incastrata in una fossetta. Dietro ad essa si intravede la cavità legamentare (*L*).

La sezione longitudinale tagliata presso il margine ventrale (tav. 32, fig. 1; fig. 5 nel testo) mostra la sezione della lamina miofora posteriore della valva sinistra (*mp*) abbastanza larga e piegata un poco ad angolo verso l'esterno, alla quale si contrappone sulla valva destra un'analoga lamina miofora posteriore (*m'p*), più ristretta ed acuta. Tra le due lamine passa la comunicazione tra la cavità principale e la cavità accessoria posteriore (*O'*) della valva sinistra, qui poco espansa.

Dimensioni [1]*:*

	Olotipo	Paratipi		
		I	II	III
lungh. tot.	mm 165 ;	220 ;	165 ;	160
valva destra:				
lungh. l. v.	mm 150 ;	235 ;	188 ;	180
lungh. l. d.	mm 86 ;	87 ;	93 ;	90
diam. d.-v.	mm 74,5;	123 ;	95 ;	83

[1] I simboli usati in questo paragrafo hanno il seguente significato: lungh. = lunghezza; tot. = totale; l. d. = lato dorsale; l. v. = lato ventrale; d.-v. = dorso-ventrale; a.-p. = antero-posteriore; ang. accr. = angolo di accrescimento, misurato in direzione dorso-ventrale e in direzione antero-posteriore. La lunghezza dei lati dorsale e ventrale è stata misurata lungo la curvatura relativa.

diam. a.-p.	mm	73,5;	76 ;	76 ;	72
ang. accr. (d.-v.)		20° ;	20°;	20°;	20°
ang. accr. (a.-p.)		25° ;	33°;	30°;	30°
valva sinistra:					
diam. d.-v.	mm	76 ;	147 ;	—	67
diam. a.-p.	mm	75 ;	87 ;	—	69

Rapporti e differenze — La specie con la quale gli esemplari esaminati presentano le maggiori somiglianze nella forma generale è *Horiopleura haydeni* Douvillé, pure abbondantemente rappresentata tra il materiale topotipico proveniente dalla località-tipo. La specie di Douvillé si distingue però per un minore allungamento della conchiglia; secondo l'A. questa raggiunge infatti una lunghezza massima di 12-13 cm (lunghezza massima del materiale topotipico 13,5 cm), mentre nella nostra specie la lunghezza totale è compresa tra 16 e 22 cm. L'angolo di accrescimento è maggiore; misura infatti in media circa 40° in direzione dorso-ventrale e circa 50° in direzione antero-posteriore in *H. haydeni*, mentre nella nostra specie si aggira sui 20° in direzione dorso-ventrale e sui 30° in direzione antero-posteriore. Le depressioni longitudinali, corrispondenti alle fasce sifonali, sono appena accennate e sembrano più superficiali, tanto che Douvillé non ne fa neppure menzione; anche gli ornamenti trasversali appaiono meno grossolani, mentre la valva sinistra è sempre di dimensioni maggiori.

Per quanto poi riguarda le strutture interne, la valva destra presenta cavità legamentare disposta diversamente; essa è infatti situata tra il dente 2 e la fossetta del dente 3 della valva sinistra ed è allungata in direzione dorso-ventrale; nella nuova specie è invece allungata parallelamente alla commissura e situata dietro la fossetta del dente 3. I denti appaiono meno massicci e la cavità principale più piccola e più regolare.

La valva sinistra, vista in sezione trasversale sia nella figura di Douvillé sia negli esemplari topotipici mostra le seguenti differenze: parete della conchiglia più ispessita anche sul margine ventrale, cerniera meno massiccia, con denti 1 e 3 meno robusti, cavità principale più piccola di forma subtriangolare, cavità accessoria posteriore di forma ovale, meno delimitata e meno marginale.

Anche le sezioni longitudinali non concordano, come risulta dalle descrizioni relative alle due specie. Non rimane quindi alcun dubbio, dopo quanto si è detto, che le due specie siano distinte l'una dall'altra.

Delle altre poche specie conosciute del gen. *Horiopleura* qualche somiglianza si può riscontrare con *H. lamberti* (Munier-Chalmas) nella forma ge-

nerale, nell'andamento e nelle dimensioni della conchiglia (lunghezza massima 15 cm). Quest'ultima specie sembra però possedere valva destra più arcuata, coste longitudinali più differenziate, fasce sifonali meno profonde. Anche le strutture interne sono diverse: nella valva destra i denti sono meno massicci ed allineati in serie rettilinea con l'impronta muscolare anteriore; nella valva sinistra la fossetta per il dente 2 non è centrale ma spostata posteriormente, la cavità principale è più piccola, la cavità accessoria posteriore, così come la lamina miofora posteriore, sono più spostate in direzione dorsale e la cavità accessoria è più lunga e più stretta. Esisterebbe inoltre, secondo Pervinquière 1912 (p. 299), ma questo carattere mi sembra piuttosto dubbio (v. p. 237), una seconda cavità accessoria in posizione anteriore, per cui l'impronta muscolare anteriore sarebbe meno marginale.

Le altre specie del gen. *Horiopleura* sono tutte molto differenti, per cui ritengo di poter considerare gli esemplari in esame come appartenenti ad una specie nuova per la scienza.

Derivazione del nome — Dal prof. A. Desio che ha raccolto il materiale.

Olotipo — Raccolto dal prof. A. Desio, in data 31/8/1955 presso la Rest House di Yasin e conservato nelle collezioni dell'Istituto di Paleontologia dell'Università di Milano. N. inv. P 1783.

Età — Aptiano superiore.

Località — Presso la Rest House di Yasin (55 PD - 108); selletta ad ovest della Rest House di Yasin (55 PD - 112) (Pakistan nord-occidentale).

Horiopleura haydeni Douvillé 1926

Tav. 36, 37, 38; Figg. 6-8 nel testo

1926 *Horiopleura haydeni* Douvillé. *Kashmir et Pamirs*, p. 350, tav. 13, figg. 2,3; figg. 3-6 nel testo.
1934 *Horiopleura haydeni* Kutassy. *Foss. Catalogus*, p. 145.
1937 *Horiopleura haydeni* Mac Gillavry. *Rudist Paleont.*, pp. 96, 104, fig. 4 nel testo.
1939 *Horiopleura haydeni* Jacob. *Henry Douvillé*, p. 491.
1956 *Horiopleura haydeni* Brunnschweiler. *Yasin Group*, p. 27.
1958 *Horiopleura haydeni* Rossi Ronchetti e Farioli Mirelli. *Rudiste e Nerinee*, pp. 355, 357.
1959 *Horiopleura haydeni* Rossi Ronchetti e Farioli Mirelli. *Rudists and Nerineids*, pp. 91, 93.

Materiale — Una ventina di esemplari bivalvi, alcuni abbastanza ben conservati, altri più o meno deformati per compressione, di dimensioni abbastanza grandi.

Descrizione — Conchiglia inequivalve, con valva destra grande, lunga, conica, quasi diritta, solo un poco ritorta all'apice, con area di attacco da piccola a molto grande; lato ventrale lungo in media più del 50% di quello dorsale, per cui la commissura tra le valve è molto obliqua. La valva si espande molto largamente verso l'alto, con angolo di accrescimento in direzione dorso-ventrale in media di 40°-45°, in direzione antero-posteriore compreso in media

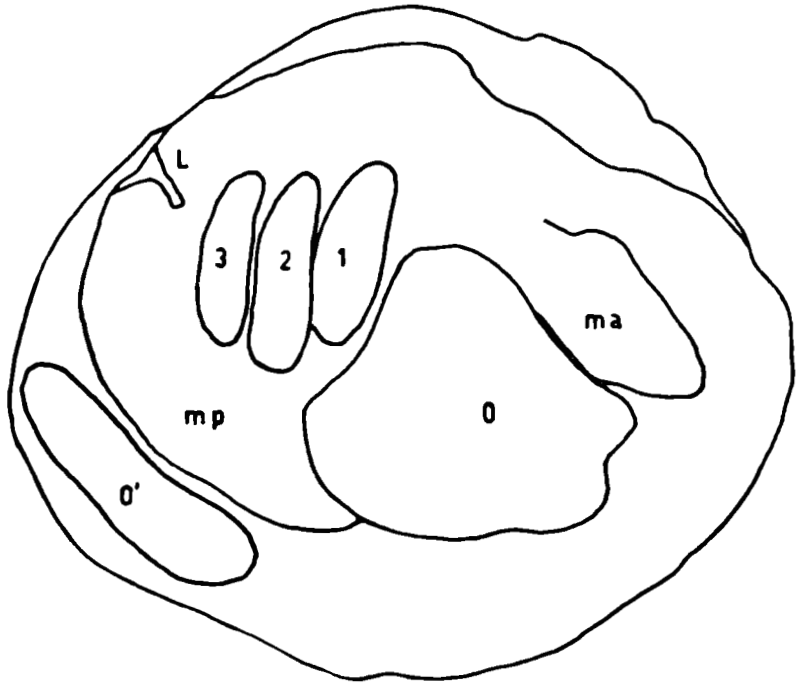


Fig. 6 - *Horiopleura haydeni* Douvillé. Sezione trasversale di valva sinistra. Gr. nat.

tra 50° e 60°. Parete della conchiglia spessa, con faccia esterna più o meno erosa, provvista di lamelle e linee di accrescimento disposte abbastanza fittamente e di rare tracce di coste longitudinali granulose discontinue. Sul lato ventrale due depressioni longitudinali alquanto superficiali, poco evidenti, corrispondenti alle fasce sifonali. Sul lato postero-dorsale un solco legamentare longitudinale distinto, arcuato, estendentesi per tutta la lunghezza della valva fin presso l'area di attacco.

Valva sinistra piuttosto grande, abbastanza convessa, capuliforme, incastrata obliquamente nella valva destra, inclinata verso l'apice dal lato ventrale; umbone marginale (postero-dorsale), più o meno sporgente sulla com-

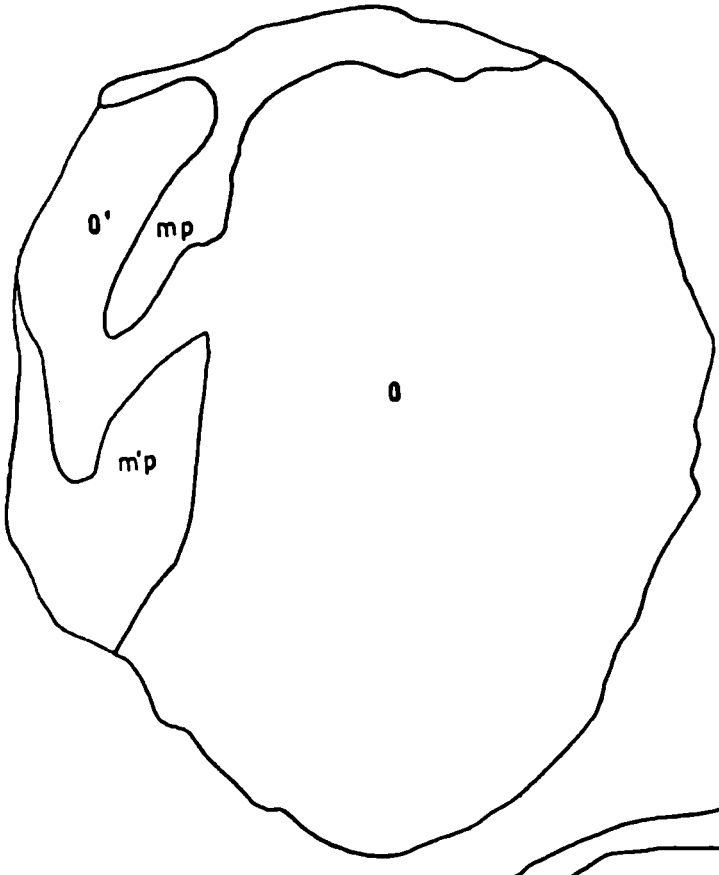


Fig. 7. – *Horiopleura haydeni* Douvillé. Sezione longitudinale eseguita presso il margine ventrale. Gr. nat.

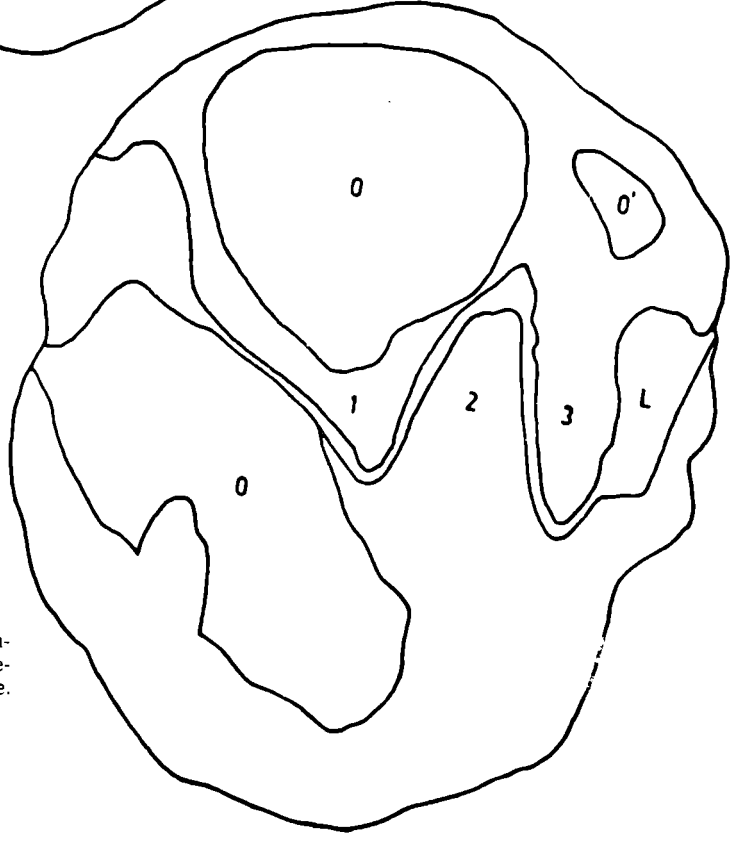


Fig. 8. – *Horiopleura haydeni* Douvillé. Sezione longitudinale eseguita presso il margine dorsale. Gr. nat.

missura, incurvato verso il basso. Rigonfiamento submediano poco pronunciato, delimitato lateralmente da due depressioni divergenti dall'umbone.

Parete della conchiglia spessa, con faccia esterna quasi liscia, erosa, con tracce di lamelle di accrescimento alla periferia.

Strutture interne — Una sezione trasversale della valva destra tagliata a livello della commissura mostra la parete della conchiglia abbastanza spessa nella regione cardinale, meno ispessita, ma sempre piuttosto spessa, in quella ventrale (8,5 mm); un solco legamentare sul lato dorsale che si apre in una cavità legamentare abbastanza ampia ed irregolare, disposta in direzione dorso-ventrale tra il dente 2 e la fossetta corrispondente al dente 3, e la cavità principale grande ed ovoidale. Elementi cardinali abbastanza robusti di forma irregolare. Impronta muscolare anteriore situata ventralmente rispetto alla fossetta di 1; impronta muscolare posteriore, ventralmente alla fossetta di 3.

Una sezione trasversale della valva sinistra (tav. 37, fig. 2; fig. 6 nel testo) tagliata a livello della commissura mostra la parete della conchiglia molto spessa su tutto il margine periferico, un solco legamentare (*L*) sul lato posteriore che attraversa tutta la parete e continua in una piccolissima cavità legamentare, la cavità principale (*O*) ristretta di forma triangolare. Apparato cardinale costituito dai due denti cardinali 1 e 3 disposti subparallelamente, separati da una fossetta ovoidale per l'articolazione del dente 2. Impronta muscolare anteriore (*ma*) su una superficie d'inserzione lunga e parallela al margine anteriore della valva, separante la cavità principale dalla faccia interna della parete della conchiglia; lamina miofora posteriore (*mp*), ovoidale in sezione, disposta ad angolo subretto rispetto agli altri elementi dell'apparato mio-cardinale, separante la cavità principale dalla cavità accessoria posteriore (*O'*), che è allungata parallelamente alla faccia interna della parete della conchiglia.

Una sezione longitudinale di una conchiglia bivalve tagliata presso il margine dorsale (tav. 38, fig. 2; fig. 8 nel testo), mostra il forte e lungo dente conico (2) della valva destra, largo alla base circa 20 mm, alla sommità 8 mm; il dente 1 in posizione submediana, il dente 3 subrettangolare, dietro il quale si apre la cavità legamentare (*L*) abbastanza vasta. Sulla valva sinistra, oltre alla sezione della cavità principale (*O*) piriforme, sono visibili le sezioni della cavità accessoria posteriore (*O'*) e della lamina miofora posteriore.

Una sezione longitudinale tagliata presso il margine ventrale (tav. 38, fig. 1; fig. 7 nel testo) mostra la sezione della lamina miofora posteriore (*mp*) della valva sinistra, lunga e stretta, strozzata presso la base, cui si affianca parzialmente verso l'interno l'analoga lamina miofora posteriore (*m'p*) della valva destra, più larga e di forma triangolare. Tra le due lamine passa la co-

municazione tra la cavità principale e la cavità accessoria posteriore (*O'*) della valva sinistra.

Dimensioni (1):

		I	II	III	IV	V
lungh. tot.	mm	93 ;	— :	118 ;	120 ;	135
valva destra:						
lungh. l. v.	mm	93 ;	121 ;	118 ;	113 ;	126
lungh. l. d.	mm	51 ;	70 ;	58 ;	51 ;	96
ang. accr. (d.-v.)		45°;	45°;	40°;	35°;	30°
ang. accr. (a.-p.)		62°;	50°;	50°;	58°;	52°
valva sinistra:						
diam. d.-v.	mm	71 ;	78 ;	78 ;	87 ;	—
diam. a.-p.	mm	84 ;	91 ;	91 ;	93 ;	—

Osservazioni — Horiopleura haydeni Douvillé si distingue nettamente anche ad un primo esame dalle altre specie del gen. *Horiopleura* per la sua valva destra assai allungata e poco arcuata. Delle sue affinità con *H. desioi* si è già discusso nel paragrafo relativo ai rapporti e differenze di questa specie e ad esso si rimanda. Per quanto riguarda invece le altre specie dello stesso genere, si analizzano rapidamente le differenze relative.

Horiopleura almerai Paquier 1905 (p. 57, tav. VII, figg. 5-7; fig. 6 nel testo) ha valva destra molto più arcuata e più exogyroide, ornamenti longitudinali più marcati, cavità principale più ampia, cavità legamentare più piccola. Sono diversi anche i caratteri dell'apparato cardinale, così come le dimensioni e la forma della cavità accessoria posteriore della valva sinistra.

Horiopleura baylei Coquand in Douvillé 1889 (p. 641, tav. XV, figg. 1-3; figg. 12, 13 nel testo) ha dimensioni minori, valva destra molto più corta e valva sinistra più piatta. In quest'ultima valva inoltre gli elementi cardinali sono piccoli e poco sviluppati ed anche la cavità accessoria posteriore è piccolissima e assai diversa come forma e posizione.

Horiopleura gregarea Palmer (p. 49, tav. VIII, figg. 1-5) ha dimensioni estremamente piccole per il genere, forma quasi cilindrica con angolo di accrescimento abbastanza costante, valva sinistra piatta, strutture interne differenti.

(1) Per il significato dei simboli usati v. p. 244.

Horiopleura lamberti Munier-Chalmas (in Pervinquière 1912, p. 297, tav. XXI, figg. 11a-b, 12; figg. 5-6 nel testo) è la specie più vicina ad *H. haydeni*, se si fa astrazione da *H. desioi* già citata. Presenta infatti notevole somiglianza nella forma generale, soprattutto della valva sinistra, e nella commissura molto obliqua. I caratteri interni permettono però di distinguere le due specie. In *H. lamberti* infatti gli elementi cardinali della valva destra sono allineati in serie rettilinea con l'impronta muscolare anteriore; nella valva sinistra la fossetta del dente 2 è spostata più posteriormente, la cavità principale è più piccola, la cavità accessoria posteriore è più lunga e più stretta, situata più dorsalmente, così come anche la lamina miofora posteriore; esisterebbe inoltre, secondo Pervinquière, una seconda cavità accessoria anteriore, per cui l'impronta muscolare anteriore sarebbe meno marginale.

Nessun dubbio quindi che le due specie vadano tenute distinte e che *H. haydeni* sia una specie valida.

Età e diffusione della specie — *H. haydeni* appare finora localizzata nella regione di Yasin (Pakistan nord-occidentale), ove è stata raccolta in terreni del Cretaceo inferiore (Barremiano superiore o Aptiano secondo Douvillé; Aptiano superiore secondo le nostre conclusioni).

Località — Presso la Rest House di Yasin (55 PD - 108); selletta ad ovest della Rest House di Yasin (55 PD - 112) (Pakistan nord-occidentale).

Fam. RADIOLITIDAE Gray 1848

Sottofam. RADIOLITINAE Gray 1848

Gen. **Eoradiolites** Douvillé 1909

Eoradiolites ? gilgitensis (Douvillé) 1926

Tav. 39, figg. 1, 2

1926 *Praeradiolites gilgitensis* Douvillé. *Kashmir et Pamirs*, p. 353, tav. 13, figg. 4a-b.
1932 *Praeradiolites gilgitensis* Kühn. *Foss. Catalogus*, p. 126.
1939 *Eoradiolites ? gilgitensis* Jacob. *Henry Douvillé*, p. 503.
1958 *Praeradiolites gilgitensis* Rossi Ronchetti e Farioli Mirelli. *Rudiste e Nerinee*, pp. 355, 357.
1959 *Praeradiolites gilgitensis* Rossi Ronchetti e Farioli Mirelli. *Rudists and Nerineids*, pp. 91, 93.

Un solo esemplare, probabilmente bivalve, di medie dimensioni, può essere riferito con qualche incertezza a causa del cattivo stato di conservazione alla specie di Douvillé.

La valva destra molto deformata per compressione in direzione cardino-sinusaria conserva gli ornamenti caratteristici solo sul lato sifonale, mentre in quello cardinale il guscio è completamente asportato. Si osservano i resti di 3 coste longitudinali piuttosto robuste più o meno arrotondate, separate da interspazi concavi più stretti delle coste stesse; le due fasce sifonali («E» e «S») piuttosto larghe e appiattite, sono separate da un'interbanda poco marcata.

Una sezione trasversale (tav. 39, fig. 2) mostra le strutture interne tutte deformate: si riconosce la cresta legamentare piuttosto lunga e pronunciata, che costituisce il prolungamento dello strato interno del guscio; essa forma un tutto unico con il dente 2 che ha forma di lamina arcuata. Da una parte e dall'altra della cresta legamentare e del dente 2 si vedono le sezioni dei denti 1 e 3 e delle apofisi miofore della valva sinistra, profondamente deformate per la compressione subita. In particolare le apofisi miofore sono state spostate verso l'interno, così da essere disposte davanti ai due denti cardinali.

Osservazioni — Douvillé aveva già messo in evidenza le affinità della sua nuova specie con diverse forme del gen. *Eoradiolites*, quali *E. davidsoni*, *sinaiticus*, *lyratus*; aveva però preferito collocarla nel gen. *Praeradiolites* Douvillé 1902 a causa della sua cerniera più robusta e dello sviluppo del legamento, caratteri che anch'io ho potuto constatare nell'esemplare in esame. Tuttavia il tipo di ornamenti e le caratteristiche delle fasce sifonali non sono corrispondenti a quelli di *Praeradiolites*, né nella descrizione fornita da Douvillé, né nell'individuo a mia disposizione. Tali elementi sembrano piuttosto concordare con quelli del gen. *Eoradiolites* Douvillé 1909, pure provvisto di una cresta legamentare e di apofisi miofore sulla valva sinistra. Per cui almeno provvisoriamente colloco questa specie nel gen. *Eoradiolites*, confortata in questa conclusione anche dalle osservazioni di Jacob 1939, che già aveva prospettato un'ipotesi del genere.

Da notare inoltre che Astre 1954 ha citato a Pech de Foix negli strati a *Horiopleura* dell'Aptiano superiore, *E. rousseli* Toucas, spostando così nell'Aptiano l'apparizione del gen. *Eoradiolites*, che secondo Piveteau (p. 352), si distribuirebbe invece dall'Albiano al Cenomaniano.

Età e diffusione della specie — *E.? gilgitensis* Douvillé è stato finora segnalato solo a Yasin (Pakistan nord-occidentale).

Località — Selletta ad ovest della Rest House di Yasin (55 PD - 112) (Pakistan nord-occidentale).

GASTROPODI

Superfam. NERINEACEA

Fam. NERINEIDAE Zittel 1873

Gen. **Cossmannea** Pčelincev 1931

Sottogen. **Eunerinea** Cox 1949

Cossmannea (Eunerinea) vogtiana (de Mortillet) 1856

Tav. 39, figg. 3, 4

1861-64 *Nerinea vogtiana* Pictet e Campiche. *Crétacé Sainte-Croix*, p. 240, tav. LXVIII, figg. 1a, b, c, 2.
1907 *Nerinea vogtiana* Cossmann. *Barrém. sup. Brouzet-les-Alais*, p. 10, tav. III, figg. 1-4, fig. 2 nel testo.
1914 *Nerinea* (s. str.) sp. Dietrich. *Tendaguru-Expedition*, p. 136, tav. 13, fig. 7.
1916 *Nerinea vogtiana* Cossmann. *Complément gisements Brouzet*, p. 14, tav. I, fig. 29.
1925 *Nerinea vogti* Dietrich. *Foss. Catalogus*, p. 121.
1939 *Nerinea vogti* Petkovic. *Nerinées Crét. inf. Kosutnjak*, tav. I, fig. 6; tav. IV, fig. 4; tav. V, figg. 1-4; figg. 6-8 nel testo.
1954 *Nerinea vogti* Andelkovic. *Urgonien et Albien Sumadija*, p. 58, tav. I, fig. 3.
1958 *Nerinea vogtiana* Rossi Ronchetti e Farioli Mirelli. *Rudiste e Nerinee*, pp. 355, 357.
1959 *Nerinea vogtiana* Rossi Ronchetti e Farioli Mirelli. *Rudists and Nerineids*, pp. 91, 93.

Materiale — Un solo esemplare di grandi dimensioni, incompleto all'apice e alla base, costituito di 4 soli giri.

Descrizione — Forma allungata, turricolata, debolmente conica, con angolo spirale di 9°, giri crescenti lentamente ed uniformemente in diametro e in altezza, con rapporto altezza-diametro = 0,75, separati da suture molto distinte, un poco depresse, lineari, leggermente ondulate, formanti una pendenza suturale di circa 20°. Giri fortemente convessi nella parte abapicale, meno convessi in quella adapicale e molto incavati nella parte mediana, così che di profilo si nota una forte insenatura in corrispondenza della concavità dei giri. Ornamenti costituiti da 2 grossi cingoli suturali tubercolati e da 3 corde spirali granulose, quasi impercettibili, distribuiti regolarmente sui lati dei giri. Cingolo suturale abapicale portante in ogni mezzo giro 7-8 tubercoli grossi e ottusi, un poco distanziati fra loro e molto usurati. Cingolo suturale adapicale meno sporgente del precedente provvisto di un ugual numero di tubercoli, meno grossi e meno sporgenti di quelli del cingolo abapicale. L'apertura non è conservata.

Nella sezione assiale (tav. 39, fig. 4) si nota la presenza della colu-

mella e di 3 pieghe interne: 1 piega columellare, 1 piega parietale, 1 piega palatale. Piega columellare piuttosto marcata, di forma subrettangolare situata ad 1/3 dell'altezza del giro, estendentesi in direzione abassiale fino alla metà del semidiametro e formante un angolo di circa 90° con l'asse della conchiglia. Piega parietale prolungata come la precedente e situata a circa 2/3 dell'altezza del giro, estendentesi fino ai 2/3 del semidiametro, formante con l'asse della conchiglia un angolo di circa 50°. Piega palatale subrettangolare, marcata ed allargata come la piega columellare, situata a circa 2/5 dell'altezza del giro ed estendentesi in direzione adassiale, subparallelamente alla piega parietale, per 1/3 del semidiametro del giro. Queste pieghe determinano la formazione di due lobi columellari situati alla stessa distanza dall'asse della conchiglia.

Dimensioni:

altezza totale	mm 79 (?)
altezza di un giro	mm 24
diametro dello stesso	mm 32
angolo spirale	9°

Osservazioni — La specie di de Mortillet presenta notevoli somiglianze con « *Nerinea* » *archimedis* d'Orbigny 1842-43 (p. 78, tav. 158, figg. 3,4), che viene attualmente considerata (Petkovic 1939, Benkö-Czabalay 1962) come una varietà di *C.* (*E.*) *vogtiana*. La forma di d'Orbigny si differenzia per l'angolo spirale minore (7°), per la mancanza di ornamenti sui lati dei giri, per la minor concavità mediana dei giri stessi; infine per l'andamento delle pieghe interne, columellare e parietale, che non hanno sviluppo così uniforme come in *C.* (*E.*) *vogtiana*.

Per la conchiglia imperforata la specie in esame potrebbe essere avvicinata anche a « *Nerinea* » *gigantea* d'Hombre-Firmas (Cossmann 1907, p. 9, tav. 1, figg. 1-5); questa è però pupoide, fortemente conica solo nei primi giri, cilindrica nei successivi e priva di ornamenti.

Alcuni AA., come Pervinquière 1912, hanno ravvicinato *Cossmannea* (*Eunerinea*) *vogtiana* a « *Nerinea* » *pauli* Coquand (in Pervinquière 1912, p. 33, tav. II, figg. 25-26 e fig. 2 nel testo), per la forma esterna e l'andamento delle pieghe interne; tuttavia « *N.* » *pauli* è più allungata e più cilindrica, con lati dei giri lisci, ad eccezione dei cingoli suturali.

La specie di de Mortillet, attribuita originariamente al genere *Nerinea*, è stata in questa sede collocata nel genere *Cossmannea*, sottogenere *Eunerinea*, in base alle conclusioni di Cox 1949. Secondo l'A. la specie-tipo del genere

Nerinea è *Nerinea mosae* Deshayes, riferita in precedenza al genere *Ptygmatis* Sharpe. Di conseguenza *Ptygmatis* diventa sinonimo di *Nerinea* s. str., per cui è necessaria « the introduction of other names for the section « *Nerinea* s. str. » in the sense of Cossmann and for the genus in which this section is to be included ». Cox propone perciò il nuovo sottogen. *Eunerinea* (specie-tipo *Nerinea castor* d'Orbigny) « for the reception of the majority of the species which formed Cossmann's section " *Nerinea* s. str. " » (compresa quindi anche *Nerinea vogtiana* de Mortillet). Tale sottogenere viene da Cox incluso nel gen. *Cossmannea* Pčelincev (specie-tipo *Nerinea desvoidyi* d'Orbigny).

Come nome specifico ho conservato quello originale proposto da de Mortillet, che ha aggettivato il nome di Vogt, poiché tale modo di procedere è approvato anche da « International Code of Zoological Nomenclature adopted by the XV International Congress of Zoology » del 1961. Non vi è quindi la necessità di sostituire tale nome aggettivato con il genitivo singolare (*vogti*), come ha fatto Dietrich nel 1925.

Età e diffusione della specie — La *C.* (*E.*) *vogtiana* de Mortillet si distribuisce, secondo Dietrich, dal Barremiano all'Aptiano in facies urgoniana ed è stata segnalata in Francia, Svizzera, Spagna, Africa orientale, Jugoslavia.

Località — Selletta ad ovest della Rest House di Yasin (Pakistan nord-occidentale) (55 PD - 112).

Gen. **Adiozoptyxis** Dietrich (1914) 1925
Adiozoptyxis coquandiana (d'Orbigny) 1842-43
Tav. 39, fig. 5; Tav. 40, figg. 1-3

1842-43 *Nerinea coquandiana* d'Orbigny. *Terr. crétacés, Gastéropodes*, p. 75, tav. 156, figg. 3-4.
1842-43 *Nerinea renauxiana* d'Orbigny. *Terr. crétacés, Gastéropodes*, p. 76, tav. 157, figg. 1-4.
1861-64 *Nerinea renauxiana* Pictet e Campiche. *Crétacé Sainte-Croix*, p. 235, tav. LXVII, figg. 3a-b.
1861-64 *Nerinea coquandiana* Pictet e Campiche. *Crétacé Sainte-Croix*, p. 237, tav. LXVII, figg. 1a-b, 2.
1866 ? *Nerinea renauxi* Costa. *Note geol. e paleont. Appenn. Campania*, p. 61, tav. II, figg. 1,2.
1887 *Nerinea renauxiana* Mallada. *Sinopsis*, p. 42, tav. XIX, figg. 1,2.
1887 *Nerinea coquandiana* Mallada. *Sinopsis*, p. 43, tav. XX, fig. 2.
1907 *Nerinea* (*Diozoptyxis*) *coquandiana* Cossmann. *Barrém. sup. Brouzet-les-Alais*, p. 12, tav. II, figg. 1-4; fig. 3 nel testo.
1907 *Nerinea* (*Diozoptyxis*) *renauxiana* Cossmann. *Barrém. sup. Brouzet-les-Alais*, p. 13, tav. I, figg. 6-9; fig. 4 nel testo.

1912 *Nerinea* (*Diozoptyxis*) *coquandiana* Pervinquière. *Paléont. tunisienne*, p. 36.
1912 *Nerinea* (*Diozoptyxis*) *renauxiana* Pervinquière. *Paléont. tunisienne*, p. 36.
1914 *Nerinea* (*Diozoptyxis*) *coquandi* Dietrich. *Tendaguru-Expedition*, p. 138, tav. 13, fig. 2.
1916 *Nerinea* (*Diozoptyxis*) *coquandiana* Cossmann. *Complément gisements Brouzet*, p. 14, tav. I, figg. 27, 28.
1916 *Nerinea* (*Diozoptyxis*) *renauxiana* Cossmann. *Complément gisements Brouzet*, p. 15.
1925 *Nerinea* (*Diozoptyxis*) *coquandi* Dietrich. *Foss. Catalogus*, p. 130.
1925 *Nerinea* (*Diozoptyxis*) *renauxi* Dietrich. *Foss. Catalogus*, p. 130.
1926 *Nerinea coquandi* Douvillé 1926. *Kashmir et Pamirs*, p. 354, fig. 9 nel testo.
1927 *Nerinea* (*Diozoptyxis*) *renauxiana* Daguin. *Etud. géol. rég. prérifaine*, p. 240, tav. XXXI, fig. 4.
1932 *Nerinea* (*Diozoptyxis*) *coquandi* Sayn. *Urgonien Barcelone*, p. 22.
1939 *Nerinea* (*Diozoptyxis*) *coquandi* Petkovic. *Nerinées Crét. inf. Kosutnjak*, p. 66, fig. 1.
1939 *Nerinea coquandi* Jacob. *Henry Douvillé*, p. 517.
1940 *Nerinea coquandi* Delpey. *Gastér. mésoz. rég. libanaise*, p. 180, tav. IV, figg. 1-5.
1950 *Nerinea* (*Diozoptyxis*) *coquandiana* Pašić. *N. coquandiana près Boljevac*, p. 143, tav. I, figg. 1-4; fig. 1 nel testo.
1952 *Nerinea coquandiana* Ciric. *Faune crét. Titov Veles*, p. 265, tav. X, fig. 1.
1953 *Nerinea coquandi* Glaçon. *Nérinées et Milioles Hodna*, p. 30, fig. 1 nel testo.
1954 *Nerinea* (*Diozoptyxis*) *coquandi* Andelkovic. *Urgonien et Albien Sumadija*, p. 57, tav. II, fig. 1.
1954 *Adiozoptyxis coquandiana* Cox. *Taxonomy superfam. Nerineacea*, p. 12.
1954 *Adiozoptyxis renauxiana* Cox. *Taxonomy superfam. Nerineacea*, p. 12.
1956 *Nerinea* cf. *N. coquandi* Brunnschweiler. *Yasin Group*, p. 27.
1958 *Adiozoptyxis coquandiana* Rossi Ronchetti e Farioli Mirelli. *Rudiste e Nerinee*, pp. 355, 357.
1958 *Adiozoptyxis renauxiana* Rossi Ronchetti e Farioli Mirelli. *Rudiste e Nerinee*, pp. 355, 357.
1959 *Adiozoptyxis coquandiana* Rossi Ronchetti e Farioli Mirelli. *Rudists and Nerineids*, pp. 91, 93.
1959 *Adiozoptyxis renauxiana* Rossi Ronchetti e Farioli Mirelli. *Rudists and Nerineids*, pp. 91, 93.
1960 *Diozoptyxis coquandi* Pčelincev. *Osnovi Paleontologii*, tav. XIII, figg. 6a-b.
1960 *Diozoptyxis renauxi* Pčelincev. *Osnovi Paleontologii*, p. 121, fig. 214 nel testo.
1962 *Nerinea* (*Diozoptyxis*) *coquandiana* Benkö-Czabalay. *Nérinées montagne Bakony*, p. 138, tav. I, figg. 6-8; tav. III, figg. 5-6.

Materiale — Due esemplari, incompleti all'apice e alla base.

Descrizione — Conchiglia di grandi dimensioni (altezza 92 mm), costituita al massimo da 4 giri e mezzo. Forma conica, turricolata, con angolo spirale variabile secondo gli esemplari da 15° a 30°, multispirale, con giri crescenti

lentamente ed uniformemente in altezza ed in diametro, con rapporto altezza/diametro variabile tra 0,30 e 0,45; suture distinte, lineari, ondulate, con pendenza suturale compresa tra 5° e 10° circa. Giri con ben marcato rigonfiamento abapicale, e parte adapicale moderatamente convessa. Ornamenti costituiti da un grosso cingolo spirale abapicale posto immediatamente sopra la sutura, portante in ogni mezzo giro un numero variabile di tubercoli (da 8 a 9 fino a 20), più o meno grossi ed ottusi, un poco distanziati fra loro, molto usurati. L'apertura non è conservata.

Nella sezione assiale (tav. 40, figg. 2, 3) si vede l'ombelico più o meno largo (da circa 1/4 del diametro del giro a 1/2) e le 3 pieghe interne: 1 piega columellare, 1 piega parietale, 1 piega palatale. Piega columellare piuttosto marcata, di forma subtriangolare, situata ad 1/3 circa dell'altezza del giro, inclinata abapicalmente di circa 45°-50° rispetto all'asse della conchiglia e prolungata fino a circa metà del semidiametro del giro. Piega parietale a circa 2/3 dell'altezza del giro; inclinata di circa 45° rispetto all'asse della conchiglia e prolungata fino a raggiungere i 3/4 del semidiametro del giro con direzione parallela a quella della piega columellare. Piega palatale anch'essa di forma subtriangolare, più ottusa delle precedenti, situata da circa 1/3 a 1/2 dell'altezza del giro; si estende per 1/4 del semidiametro, conservando la stessa inclinazione delle altre rispetto all'asse della conchiglia.

Dimensioni:

altezza totale	mm 90 (?)
altezza di un giro	mm 21
diametro dello stesso	mm 50
angolo spirale	15°

Osservazioni — Autori precedenti, come Douvillé 1926 (p. 354), avevano affacciato la possibilità di una riunione di *Adiozoptyxis coquandiana* (d'Orbigny) e di *A. renauxiana* (d'Orbigny). Tale riunione è stata in seguito effettuata da Delpey 1940 (p. 182), in conseguenza del fatto che nel Libano non è possibile distinguere le due forme neppure come due varietà di una stessa specie; tra gli estremi infatti vi sarebbero, secondo l'A., numerosi termini intermedi, mentre i caratteri associati sarebbero generalmente misti. Queste conclusioni sono state accettate anche da Glaçon 1953 e da Benkö-Czabalay 1962.

Nella fauna di Yasin sono presenti due soli esemplari, dei quali uno mostra i caratteri ben definiti di *A. coquandiana* (tav. 40, figg. 1, 2), l'altro

quelli di *A. renauxiana* (tav. 39, fig. 5; tav. 40, fig. 3). Essi concordano infatti nella presenza di ombelico e nel numero delle pieghe interne; il secondo (= *A. renauxiana*) si differenzia tuttavia per la maggior ampiezza dell'angolo spirale (30° invece di 15°), per i giri meno alti (rapporto altezza/diametro = 30% invece che = 45%), per i tubercoli del cingolo suturale più numerosi e meno sporgenti (20 in mezzo giro, in luogo di 8-9), per l'ombelico più largo (1/2 del semidiametro invece di 1/4) e per la piega palatale più spostata abapicalmente (ad 1/3 dell'altezza del giro, invece che a metà altezza). Si è quindi verosimilmente in presenza dei due tipi estremi della specie, che non sono collegati, almeno a Yasin, da termini intermedi. La mancanza di una collezione completa non mi permette di controllare personalmente le conclusioni di Delpey, alle quali tuttavia ritengo di dovermi associare.

Anche Benkö-Czabalay (1962) considera, come ho già detto, « *N.* » *renauxiana* sinonima di « *N.* » *coquandiana*, che riferisce ancora al gen. *Nerinea*, sottogen. *Diozoptyxis*. Istituisce inoltre per l'Aptiano-Albiano del monte Bakony una nuova sottospecie, che denomina *ajkaënsis* dalla località di provenienza. Questa nuova sottospecie si differenzia da *A. coquandiana* (d'Orbigny) per giri più concavi medialmente, più angolosi e prominenti nelle regioni suturali e per diverso andamento delle pieghe interne. La piega parietale è infatti meno estesa, per cui il lobo parieto-columellare appare meno distinto; la piega palatale invece è più prolungata ed accentuata.

Nelle sue note relative alla tassonomia della superfam. *Nerineacea* Cox (1954) propone di adottare, in sostituzione del gen. *Diozoptyxis* Cossmann (specie-tipo *Nerinea monilifera* d'Orbigny), incluso ora nella fam. *Campanilidae*, il gen. *Adiozoptyxis* Dietrich (1914) 1925 (specie-tipo *Nerinea polimorpha* Gemmellaro) per tutte quelle forme di *Nerineidae* che rispondono alla diagnosi del genere, così da lui formulata: « shell moderately stout, often large, with broad umbilicus; whorls low, strongly concave to flat, smooth or tuberculate, with an angular adaxial projection forming a helix within the umbilicus. Details of aperture unknown. Three internal folds present (2, 0, 1, 0 or 1, 1, 1, 0) ».

La specie di d'Orbigny sopra descritta corrisponde bene nei caratteri generici a questo nuovo genere e quindi viene inclusa in esso, come del resto lo stesso Cox aveva già fatto notare.

In proposito devo aggiungere che Pčelincev (1960) nel volume relativo ai Gastropodi di Osnovi Paleontologii (p. 121) conserva il gen. *Diozoptyxis* Cossmann 1896, emend. Pčelincev 1931 e lo colloca in una nuova sottofamiglia delle *Diozoptyxisinae*, considerando come specie-tipo *Nerinea renauxiana*

d'Orbigny 1842, in luogo di *N. monilifera* d'Orbigny, trasferita in un'altra famiglia.

In una comunicazione scritta il prof. Cox da me interrogato in merito all'emendamento di Pčelincev, si è così pronunciato: « As Cossmann cited *Nerinea monilifera* d'Orbigny as type species of *Diozoptyxis* when founding this genus, the action of Pčelincev in " emending " the genus, by taking *Nerinea renauxiana* as its type species instead, is illegal and inadmissable ».

Per quanto riguarda la terminazione del nome specifico si rimanda a quanto si è detto nelle osservazioni relative a *Cossmannea* (*Eunerinea*) *vogtiana* (de Mortillet) a p. 255.

Età e diffusione della specie — *A. coquandiana* (d'Orbigny) è una specie a vasta diffusione, ritrovandosi ovunque la facies urgoniana è rappresentata in Francia, Spagna, Italia, Svizzera, Jugoslavia, Bulgaria, Romania, Tunisia, Algeria, Marocco, Africa orientale, Libano, Pakistan. In particolare nell'Aptiano è stata citata in Spagna, in Italia, nel Libano. In Ungheria è stata segnalata recentemente nell'Aptiano-Albiano della montagna del Bakony. La specie era già stata indicata nella località di Yasin da Douvillé.

Località — Selletta ad ovest della Rest House di Yasin (Pakistan nord-occidentale) (55 PD - 112).

Fam. NERINELLIDAE Pčelincev 1960

Gen. **Plesioptyxis** Pčelincev 1954

L'attribuzione generica di alcune forme di *Nerineacea* pakistane è stata piuttosto ardua, in quanto nessuno dei generi finora conosciuti nella letteratura occidentale presentava i medesimi caratteri diagnostici. Per questo motivo nella diagnosi della nuova specie istituita nel 1956 (*Nerinea desioi* Farioli Mirelli) e nelle note preliminari successive (1958, 1959) si era ripiegato sull'attribuzione al gen. *Nerinea*, inteso però in senso lato, poiché la struttura delle pieghe interne non corrispondeva a quella nota per tale genere.

In seguito si è avuta la possibilità di consultare al riguardo la letteratura russa e su queste nuove basi si è potuto procedere all'attribuzione generica. Dall'esame dei diversi generi della superfamiglia *Nerineacea* elencati da Pčelincev nel volume sui Gastropodi di Osnovi Paleontologii del 1960, è risultato infatti che il genere meglio rispondente nei caratteri diagnostici, sia interni sia esterni, alle nuove forme distinte nel materiale pakistano, è il gen. *Ple-*

sioptyxis Pčelincev 1954 (che secondo l'A. ha come specie-tipo *Nerinea fleuriausa* d'Orbigny 1842); tale genere è incluso nella fam. *Nerinellidae*, istituita pure da Pčelincev nel 1960. Nel 1954 l'A. ha dato del genere la seguente diagnosi: « conchiglia strettamente turricolata, talora subcilindrica, composta di numerosi giri bassi, di solito congiunti da suture lineari, spostate nella parte inferiore del cingolo suturale. Parti laterali dei giri più o meno concave, talora piane. Ornamenti, fatta eccezione di radi tubercoli presenti sulla parte superiore del cingolo suturale e delle linee di accrescimento, assenti. Ombelico stretto, chiuso, talora mancante. Apertura romboidale con 6-7 pieghe interne, delle quali 2-3 debolmente sviluppate o rudimentali. Piega inferiore columellare e " piega labiale esterna " (1) di solito complicate ».

Nella discussione relativa al nuovo genere Pčelincev dichiara che la sua istituzione è basata sulle pieghe interne, che presentano evoluzione e complicazione ulteriori rispetto a quelle dei rappresentanti del gen. *Triptyxis* Pčelincev 1924 (Titonico-Valanginiano), dal quale il gen. *Plesioptyxis* sarebbe probabilmente derivato. Chiarisce inoltre che delle 6-7 pieghe interne caratteristiche per tale genere, le principali sono essenzialmente: 2 pieghe columellari, la parietale e la « labiale esterna inferiore ».

Per tali caratteristiche il gen. *Plesioptyxis* si differenzia, secondo Pčelincev, dal gen. *Plesioptygmatis* Böse 1906, emend. Pčelincev 1953, del Cretaceo superiore, che ha 4 pieghe interne lamellari semplici, di cui la più sviluppata è la « labiale esterna »; dal gen. *Plesioplocus* Pčelincev 1953 (Barremiano-Senoniano), pure provvisto di 4 pieghe interne semplici (più sviluppata è la « labiale esterna »), che ha inoltre aspetto nerineide; dal gen. *Multiptyxis* Pčelincev 1953 (Titonico-Cenomaniano) caratterizzato da 5 pieghe interne principali, delle quali sono complicate la « labiale esterna » e la parietale.

Le specie distinte nel materiale pakistano corrispondono bene ai caratteri generici sopra discussi delle pieghe interne e della forma della conchiglia. Si differenziano invece per quanto riguarda gli ornamenti, in quanto presentano, come si vedrà nella descrizione relativa, oltre al cingolo suturale tubercolato, anche corde spirali pure tubercolate; questo carattere tenderebbe ad avvicinarle al gen. *Multiptyxis*, che però, come si è visto, ha struttura diversa delle pieghe interne. Per tutte queste considerazioni ritengo di dover attribuire le specie in esame al gen. *Plesioptyxis*.

Altre osservazioni vanno fatte a proposito della distribuzione stratigrafica del gen. *Plesioptyxis*. Secondo Pčelincev, detto genere si distribuirebbe dal

(1) La « piega labiale esterna » corrisponde nella nomenclatura anglosassone alla piega palatale.

Cenomaniano al Senoniano incluso ed, oltre che nella regione transcaucasica, sarebbe diffuso nell'Europa meridionale (Italia, Portogallo, Francia) e nell'America settentrionale; in tali regioni sarebbe rappresentato da *P. fleuriausa* (d'Orbigny), *P. eschwegei* (Sharpe), *P. olisiponensis* (Sharpe), *P. di-stefanoi* (Schnarrenberg), *P. blanckenhorni* Pčelincev.

Le forme del Pakistan provengono invece da depositi sicuramente datati come Cretaceo inferiore (Aptiano), per cui la loro attribuzione ad un genere limitato al Cretaceo superiore sembrerebbe creare qualche difficoltà. Da parte sua però Pčelincev fa notare che i Gastropodi aptiani e albiani non sono stati ancora studiati sufficientemente, in modo da permettere di distinguere l'antenato diretto del gruppo suddetto. Con queste espressioni l'A. non esclude la possibilità che l'evoluzione del gen. *Plesioptyxis* abbia avuto inizio prima di quanto ritenuto, ossia prima del Cenomaniano; le forme del Pakistan da parte loro consentono appunto di confermare la supposizione di una più precoce apparizione del genere.

L'esame della letteratura paleontologica più recente relativa alle *Nerineacea* del Cretaceo sembra pure fornire ulteriori elementi a convalida di quanto sopra espresso. Sembrano infatti riferibili al gen. *Plesioptyxis: Nerinea prefleuriaui* Delpey dell'Aptiano del Libano, *Nerinea* (*Diozoptyxis*) *prefleuriaui rengarteni* Benkö-Czabalay dell'Albiano del monte Bakony, *Nerinea* (*Diozoptyxis*) *baconica* Benkö-Czabalay dell'Aptiano della stessa regione e *Nerinea preolisiponensis* Delpey dell'Albiano del Madagascar. Si può citare ancora, seppure con qualche dubbio a causa dell'illustrazione poco chiara, *Nerinea* (*Diozoptyxis*) sp. ind. Andelkovic dei sedimenti a facies urgoniana (Barremiano superiore, secondo l'A.) della zona di Sumadija (Serbia); questa forma sembra infatti avere forma esterna e struttura delle pieghe interne analoghe a quelle del genere qui considerato. Queste caratteristiche sono state fatte rilevare anche da Benkö-Czabalay, che ha confrontato la sua *Nerinea* (*Diozoptyxis*) *baconica* con questa specie indeterminata di Andelkovic.

Le specie nominate colmano quindi la lacuna pre-cenomaniana del gen. *Plesioptyxis*, il quale sarebbe comparso almeno nell'Aptiano e avrebbe proseguito la sua evoluzione attraverso l'Albiano, il Cenomaniano e il Turoniano, fin nel Senoniano.

Dagli elementi forniti in questa discussione risulta infine ampliata anche la diffusione geografica del genere esaminato; tale genere si sarebbe diffuso oltre che nelle regioni sopra citate, anche in Jugoslavia, Ungheria, Madagascar, Libano e nel Pakistan.

Plesioptyxis desioi (Farioli Mirelli) 1956
Tav. 41, figg. 5-8; Tav. 42, figg. 1-3; Fig. 9 nel testo

1956 *Nerinea desioi* Farioli Mirelli. *Diagnosi di forme nuove*, p. 133, figg. 1a, b, c nel testo.
1958 *Nerinea desioi* Rossi Ronchetti e Farioli Mirelli. *Rudiste e Nerinee Pakistan*, pp. 355, 357.
1959 *Nerinea desioi* Rossi Ronchetti e Farioli Mirelli. *Rudists and Nerineids Pakistan*, pp. 91, 93.

Materiale — L'olotipo (tav. 41, figg. 7, 8; tav. 42, fig. 1) e 3 paratipi tutti più o meno frammentari, di dimensioni abbastanza grandi, sono riferibili a questa specie di recente istituzione per la scienza, che viene per la prima volta descritta in tutti i suoi caratteri e nei suoi rapporti e differenze con le specie vicine.

Descrizione — Olotipo di grandi dimensioni (circa 180 mm di altezza), incompleto all'apice ed alla base, fossilizzato in calcare bituminoso grigio-nerastro con macchie giallastre.

Forma subcilindrica, turricolata, con angolo spirale di 8° (l'angolo apicale non si è potuto misurare), multispiralata, con più di 9 giri crescenti molto lentamente ed uniformemente in diametro ed in altezza, con rapporto altezza/diametro = 0,60, separati da suture distinte, lineari, un poco oblique e leggermente ondulate, con pendenza suturale di 16°. Primi 3-4 giri a sezione subrettangolare, con regioni suturali rigonfie, più convesse abapicalmente che adapicalmente, con parte mediana piuttosto depressa e concava.

Ornamenti costituiti da un grosso cingolo suturale e da 3 corde secondarie spirali più deboli, irregolarmente distanziate. Il cingolo abapicale subito sopra la sutura, ottuso molto sporgente, piuttosto alto, porta ogni mezzo giro 12 tubercoli rotondeggianti ed ottusi, un poco distanziati fra loro. Prima corda molto ravvicinata al cingolo abapicale, provvista di numerosi piccoli granuli in numero doppio di quelli del cingolo suturale, separata dalla seconda corda da un solco abbastanza largo e profondo. Seconda corda più grossa della prima, ma meno della terza, provvista di piccoli granuli meno numerosi ed evidenti dei precedenti. Terza corda notevolmente più grossa della seconda, piuttosto ottusa, anch'essa provvista di granuli abbastanza ravvicinati tra loro (non si possono contare perché non sono conservati su tutto il giro), più grossi di quelli della prima e della seconda corda; è separata da quest'ultima da un interspazio meno largo del precedente. Lo spazio tra la terza corda e la sutura adapicale è prima incavato, poi leggermente rigonfiato in una convessità adapicale.

A mano mano che la conchiglia si allunga, i giri più adulti conservano la sezione subrettangolare, ma presentano una maggior convessità tanto abapicale che adapicale (rimanendo tuttavia maggiore quella abapicale) e quindi una maggiore concavità nel profilo. Il cingolo abapicale di ogni giro diviene più marcato, ottuso e sporgente ed i tubercoli più prominenti e distanziati fra loro. Le corde secondarie sono sempre bene evidenti, mentre forse per lo stato di conservazione i granuli sono impercettibili. Gli interspazi tra i vari ornamenti spirali rimangono in proporzione costanti. L'apertura non è conservata.

Nella sezione assiale (tav. 42, fig. 1) si vede una columella non molto larga (1/10 del diametro di ogni giro) e pieghe interne numerose ed elaborate: una piega columellare abapicale (1), una piega columellare adapicale (2), una piega parietale adassiale (3), una piega parietale adapicale (4), una piega palatale adapicale (5), una piega palatale abapicale (6), una piega basale (7). Il numero delle pieghe è costante in ogni giro.

Nel primo giro osservato la piega columellare abapicale è prolungata notevolmente in direzione abassiale, formando un angolo di circa 45° con l'asse della conchiglia; occupa i 2/3 del semidiametro ed 1/3 dell'altezza del giro. La piega columellare adapicale, meno marcata e prolungata della prima, è situata a circa metà altezza del giro e si estende per 1/6 del semidiametro determinando due lobi columellari: l'abapicale più grande dell'adapicale. La piega parietale adassiale, più estesa delle precedenti (5/6 del semidiametro), è uncinata verso l'apice ed inclinata subparallelamente alla piega columellare abapicale. La piega parietale adapicale appena accennata, determina due lobi asimmetrici. La piega palatale adapicale è appena segnata ed è spostata verso la sutura adapicale. La piega palatale abapicale è situata nel terzo abapicale del giro e sul prolungamento della piega columellare abapicale, da cui è separata da una stretta cavità. La piega basale piuttosto periferica e poco marcata, delimita con la piega palatale un lobo abapicale assai pronunciato.

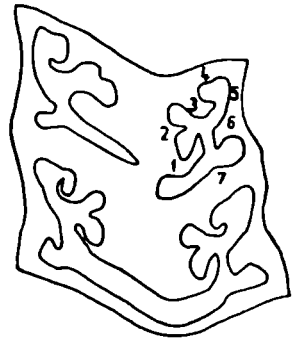


Fig. 9 - *Plesioptyxis desioi* (Farioli Mirelli). Sezione assiale: 1) piega columellare abapicale; 2) p. columellare adapicale; 3) p. parietale adassiale; 4) p. parietale adapicale; 5) p. palatale adapicale; 6) p. palatale abapicale; 7) p. basale. × 1,5.

Nei giri seguenti le pieghe mantengono l'estensione e l'inclinazione di quelle del primo giro, divenendo mano a mano più marcate e determinando lobi più grandi.

Della serie-tipo fanno parte anche 3 paratipi più o meno ben conservati

e di dimensioni variabili (tav. 41, figg. 5, 6; tav. 42, figg. 2, 3). Essi sono facilmente riferibili a questa specie per la forma subcilindrica della conchiglia, per i giri che mantengono lo stesso rapporto tra altezza e diametro, per la loro concavità mediana, per i caratteristici ornamenti e per la struttura sempre costante delle pieghe interne, che rispondono alla formula dell'olotipo (2, 2, 2, 1).

Dimensioni:

	Olotipo	Paratipo I
altezza totale	mm 105 (?);	106 (?)
altezza giro adulto	mm 11 ;	13
diametro dello stesso	mm 19 ;	20
angolo spirale	8° ;	8°

Rapporti e differenze — Nessuna delle specie di *Nerineacea* del Cretaceo finora conosciute presenta decise affinità con questa forma di Yasin; si ritiene quindi di essere in presenza di una specie nuova per la scienza.

Le maggiori somiglianze si riscontrano con un'altra specie pakistana, pur essa nuova per la scienza, *Pl. yasinensis*. Le due specie concordano infatti nella forma generale e nell'andamento complessivo delle pieghe interne. *Pl. yasinensis* si differenzia tuttavia per le proporzioni maggiori, per l'andamento della spira, che ha angolo spirale minore (5° invece di 8°), per i giri meno incavati e con diverso rapporto tra altezza e diametro (43% invece di 60%-65%), per gli ornamenti differenti (cingolo suturale più sottile e meno sporgente, 4 corde spirali secondarie invece di 3), per la maggior inclinazione delle suture (pendenza suturale di 18° invece di 16°). Tutte queste differenze mi sembrano sufficienti per giustificare la distinzione delle due specie.

Con le altre specie del Cretaceo inferiore che, come abbiamo detto, si possono considerare appartenenti al gen. *Plesioptyxis*, le affinità sono ancora minori.

Nerinea prefleuriaui Delpey 1940 (p. 185, tav. III, figg. 11-15; tav. IV, fig. 6) dell'Aptiano del Libano, che concorda con la nostra specie nell'andamento delle pieghe interne, se ne differenzia per le proporzioni notevolmente inferiori, per l'angolo spirale maggiore (15°-25° invece di 8°), per diverso rapporto tra altezza e diametro dei giri (0,3-0,5 invece di 0,6), per la maggior concavità dei giri stessi, per il cingolo suturale più sporgente e per la presenza dell'ombelico.

Nerinea (*Diozoptyxis*) *prefleuriaui rengarteni* Benkö-Czabalay 1962 (p. 162, tav. II, fig. 3) dell'Albiano del monte Bakony si distingue per la presenza di ombelico, per un diverso andamento dei giri, che hanno rapporto altezza/dia-

metro = 0,24, per la piega columellare più prolungata e per quella parietale meno uncinata.

Nerinea (*Diozoptyxis*) *baconica* Benkö-Czabalay 1962 (p. 161, tav. II, figg. 4-5) dell'Aptiano del Bakony si differenzia per proporzioni maggiori, forma meno slanciata e più pupoide, giri meno concavi con diverso rapporto altezza/diametro (0,38 invece di 0,60) e lisci, ad eccezione del cingolo suturale non tubercolato. Anche la sezione assiale mostra differenze, che consistono principalmente nella presenza di un ampio ombelico e nel diverso andamento delle pieghe interne. La piega columellare abapicale è infatti più sottile, la columellare adapicale appena segnata, per cui i due lobi relativi sono meno pronunciati. La piega parietale adassiale non è uncinata verso l'apice, ma inclinata verso la base; infine la piega palatale principale sembra più larga e meno prolungata.

Nerinea preolisiponensis Delpey 1948 (p. 20, tav. IV, figg. 8, 9) dell'Albiano del Madagascar, si distingue per un maggior angolo spirale, per giri più bassi e più larghi che danno un rapporto percentuale alquanto inferiore, per il numero e lo sviluppo delle pieghe interne. A quanto si può vedere dalla figura sono presenti infatti solo 4 pieghe interne (2 columellari, 1 parietale e 1 palatale), che corrispondono come posizione alle 4 pieghe interne principali di *Pl. desioi*; mancano invece le 3 pieghe rudimentali che completano il numero delle pieghe interne nella forma pakistana. Inoltre le pieghe sono meno accentuate, per cui la cavità interna dei giri risulta più ampia e meno tormentata.

Nerinea (*Diozoptyxis*) sp. ind. Andelkovic (p. 58, tav. II, fig. 2) del Barremiano superiore di Sumadija (Serbia), nota solo attraverso la sezione assiale, sembra avere dimensioni molto superiori, angolo spirale maggiore, giri più concavi e con rapporto diverso tra altezza e diametro, pieghe interne corrispondenti come numero, ma meno pronunciate.

Tra le specie illustrate da Pčelincev 1954, qualche somiglianza si può osservare con *Plesioptyxis similis* Pčelincev del Santoniano superiore della regione transcaucasica, soprattutto per quanto riguarda la forma della conchiglia e la struttura delle pieghe interne (tav. VII, figg. 2 a, b; fig. 22 nel testo). *Pl. similis* si differenzia però per l'angolo spirale più ampio (10°), per diverse proporzioni dei giri (altezza uguale a circa la metà del diametro), per la presenza dell'ombelico e per la mancanza di ornamenti esterni.

Va infine fatto notare che, nell'elenco fornito da Brunnschweiler (1956) delle specie identificate nel materiale raccolto nei dintorni di Yasin da Ivanac, Traves e King nel 1951, compare una *Ptygmatis* n. sp., che dovrebbe essere

probabilmente conspecifica o di questa specie o della seguente (*Pl. yasinensis* n. sp.).

Derivazione del nome — In onore del prof. A. Desio, raccoglitore del materiale.

Olotipo — Raccolto dal prof. A. Desio in data 1/9/1955 e depositato presso l'Istituto di Paleontologia dell'Università di Milano. N. inv. P 301.

Età — Aptiano superiore.

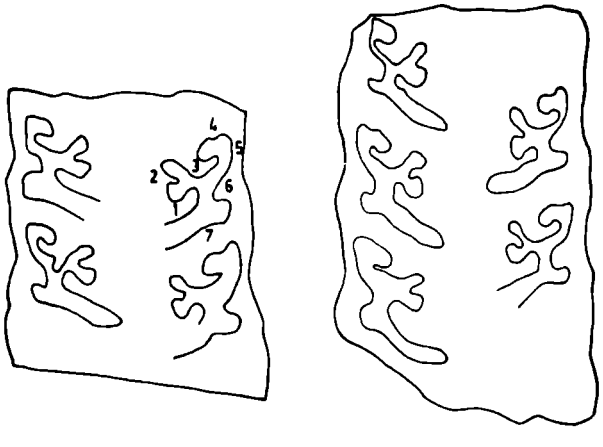
Località — Selletta ad ovest della Rest House di Yasin (Pakistan nord-occidentale) (55 PD - 112).

Plesioptyxis yasinensis n. sp.

Tav. 40, figg. 4, 5; Tav. 41, figg. 1-4, 9; Tav. 42, figg. 4-6; Tav. 43, figg. 1-8

Materiale — L'olotipo (tav. 41, figg. 1, 2; tav. 42, figg. 5, 6; figg. 10, 11 nel testo) e una ventina di paratipi più o meno frammentari, in genere di dimensioni piuttosto grandi, costituiscono la serie-tipo di questa nuova specie, che non è identificabile con alcuna delle forme finora conosciute del gen. *Plesioptyxis* Pčelincev.

Descrizione — Olotipo di grandi dimensioni (circa 90 mm di altezza), incompleto all'apice e alla base, fossilizzato come modello esterno in un calcare bituminoso grigio-nerastro, con macchie giallastre.



Figg. 10, 11 - *Plesioptyxis yasinensis* n. sp. Sezioni assiali della porzione adapicale dell'olotipo. × 1,5. (V. Tav. 42, figg. 5, 6).

Forma subcilindrica turricolata, con angolo spirale di 5°, multispirale, con più di 8 giri bassi, separati da suture lineari oblique, situate sulla parte abapicale del cingolo suturale, con una pendenza suturale di circa 18°. Giri crescenti molto lentamente ed uniformemente in altezza ed in diametro, più larghi che alti, con rapporto altezza/diametro uguale in media a 0,43. Giri concavi nella parte submediana, con concavità spostata un poco abapicalmente, più convessi nella porzione adapicale che in quella abapicale.

Ornamenti esterni uniformi su tutta la spira, costituiti da un cingolo sutu-

rale abapicale tubercolato e da 4 corde spirali secondarie. Cingolo suturale abapicale piccolo e poco marcato, portante in mezzo giro una dozzina circa di tubercoli piccoli, bassi ed ottusi. Le 4 corde spirali secondarie granulose sono distribuite più o meno regolarmente; di esse quelle che percorrono la parte mediana del giro sono più marcate delle altre.

Nella sezione assiale si vede una columella stretta (circa 1/8 del diametro del giro) e pieghe interne numerose ed elaborate (figg. 10, 11), di cui le principali sono: due pieghe columellari (1, 2), una piega parietale adassiale (3) ed una piega palatale abapicale (6); le altre tre pieghe (parietale adapicale (4), palatale adapicale (5), basale (7)) sono solo debolmente sviluppate.

Piega columellare abapicale grossa e assai prolungata in direzione abassiale, occupando più della metà del semidiametro (4/7), formante un angolo di circa 45° con l'asse della conchiglia. Piega columellare secondaria adapicale assai meno marcata della prima, spostata a poco più di metà altezza del giro nella regione adapicale; occupa la metà del semidiametro e determina due lobi columellari subeguali. Piega parietale adassiale più estesa delle precedenti (4/5 del semidiametro), uncinata verso l'apice. Piega palatale abapicale situata nel terzo abapicale dell'altezza del giro, sul prolungamento della piega columellare abapicale, da cui è separata da una stretta cavità. Essa determina con la piega basale un lobo assai pronunciato. Le altre tre pieghe sono, come abbiamo già detto, appena accennate.

Dimensioni:

	Olotipo	Paratipo I
altezza totale	mm 88 (?);	88 (?)
altezza giro adulto	mm 11,5 ;	11,2
diametro dello stesso	mm 26,2 ;	25,5
angolo spirale	5° ;	5°

Rapporti e differenze — A proposito di questa specie si possono fare osservazioni analoghe a quelle già fornite per *Plesioptyxis desioi*, con la quale si riscontrano le maggiori affinità. Le differenze tra le due specie consistono soprattutto nel fatto che *Pl. desioi* ha angolo spirale più ampio, giri più incavati e più alti, con rapporto altezza/diametro uguale in media a 0,65, cingolo suturale più grosso e più sporgente, 3 sole corde spirali secondarie, pendenza suturale minore.

Per quanto riguarda le altre forme affini si devono citare anche per *Pl. yasinensis* le specie già ricordate per *Pl. desioi*. *Nerinea prefleuriaui* Delpey

ha proporzioni nettamente inferiori, angolo spirale assai maggiore, giri molto più concavi, cingolo suturale nettamente più sporgente, strie spirali solo sui giri giovani; inoltre è provvista di ombelico.

Nerinea (*Diozoptyxis*) *prefleuriaui rengarteni* Benkö-Czabalay si distingue per la presenza di ombelico, per diverso rapporto tra altezza e diametro dei giri (0,24 invece di 0,43), per la piega columellare abapicale più sottile e più prolungata, per la piega parietale adassiale meno grossa e meno uncinata verso l'apice.

Nerinea (*Diozoptyxis*) *baconica* Benkö-Czabalay si differenzia per la diversa forma della conchiglia, per i lati dei giri lisci, per diverso rapporto altezza/diametro dei giri stessi (= 0,38), per la presenza di un ampio ombelico e per la struttura meno elaborata delle pieghe interne. La piega columellare abapicale è più lunga e sottile, quella secondaria appena segnata; la piega parietale adassiale è meno robusta, inclinata verso la base e non uncinata verso l'apice; la piega labiale abapicale è più angolosa. Per tutte queste considerazioni la cavità interna dei giri appare più grande e meno tormentata.

Nerinea preolisiponensis Delpey ha angolo spirale assai più ampio, giri molto più incavati, però con rapporto altezza/diametro abbastanza corrispondente, cingolo suturale molto più sporgente, lati dei giri lisci, pieghe interne in numero inferiore (4 invece di 7) e meno pronunciate.

Nerinea (*Diozoptyxis*) sp. ind. Andelkovic ha dimensioni maggiori, angolo spirale più ampio, giri più concavi, pieghe interne meno marcate.

Tra le specie segnalate da Pčelincev (1954) si nota qualche somiglianza con *Plesioptyxis grandis* del Coniaciano inferiore del Caucaso (p. 88, tav. IV, figg. 2 a-b; figg. 23-24 nel testo), nella conchiglia grande, subcilindrica, e nella struttura delle pieghe interne. La specie di Pčelincev si differenzia però per la maggior ampiezza dell'angolo spirale (12°), per le proporzioni dei giri (altezza uguale a circa metà diametro) e per la loro maggiore concavità, per il cingolo suturale più sporgente e per la mancanza di altri ornamenti; infine per la presenza di uno stretto ombelico.

Per quanto riguarda poi *Ptygmatis* n. sp. Brunnschweiler (1956) si rimanda a quanto già riferito a p. 265 a proposito di *Pl. desioi.*

Dai vari confronti risulta chiaramente che si tratta di una specie nuova per la scienza.

Derivazione del nome — Il nome specifico *yasinensis* è un aggettivo tratto dalla località di provenienza Yasin.

Olotipo — Raccolto dal prof. A. Desio in data 1/9/1955 e depositato presso l'Istituto di Paleontologia dell'Università di Milano. N. inv. P 1782.

Età — Aptiano superiore.

Località — Selletta ad ovest della Rest House di Yasin (Pakistan nord-occidentale) (55 PD - 112).

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