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THE EPICONTINENTAL TRIASSIC CHAROPHYTES OF POLAND

Ramienice triasu epikontynentalnego Polski

ABSTRACT. 52 species (including 4 new ones) representing eight genera and four subfamilies of the family *Porocharaceae* were found in sediments of the Epicontinental Triassic of Poland. The paper deals with a critical analysis of the fundaments of the binding classification and the diagnostical features of the subfamily, genus, and species categories. It advocates the necessity of elimination of erroneous, ambiguous, or useless denominations contained in previous diagnoses. Phylogenetic consanguinities of subfamilies and genera have been determined basing on the morphological variation of the apical pole and the stratigraphic ranges of the genera. The Carboniferous and Permian were the period of an early development of *Porocharaceae,* and intensive development of the group occurring on the turn of the Permian and Triassic. In the Triassic period three phases of development can be distinguished; in the end of the period most of *Porocharaceae* died out, and the next phase of the development of this flora was the Jurassic period. Taking into consideration the existing divisions a biostratigraphic scheme was drawn, comprising five charophyte partial range zones (*Vladimiriella globosa* Zone, *Porochara triassica* Zone, *Stellatochara dnjeproviformis* Zone, *Stellatochara hoellvicensis* Zone, *Stellatochara thuringica* Zone), and one range zone (*Auerbachichara rhaetica* Zone). The most important factors, limiting the Triassic charophyte vegetation, are listed as follows: depth, salinity, the content of iron compounds and calcium carbonate, and redox potential. The charophyte assemblages characterized by a quantitative predominance of representatives of some genera (the *Porochara* and *Vladimiriella* assemblage, *Porochara* and *Stenochara* assemblage, *Stenochara* and *Stellatochara* assemblage, *Stellatochara* assemblage, *Auerbachichara* assemblage) have been distinguished, and their connection with particular environmental conditions has been determined. The pattern of the distribution of the assemblages in the Polish part of the Central European Basin was drawn pointing out similarities of the charophyte development in other Triassic continental basins of Laurasia. Charophytes were proved to be useful for purposes of both correlation and paleogeographic reconstructions of the Triassic continental basins.

CONTENTS

INTRODUCTION

Charophytes occur numerously in the sediments of the Epicontinental Triassic of Poland, and are an important group for stratigraphy, correlation and reconstruction of the environmental conditions of the sediments of the period. These are thus the reasons why the interesting microfossils have become the subject of the present summarizing paper.

The earliest data on the Triassic charophytes come from the second half of the previous century. Schimper (1869) recorded them from the Triassic sediments of the vicinity of Moscow (Groves 1924 observed, that the source of the information seemed vague), and Auerbakh (1871) gave the first description of a species from the sediments of the period. Pia (1924) recorded the occurrence of charophytes in the Triassic sediments, his records being based on the notes (Schimper & Schenk 1879; Solms-Laubach 1887; Hauptfleisch 1897) considering the occurrence of *Spirangium* in the Buntsandstein and Keuper. Charophytes were also recorded from the sediments, being in that time erroneously regarded as Triassic ones (Leriche 1928; Peck 1934).

In the following years gyrogonites were found in the Lower Triassic of East Prussia — now the Kaliningrad district, USSR (Krause 1939) and in the Middle Triassic of Sweden (Brotzen 1950). Horn af Rantzien (1953, 1954) studied the gyrogonites of the Höllviken profile (Scania) and his results are very important for the knowledge of the Triassic charophyte flora. In his monograph Horn af Rantzien presented the descriptions of five genera and eleven species, inviting attention to the stratigraphic meaning of these microfossils.

Demin (1956) described two species from the Lower Triassic of the Ukraine, while Saidakovsky (1960, 1962, 1966a, 1966b, 1967) completed his complex studies on the charophytes of the Upper Permian and Triassic of the southern part of the East European Platform. The latter author presented the descriptions of new genera and species, and distinguished seven biostratigraphic zones, basing on the differentiation of the charophyte assemblages. In his following papers he dealt with the descriptions of other genera and species from the Triassic of the Caspian depression, GDR, and Bulgaria (Saidakovsky 1968, 1971a).

The descriptions of new species from the Triassic of the Caspian depression presented Kisielevsky (1967, 1969b, 1969e). He gave also a biostratigraphic division of the Triassic of the Caspian depression, basing on the differentiation of the charophyte flora (Kisielevsky 1969a), and determined gyrogonites in thin sections (Kisielevsky 1969c).

Charophytes were also found in the Triassic sediments of GDR. Reinhardt (1963) described gyrogonites from the Lower Keuper, while Kozur and Reinhardt (1969) gave the descriptions of species from the Muschelkalk and the Lower Keuper. Considering the occurrence of numerous synonyms and uncorrectnesses in the determination of the ranges of taxons, Kozur (1971b, 1973) advocated the necessity of a taxonomical revision of the Triassic gyrogonites. Then he presented lists of the species of the particular intervals of the profile of the Triassic of GDR, and distinguished five charophyte zones in the Middle Triassic (Kozur 1974b, 1975).

Other two species of the Triassic charophytes of the Caspian depression were described by Kisielevsky and Aleshina (1979), whereas Kisielevsky (1984) presented a biostratigraphic division of the Triassic of the western part of Kazakhstan (Mangyshlak, Ustiurt), basing on the newest charophyte division of the Triassic of the East European Platform presented by Saidakovsky and Kisielevsky (1985).

Gyrogonites were found also in the Triassic sediments of other regions of Laurasia. Peck and Eyer (1963) described a species from the Lower Triassic of the USA (Arizona, Colorado), while Wang Zhen and Huang Ren-jin (1978), Huang Ren-jin (1983), and Lu Hui-nan and Luo Qi-xin (1984) described a number of species from the Triassic of China.

In the epicontinental facies of the Triassic of Poland there are the sediment complexes lacking macrofauna. These deposits, created partly in freshwater and brackish basins, contain numerous microfossils, but mainly ostracods, mio- and megaspores, and charophytes. The microfossils are essential for determination of the stratigraphy and correlation of the Triassic sediments. Bilan (1969, 1974) described thirteen species, including three new ones from the Upper Triassic of the eastern margin of the Upper Silesian Coal Basin, and found the range differentiation of the particular species in the studied profiles (Bilan 1976a).

Facing the existing vaguenesses of the nomenclature, doubts concerning the individualism of some taxons, and views questioning the bases of the binding classification, the present paper deals with a critical evaluation of the bases of the taxonomy of the Triassic charophytes and the diagnostical characters of the particular taxonomical categories. Particular note has been taken of ambiguous determinations contained in the previous descriptions of various categories, as well as of useless denominations, unnecessarily extending descriptions and diagnoses. The occurrence of 52 species (including 4 new ones) from eight genera and four subfamilies of the family *Porocharaceae* have been found in the epicontinental sediments of the Triassic of Poland. The ranges of the genera described so far have been listed, and an attempt at interpretation of the phylogeny of the family in the Triassic period have been made. In relation to the so far proposed divisions a biostratigraphic scheme of the epicontinental Triassic of Poland has been drawn basing on charophytes. In the interval comprising the Middle Buntsandstein — Lower Rhaetic five partial range zones and one range zone have been distinguished. The most important factors limiting the charophyte vegetatation in the epicontinental basin of the Triassic have been mentioned, and the relation of the distinguished charophyte associations with their environment, has been determined as well as their distribution. Similar tendencies in development of the charophyte flora have been observed in extensive regions of Laurasia.

The author is much indebted to Prof. dr. S. W. Alexandrowicz, who have read and criticized the manuscript, for his invaluable remarks and discussion. Special thanks would be given to Doc. dr. H. Senkowiczowa, who has been extraordinarily generous in passing samples of numerous borings and in determining of their stratigraphy, as well as to Dr. O. Styk and Doc. dr. S. Kotlicki for allowing the author to make use of their borehole materials. Finally the author would record his thanks to Prof. dr. J. Małecki, for the photographs, and to Mrs. M. Kuśmierek for drawing of the figures.

MATERIAL

The study of the Triassic charophytes has been written basing on the material coming from more than 80 borings. A majority of the analysed material comes from boreholes situated at the margin of the Upper Silesian Coal Basin, a number of samples come from drillings made in the NE and SW part of the country, whereas rather unnumerous ones come from the central and NW part of Poland (Fig. 1). Gyrogonites have been found in the following numbers of samples: Buntsandstein — 34, Muschelkalk — 15, Keuper — 165, Rhaetic — 224.

In the samples of the Middle Buntsandstein numerous gyrogonites have been found, though the specimens from these sediments sometimes are poorly preserved due to deformations caused by compaction of sediment or tectonization of rock. Gyrogonites of the Upper Buntsandstein and Muschelkalk have been numerous and usually well-preserved. A rich material of charophytes comprising thousands of specimens, have appeared in rather few samples of these sediments. An especially numerous occurrence of gyrogonites have been noticed in the sediments of the Upper Triassic. In the samples of the Keuper and Rhaetic a considerable differentiation of number of specimens have been observed, the specimens being usually well-preserved. In most cases gyrogonites have been uniform as for their state of preservation, but in some samples coming mainly

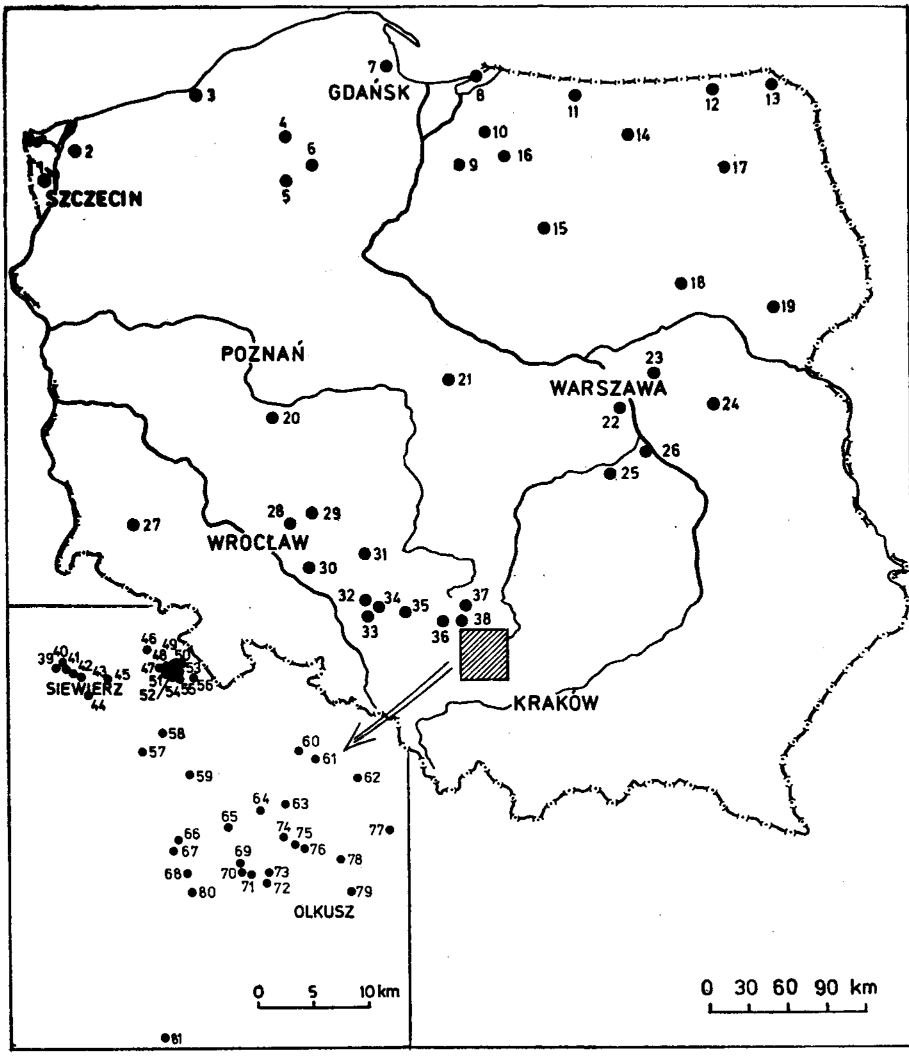


Fig. 1. Localization of borings from which samples with charophytes were taken: 1 — Trzebież 3, 2 — Człuchów IG-2, 3 — Jamno 3, 4 — Brda 7, 5 — Debrzno IG-1, 6 — Klosnowo IG-1, 7 — Sopot IG-1, 8 — Krynica Morska IG-1, 9 — Prabuty IG-1, 10 — Pasłęk IG-1, 11 — Bartoszyce IG-1, 12 — Gołdap IG-1, 13 — Udryń IG-1, 14 — Kętrzyn IG-1, 15 — Nidzica IG-1, 16 — Olsztyn IG-2, 17 — Ełk IG-1, 18 — Ostrów Mazowiecka IG-1, 19 — Brańsk IG-1, 20 — Książ IG-2, 21 — Krośniewice IG-1, 22 — Warszawa IG-1, 23 — Okuniew IG-1, 24 — Żebrak IG-1, 25 — Białobrzegi IG-1, 26 — Magnuszew IG-1, 27 — U-107, 28 — Drołtowice 1, 29 — Szymonków IG-1, 30 — Wężowice IG-1, 31 — Wołczyn IG-1, 32 — Krasiejów V-6, 33 — Krasiejów I-8, 34 — Krasiejów V-8, 35 — Lubliniec IG-1, 36 — CW-62, 37 — Poraj 666, 38 — 24-Za, 39 — SP-63, 40 — SP-62, 41 — SP-67, 42 — SP-71, 43 — SP-83, 44 — SP-115, 45 — 16-Za, 46 — ZK 9—2, 47 — ZL 7—3, 48 — ZŁ 6—21, 49 — ZŁ 7—14, 50 — ZN 7—8, 51 — ZŁ 6—20, 52 — ZŁ 6—10, 53 — ZM 6—6, 54 — ZŁ 6—4, 55 — ZM 6—9, 56 — ZN 6—5, 57 — 96TN, 58 — 11TN, 59 — WB-11, 60 — BJ-82, 61 — BJ-65, 62 — BJ-76, 63 — BK-148, 64 — BB-24, 65 — BB-53, 66 — BL-180, 67 — BL-142, 68 — BL-162, 69 — BPH-142, 70 — BPH-141, 71 — B-501, 72 — B-480, 73 — B-439, 74 — BK-93, 75 — WB-146, 76 — BJ-58, 77 — WB-95, 78 — BJ-45, 79 — WB-66, 80 — BKR — 32, 81 — LIX Siersza

from the Rhaetic, specimens have shown differences in colour, state of preservation and distinctness of particular elements of morphology. It is probable that (at least in part) these microfossils occur on a secondary deposit.

To characterize the inner structure of the studied gyrogonites numerous longitudinal sections of gyrogonites have been made, but in most cases such sections are poorly discernible due to fossilization.

BASES OF CLASSIFICATION OF THE TRIASSIC GYROGONITES

Among the earlier described Triassic taxons of various rank there are synonyms; yet diagnoses of some genera and subfamilies contain erroneous, ambiguous, and useless determinations. Another fact causing vaguenesses in nomenclature is, that some authors, creating new taxons of various categories, do not take the earlier published diagnoses into consideration. This situation seems to necessitate both unification of the criteria distinguishing the taxons of various rank and adjustment of classification. The taxonomical characters of the supergenus, genus, and species levels are presented below. In the chapter on paleontology the diagnosis of a new subfamily is presented, along with the descriptions of new species (out of all the 52 identified ones), new combinations, the species having synonyms and those having been unpublished by the author, and finally the index species of the zones defined in the chapter titled: "A biostratigraphic subdivision of the Epicontinental Triassic of Poland".

Taxonomical characters of the supergenus categories

The generative organs of the *Charophyta* are characterized by a rather considerable uniformity, whereas the vegetative parts, in spite of the uniform plan of their organization, are markedly differentiated in morphology. The systematics of the recent forms is based upon the features of the vegetative organs. The oogonia of the contemporary charophytes show only two types of structure, allowing two groups of genera to be distinguished, having either a five-cell or a ten-cell (two rows of cells) coronula (Dąmbska 1964). The antheridia of the recent forms show a distinct monotypic character and are of little value in systematics. Hence, the features of the generative organs of the recent charophytes are only superficialy considered by present taxonomists. Since the fossil charophytes are known almost entirely by their fossil oospore envelopes (gyrogonites, utricles), the taxonomy of the fossil forms and that of the recent forms are based upon different criteria.

The studies of Horn af Rantzien (1956a, 1959c) showed that che classification of the recent forms may be based on the oospores and their calcareous envelopes too, but the taxonomical categories distinguished according to such criteria should be recognized (also in respect of the fossil taxons) as morphological types: organ-genera and organ-species. This does not concern the cases when the fossil generative organs are directly connected with vegetative parts (e. g. *Lagynophora* Stache 1889; *Clavator* Harris 1939; *Chara sausari* Sahni & Rao 1943). In the classification of the fossil charophytes the categories of the subspecies, species, genus, subfamily, family, order, and other ranks are distinguished, the so far systems being based on various criteria. Defining the supergenus taxonomical categories the following characters are being considered now: direction of the cell coiling, number of cells, type of the calcareous envelope (gyrogonite, utricle), and morphology of the gyrogonite summit.

In some cases diagnoses of the supergenus categories are elaborated in an inconsistent way. This results from the fact that various taxonomical characters are regarded as diagnostically useful at the subfamily level. In some diagnoses of subfamilies useless determinations are found, unnecessarily extending the contents of the diagnoses. For instance, in the diagnosis of the subfamily *Maslovicharoideae* (Saidakovsky 1966a, p. 114) the diagnostical features belonging to the taxonomical categories higher than the subfamily category and contained in the definitions of the family and order, are determined. This concerns such features as: the lacking utricle, the presence of five sinistrorse spirals, and the occurrence of the apical opening. These features are mentioned together with the morphology of the summit (the presence of an elongated apical neck having a big pentagonal or angular opening in the centre of the apical zone), the latter character being the only one of the subfamily level. In the diagnosis of the subfamily *Stomocharoideae* (Saidakovsky 1968, p. 101) besides the mentioned useless determinations, the only one diagnostical character of the taxon is to be the shape of the apical opening, whereas the morphology of the summit is not described.

Some authors believed in a considerable meaning of the morphology of the apical opening. Basing on the form of the apical opening Mädler (1952) distinguished the subfamily *Aclistocharoideae.* Since Grambast (1956b) described the process of germination of the oospore, leading to disruption of a membrane at the summit and to detachment of the operculum, leaving a circular opening, there are no bases for distinguishing of taxons using the form of the apical opening, formed as a result of the oospore germination (Maslov 1963). Within some taxons of the Triassic gyrogonites a considerable variability of the diameter of the apical opening is apparent, covering the shape of the opening, and partly the morphology of the summit. One cannot exclude that the variability may be in some cases also an effect of the oospore germination.

Taxonomical characters of the genus category

The diagnoses of the Triassic genera comprise determinations of the shape of gyrogonites, a characteristic of the spiral (a constant or variable inclination of the spiral from the equator to the poles, the shape of the spirals surface, the possible presence of ridges and sutures at the junctions of the spiral), the morphology of the summit (the shape of the apical pole, the pattern of the spiral at the summit, the size and shape of the apical opening) and base (the shape of the basal pole, the size and shape of the basal opening).

The analysis of the organ-genera of the Triassic charophytes allows to conclude that designations of shape are usually little precise, and specimens of various shape may be found within most of the genera. The determinations used are sometimes contradictory, for instance in the diagnosis of the genus *Stenochara* Grambast, Saidakovsky (1966a, p. 126) wrote: "the apical and basal poles project forming a cone or are slightly obtuse", and: "the basal pole rounded or slightly protruded".

In the same paper, among comparisons, there is a statement that "the genus *Stenochara* approximates mainly to the genus *Cuneatochara*, from which it differs only in its form of a symmetrical spindle with evenly protruded poles, whereas in the genus *Cuneatochara* only the apical pole is protruded, being besides sharper and higher". On the other hand, the descriptions of some species contain the determinations that cannot be covered by the so formulated diagnosis. For instance, from the description of *Stenochara donetziana* (Saidakovsky) it is clear, that the gyrogonites of this species are asymmetrical (cf. Saidakovsky 1966a, p. 128); in the description of *Stenochara schaikini* Saidakovsky there is a statement, that "the gyrogonites are egg-shaped, with a sharply-oval summit and a broadly-oval base" (Saidakovsky 1966a, p. 129), and in the description of *Stenochara rantzieni* Saidakovsky it is stated: "the gyrogonites egg-shaped, having a sharply-oval slightly conical summit and a broadly-oval base" (Saidakovsky 1968, p. 106).

Comparing the descriptions of the morphology of the basal pole of the organ-species of the Triassic charophytes, a considerable variability of shape can be observed within a majority of the genera, the basal opening being small in most of the genera, the shape of the basal opening designated as pentagonal, or not described at all.

The calcareous envelope of the oospore — the gyrogonite, consists of spirally coiled cells, named "spirals" by Maslov (1963). The character and ornamentation of the surface of the spirals belonged to the key features of the earlier classifications. Comparisons of various types of the structure of the spirals presented a. o. Groves (1920), Mädler (1955), and Demin (1967). The surface of the spirals exhibits sometimes the ornamentation developed in the form of bosses and knobs of various type (characteristic of some representatives of the families *Raskyellaceae* Grambast and *Characeae* Agardh). This ornamentation was even regarded as useful for taxonomy (subfamily *Kosmogyreae* Stache 1889), though Peck and Reker (1947, 1948) and Grambast (1957) showed, that the ornamentation of the spirals appears independently on other morphological characters in some particular environmental conditions and cannot be acknowledged a taxonomical character.

The calcareous spirals of most of the Triassic species show a constant inclination; only the gyrogonites of the organ-genus *Cuneatochara* Saidakovsky 1962 = *Clavatorites* Horn af Rantzien 1954 (Kozur 1973) are characterized by a gradually increasing angle of inclination of the spirals from the equator to the poles. In most cases the spirals are concave or flat, only in *Altochara* Saidakovsky and in few species of the other genera the spirals have a convex surface. In the diagnosis of *Auerbachichara* Kisielevsky & Saidakovsky (Saidakovsky 1968, p. 102) there is a statement, that the spirals at junctions form wide and flat ridges having a well-preserved secondary suture, but this character show also the species of other organ-genera (e. g. *Maslovichara compacta* Saidakovsky and *Porochara urusovi* Saidakovsky), while not all the species of the genus *Auerbachichara* exhibit it fully. Kisielevsky (1967, p. 38) in the description of *Auerbachichara saidakovskyi*, being the type species of the genus, recorded that "the primary suture is well developed, and in a part of the gyrogonites also the secondary suture is marked". Similar determinations are found in the descriptions of *Auerbachichara achtubiensis* Kisielevsky, *A. starozhilovae* Kis. and *A. baskuntschakiensis* Kis. (Kisielevsky 1967, pp. 38—41). However, in the description of *A. collacerata* Said. (Saidakovsky 1968, p. 103) there is a statement, that "at the junctions of the neighbouring spirals narrow and flat ridges occur".

In single cases some other determinations may be found, for instance in the diagnosis of the genus *Stenochara* Grambast (Saidakovsky 1966a, p. 126) there is a statement that "the spirals form neither hills nor bosses". In the light of the fact that no ornamentation of this kind has been recorded so far from a Triassic charophyte material, the latter statement should be regarded as superfluous. On the other hand, the definition of the genus *Vladimiriella* Saidakovsky contains the description of the inner structure of the gyrogonites (Saidakovsky 1971a, p. 120).

In this context only the diagnosis of the organ-genus *Latochara* Mädler, presented by Saidakovsky (1966a, p. 136), and containing a concise description of the structure of the summit, is (in spite of a superfluous determination: "the gyrogonites of various form and shape") a good, differentiating diagnosis.

Since each of the organ-genera described from the Triassic is distinct with its different morphology of the summit, the determinations of the other characters in the diagnoses of the genera being reproducible or often either ambiguous or incomparable, also in this case the morphology of the apical pole may be acknowledged the basic character of the genus level. This character is important also in definitions of the subfamilies, where it is limited only to determination of a general view of the summit, while in the descriptions of the organ-genera the structure of the apical pole is determined with more details, considering not only its shape but also the pattern of the spirals at the summit and the shape of the apical opening.

Taxonomical characters of the species category

Among a dozen or so commonly accepted characters of the species level, the size and shape of a gyrogonite are regarded as the most important. Since the features are being differently evaluated, or differently determined, their taxonomical value is discussed below.

Size

The dimensions of a gyrogonite are regarded as an important diagnostical character, and many comparisons were made between the fossile gyrogonites and the oospores of the recent charophytes. The opinion that the size of the generative organ increases with its maturation was very common. The gyrogonites of a small size, having the surface of the spirals flat or concave, were regarded as "young" or "immature" and it was acknowledged that size intervals in gyrogonites depend on stages of the oospore maturation.

Some studies showed that the calcareous envelope developes not earlier than after fertilization, in the fully mature oosporangium. Tongiorgi (1959) observed, that mature oospores may have the calcareous envelopes of different thickness, and size alterations of gyrogonites are connected with the size differentiation of the oospores and with a various thickness of the calcareous envelopes. He showed that the size of the oosporangium of a particular species varies in a relatively narrow range, and the intensity of calcification of the envelope varies with environmental conditions. Maslov (1966) considered that size alterations in gyrogonites depend on the local conditions of vegetation, the intensity of calcification, and the state of the preservation of the gyrogonites. That author was convinced that infraspecific size alterations of gyrogonites should not exceed a double maximum thickness of the calcareous envelope. Demin (1967), however, presented the opinion, that size may alter up to 35% within a species.

On the contrary, the studies on the recent charophyte flora showed a differentiated scale of the infraspecific variation. Besides the species of a relatively low variability, the other ones were described, showing a considerable variability of size and shape of the main stem, branches, branchlets, and spines, as well as variability of cortication and development of a whorl of stipules. Within the latter species some scores of forms were distinguished, the rank of the forms having been regarded by their authors as the subspecies, form, or variety. In most cases no detailed studies on variability of the generative organs were completed, but the alterations in size of the antheridia, oogonia, and oospores, mentioned in the descriptions of the species, allow to suppose that the scale of variability of their morphology differs in the particular species. The recorded alterations in length of the oospores are either considerable — for instance in *Tolypella glomerata* (Desvaux) : 200—380 μm, *Chara canescens* Laseleur: 360—625 μm, *Chara fragilis* Desvaux: 500—700 μm, *Chara tomentosa* L.: 800—1050 μm, or relatively small — for instance in *Nitella gracilis* (Smith): 225—270 μm, *Tolypella intricata* (Trentepohl): 320—400 μm, *Chara scoparia* Bauer: 500—550 μm. In the light of the fact that the range of the size variability of the oospores of a particular species is much narrower than the caused by environmental conditions variabity range of the size of the gyrogonites of the species, the above alterations suggest a possible different, in some cases a considerable, size variability of the gyrogonites of the fossil species. In this context the suggested by Maslov and Demin scale of the size alterations of the gyrogonites within a species may be regarded at most as probable.

The size of a gyrogonite is determined by means of measurment of its length and breadth, commonly adopting the symbols introduced by Horn af Rantzien (1956a): LPA — length of the polar axis of the gyrogonite, and LED — the equatorial diameter (Fig. 2). The length of the gyrogonite having the apical neck was designated by Kozur and Reinhardt (1969) as L; the symbol means the length of the polar axis of the gyrogonite together with its apical neck. The height of the apical neck comprises then the difference: L — LPA. The common

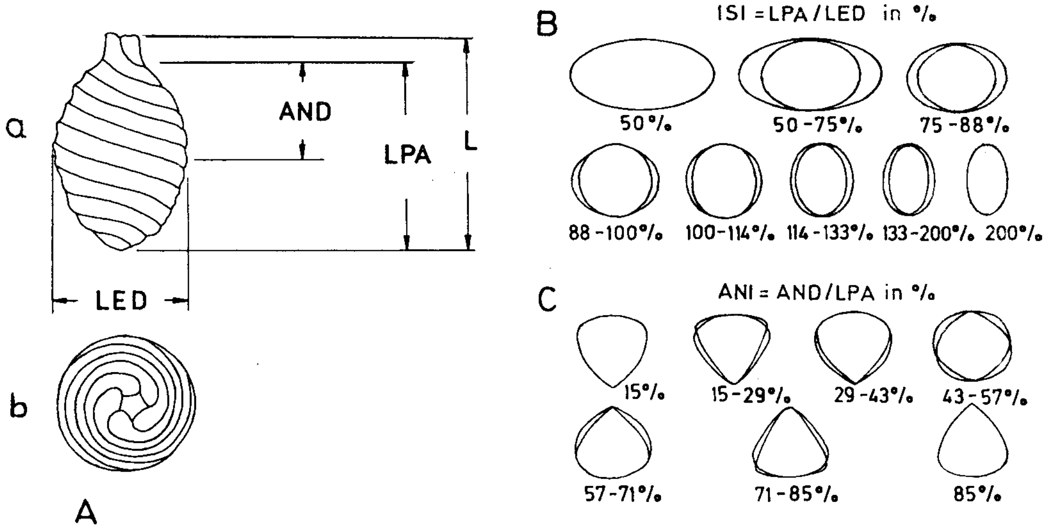


Fig. 2. Taxonomical parameters and shape of gyrogonites. A — gyrogonite, a — lateral view, b — apical view, B — shape of gyrogonites (after Peck & Morales 1966); terminology — see Table 1 and 2

designations: — big, of medium size, or — small, which are to precise the size of the specimens of a particular organ-species, seem useless since the determination of the gyrogonite size is contained in the description, and in a number of cases the variability range of the gyrogonite length may cover the smallest forms of the group of the "big" gyrogonites as well as the biggest ones out of those "of medium size", etc.

Shape

The shape of the gyrogonite, being determined in its lateral position, is very important for the taxonomy of the fossil charophytes. Various terms are used to designate it. In the recent years the determinations based on value of the indexes proposed by Horn af Rantzien (1956a) have been commonly used. The isopolarity index — ISI, means the proportion of the gyrogonite length (LPA) to its maximum diameter (LED), expressed in percentages:

$$ISI = \frac{LPA}{LED} \times 100(\%)$$

The anisopolarity index — ANI, means the proportion of the distance between the summit and the equator (AND) to the gyrogonite length (LPA), expressed in percentages:

$$ANI = \frac{AND}{LPA} \times 100(\%)$$

The particular ranges of the values of the indexes have the respective terminology precising the shape of the gyrogonites (Table 1 and 2).

Being conscious of difficulties in a precise determination of the location of the equatorial diameter of the gyrogonite, Maslov (1963, 1966) presented his critical remarks on the usefulness of the determinations of shape proposed by Horn af Rantzien. The previous author considered, that the length-breadth proportion is one of the most important characters of the shape of the gyrogonite, but this proportion does not determine the form, which may be various showing identical values of the index. Maslov suggested the use of the shape determinations

Table 1. Isopolarity index ISI= LPA /LED in % (See Fig. 2)

ISI (%)	Term
< 50	peroblate
50— 75	oblate
75— 88	suboblate
88—100	oblate spheroidal
100—114	prolate spheroidal
114—133	subprolate
133—200	prolate
> 200	perprolate

Table 2. Anisopolarity index ANI= AND/LPA in % (See Fig. 2)

ANI (%)	Term
< 15	perovoidal
15—29	ovoidal
29—43	subovoidal
43—57	ellipsoidal
57—71	subobovoidal
71—85	obovoidal
> 85	perobovoidal

according to a scheme comprising 10 types of forms, allowing the use of supplementary terms as: sub-, super-, widely-, etc., for the specimens of an intermediate form.

Demin (1967) considered that the forms of the gyrogonites may be approximated to geometric figures, and each form may be described using mathematical parameters. He proposed the use of the spirality index, expressing the proportion of the length of a gyrogonite to the breadth of the spiral, as well as of the index:

$$e = \frac{a^2—b^2}{a}$$

where: a — the length of a gyrogonite, b — the maximum breadth. To determine the shape of the gyrogonites having the apical neck Kozur and Reinhardt (1969) used the LDI index:

$$LDI = \frac{L}{LED} \times 100(\%)$$

where: L — the length of the polar axis of a gyrogonite together with its apical neck, LED — the maximum diameter.

The objections of Maslov as to the determination of the gyrogonite shape using the ISI and ANI indexes seem unjustified. On the other hand, it is useless to limit the variety of shapes of the gyrogonites to 10 basic types, since in many cases the gyrogonites of various shape may be found, differing from the typical forms. The use of such designations as; for instance: "slightly fusiform", "distinctly fusiform", or "broadly fusiform", also raises doubts. Unlike these subjective denominations, the terms used by Horn af Rantzien, basing on number relations, illustrate the shape of a gyrogonite in a particular respect, and objectively precise the values expressing so determined shape.

The shape determinations using the e index proposed by Demin (1967) do not implicate a particular nomenclature for particular values of the index. Moreover, in many cases the shape of a gyrogonite cannot be expressed in the form of ellipse but in the form of a combination of ellipse and circle, or of ellipse and polygons. For the above reasons this index seems useless.

For the shape determination of the studied gyrogonites the terminology of Horn af Rantzien (1956a) has been adopted, while for the determination of the quantitative diagnostical characters the following, earlier used symbols (Bilan 1974) have been accepted: NS — number of spirals visible in the lateral view of the gyrogonite, WS — width of the spirals at the equator, EA — equatorial angle, DA — diameter of the apical opening, and SPI — spirality ndex:

$$SPI = \frac{LPA}{WS} \times 100(\%)$$

Other specific characters

An important element of morphology is the number of spirals being visible laterally in a gyrogonite. This feature, in the Triassic charophytes being variable within a relatively wide range, is commonly acknowledged a specific parameter. In the descriptions of species authors commonly determine the number of spiral coils around a gyrogonite. It seems useless, since a slight variability of the character as well as approximate denominations that appear in the descriptions do not allow it to be a diagnostical parameter. Bilan (1974) observed that the number of the spiral coils around a gyrogonite results directly from the number of the spirals being visible laterally in the specimen (with a constant of 5 spirals in *Porocharaceae*). This character is thus superfluous, being a correlate of the other characters.

Besides the morphological characters of the gyrogonite that are commonly acknowledged the specific characters, determinations of the inner structure in thin sections appear in numerous elaborations. A characteristic laminar structure of the calcareous envelope was found in both the recent (Migula 1897; Horn af Rantzien 1959c) and fossil charophytes (a. o. Karpinsky 1906; Stepanov 1928; Maslov 1947; Croft 1952; Shaikin 1956, 1966; Karczewska & Ziembińska-Tworzydło 1972, 1981). The inner structure of the gyrogonite was in some cases considered a valuable diagnostical character at the genus level. Maslov (1966) acknowledged a great importance of the gyrogonite anatomy in the taxonomy of the fossil charophytes, but pointed out that analysing of the inner structure leads to paradoxes. If the inner structure in section is to be determined for the diagnosis of an organ-genus, the gyrogonite must be destroyed. Such a gyrogonite cannot be conserved as the holotype. If therefore a thin section is made of a specimen which is not the holotype, one cannot be sure whether the specimen of which the section has been made and the one determined as the holotype belong to the same genus or organ-species. Hence, only the outer characters of gyrogonites are acceptable as the diagnostical features, and description of the outer structure of the gyrogonite is fundamental (Maslov 1966).

In the descriptions of species some authors determine the colour of gyrogonites. In Triassic sediments white, grey, honey yellow, brown, and black gyrogonites may occur. Since in most cases the colours effect from the process of fossilization they should not be taken into consideration in the descriptions of species.

The question of the species distinctness raises many controversies expressed in the descriptions of both the fossil and recent charophytes. For many years authors have presented two opposite views, which according to Mayr (1969) may be determined as "splitting" and "lumping". "Splitters" tend to present each shade of difference and of a consanguinity level by the formal distinguishing of separate taxons and by placing the taxons in a complicated schedule, while the aim of "lumpers" is to express consanguinities in classification. Extreme "splitting" tendencies are marked in the elaboration of Migula (1897), while in the papers of Groves and Bullock-Webster (1920, 1924) and Wood and Imahori (1965) signs of "lumping" can be found. Gollerbach (1967) paid attention to errors of these controversial points of view.

In the taxonomy of the fossil charophytes the infraspecific variability is determined by the variability of particular characters, in different cases different key characters being considered in defining of a species. The basic species characters being adopted in most cases are as follows: size of the gyrogonite, its shape, number of spirals visible in the lateral view, from and diameter of the apical opening, situation of the equatorial diameter, pattern of spirals junctions at the summit, and form of the apical and basal poles. In the descriptions of species various variability ranges are being adopted for various characters. The other characters (form and diameter of the basal opening) are less important, or (like the breadth of the spiràl at the equator and in the apical and basal parts, shape of the spiral surface, occurrence of ridges and sutures) may be very important in case of particular taxons. To eliminate the extreme subjectivity in determining of the species distinctness it seems justified to compare the variability range of the characters of the defined organ-species with the variability amplitude of the same characters in the recent species. Usually in the descriptions of the recent charophytes only general characteristics of their oospores and gyrogonites can be found, although the recorded ranges of variability of their size and, in some cases, shape illustrate a possible scale of the infraspecific variability. In the present taxonomy of the fossil charophytes still more and more characters are being taken into consideration. In case of the species category the value of key characters as well as of the classification based upon single features, which for various reasons more than others attract attention of taxonomists, is going down. On the other hand, a number of characters mentioned in the diagnoses of subfamilies, genera, and some species, turns out a useless burden being oppressive for effectiveness of grouping.

A CRITICAL EVALUATION OF THE BASES OF THE TAXONOMICAL SYSTEM OF THE TRIASSIC GYROGONITES

In the recent 40-year period a considerable progress has been observed in the studies on the fossil charophytes. In this period a new classification and terminology as well as new methods of studies on the fossil charophytes were elaborated (a. o. Peck 1946, 1953; Maslov 1957, 1963; Horn af Rantzien 1951, 1956a, 1956b, 1959a, 1959b; Mädler 1952, 1953a, 1953b, 1955; Grambast & Grambast 1953; Grambast 1956b, 1962, 1963). The morphology of the summit of the gyrogonite was considered an important character in defining of the taxons of the subfamily level, what was in accordance with a common tendency in the taxonomy of the fossil charophytes of those years. In some authors' opinion the character is not equivalent in meaning. Some doubts have arisen also during the studies on the material coming from the Polish

Lowland. The analysis of the descriptions of the organ-species of the Triassic gyrogonites allows to find out that the state of preservation of the summit as well as a gradual passing of one structure into another are obstacles for a precise demarcation of particular taxons. Despite that the summit morphology is the decidable character of the subfamily and genus categories, it may alter in a rather narrow range within some organ-species. For instance, the specimens being similar in respect of size, shape, breadth of the spiral and its inclination to the equator, and morphology of the basal pole, are found to differ in shape of the apical projection. This is characteristic of specimens of *Stellatochara hóel-lvicensis* Horn af Rantzien (Pl. I, figs 1—4). Similar characters show specimens of *Stellatochara lipatovae* (Saidakovsky). The species comprises the specimens of three types of the summit: the "*Maslovichara* type" having the apical projection narrowed in its lower part and broadened calix-shaped in its upper part (Saidakovsky 1968; Pl. XV, figs 5, 6), the "*Stellatochara* type" having the projection in the form of a neck (Kozur & Reinhardt 1969; Pl. 1, fig. 5), and the "*Stenochara* type" having the apical projection in the shape of an obtuse cone (Kozur & Reinhardt 1969; Pl. 1, figs 6 and 7). Another example is the shape variability of the summit within *Stellatochara schneiderae* Saidakovsky. One out of the two specimens presented by Saidakovsky (1966a; Pl. 1, figs 14—16) is the holotype characterized by a neck-shaped projection, being typical of the organ—genus *Stellatochara* whereas the other one has the summit of the "*Stenochara* type".

Another kind of ambiguousnesses are observed studying specimens from the organ-genus *Auerbachichara* Kisielevsky & Saidakovsky. In a rich material coming from the Triassic of the Polish Lowland particular specimens show a various state of preservation of the distal ends of the spirals at the summit. In a number of cases the distal ends in the form of five isolated denticles are well--preserved, while in other cases there are only fragments of the denticles or no denticles are visible and the summit has the structure of the "*Porochara* type". A similar kind of variability was recorded from specimens being included to *Clavatorites* Horn af Rantzien, where specimens belonging to a particular species showed a various state of preservation of the summit. This may be developed in the form of a sharp point, or blunted in a various degree. The situation we deal with is then apparently paradoxical: a particular organ-species comprises the specimens whose summit may have characters of different genera. This leads to the conclusion that studies on the species distinctness are to base on a rich comparative material. Such studies should be not less important than those comprising analyses of geometrical characters.

According to Demin (1967) genera and organ-genera may be created only on the basis of thorough studies of the form of the gyrogonite and its variability range. He determined the shape of the oospores of the recent genera: *Nitella*, *Tolypella*, *Nitellopsis*, *Lamprothamnium*, and *Lychnothamnus*; after Wood (1959) he indicated that also the size of a gyrogonite may be a significant diagnostical character. Demin (1967) considered that the form of a gyrogonite reflects changes the oogonium went through in the process of evolution. However, not less suggestive seem the remarks of Maslov (1963) and Grambast (1974) on the evolutionary changes of the summit in the phylogeny of *Charophyta*. Refering to those views, it should be stressed that a considerable progress in elaboration of new bases of taxonomy and methods of studies is associated with the present stage of the studies on the fossil charophytes. In this stage the summit is considered an important taxonomical feature. The stage is characterized by the determinations of both the stratigraphic ranges of taxons and their role as indicators of environmental conditions. The stage is also distinct with the studies whose results show that the number of lineages in the phylogeny of *Charophyta* is much higher than it was assumed earlier, and open up future prospects of further studies. To neglect the taxonomical meaning of the shape of the apical pole would mean a sort of return to a stage from before forty years.

Summing up, it may be stated that in the light of the presented remarks, the present state of studies on the Triassic charophytes does not allow for a change of the rank of the basic diagnostical characters. Such a change would result in considerable alterations in the binding taxonomical system, what would be premature, since the presented arguments do not justify it clearly. Moreover, the studies focused on the development of the charophytes in the Triassic period and analysing the development must base on an existing taxonomical key, then should be referable to the present stage of taxonomy. A further progress in classification of the fossil charophytes needs not only detailed studies on morphology of gyrogonites, but also thorough studies of paleoecology and phylogeny of charophytes. Hence, the statement of Maslov (1963, p. 11): "we are in the stage of elaboration of not only the classification but also the terminology and methods of studies on charophytes which are not to be regarded as finally determined and will be still developing and changing", is still true, and refering to this statement one may add that the studies on the Triassic gyrogonites are still in the stage of the alpha taxonomy, in spite of some studies undertaken in the field of the beta and gamma taxonomy.

PALEONTOLOGICAL PART

Order *Charales*
Family *Porocharaceae* Grambast 1962
Subfamily ***Stellatocharoideae*** Grambast 1962

Remarks. Grambast (1962) included to the *Stellatocharoideae* the following genera: *Stellatochara* Horn af Rantzien, *Leonardosia* Sommer, and *Maslovichara* Saidakovsky. Saidakovsky (1966a) distinguished the subfamily *Maslovicharoideae*, to which he included *Stellatochara* and *Maslovichara*. The representatives of the *Stellatochara* have the apical projection in the form of a straight neck, while the genus *Maslovichara* is to be characterized by the apical neck being narrowed in its lower part and broadened at the summit with the spiral belled out. Kozur and Reinhardt (1969) regarded *Maslovicharoideae* Saidakovsky as a synonym of *Stellatocharoideae* Grambast. The distinctness of some species of the subfamily *Maslovicharoideae* raises doubts in many cases. Bilan and Krawczyk (1975) considering the problem of the quality of the distinctness and similarity of the species of the *Stellatochara* and *Maslovichara* found a distinct similarity between some species of the two genera. In the descriptions of the genus *Stellatochara* the apical opening is determined as big, whereas the representatives of the genus *Maslovichara* are to have a much smaller apical opening (Saidakovsky 1966a, p. 115). Kozur (1973) gave examples to indicate that the difference does not exist. He found that in most of the species of the genus *Maslovichara* there is a characteristically marked narrowness of the apical neck in its lower part and a bell of the spiral in the upper one. However, the feature may be also observed in some specimens of *Stellatochara sellingii* which is the type species of the genus *Stellatochara*. Kozur considered that the feature may occur in the mature forms having a sufficiently high neck. Despite that Kozur is generally right in his conclusions, it must be stressed that formation of the summit cannot be connected with the "mature stage" because the calcareous envelope (gyrogonite) developes after fertilization, in a quite mature oosporangium.

The analysis of the apical projection of the holotypes of the species of the genus *Maslovichara* shows that some of them exhibit the characters of *Stellatochara* (e. g. *Maslovichara incerta* Said., *M. rotunda* Said.). Besides *S. sellingii*, also specimens of other species may show a shape variability of the apical projection, covering the range from the summit of the "*Maslovichara* type" to the apical pole of the "*Stellatochara* type", the variability being continuous. Hence, there are no bases for distinguishing of both the genus *Maslovichara* and the subfamily *Maslovicharoideae*.

Organ-genus ***Stellatochara*** Horn af Rantzien 1954 emend.

1954 *Stellatochara* H. af R., n. g.; Horn af Rantzien, p. 26—33.
1960 *Stellatochara* Horn af Rantzien; Saidakovsky, p. 53.
1962 *Maslovichara* Saidakovsky, gen. nov.; Saidakovsky, p. 1143.
1966a *Stellatochara* Horn af Rantzien; Saidakovsky, p. 115—116.
1966a *Maslovichara* Saidakovsky; Saidakovsky, p. 121—122.
1973 *Stellatochara* Horn af Rantzien; Kozur, p. 25—26.
(Type species: *Stellatochara sellingii* Horn af Rantzien 1954, p. 33—41, Pl. I, figs 1—9, Pl. II, figs 1—7).

Diagnosis. Gyrogonites with spirals of a constant breadth, vertically bent at the summit forming a projection in the form of a neck, sometimes apically broadened and having a pentagonal, star-shaped or round opening.

Stellatochara hoellvicensis Horn af Rantzien 1954

Pl. I, figs 1—4

1954 *Stellatochara höllvicensis* H. af R., n. sp.; Horn af Rantzien, p. 44—47, Pl. IV, figs 1—3.
1960 *Stellatochara dnjeprovica* Saidakovsky sp. nov.; Saidakovsky, p. 53—54, Pl. I, fig. 1a, b.
1966a *Stellatochara hoellvicensis* Horn af Rantzien; Saidakovsky, p. 116—117, Pl. I, figs 1, 2.
1966a *Stellatochara dnjeprovica* Saidakovsky; Saidakovsky, p. 119, Pl. I, figs 7, 8.
1969 *Stellatochara hoellvicensis* Horn af Rantzien; Kozur & Reinhardt (partim), p. 371, 372, Pl. I, fig. 8.
1978 *Stellatochara hoellvicensis* Horn af Rantzien; Wang Zhen & Huang Ren-jin, Pl. I, figs 1—4.
1983 *Stellatochara hoellvicensis* Horn af Rantzien; Huang Ren-jin, Pl. I, figs 7—12.

Material. Over 100 well preserved specimens.

Description. Gyrogonites subprolate to prolate (ISI = 127—136, LDI = = 142—160), ellipsoidal (ANI = 47—53). L = 500—670 μm, LPA = 452—595 μm, LED = 348—457 μm. Maximum diameter of a gyrogonite in the middle of its length. Near the summit spirals bend allong the longitudinal axis forming the apical neck, being sometimes broadened in its upper part. Height of the apical neck: 48—104 μm. Apical opening pentagonal, its diameter: 35—75 μm. 9—12 concave or sometimes slightly concave, almost flat spirals visible in lateral view. Equatorial angle: 12—22°. Width of a spiral in the middle of a gyrogonite: 56—70 μm; SPI = 753—960. Interspiral ridges rather low, usually sharp, sutures inconspicuous. Basal pole rounded or conical. Basal opening small, pentagonal.

Comparison. *Stellatochara hoellvicensis* Horn af Rantzien differs from *S. lipatovae* (Saidakovsky) in size (being smaller than the latter one) and shape (lower ISI values); from *S. piriformis* Kozur and Reinhardt it differs in size (being smaller than that species) and shape of the base; from *S. kozuri* Bilan — in shape (higher ISI and LDI values) and in a smaller breadth of its spirals, from *S. thuringica* Kozur and Reinhardt — in shape (higher values of ISI and LDI) and in situation of the equatorial diameter.

Remarks. Saidakovsky (1966a) regarded the gyrogonites of *Stellatochara hoellvicensis* described by Horn af Rantzien (1954) as specimens of different species. However, Kozur and Reinhardt (1969) regarded *S. dnjeprovica* Said., *S. dnjeproviformis* Said., *Maslovichara incerta* Said., and *M. brevicula* Said. as synonyms of *S. hoellvicensis* H. af R. Bilan and Krawczyk (1975) found a distinct similarity of the holotypes of *S. hoellvicensis* and *S. dnjeprovica* on the one hand, and of *S. dnjeproviformis*, *M. incerta*, and *M. brevicula* on the other hand. Studies on the material coming from the Triassic of the Polish Lowland showed that *S. hoellvicensis* (together with the *S. dnjeprovica* synonym) differs from *S. dnjeproviformis* (and from *M. incerta* and *M. brevicula* being its synonyms) in size and in breadth of spirals (the previous species is bigger and has broader spirals). The differences are to a certain degree reflected in the description presented by Kozur and Reinhardt (1969), in which those authors characterize separately the two groups of specimens differing, among others, in size. A rich comparative material allows to suppose that both the specimens of *S. dnjeprovica* and the 540—570 μm long specimens described by Kozur and Reinhardt as *S. hoellvicensis* are of a rather small size. In the examined material besides of the specimens of a similar size, there were those, whose size was approximate to the size of the holotype, or larger ones, and independent on the variability recorded in the present descriptions a morphological variation of the summit was observable.

Occurrence. The species was described from the sediments determined as the Lower Keuper or Muschelkalk (Horn af Rantzien 1954) in the Höllviken II profile (Scania). It occurs also in a higher part of the Middle Triassic and in the Upper Triassic of the European part of the USSR (Saidakovsky 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), in the Middle Triassic of China (Huang Ren-jin 1983), and in the Uppest Anisian and Lower Ladinian of GDR (Kozur 1974c). In the Polish part of the epicontinental basin it occurs in the Upper Muschelkalk — Lower Rhaetic interval.

Stellatochara maedleri Horn af Rantzien 1954

Pl. I, fig. 6

1954 *Stellatochara mädleri* H. af R., n. sp.; Horn af Rantzien, p. 41—44, Pl. III, figs 1—5.
1962 *Stellatochara maedleriformis* Saidakovsky sp. nov.; Saidakovsky, Pl. I, fig. 13 (nomen nudum).
1966a *Stellatochara maedleri* Horn af Rantzien; Saidakovsky, p. 117—118, Pl. I, figs 3, 4.
1966a *Stellatochara maedleriformis* Saidakovsky; Saidakovsky, p. 121, Pl. I, figs 9, 10.
1969 *Stellatochara maedleri* Horn af Rantzien; Bilan, p. 437—439, fig. 3a, b.

Material. 71 gyrogonites

Description. Gyrogonites subprolate (ISI = 115—120, LDI = 127—144), ellipsoidal (ANI = 48—53). L = 280—382 μm, LPA = 258—342 μm, LED = = 220—291 μm. Maximum diameter in the middle of the gyrogonite length. Summit ended a rather low projection or a poorly marked apical neck whose height do not exceede 36 μm having a pentagonal apical opening 45—62 μm in diameter. 7—9 slightly concave, almost flat spirals are visible in lateral view. Equatorial angle 12—18°. Breadth of the spiral in the middle part of a gyrogonite 38—56 μm; SPI = 536—789. Interspiral ridges poorly marked, sutures indistinct. Basal pole rounded, having a small basal opening.

Comparison. *Stellatochara maedleri* H. af R. differs from the similar in size *S. donbassica* (Demin) and *S. schneiderae* Said., in its poorly marked apical neck and shape of the basis.

Remarks. Saidakovsky (1966a) considered that the *Stellatochara maedleriformis* Said. shows a great similarity to the *S. maedleri* H. af R. but differs from that species in the following characters: a lower value of the equatorial angle, a smaller size, broadly ovate form, and the apical projection almost completely lacking. Bilan and Krawczyk (1975) found a considerable similarity of the holotypes of both species. Comparing the variability ranges of the characters, that according to Saidakovsky (1966a) differ the two species, one can found that in the descriptions presented by that author the equatorial angle of *S. meadleri* alters within the 13—16° range, while that of *S. maedleriformis* — within the 10—16° interval; the difference is thus not significant. The variability ranges of the equatorial diameter are much overlapping, too. Unlike *S. maedleri* (ovate to broadly ovate), *S. maedleriformis* it to be distinct with its broadly ovate form. Such a shape difference seems not significant (the value of the LDI index of the specimen of *S. maedleri*, whose dimentions gave Saidakovsky, is 143, hence does not belong to the variability range determined by that author as 128—131). Summing up, the differences occurring between specimens of *S. maedleri* and those of *S. maedleriformis* may be regarded as a kind of infraspecific variability, moreover in the examined material there were some specimens bearing the characters of both forms.

Occurrence. The species was described from the sediments determined as the Lower Keuper or the Muschelkalk (Horn af Rantzien 1954) from Scania. It occurs also in the Lower and Middle Triassic of the European part of the USSR (Saidakovsky 1962, 1966a, 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), as well as in the Middle Triassic (the Uppermost Anisian and the Ladinian excluding the Uppermost Langobardian) of GDR (Kozur 1974c). In the Polish part of the epicontinental basin it occurs in the Middle Buntsandstein — Lower Rhaetic interval.

Stellatochara donbassica (Demin 1956) Saidakovsky 1966a

Pl. III, fig. 8

1956 *Chara donbassica* Demin sp. nov.; Demin, p. 56, Pl. I, figs 9—11.
1966a *Stellatochara donbassica* (Demin) Saidakovsky; Saidakovsky, p. 118, Pl. I, figs 5, 6.
1969 *Stellatochara donbassica* (Demin); Bilan, p. 439—441, fig. 4a, b.
1969 *Stellatochara donbassica* (Demin) Saidakovsky; Kozur & Reinhardt, p. 337.

Material. 81 gyrogonites.

Remarks. In the examined material the specimens corresponding to the description of the species occured along with the other ones (cf. Pl. III, fig. 8) differing from the holotype in shape (LDI = 132—140) and in the summit structure. The latter specimens have the apical neck of a similar height (in some cases slightly lower) but broader than the holotype.

Occurrence. The Middle Triassic of the European part of the USSR (Saidakovsky 1966a; Kisielevsky 1969a) and of Kazakhstan (Kisielevsky 1984), the Anisian and Lower Fassanian of GDR (Kozur 1974c) and the Röt — Lower Rhaetic of the Polish Lowland.

Stellatochara dnjeproviformis Saidakovsky 1966a

Pl. II, figs 3—5

1962 *Stellatochara dnjeproviformis* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 11 (nomen nudum).

1962 *Maslovichara incerta* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 5 (nomen nudum).
1966a *Stellatochara dnjeproviformis* Saidakovsky; Saidakovsky, p. 119, 120, Pl. I, figs 11—13.
1966a *Maslovichara incerta* Saidakovsky; Saidakovsky, p. 122, 123, Pl. II, figs 5, 6.
1968 *Maslovichara brevicula* Saidakovsky sp. nov.; Saidakovsky, p. 95, 96, Pl. 15, figs 1, 2.

Material. Over 450 well preserved specimens.

Description. Gyrogonites prolate (ISI = 140—152, LDI = 154—175) ellipsoidal (ANI = 18—52). L = 395—490 μm, LPA = 356—430 μm, LED = = 250—316 μm. Maximum breadth in the middle part of a gyrogonite. Near the summit spirals bend along the polar axis, forming the apical neck 38—70 μm high, with a pentagonal apical opening 40—75 μm in diameter. 9—13 concave, sometimes slightly concave almost flat spirals are visible in lateral view. Equatorial angle 12—17°. Breadth of the spiral in the middle part of a gyrogonite: 38—58 μm; SPI = 690—926. Interspiral ridges rather low, usually sharp, sutures inconspicuous. Basal pole rounded or in the form o a truncated cone. Basal opening small pentagonal.

Comparison. *Stellatochara dnjeproviformis* Said. differs from *S. bulgarica* Said. in a lower value of the equatorial angle, and from *S. gracilis* (Said.) in shape of the base and in situation of the equatorial diameter.

Remarks. Saidakovsky (1966a, p. 123) recorded that the *Maslovichara incerta* Said. is similar to the *Stellatochara dnjeproviformis* and as regards the specimens having the apical neck with a poorly marked narrowness it is difficult to determine to what genus they belong. According to that author the *M. incerta* differs from the *S. dnjeproviformis* in fissi-cellular spirals at the end of the apical projection, being narrower than in the latter species, and in a very small apical opening. Kozur and Reinhardt (1969) regarded *S. dnjeproviformis*, *M. incerta*, and *M. brevicula* as synonyms of *S. hoellvicensis* H. af R. Bilan and Krawczyk (1975) found a distinct similarity of the holotypes of *S. dnjeproviformis*, *M. incerta*, and *M. brevicula*. A comparison of the descriptions of the forms allows for the statement that they are different only in details of the summit structure and in dimension of the apical opening. Since the shape variation of the apical neck was found continuous in numerous species of the genus *Stellatochara* (the holotype of *M. incerta* has the apical neck being typical of the *Stellatochara*), among them also in the specimens included to *S. dnjeproviformis*, *M. incerta* and *M. brevicula* may be regarded as synonyms of *S. dnjeproviformis*. This species (together with its synonyms) differs from *S. hoellvicensis* in a smaller size and narrower spirals.

Variability of the *S. dnjeproviformis* is exhibited mainly in a varying number of laterally visible spirals and in the summit morphology. The apical neck may vary in height breadth, and shape (straight or broadened in the upper part). In the examined material two types of specimens were observed. One of them was characterized by a higher number (11—13) of narrower laterally visible spirals, while the other one — by a lower number (9—10) of broader laterally visible spirals. The specimens having the narrower spirals came from marly sediments, whereas those bearing the broader spirals were found in clayey sediments. Since some specimens were found showing intermediate characters, the recorded variability may be due to the ecophenotypic variation connected with the adaptation to habitats of various content of calcium carbonate.

Occurrence. The Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1968, 1973; Saidakovsky & Kisielevsky 1985), the Middle Triassic of Kazakhstan (Kisielevsky 1984; Lipatova et. al. 1984b) and of Bulgaria (Saidakovsky 1968), as well as the Anisian (excluding its uppermost part) of GDR (Kozur 1974c). In the Polish part of the epicontinental basin it occurs in the Röt — Lower Rhaetic interval.

Stellatochara schneiderae Saidakovsky 1966a

Pl. IV, fig. 2

1962 *Stellatochara schneiderae* Saidakovsky sp. nov.; Saidakovsky, Pl. I, fig. 12 (nomen nudum).
1966a *Stellatochara schneiderae* Saidakovsky; Saidakovsky, p. 120, Pl. I, figs 14—16.
1969 *Stellatochara schneiderae* Saidakovsky; Bilan, p. 441—442, Fig. 5a, b, c.

Material. More than 250 well preserved specimens.

Remarks. Specimens of this species, which unlike specimens of the other species of the genus *Stellatochara* of a similar size are distinct with their flat base, show a considerable variability of the summit morphology. The shape of the summit of the *S. schneiderae* alters from a relatively high apical neck to a rather low projection resembling the summit of the "*Stenochara* type" (cf. Saidakovsky 1966a, Pl. I, figs 14 and 16). Most of the parameters of the examined specimens were included in the variability ranges determined by the author of the species; only scarce specimens were longer (L reaches 420 μm) and have a higher number of laterally visible spirals (8—10).

Occurrence. The Lower — Upper Triassic of the European part of the USSR (Saidakovsky 1966a; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985), the Lower and Middle Triassic of Kazakhstan (Kisielevsky 1984), the Lower Triassic (Jakutian) of GDR (Kozur 1974c), and the Rot — Lower Rhaetic of the Polish part of the epicontinental basin.

Stellatochara gracilis (Saidakovsky 1962) n. comb.

Pl. I, fig. 5

1962 *Maslovichara gracilis* Saidakovsky sp. nov.; Saidakovsky, p. 1143, Pl. I, figs 1, 2.
1966a *Maslovichara gracilis* Saidakovsky; Saidakovsky, p. 122, Pl. II, figs 3, 4.
1969 *Maslovichara gracilis* Saidakovsky; Bilan, p. 437, Figs 2a—d.

Material. 54 well preserved specimens.

Description. Gyrogonites prolate (ISI = 134—138, LDI = 142—168) subovoidal (ANI = 37—42). L = 425—504 μm, LPA = 370—428 μm, LED =

= 260—362 μm. Maximum breadth slightly above the middle part of a gyrogonite. Near the summit spirals bend along the longitudinal axis forming the apical neck being straight or to a various degree broadened into a bell in its upper part. Height of the apical neck 50—88 μm. Apical opening in the shape of a pentagon, commonly irregular, 30—54 μm in diameter. 9—11 slightly concave, sometimes almost flat, spirals are visible in lateral view. Equatorial angle 14—18°. Breadth of the spiral in the middle part of a gyrogonite 45—58 μm; SPI = 812—986. Interspiral ridges rather low, sharp or slightly blunted. Basal pole conical. Basal opening small, pentagonal.

Comparison. *Stellatochara gracilis* (Saidakovsky) differs from the other species of the genus *Stellatochara* in shape of the base and in situation of the equatorial diameter.

Occurrence. The Middle Triassic of the European part of the USSR (Saidakovsky 1966a; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985), as well as the Röt — Lower Rhaetic of the Polish Lowland.

Stellatochara lipatovae (Saidakovsky 1968) Kozur & Reinhart 1969

Pl. II, figs 1, 2

1968. *Maslovichara lipatovae* Saidakovsky, sp. nov; Saidakovsky, p. 100—101, Pl. 15, figs 5, 6.
1969. *Stellatochara lipatovae* (Saidakovsky) n. comb.; Kozur & Reinhardt, p. 372—374, Pl. I, figs. 5, 6a—c, 7.

Material. 81 well preserved specimens.

Remarks. Saidakovsky (1968) determined the base of the gyrogonites of *M. lipatovae* as ovate, blunted. The specimens of *S. lipatovae* (Said.) presented by Kozur and Reinhardt (1969, Pl. I, figs 5—7) have the basal pole in the shape of a blunted cone. The apical pole of those specimens is of the "*Stellatochara* type" with a rather low apical projection (figs 6, 7). In the material from the Triassic of the Polish Lowland specimens of *S. lipatovae* show a slight shape variability of the summit, whereas the shape of their basal pole corresponds with the description given by Saidakovsky as well as with that given by Kozur and Reinhardt.

Occurrence. The upper part of the Middle Triassic — the Upper Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985), the Ladinian and Carnian of Bulgaria (Saidakovsky 1968), the upper Langobardian (excluding the uppermost part) of GDR (Kozur 1974c), the Röt — Lower Rhaetic of the Polish Lowland.

Stellatochara germanica Kozur & Reinhardt 1969

Pl. I, fig. 7

1969 *Stellatochara germanica* n. sp.; Kozur & Reinhardt, p. 374—376, Pl. I, figs 1, 2a, b, c.

Material. Over 100 well preserved specimens.

Remarks. In the diagnosis of *Stellatochara germanica* Kozur and Reinhardt the shape of the spirals surface is determined as slightly convex. The examined gyrogonites, whose parameters were contained within the variability ranges of the species, had in most cases the flat spirals. They are similar to the *Stellatochara bulgarica* Said., from which they differ in a lower value of their equatorial angle and in narrower spirals.

Occurrence. The Uppermost Anisian and the Ladinian of GDR (Kozur & Reinhardt 1969), the Anisian of the East European Platform (Saidakovsky & Kisielevsky 1985), the Röt — Lower Rhaetic of the Polish Lowland.

Stellatochara subsphaerica Kozur & Reinhardt 1969

Pl. IV, fig. 1

1969 *Stellatochara subsphaerica* n. sp.; Kozur & Reinhardt, p. 376, Pl. I, fig. 4a, b, c.

Material. 33 well preserved specimens.

Remarks. Besides the specimens closely corresponding with the description of the *S. subsphaerica*, the studied material comprised the ones with the basal pole in the form of a broad oval (then slightly different from the holotype) and a relatively low apical neck.

Occurrence. The Upper Fassanian — the Langobardian (excluding the uppermost part) of GDR (Kozur 1974c), as well as the Röt, Muschelkalk, and Lower Rhaetic of the Polish part of the Central European Basin.

Stellatochara piriformis Kozur & Reinhardt 1969

Pl. II, fig. 7

1969 *Stellatochara piriformis* n. sp.; Kozur & Reinhardt, p. 376, 377, Text-figs 2, 3.

Material. 16 well preserved specimens.

Occurrence. The Langobardian (excluding the uppermost part) of GDR (Kozur 1974c), the upper part of the Middle Triassic and the Upper Triassic of the East European Platform (Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), as well as the Röt — Schilfsandstein of the Polish Lowland.

Stellatochara thuringica Kozur & Reinhardt 1969

Pl. II, fig. 6

1969 *Stellatochara? thuringica* n. sp.; Kozur & Reinhardt, p. 377, 378, Pl. I, fig. 9a, b, c.

Material. Over 200 gyrogonites.

Description. Gyrogonites subprolate (ISI = 118—125, LDI = 130—142), ellipsoidal to subovoidal (ANI = 49—62). L = 428—526 μm, LPA = 385—468 μm, LED = 326—362 μm. Maximum breadth usually below the middle part of a gyrogonite. Near the summit spirals alter their direction and form a rather low projection or an apical neck, depending on how much they are bent along the longitudinal axis. Apical neck no more than 60 μm high. Apical opening in the shape of a star or pentagon, commonly irregular, 65—110 μm in diameter. 8—10 laterally visible concave, sometimes weakly concave almost flat spirals. Equatorial angle 14—20°. Breadth of the spiral in the middle part of a gyrogonite 60—78 μm; SPI = 558—652. Interspiral ridges rather low, usually slightly blunted. Basal pole oval to broadly oval. Basal opening small, pentagonal.

Comparison. *Stellatochara thuringica* Koz. and Reinh. differs from *S. hoellvicensis* H. af R. in shape (lower values of ISI and LDI) and in situation of the equatorial diameter; it is smaller than *S. kozuri* Bilan; it differs from *S. silesiana* n. sp. in shape and in a greater diameter of the apical opening.

Occurrence. The Langobardian (excluding the uppermost part) of GDR (Kozur 1974c), the upper part of the Middle Triassic and the Upper Triassic of the East European Platform (Saidakovsky & Kisielevsky 1985), as well as the Keuper and Lower Rhaetic of the Polish Lowland.

Stellatochara kozuri Bilan 1974

Pl. III, fig. 1

1974 *Stellatochara kozuri* n. sp.; Bilan, p. 485, 486, Pl. I, figs 1, 2, Text-fig. 2a, b, c.

Material. 54 gyrogonites.

Occurrence. Poland (the Upper Keuper, the Lower Rhaetic).

Stellatochara pomerana n. sp.

Pl. III, figs 2—4, Pl. XII, fig. 1

Holotype. ZPAL. Ch 7—637,8/60; Pl. III, fig. 2a, b.

Type Locality. The Sopot IG-1 boring.

Type horizon. The Upper Muschelkalk.

Derivation of the name. Pomerana — from Pomerania.

Diagnosis. Gyrogonites subprolate and ellipsoidal with a neck-shaped summit and conical base. 9—11 laterally visible concave spirals with rather low but sharp interspiral ridges.

Material. Over 150 well preserved specimens.

Description. Gyrogonites subprolate (ISI = 115—132, LDT = 138—149), ellipsoidal (ANI = 45—51). L = 377—467 μm, LPA = 327—415 μm, LED = = 268—327 μm. Maximum diameter in the middle part of a gyrogonite. Near the summit spirals bend along the longitudinal axis forming the apical neck 39—66 μm high, having a pentagonal apical opening 40—52 μm in diameter. 9—11 concave spirals are visible laterally. Equatorial angle 10—16°. Breadth of the spiral in the middle part of a gyrogonite 38—54 μm; SPI = 670—967. Interspiral ridges rather low but sharp, sutures inconspicuous. Basal pole conical. Basal opening small, pentagonal. In the longitudinal section the about 40 μm thick spirals consist of two calcite layers: the thin and dark inner layer, distinctly visible only from part to part, and the fairer outer layer being five times thicker. Apical opening indistinct, its upper part in the shape of a funnel, its lower part cylindrical 30 μm in diameter. Calcareous envelope inconspicuously separated with and indistinct dark streak from the inside of the gyrogonite and broken with dark interspiral sutures. The fragmentarically preserved dark streak dividing the outer layer and the inside probably corresponds not only with the inner layer of the spirals but also with the membrane of the oospore.

Comparison. The species differs from the *Stellatochara germanica* Koz. and Reinh. in concave spirals and in a smaller diameter of the apical opening, while from *S. donbassica* (Demin) in a higher number of laterally visible spirals and in shape of the base.

Occurrence. Poland (the Röt — Lower Rhaetic).

Stellatochara silesiana n. sp.

Pl. III, figs 5—7, Pl. XII, fig. 2

Holotype. ZPAL. Ch 54—94,2/21; Pl. III, fig. 6a, b.

Type locality. The ZŁ 6—4 boring.

Type horizon. The Lower Rhaetic.

Derivation of the name. Silesiana — from Silesia.

Material. Over 250 well preserved specimens.

Diagnosis. Gyrogonites subprolate to prolate and elliproidal with a neck-shaped summit and rounded base; 8—10 laterally visible concave spirals with rather low interspiral ridges.

Description. Gyrogonites subprolate to prolate (ISI = 120—138, LDI = = 136—152), ellipsoidal (ANI = 45—53), L = 403—512 μm, LPA = 361—452 μm, LED = 276—349 μm. Maximum breadth in the middle part of a gyrogonite. Near the summit spirals bend along the polar axis forming the 53—67 μm high apical neck having a pentagonal, sometimes irregular, apical opening 52—70 μm in diameter. 8—10 concave spirals are visible in lateral view. Equatorial angle 12—18°. Breadth of the spiral in the middle part of a gyronite 56—70 μm; SPI = 582—750. Interspiral ridges rather low, sometimes slightly blunted, sutures inconspicuous. Basal pole rounded. Basal opening small, pentagonal. In the longitudinal section the spirals, over 50 μm thick, are composed with two calcite layers. The inner layer is dark and thin. The outer layer is fairer and five to six times thicker than the inner one. The apical opening, its outline being set off with a dark mass filling it, in the upper part it funnel-shaped, while in the lower one it is cylindrical, about 40 μm in diameter. Basal opening poorly visible. The oospore membrane probably composes the thin layer dividing the fair outer layer from the inside of the oospore.

Comparison. The species is different from *Stellatochara thuringica* Koz. & Reinh. in shape and in a smaller diameter of the apical opening; from *S. bulgarica* Said. it differs in a broader spiral and in a lower value of the equatorial

Table 3. Measured gyrogonites of *Stellatochara pomerana* n. sp.

Specimen	L (μm)	LPA (μm)	L-LPA (μm)	LED (μm)	ISI (%)	LDI (%)	AND (μm)	ANI (%)	NS	WS (μm)	SPI (%)	EA (°)	DA (μm)
7—637,8/60	422	362	60	295	123	143	180	50	10	54	670	13	52
4—1306/35	398	332	66	289	115	138	162	49	9	49	677	10	50
7—637,8/59	445	383	62	319	120	139	180	47	11	54	709	11	45
42—80/25	445	394	51	318	124	140	176	45	9	52	758	15	46
6—1555,4/2	467	415	52	327	127	143	192	46	10	54	768	15	50
4—1306/38	400	359	41	287	125	139	182	51	10	51	704	16	51
4—1306/39	429	380	49	288	132	149	192	50	11	45	844	15	45
8—736/52	377	327	50	268	122	141	156	48	11	38	860	15	40
8—736/53	403	340	63	281	121	143	168	49	11	38	895	10	—
7—637,8/65	426	387	39	304	127	140	170	44	11	40	967	16	45
Range	377—467	327—415	39—66	268—327	115—132	138—149	156—192	44—51	9—11	38—54	670—967	10—16	40—52

Table 4. Measured gyrogonites of *Stellatochara silesiana* n. sp.

Specimen	L (μm)	LPA (μm)	L-LPA (μm)	LED (μm)	ISI (%)	LDI (%)	AND (μm)	ANI (%)	NS	WS (μm)	SPI (%)	EA (°)	DA (μm)
54—94,2/21	410	371	39	276	134	148	181	49	9	58	640	14	70
42—66/23	512	452	60	349	129	147	217	48	10	70	646	13	60
54—94,2/20	410	364	46	301	121	136	189	52	8	58	628	14	64
46—46/4	448	403	45	307	131	146	180	45	8	60	672	15	67
59—68/12	435	400	35	298	134	146	198	49	8	60	666	18	52
59—68/13	441	390	51	324	120	136	188	48	8	67	582	12	52
47—110/14	473	435	38	326	133	145	208	48	9	58	750	14	54
35—99/15	496	451	45	327	138	152	212	47	9	64	704	18	70
35—99/16	480	413	67	330	125	145	220	53	9	68	607	14	68
80—9/1	403	361	42	280	129	144	176	49	8	56	645	12	58
Range	403—512	361—452	35—67	276—349	120—138	136—152	176—220	45—53	8—10	56—70	582—750	12—18	52—70

angle; from *S. pomerana* n. sp. it differs in broader spirals and in shape of the basal pole.

Occurrence. Poland (the Upper Muschelkalk — Lower Rhaetic).

Subfamily ***Porocharoideae*** Grambast 1961

Remarks. Grambast (1961) included to the *Porocharoideae* the following genera: *Stomochara* Grambast, *Stenochara* Grambast, *Porochara* Mädler, *Cuneatochara* Saidakovsky, and *Latochara* Mädler. Saidakovsky (1971) included to the family also the genus *Vladimiriella* Saidakovsky. The subfamily comprises than the taxons markedly differentiated in respect of the summit morphology. Hence, it was justified that Kozur (1973) distinced the subfamily *Clavatoritinae* — nom. correct. *Clavatoritoideae*, comprising the genera *Clavatorites* Horn af Rantzien (a synonym: *Cuneatochara* Saidakovsky) and *Latochara* Mädler. Feist and Grambast-Fessard (1982) included to the *Porocharoideae* the following genera: *Stomochara* Grambast = *Catillochara* Peck & Eyer = = *Altochara* Saidakovsky, *Porochara* Mädler = *Euaclistochara* Wang Zhen, Huang Ren-jin & Wang Shui, *Vladimiriella* Saidakovsky = *Porosphaera* Wang Zhen & Huang Ren-jin, *Horniella* Shaikin, *Nitella* Agardh, and *Musacchiella* Feist & Grambast-Fessard. However, Schudack (1986) regarded *Musacchiella* as a synonym of *Porochara*, moreover he included to the *Porocharoideae* the genus *Feistiella* Schudack. Nothing in that qualification raises doubts but considering of the genera *Altochara* and *Stomochara* to be synonyms, since these genera differ in the summit structure.

Saidakovsky (1968) distinguished the subfamily *Stomocharoideae* to which he included the following genera: *Stomochara* Grambast, *Horniella* Shaikin, *Auerbachichara* Kisielevsky & Saidakovsky, and *Altochara* Saidakovsky, being characterized by a big, starshaped, angularly-pentagonal apical opening at the summit. Since the definition of the subfamily bases only upon the shape of the apical opening (however, a similar morphology of it show also species belonging to other subfamilies), but does not determine the shape of the apical pole, there are no bases for distinguishing of the subfamily comprising such a content (cf. Feist & Grambast-Fessard 1982).

Organ-genus ***Stenochara*** Grambast 1962 emend.

1954 *Praechara* H. af R., n. g.; Horn af Rantzien, p. 57—62.
1960 *Praechara* Horn af Rantzien; Saidakovsky, p. 54, 55.
1961 *Praechara* Horn af Rantzien; Grambast, p. 66.
1962 *Stenochara* nomen novum; Grambast, p. 66, 67.
1966a *Stenochara* Grambast; Saidakovsky, p. 126.
non Birina 1948.

(Type species: *Stenochara maedleri* (Horn af Rantzien) Grambast 1962 = *Praechara mädleri* Horn af Rantzien 1954, p. 62—64, Pl. 5, figs 6—8).

Diagnosis. Gyrogonites with the summit ended with a rather low projection in the shape of a blunted cone, at which the spirals not altering their breadth leave a pentagonal, star-shaped or roundish apical opening.

Stenochara maedleri (Horn af Rantzien 1954) Grambast 1962
Pl. V, fig. 6

1954 *Praechara mädleri* H. af R., n. sp.; Horn af Rantzien, p. 62—64, Pl. V, figs 6—8.
1962 *Stenochara maedleri* (Horn af Rantzien) nov. comb.; Grambast, p. 66.
1966a *Stenochara maedleri* (Horn af Rantzien); Saidakovsky (partim), p. 126, 127, Pl. II, figs 13, 14.
1969 *Stenochara maedleri* (Horn af Rantzien); Bilan, p. 448, 449, Fig. 11a, b, c.
1969 *Stenochara maedleri* (Horn af Rantzien) Grambast; Kozur & Reinhardt, p. 378, Pl. 2, fig. 2a, b.

Material. Over 800 gyrogonites.

Remarks. Saidakovsky (1966a) considered that gyrogonites of various species were described under the name of *Praechara mädleri* Horn af Rantzien. In the description of *Stn. maedleri* (Horn af Rantzien) based on an incomparably richer material of 320 specimens he gave the variability ranges of particular characters almost identical with those given by Horn af Rantzien (1954), the material of the latter author comprising 9 gyrogonites. The only one but important difference from the description given by Horn af Rantzien is the presented by Saidakovsky extremely narrow range of the ISI index. Horn af Rantzien determined the variability range of ISI as 143—170. In the descriptions of other authors the values of particular parameters are included in the limits determined by the author of the species, or slightly exceede the limits, the variability range of the ISI being 152—158 according to Bilan (1969) and 135—150 according to Kozur and Reinhardt (1969). Saidakovsky determined the variability range of the index as 155—157 (however, the specimen whose dimensions he presented was not covered by this variability interval, since its ISI was 160). Besides the shape differentiation, another sign of variability is a varying number and breadth of laterally visible spirals (NS = 9—13, WS = = 40—60 μm).

Occurrence. The species was described from the sediments determined as the Lower Keuper or Muschelkalk (Horn af Rantzien 1954) in the profile of the Höllviken II boring (Scania). It occurs also in the middle and upper part of the Lower Triassic and in the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984; Lipatova et al. 1984b) as well as in the Lower and Middle Triassic of GDR (Kozur 1974c). In the Polish part of the Central European Basin it occurs in the Middle Buntsandstein-Lower Rhaetic interval.

Stenochara pseudoglypta (Horn af Rantzien 1954) Grambast 1962
Pl. V, figs 3, 4

1954 *Praechara pseudoglypta* H. af R., n. sp.; Horn af Rantzien p. 65—69, Pl. V, figs 2—5.
1962 *Stenochara pseudoglypta* (Horn af Rantzien) nov. comb.; Grambast, p. 66, 67.
1966a *Stenochara pseudoglypta* (Horn af Rantzien); Saidakovsky, p. 127.

Material. 72 well preserved specimens.

Remarks. The variability ranges of the characters of *Stn. pseudoglypta* were estimated by Horn af Rantzien (1954) basing on seven specimens. Most of the parameters of the examined material either were contained in those ranges of variability or slightly exceeded them, although the specimens of a higher ISI value (up to 150) as well as the ones having broader spirals (up to 38 μm) were also found.

Occurrence. The species was described from the sediments determined as the Lower Keuper or the Muschelkalk of Scania (Horn af Rantzien 1954). It occurs also in the Lower and Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984; Lipatova et al. 1984b) as well as in the Olenekian and the Upper Anisian (excluding the uppermost part) of GDR (Kozur 1974c). In the Polish part of the Central European Basin it occurs in the Middle Buntsandstein — Lower Rhaetic interval.

Stenochara donetziana (Saidakovsky) Grambast 1962
Pl. IV, fig. 3

1960 *Praechara donetziana* Saidakovsky sp. nov.; Saidakovsky, p. 54, 55, Pl. I, fig. 2a, b.
1962 *Stenochara donetziana* (Saidakovsky) nov. comb.; Grambast, p. 67.
1966a *Stenochara donetziana* (Saidakovsky); Saidakovsky, p. 127, 128, Pl. III, figs 3—5.
1969 *Stenochara donetziana donetziana* (Saidakovsky); Kozur & Reinhardt (partim), p. 378, 379, Pl. II, fig. 6a, b, c.

Material. Over 500 gyrogonites.

Remarks. *Stenochara ovata* (Said.) and *Stn. blanda* Said. were regarded by Kozur and Reinhardt (1969) as synonyms of *Stn. donetziana* (Said.). Actually, the variability ranges of the parameters of the three species are much overlapping. The asymmetry of the gyrogonites of *Stn. donetziana* seems not a characteristic feature of the very species since it is manifested by some specimens of other species described by Saidakovsky, for instance by *Maslovichara magna* Said. or *Cuneatochara capitata* Said. The asymmetry of specimens of *Stn. donetziana* is variously distinct, or even completely indistinct in some specimens. However, the summit structure is the feature that allows to distinguish *Stn. donetziana* from *Stn. ovata*. The gyrogonites of *Stn. ovata* are roundish in outline and have a poorly marked apical projection, whereas those of *Stn. donetziana* are distinct with a more conspicuous apical projection.

Occurrence. The middle part of the Lower Triassic — the Upper Triassic of the European part of the USSR (Saidakovsky 1966a; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985), the Röt — Lower Rhaetic of the Polish Lowland.

Stenochara ovata (Saidakovsky) Saidakovsky 1966a
Pl. IV, fig. 4

1962 *Praechara ovata* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 14 (nomen nudum).
1966a *Stenochara ovata* (Saidakovsky) comb. nov.; Saidakovsky, p. 128, 129, Pl. III, figs 1, 2.
1968 *Stenochara blanda* Saidakovsky, sp. nov.; Saidakovsky, p. 105, 106, Pl. 16, figs 1, 2.
1984 *Stenochara ovata* (Saidakovsky) Saidakovsky; Lu Hui-nan & Luo Qi-xin, Pl. 2, fig. 10.

Material. Over 150 gyrogonites.

Description. Gyrogonites subprolate to prolate (ISI = 128—150) ellipsoidal (ANI = 46—52). LPA = 420—512 μm, LED = 325—366 μm. Maximum breadth in the middle part of a gyrogonite. Summit and base in the shape of a more or less truncated cone. Apical opening rounded, 30—45 μm in diameter. 9—12 slightly concave spirals are visible laterally. Equatorial angle 8—15°. Breadth of the spiral in the middle part of a gyrogonite 40—60 μm; SPI = 852—986. Interspiral ridges rather low but sharp, sutures inconspicuous. Basal opening small, pentagonal.

Comparison. *Stenochara ovata* (Said.) differs from *Stn. donetziana* (Said.) in shape of the apical pole, while from *Stn. maedleri* (H. af R.) in a higher value of the equatorial diameter.

Remarks. The variability ranges of particular characters of *Stn. ovata* (Said.) and *Stn. blanda* Said. in most cases are at least partly overlapping. The only one difference is breadth of the spirals, in *Stn. ovata* ranging from 40—50 μm, while in *Stn. blanda* from 50—57 μm. Considering similarity of the other characters, the difference seems a sign of the infraspecific variability.

Occurrence. The Middle and Upper Triassic of the European part of the USSR (Saidakovsky 1966a, 1968, 1973; Kisielevsky 1969a) and of Kazakhstan (Kisielevsky 1984), the Middle Triassic of China (Lu Hui-nan & Luo Qi-xin 1984) and of Bulgaria (Saidakovsky 1968) as well as the Röt — Lower Rhaetic of the Polish Lowland.

Stenochara elongata (Saidakovsky) Saidakovsky 1966a
Pl. V, fig. 7

1962 *Praechara elongata* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 15 (nomen nudum).
1966a *Stenochara elongata* (Saidakovsky) comb. nov.; Saidakovsky, p. 129, Pl. III, figs 15, 16.
1969 *Stenochara elongata* (Saidakovsky); Bilan, p. 449—451, Fig. 13a—c.

Material. Over 150 well preserved specimens.

Remarks. Comparing *Stenochara elongata* (Said.) with the other species of the genus *Stenochara*, Saidakovsky (1966a) found that it differs from the others in its elongate form, broad spirals, and blunted poles. According to the description given by Saidakovsky the gyrogonite length and the value of the

ISI index in the *Stn. elongata* range from 480 to 530 μm, and from 160 to 190 respectively. In the present material of the Triassic of the Polish Lowland there were the specimens corresponding with the *Stn. elongata* in shape, but showing a higher variability of come parameters (LPA = 435—530 μm, WS = 45—65 μm). Variability was manifested also in the shape of the surface of the spirals (from slightly to distinctly concave) and in a variable height of the interspiral ridges.

Occurrence. The middle and upper part of the Lower Triassic and the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985), the upper part of the Middle Triassic and the Upper Triassic of Kazakhstan (Kisielevsky 1984), the Olenekian of GDR (Kozur 1974c), the Röt — Lower Rhaetic of the Polish Lowland.

Stenochara schaikini Saidakovsky 1966a

Pl. IV, fig. 10

1966a *Stenochara schaikini* Saidakovsky, sp. nov.; Saidakovsky, p. 129, 130, Pl. III, figs 6, 7.

Material. 39 gyrogonites.

Occurrence. The middle part of the Lower Triassic — the Upper Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985), the upper part of the Middle Triassic and the Upper Triassic of Kazakhstan (Kisielevsky 1984), the Olenekian of GDR (Kozur 1974c), the Röt — Lower Rhaetic of the Polish Lowland.

Stenochara saratoviensis Kisielevsky 1967

Pl. V, fig. 5

1967 *Stenochara saratoviensis* Kisielevsky sp. nov.; Kisielevsky, p. 41, 42, Pl. I, figs 9—10.

Material. 65 gyrogonites.

Remarks. In the examined material the specimens of *Stn. saratoviensis* Kis. were found to show higher (exceeding the variability range determined by the author of the species) values of the equatorial angle: EA = 8—18°.

Occurrence. The upper part of the Middle Triassic and the Upper Triassic of the East European Platform (Kisielevsky 1967, 1969a; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984) as well as the Röt, Muschelkalk and Schilfsandstein of the Polish Lowland.

Stenochara pseudoovata Saidakovsky 1968

Pl. V, figs 1, 2

1968 *Stenochara pseudoovata* Saidakovsky sp. nov.; Saidakovsky, p. 106, Pl. 16, figs 5, 6.

Material. Over 100 gyrogonites.

Occurrence. The upper part of the Middle Triassic and the Upper Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), the Carnian of Bulgaria and the Lower Keuper of GDR (Saidakovsky 1968). In the Polish part of the Central European Basin it occurs in the Röt — Lower Rhaetic interval.

Stenochara rantzienii Saidakovsky 1968
Pl. V, fig. 8

1968 *Stenochara rantzienii* Saidakovsky, sp. nov.; Saidakovsky, p. 106, 107, Pl. 16, figs 3, 4.

Material. 38 gyrogonites.

Remarks. Saidakovsky (1968) considered that the specimen described by Horn af Rantzien (1954) as *Praechara* sp. A corresponds fully with the description of *Stn. rantzienii* Said., though its general appearance and shape of the basal pole resemble more the *Stn. pseudoovata* Said. (cf. Horn af Rantzien 1954; Pl. 5, fig. 9 and Saidakovsky 1968; Pl. 16, figs 3 and 5).

Occurrence. The upper part of the Middle Triassic and the Upper Triassic of the European part of the USRR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), the Anisian — Carnian of Bulgaria (Saidakovsky 1968), and the Uppermost Anisian and the Ladinian (excluding the uppermost part) of GDR (Kozur 1974c). In the Polish part of the Central European Basin it occurs in the Upper Muschelkalk — Lower Rhaetic interval.

Stenochara karpinskyi (Demin) Kozur & Reinhardt 1969
Pl. IV, fig. 5

1956 *Chara karpinskia* Demin, sp. nov.; Demin, p. 55, Pl. I, figs 6—8.
1966a *Sphaerochara? karpinskyi* (Demin) comb. nov.; Saidakovsky, p. 138, Pl. IV, figs 9, 10.
1969 *Stenochara* cf. *karpinskyi* (Demin) n. comb.; Kozur & Reinhardt, p. 379, 380, Pl. 2, fig. 4a, b.
1971 *Vladimiriella karpinskyi* (Demin) comb. nov.; Saidakovsky, p. 119.

Material. 78 gyrogonites.

Remarks. Among the examined specimens of *Stn. karpinskyi* (Demin) some were found somewhat smaller (LPA — from 313 μm, LED — from 275 μm) and showing a higher value of the ISI (up to 120) than those described earlier.

Occurrence. The Lower and Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985), the Brahmanian — Ladinian (excluding the uppermost part) of GDR (Kozur 1974c) as well as the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Stenochara kisielevskyi n. sp.

Pl. IV, figs 6—9, Pl. XII, fig. 3

Holotype. ZPAL. Ch 24—1012,5/13; Pl. IV, fig. 7a, b.

Type locality. The Żebrak IG-1 boring.

Type horizon. Röt.

Derivation of the name. The name of F. J. Kisielevsky, a geologist.

Diagnosis. Gyrogonites subprolate to prolate, ellipsoidal, with a rather low apical projection. Basal pole rounded or in the shape of a truncated cone. 7—9 concave spirals with rather low interspiral ridges are visible laterally. Diameter of the apical opening ranges from 25 to 38 μm.

Material. Over 350 well preserved specimens.

Description. Gyrogonites subprolate to prolate (ISI = 130—158), ellipsoidal (ANI = 49—55), LPA = 312—415 μm, LED = 223—318 μm. Maximum breadth in the middle part of a gyrogonite. At the summit spirals bend along the longitudinal axis forming a rather low projection with a star-shaped or pentagonal apical opening, 25—38 μm in diameter. 7—9 convex spirals are visible laterally. Equatorial angle 15—25°. Breadth of the spiral in the middle part of a gyrogonite 52—63 μm; SPI = 557—680. Interspiral ridges rather low, sharp or sometimes slightly rounded, sutures inconspicuous. Basal pole rounded or in the shape of a truncated cone. Basal opening small, pentagonal. In the longitudinal section the spirals about 35 μm thick consist of two calcite layers. The inner layer, being visible only in parts, is dark and thin, while the outer layer is four times thicker and fair. In the apical part the spirals get narrower and the apical opening is in the form of a funnel. The oospore membrane is probably a component of the dark layer dividing the fair layer and the inside of the oospore.

Comparison. *Stn. kisielevskyi* n. sp. differs from *Stn. incerta* n. sp. in the summit morphology and in a smaller diameter of the apical opening. The described species has a similar shape as *Stn. maedleri* (H. af R.), *Stn. pseudoglypta* (H. af R.) and *Stn. donetziana* (Said.). However, it differs from the previous two species in broader spirals, from the latter one in a smaller size, and from all the three in a lower number of laterally visible spirals.

Occurrence. Poland (the Middle Buntsandstein — Lower Rhaetic).

Stenochara incerta n. sp.

Pl. VI, figs 1, 2, Pl. XII, fig. 4

Holotype. ZPAL. Ch. 42—74/19; Pl. VI, fig. 1a, b.

Type locality. The SP-71 boring.

Type horizon. The Lower Rhaetic.

Derivation of the name. Incertus (lat.) — uncertain.

Diagnosis. Gyrogonites prolate, ellipsoidal to subovoidal with the summit

Table 5. Measured gyrogonites of *Stenochara kisielevskyi* n. sp.

Specimen	LPA (μm)	LED (μm)	ISI (%)	AND (μm)	ANI (%)	NS	WS (μm)	SPI (%)	EA (°)	DA (μm)
24—1012,5/13	361	258	140	199	55	8	58	622	18	36
8—740/30	413	281	147	214	52	8	63	656	15	35
8—736/42	373	257	145	196	52	8	59	632	18	32
57—16,5/14	352	223	158	181	51	8	54	652	22	25
42—71/19	312	233	134	154	49	7	56	557	20	32
42—71/20	374	265	141	185	49	7	60	623	25	38
42—71/21	377	272	139	205	54	8	58	650	15	32
36—64,3/23	415	318	130	224	54	9	61	680	16	30
36—64,3/24	372	286	130	194	52	7	64	581	18	30
36—64,3/25	320	234	137	167	52	7	52	615	15	30
Range	312—415	223—318	130—158	154—224	49—55	7—9	52—64	557—680	15—25	25—38

Table 6. Measured gyrogonites of *Stenochara incerta* n. sp.

Specimen	LPA (µm)	LED (µm)	ISI (%)	AND (µm)	ANI (%)	NS	WS (µm)	SPI (%)	EA (°)	DA (µm)
8—736/58	375	272	138	185	49	8	54	694	15	30
26—1711/23	377	272	139	192	51	7	57	661	22	58
8—736/56	384	275	140	218	57	9	54	711	15	30
26—1711/24	400	275	145	218	55	8	60	666	18	32
42—74/21	423	277	153	228	54	8	74	572	15	—
43—23/19	426	278	153	233	55	8	58	734	18	48
42—74/19	428	288	149	233	54	8	66	648	20	60
8—736/57	441	290	152	224	51	9	56	787	20	42
61—100/11	451	304	148	250	55	7	62	727	15	32
43—23/18	480	312	154	278	58	9	61	787	16	54
Range	375—480	272—312	138—154	185—278	49—58	7—9	54—74	572—787	15—22	30—60

ended with a rather low projection and the basal pole rounded or in the shape of a truncated cone. 7—9 concave spirals with rather low and blunted interspiral ridges are visible laterally. Equatorial angle increases more or less markedly near the poles. Dimension of the apical opening ranges from 30 to 60 μm.

Material. Over 150 gyrogonites.

Description. Gyrogonites prolate (ISI = 138—154), ellipsoidal to subovoidal (ANI = 49—58). LPA = 375—480 μm, LED = 272—312 μm. Maximum breadth in the middle part of a gyrogonite or slightly below. At the summit the spirals alter their direction forming a rather low, often excentrically sharpened, projection. Apical opening pentagonal, sometimes irregular or star-shaped, 30—60 μm in diameter. 7—9 concave spirals are visible laterally. Equatorial angle 15—22°, increases more or less distinctly near the poles. Breadth of the spirals in the middle part of a gyrogonite 54—74 μm; SPI = 572—787. Interspiral ridges rather low, blunted; sutures inconspicuous. Basal pole rounded or in the shape of a truncated cone. Basal opening small, pentagonal. In the longitudinal section the spirals thickness ranges from 40 μm in the apical to over 50 μm in the basal part. A thin and dark inner layer is visible only in parts. The outer layer is fairer and nearly five times thicker. The apical and basal openings are poorly visible. The membrane of the oospore is probably a component of the dark layer dividing the outer layer of the spirals from the inside of the oospore.

Comparison. *Stn. incerta* n. sp. differs from *Stn. kisielevskyi* n. sp. in its excentrically sharpened summit, a greater diameter of the apicál opening and an increasing inclination of the spirals near the poles. The described species differs from the similar in shape and size species of the genus *Stenochara* in a lower number of laterally visible spirals, their greater breadth and a great diameter of the apical opening.

Remarks. Specimens of this species have the apical opening of a great diameter being characteristic of the *Stellatochara* Horn af Rantzien, but do not have the apical neck. Furthermore, they show some characters (shape of the summit and increase of the equatorial angle near the poles) being typical of the *Clavatorites* Horn af Rantzien. The mentioned characters do not allow to include the described species to any of those genera. It shows a mixture of the characters of the genera *Stellatochara* and *Clavatorites*, that does not exclude its belonging to the genus *Stenochara* Grambast.

Occurrence. Poland (the Middle Buntsandstein — Lower Rhaetic)

Organ-genus *Porochara* Mädler 1955

1955 *Porochara* nov. gen.; Mädler, p. 271.
1961 *Porochara* Mädler; Grambast, p. 201.
1962 *Porochara* Mädler; Grambast, p. 67.
1966a *Porochara* Mädler; Saidakovsky, p. 132.
1976 *Euaclistochara* nov. gen.; Wang Zhen, Huang Ren-jin & Wang Shui, p. 71.

1984 *Musacchiella* nov. gen.; Feist & Grambast-Fessard, p. 301.
(Type species: *Porochara kimmeridgensis* (Mädler) Mädler 1955 = *Aclistochara kimmeridgensis* Mädler 1952, p. 26, Pl. B, figs 13—19).

Porochara brotzeni (Horn af Rantzien) Grambast 1961
Pl. VI, fig. 9

1954 *Aclistochara brotzeni* H. af R., n. sp.; Horn af Rantzien, p. 52—56, Pl. IV, figs 5—10.
1961 *Porochara brotzeni* (Horn af Rantzien) nov. comb.; Grambast, p. 200.
1966a *Porochara brotzeni* (Horn af Rantzien) Grambast; Saidakovsky, p. 134.
1969 *Porochara brotzeni* (Horn af Rantzien); Bilan, p. 442—444, Fig. 7a, b.
1969 *Porochara brotzeni* (Horn af Rantzien) Grambast; Kozur & Reinhardt, p. 381, Pl. 2, figs 9, 10.

Material. Over 100 well preserved specimens.

Occurrence. The species were described from the sediments determined as the Lower Keuper or Muschelkalk of Scania (Horn af Rantzien 1954). It occurs also in the middle part of the Lower Triassic and in the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Saidakovsky & Kisielevsky 1972, 1985), in the upper part of the Lower Triassic of Kazakhstan (Kisielevsky 1984), from the Olenekian to the Lower Fassanian of GDR (Kozur 1974c) as well as from the Middle Buntsandstein to the Lower Rhaetic of Poland.

Porochara triassica (Saidakovsky) Grambast 1961
Pl. VII, fig. 1

1960 *Aclistochara triassica* Saidakovsky, sp. nov.; Saidakovsky, p. 55, 56, Pl. I, fig. 3a, b.
1961 *Porochara triassica* (Saidakovsky) nov. comb.; Grambast, p. 201.
1966a *Porochara triassica* (Saidakovsky) Grambast; Saidakovsky, p. 133, 134, Pl. IV, figs 5, 6.
1969 *Porochara triassica* (Saidakovsky); Bilan, p. 445, 446, Fig. 8a, b, c.

Material. Over 200 gyrogonites.

Occurrence. The upper part of the Lower Triassic and the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985) and of Kazakhstan (Kisielevsky 1984; Lipatova et al. 1984b) as well as the Olenekian of GDR (Kozur 1974c). In the Polish part of the Central European Basin it occurs in the Middle Buntsandstein — Lower Rhaetic interval.

Porochara ukrainica Saidakovsky 1966a
Fig. 3

1962 *Porochara ukrainica* Saidakovsky, sp. nov.; Saidakovsky, Pl. 1, fig. 17 (nomen nudum).
1966a *Porochara ukrainica* Saidakovsky; Saidakovsky, p. 134, 135, Pl. IV, figs 3, 4.
1969 *Porochara ukrainica* Saidakovsky; Kozur & Reinhardt, p. 381, Pl. 2, fig. 1a, b, c.

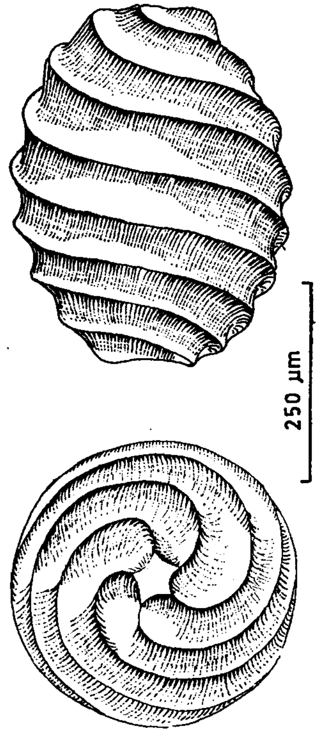


Fig. 3. *Porochara ukrainica* Saidakovsky, a — lateral view, b — apical view

Material. 23 gyrogonites.

Occurrence. The upper part of the Lower Triassic and the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985), the upper part of the Lower Triassic of Kazakhstan (Kisielevsky 1984), the Olenekian and Langobardian (excluding the uppermost part) of GDR (Kozur 1974c), the Röt — Lower Rhaetic of the Polish Lowland.

Porochara urusovi Saidakovsky 1966a
Pl. VI, fig. 3

1966a *Porochara urusovi* Saidakovsky, sp. nov.; Saidakovsky, p. 132, 133, Text-fig. 2a, b.
1969 *Porochara urusovi* Saidakovsky; Bilan, p. 445, 446, Fig. 9a, b, c.

Material. Over 100 gyrogonites.

Occurrence. The upper part of the Lower Triassic and the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985), the upper part of the Lower Triassic of Kazakhstan (Kisielevsky 1984), the Upper Anisian (excluding the uppermost part) of GDR (Kozur 1974c), as well as the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Porochara belorussica Saidakovsky 1966a
Pl. VI, figs 6, 7

1966a *Porochara belorussica* Saidakovsky, sp. nov.; Saidakovsky, p. 135, Pl. IV, figs 1, 2.
1969 *Porochara belorussica* Saidakovsky; Bilan, p. 446—448, Fig. 10a, b, c.
1983 *Porochara subquadrata* sp. nov.; Huang Ren-jin (partim), p. 434, Pl. III, fig. 10.

Material. 61 gyrogonites.

Description. Gyrogonites prolate spheroidal to subprolate (ISI = 112—122), ellipsoidal (ANI = 50—55). LPA = 300—390 μm, LED = 250—325 μm. Maximum breadth in the middle part of a gyrogonite. Summit flat. Apical opening pentagonal, sometimes star-shaped, 30—40 μm in diameter. 6—8 concave spirals visible laterally. Equatorial angle 10—28°. Breadth of the spirals in the middle part of a gyrogonite 60—75 μm; SPI = 430—583. Interspiral ridges rather low, sutures inconspicuous. Basal pole flat with a small apical opening.

Comparison. *Porochara belorussica* Said. differs from the other species of the genus *Porochara* in its characteristic form and in size.

Remarks. The original description of the *Porochara belorussica* Said. gives the variability range of the equatorial angle 10—12°. In the examined material among the specimens belonging to this species there were the ones whose value of the equatorial angle reached up to 28° (comp. Pl. VI, fig. 7).

Occurrence. The Lower Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985) and of Kazakhstan (Kisielevsky 1984), the Middle Triassic of China (Huang Ren-jin 1983), the Jakutian of GDR (Kozur 1974c), the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Porochara dergatschiensis Kisielevsky 1967
Pl. VI, fig. 8

1967 *Porochara dergatschiensis* Kisielevsky, sp. nov.; Kisielevsky, Pl. I, figs 12, 13.

Material. 11 gyrogonites.

Occurrence. The Lower Triassic of the European part of the USSR (Kisielevsky 1967, 1969a; Saidakovsky & Kisielevsky 1972, 1985) and of Kazakhstan (Kisielevsky 1984), the Olenekian of GDR (Kozur 1974c), as well as the Middle Buntsandstein — Middle Muschelkalk of the Polish Lowland.

Porochara concica Saidakovsky 1968
Pl. VI, fig. 5

1968 *Porochara concisa* Saidakovsky, sp. nov.; Saidakovsky, p. 109, Pl. 16, figs 15, 16.

Material. 33 gyrogonites.

Occurrence. The upper part of the Lower Triassic and the Middle Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky

& Kisielevsky 1985), the Anisian and Ladinian of Bulgaria (Saidakovsky 1968) as well as the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Porochara abjecta Saidakovsky 1968
Pl. VII, figs 2, 3

1968 *Porochara abjecta* Saidakovsky, sp. nov.; Saidakovsky, p. 108, Pl. 16, figs 17, 18.

Material. 22 gyrogonites.

Remarks. The examined material presented a slightly greater variety of sizes and shapes of the gyrogonites of *Porochara abjecta* Said. than that given in the original description of the species. Some specimens were recorded to reach 560 μm in length (the variability range according to Saidakovsky — 415—543 μm) and 435 μm in the equatorial diameter (the variability range according to the author of the species: 300—386 μm), their ISI value ranging from 125 to 140 (according to Saidakovsky: 130—152).

Occurrence. The Middle Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), the Anisian and Ladinian of Bulgaria (Saidakovsky 1968), the Upper Anisian (excluding the uppermost part) of GDR (Kozur 1974c) as well as the Röt, Lower Muschelkalk and the Upper Triassic of the Polish Lowland.

Porochara cylindrica Kisielevsky 1969
Pl. VII, figs 6, 7

1969 *Porochara cylindrica* Kisielevsky, sp. nov.; Kisielevsky, p. 27, 28, Pl. I, figs 3—5.

Material. Over 150 well preserved specimens.

Remarks. The examined specimens of the species showed a slightly wider variability range of the ISI than that given by the author of the species. Fig. 6 in Pl. VII presents a specimen whose ISI value exceeded 190. Some specimens of *P. cylindrica* Kis. showed also a slightly higher value of the equatorial angle (up to 23°) than that determined in the original description of the species.

Occurrence. The upper part of the Lower Triassic of the East European Platform (Kisielevsky 1969b; Saidakovsky & Kisielevsky 1985), the Olenekian of GDR (Kozur 1974c), the Middle Buntsandstein Röt and the Upper Triassic of the Polish Lowland.

Porochara sphaerica Kisielevsky 1969
Pl. VI, fig. 4

1969 *Porochara sphaerica* Kisielevsky, sp. nov.; Kisielevsky, p. 29, 30, Pl. I, figs 8, 9.

Material. 82 gyrogonites.

Remarks. The examined material comprised the specimens somewhat differing in shape from those described by Kisielevsky (1969). Their ISI value ranged from 110 to 130 (the author of the species gave the variability ranges 100—120). In some specimens of *P. sphaerica* Kis. ridges with a central groove are found at junctions of neighbouring spirals (Kisielevsky 1969). The fact that only certain specimens show this character seems an effect of their various state of preservation.

Occurrence. The lower part of the Lower Triassic of the East European Platform (Saidakovsky & Kisielevsky 1985), the upper part of the Lower Triassic of Kazakhstan (Kisielevsky 1984), the Brahmanian of GDR (Kozur 1974c) and the Röt — Lower Rhaetic of the Polish Lowland.

Organ-genus ***Vladimiriella*** Saidakovsky 1971a emend.

1954 *Sphaerochara* Mädler; Horn af Rantzien (partim), p. 71.
1966a *Sphaerochara* Mädler; Saidakovsky (partim), p. 137.
1971a *Vladimiriella* Saidakovsky, gen. nov.; Saidakovsky, p. 119.
1978 *Porosphaera* nov. gen.; Wang Zhen & Huang Ren-jin, p. 273.
(Type species: *Vladimiriella globosa* (Saidakovsky) Saidakovsky 1971a = *Tolypella globosa* Saidakovsky 1960, p. 56, Pl. I, fig. 4a = *Sphaerochara? globosa* (Saidakovsky) Saidakovsky 1966a, p. 137, 138, Pl. IV, figs 11—13).

Diagnosis. Gyrogonites with a rounded summit, at which the spirals not altering their breadth leave a rounded or pentagonal apical opening.

Remarks. Kozur (1974c) included to the genus *Stenochara* Grambast most of the earlier described species of the genus *Vladimiriella* Saidakovsky. *Stenochara* cf. *karpinskyi* (Demin) Kozur and Reinhardt shows the summit structure (the presence of a rather low apical projection) of the "*Stenochara* type", however the other species of the genus *Vladimiriella* have a rounded summit — the typical character of this genus.

Wang Zhen and Huang Ren-jin (1978), without considering of the diagnosis of the earlier defined genus *Vladimiriella* (Saidakovsky 1971b) distinguished the genus *Porosphaera*. According to Feist and Grambast-Fessard (1982) this genus is a synonym of *Vladimiriella* Saidakovsky.

Vladimiriella globosa (Saidakovsky) Saidakovsky 1971a
Pl. VIII, fig. 1

1960 *Tolypella globosa* Saidakovsky, sp. nov.; Saidakovsky, p. 56, Pl. I, fig. 4a.
1966a *Sphaerochara? globosa* (Saidakovsky) comb. nov.; Saidakovsky, p. 137, 138, Pl. IV, figs 11—13.
1971a *Vladimiriella globosa* (Saidakovsky) comb. nov.; Saidakovsky, p. 119.

Material. 55 gyrogonites.

Description. Gyrogonites prolate spheroidal to subprolate (ISI = 112—118), ellipsoidal (ANI = 53—56). LPA = 240—320 μm, LED = 200—270 μm. Maximum breadth in the middle part of a gyrogonite. Summit rounded. Apical opening rounded or in the shape of an irregular pentagon not exceeding 25 μm in diameter. 6—7 laterally visible concave spirals. Equatorial angle 8—18°. Breadth of the spirals in the middle part of a gyrogonite 35—50 μm; SPI = = 608—726. Interspiral ridges distinct, sharp, sometimes slightly blunted. Basal pole rounded, with a rather small basal opening.

Comparison. *Vladimiriella globosa* (Said.) differs from the similar in size *V. wetlugensis* (Said.) in a lower number of laterally visible spirals.

Occurrence. The Lower and Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Saidakovsky & Kisielevsky 1972, 1985), the Lower Triassic of Kazakhstan (Kisielevsky 1984), the Jakutian of GDR (Kozur 1974c) and the Middle and Upper Buntsandstein of the Polish Lowland.

Vladimiriella wetlugensis (Saidakovsky) Saidakovsky 1971a

Pl. VIII, fig. 2

1962 *Sphaerochara wetlugensis* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 16 (nomen nudum).
1966a *Sphaerochara? wetlugensis* Saidakovsky; Saidakovsky, p. 139, Pl. IV, figs 14—16.
1971a *Vladimiriella wetlugensis* (Saidakovsky) comb. nov.; Saidakovsky, p. 119.

Material. 58 gyrogonites.

Remarks. In the examined material some specimens of *V. wetlugensis* (Said.) were found to differ in values of some parameters (LED = 200—280 μm; ISI = 102—115; WS = 30—42 μm) from those presented in the original description of the species.

Occurrence. The Lower Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Saidakovsky & Kisielevsky 1972, 1985), the Jakutian of GDR (Kozur 1974c), the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Vladimiriella decora (Saidakovsky) Saidakovsky 1971a

Pl. VII, figs 4, 5

1968 *Sphaerochara? decora* Saidakovsky, sp. nov.; Saidakovsky, p. 109, Pl. 16, figs 25, 26.
1971a *Vladimiriella decora* (Saidakovsky) comb. nov.; Saidakovsky, p. 119.

Material. 12 gyrogonites.

Remarks. Besides the specimens closely corresponding to those described by Saidakovsky (1968), the others were found to have slightly broader spirals (up to 85 μm) and the equatorial angle up to 14°.

Occurrence. The upper part of the Middle Triassic and the Upper Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985), the Ladinian — Norian of Bulgaria and the Lower Keuper of GDR (Saidakovsky 1968), as well as the Röt, Schilfsandstein and Lower Rhaetic of the Polish Lowland.

Subfamily *Clavatoritoideae* Kozur 1973

Remarks. Kozur (1973) distinguished the subfamily *Clavatoritinae* — nom. correct — *Clavatoritoideae* and included to it the genera *Clavatorites* Horn af Rantzien and *Latochara* Mädler. Comparing the descriptions and illustrations of the *Clavatorites* and *Cuneatochara* Saidakovsky and basing on his own material Kozur regarded *Cuneatochara* as a synonym of *Clavatorites*. Wang Zhen and Huang Ren-jin (1978) without considering of the definition given by Kozur (1973) distinguished the subfamily *Cuneatocharoideae* (type species-*Cuneatochara* Saidakovsky). Feist and Grambast-Fessard (1982) included to the subfamily *Cuneatocharoideae* Wang Zhen and Huang Ren-jin the following genera: *Auerbachichara* Kisielevsky and Saidakovsky, *Cuneatochara* Saidakovsky, *Stenochara* Grambast, and *Latochara* Mädler, all the taxons showing a markedly different summit morphology.

Organ-genus *Clavatorites* Horn af Rantzien 1954 emend.

1954 *Clavatorites* H. af R., n. g.; Horn af Rantzien, p. 47, 48.
1962 *Cuneatochara* Saidakovsky, gen. nov.; Saidakovsky, p. 1144.
1962 *Cuneatochara* Saidakovsky; Grambast, p. 67.
1966a *Cuneatochara* Saidakovsky; Saidakovsky, p. 130.
1973 *Clavatorites* Horn af Rantzien; Kozur, p. 26.
(Type species: *Clavatorites hoellvicensis* Horn af Rantzien 1954, p. 48—51, Pl. IV, fig. 4)

Diagnosis. Gyrogonites whose spirals from at the summit a conical, pointed or slightly blunted bill-shaped projection with a rather small pentagonal or rounded apical opening.

Clavatorites hoellvicensis Horn af Rantzien 1954
Pl. VIII, figs 4, 5

1954 *Clavatorites höllvicensis* H. af R., n. sp.; Horn af Rantzien, p. 48—51, Pl. IV, fig. 4.

Material. 32 gyrogonites.

Remarks. The original description of *Clavatorites hoellvicensis* H. af R. does not precise the variability of the characters of the species, since it is based on a single specimen. The variability ranges of the characters of the species determined basing on the material from the Triassic of the Polish Lowland, are presented in Table 7.

Occurrence. The species was described from the sediments determined as the Lower Keuper or the Muschelkalk of Scania (Horn af Rantzien 1954). It occurs also in the Upper Langobardian (excluding the uppermost part) of GDR (Kozur 1974c) and in the Röt — Lower Rhaetic interval of the Polish Lowland.

Table 7. Measured gyrogonites of *Clavatorites hoellvicensis* Horn af Rantzien

Specimen	LPA (μm)	LED (μm)	ISI (%)	AND (μm)	ANI (%)	NS	WS (μm)	SPI (%)	EA (°)	DA (μm)
7—637,8/48	640	416	154	325	51	12	64	1000	15	52
7—637,8/54	572	325	176	313	55	12	66	867	20	50
26—1718/9	686	410	167	407	59	10	75	915	18	—
26—1718/14	642	432	149	326	51	10	64	1003	15	—
36—64,3/22	538	364	148	287	53	10	58	927	20	40
7—637,8/64	688	454	151	374	54	11	70	983	18	45
4—1306/36	618	410	151	320	52	11	58	1065	15	45
4—1306/37	652	440	148	338	52	11	67	973	20	—
71—3,9/6	590	377	156	336	57	11	58	1017	22	38
71—3,9/7	625	390	156	378	58	11	64	976	20	—
Range	538—688	325—454	148—176	287—407	51—59	10—12	58—75	867—1065	15—22	38—52

Clavatorites acuminatus (Saidakovsky) Kozur 1974c
Pl. VIII, fig. 6

1962 *Cuneatochara acuminata* Saidakovsky, sp. nov.; Saidakovsky, p. 1144, Pl. I, figs 7, 8.
1962 *Cuneatochara procera* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 9 (nomen nudum).
1966a *Cuneatochara acuminata* Saidakovsky; Saidakovsky, p. 130, 131, Pl. III, figs 8—10.
1966a *Cuneatochara procera* Saidakovsky; Saidakovsky, p. 131, Pl. III, figs 11—13.
1974c *Clavatorites acuminatus* (Saidakovsky) n. comb.; Kozur, p. 156.
1978 *Cuneatochara acuminata* Saidakovsky; Wang Zhen & Huang Ren-jin, Pl. II, figs 7, 8.

Material. Over 150 gyrogonites.

Description. Gyrogonites prolate (ISI = 152—168), ellipsoidal to subovoidal (ANI = 48—58). LPA = 362—448 μm, LED = 215—292 μm. Maximum breadth in the middle part of a gyrogonite or slightly below. Near the apical pole the spirals bend along the longitudinal axis forming a conical, pointed or slightly blunted summit. Apical opening round, very small in diameter. 9—11 laterally visible, concave spirals. Equatorial angle 10—15°. Breadth of the spirals in the middle part of a gyrogonite 35—50 μm; SPI = 878—1024. Interspiral ridges distinct, sharp or slightly blunted. Basal pole conical, sometimes having a rounded tip with a rather small basal opening.

Comparison. The species differs from the *Clavatorites cuneatus* (Said.) in form (higher values of the ISI) and in shape of the base.

Remarks. Saidakovsky (1966a) recorded that the *Cuneatochara acuminata* Said. and *C. procera* Said. differ in a more or less sharpened summit, shape of the base, and breadth of the spirals. He found that in the *C. acuminata* the spirals are fissured at the end of the strongly sharpened apical pole, while the *C. procera*, distinct with its broader and less sharpened summit, is lacking that character; the difference seems an effect of various state of preservation. Comparing the differences in shape of the base (round in *C. acuminata*, sharply-oval in *C. procera*) and in breadth of the spirals (35—40 μm in *C. acuminata*, 40—45 μm in *C. procera*) described by Saidakovsky (1966a, p. 130—131) one can find out that such differences are insignificant, moreover, in the material coming from the Triassic of the Polish Lowland some specimens were found to show mixed characters of both species. Saidakovsky considered the *C. procera* to be different from the *C. acuminata* also in the alteration of the direction of the spirals near the basal pole, although this character — "five surrounding cells in the middle of a gyrogonite show a low value of the equatorial angle, gradually increasing towards the poles" (Saidakovsky 1966a, p. 130) — is the genus character of the *Cuneatochara* Saidakovsky.

Occurrence. The Lower Triassic — the lower part of the Upper Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984). It occurs also in the Triassic of China (Wang Zhen & Huang Ren-jin 1978), the Brahmanian of GDR (Kozur 1974c) and in the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Clavatorites cuneatus (Saidakovsky) Kozur 1974c
Pl. VIII, fig. 3

1962 *Cuneatochara cuneata* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 10 (nomen nudum).
1966a *Cuneatochara cuneata* Saidakovsky; Saidakovsky, p. 131, 132, Pl. III, figs 14, 15.
1974c *Clavatorites cuneatus* (Saidakovsky) n. comb.; Kozur, p. 165.

Material. Over 150 gyrogonites.

Occurrence. The Lower and Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985), the Lower Triassic of Kazakhstan (Kisielevsky 1984), the Olenekian — Anisian (excluding the uppermost part) of GDR (Kozur 1974c), the Middle Buntsandstein — Lower Rhaetic of the Polish Lowland.

Clavatorites capitatus (Saidakovsky & Kisielevsky) Kozur 1974c
Pl. IX, fig. 1

1968 *Cuneatochara capitata* Saidakovsky & Kisielevsky, sp. nov.; Saidakovsky, p. 107, 108, Pl. 16, figs 11, 12.
1974c *Clavatorites capitatus* (Saidakovsky) n. comb.; Kozur, p. 176.

Material. 28 gyrogonites.

Remarks. Most of the parameters of the examined specimens did not exceede the variability range of *Cuneatochara capitata* Said. and Kis., some specimens only are somewhat bigger (LPA = 470—590 μm) and show a higher value of the equatorial angle (EA = 10—25°).

Occurrence. The upper part of the Middle Triassic and the Upper Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), the Ladinian and Rhaetic of Bulgaria (Saidakovsky 1968), the Uppermost Anisian and the Ladinian (excluding its uppermost part) of GDR (Kozur 1974c) and the Röt and Upper Triassic of the Polish Lowland.

Organ-genus *Latochara* Mädler 1955

1955 *Latochara* nov. gen.; Mädler, p. 271.
1957 *Latochara* Mädler; Peck, p. 31.
1961 *Latochara* Mädler; Grambast, p. 201.
1962 *Latochara* Mädler; Grambast, p. 67.
1966a *Latochara* Mädler; Saidakovsky, p. 136.
(Type species: *Latochara latitruncata* (Peck) Mädler 1955 = *Aclistochara latitruncata* Peck 1937, p. 89, Pl. 14, figs 1—4).

Latochara acuta Saidakovsky 1966a
Pl. VIII, fig. 7

1962 *Latochara acuta* Saidakovsky, sp. nov.; Saidakovsky, Pl. I, fig. 18 (nomen nudum).
1966a *Latochara acuta* Saidakovsky; Saidakovsky, p. 136, 137, Pl. IV, figs 7, 8.

Material. 7 gyrogonites.

Remarks. Scarce specimens of *Latochara acuta* Said. from the Triassic of the Polish Lowland have a relatively little distinct apical depression. However, similar character show the other forms included to the genus Latochara Mädler, for instance *Latochara latitruncata* (Peck 1957, Pl. 5, figs 22 and 29), *L. bellatula* (Peck 1957, Pl. 5, fig. 19) and *L. sphaerica* (Peck 1957, Pl. 5, fig. 34).

The specimen presented in fig. 7, Pl. VIII in respect of its size and the breadth of its spirals is outside the variability range determined by Saidakovsky (1966a), though other parameters, being similar to those of the holotype, allow that specimen to be regarded as *L. acuta* — the so far only one known Triassic representative of the genus *Latochara*.

Occurrence. The upper part of the Lower Triassic — the Middle Triassic of the European part of the USSR (Saidakovsky 1966a, 1973; Saidakovsky & Kisielevsky 1972) as well as the Röt and Lower Muschelkalk of the Polish Lowland.

Subfamily ***Auerbachicharoideae*** nov. subfam.

(Type genus: *Auerbachichara* Kisielevsky & Saidakovsky 1967, p. 37, 38).

Diagnosis. *Porocharaceae*, having the gyrogonites with the spirals ends at the summit in the form of denticles or buckles.

Remarks. The commonly acknowledged diagnostical character of the subfamily and genus rank is shape of the gyrogonite summit. Saidakovsky (1968) basing on the shape of the apical opening distinguished the subfamily *Stomocharoideae*, to which he included the genera: *Stomochara* Grambast, *Horniella* Shaikin, *Auerbachichara* Kisielevsky and Saidakovsky, and *Altochara* Saidakovsky, all of them showing a various structure of the summit. However, some species from other subfamilies show the typical of the *Stomocharoideae* Said. shape of the apical opening, while the *Stomochara* and *Horniella* have the summit of the typical shape of that of the *Porocharoideae* Grambast. Feist and Grambast-Fessard (1982) regarded *Altochara* Saidakovsky as a synonym of *Stomochara* Grambast, while *Auerbachichara* Kisielevsky & Saidakovsky as belonging to the subfamily *Cuneatocharoideae* Wang Zhen & Huang Ren-jin. However, the *Auerbachichara* and *Altochara* show a markedly distinct structure of the apical pole (decidedly different from that of the *Cuneatochara* Saidakovsky), what allows the subfamily comprising those genera to be distinguished.

Organ-genus ***Auerbachichara*** Kisielevsky & Saidakovsky 1967 emend.

1967 *Auerbachichara* Kisielevsky & Saidakovsky; Kisielevsky, p. 37, 38.
1968 *Auerbachichara* Kisielevsky & Saidakovsky; Saidakovsky, p. 102.
(Type species: *Auerbachichara saidakovskyi* Kisielevsky 1967, p. 38, 39, Pl. I, figs 1, 2).

Diagnosis. Gyrognites, whose narrowing ends of the spirals form five denticles at the summit and leave the apical opening in the shape of either a star, its rays commonly sinistrorsely bent, or an irregular pentagon.

Remarks. The diagnoses of the organ-genus *Auerbachichara* Kisielevsky & Saidakovsky contain controversial determinations of the basal pole morphology. Kisielevsky (1967, p. 38) wrote: "spiral cells near the base in some specimens pass into the basal opening not altering their direction, while in the others they broaden slightly, forming a rather small projection. Basal opening rounded, less commonly irregular, of a small size, sometimes big". Saidakovsky (1968, p. 102) stated on the contrary: "Base of the gyrogonite is sharply — to broadly-oval; basal opening pentagonal, very small". Such determinations seem not useful in a diagnosis of the organ-genus, though are important in descriptions of species. According to the descriptions of the known species, some of them (*A. saidakovskyi* Kis., *A. achtubiensis* Kis., *A. starozhilovae* Kis., *A. alyoshinii* Kis. & Al., *A. bilanii* Kis. & Al., and particularly *A. baskuntschakiensis* Kis.) are characterized by a great diameter of the basal opening, a little smaller than the diameter of the apical opening, while the other ones (*A. collacerata* Said., *A. kisielevskyi* Said., *A. rhaetica* Bilan and *A. polonica* Bilan) have a relatively small basal opening.

Auerbachichara starozhilovae Kisielevsky 1967

Pl. IX, figs 2, 3, Pl. X, fig. 1

1967 *Auerbachichara starozhilovae* Kisielevsky sp. nov.; Kisielevsky, p. 40, Pl. I, figs 6, 7.

Material. 34 gyrogonites.

Remarks. The original description of *Auerbachichara starozhilovae* Kis. gives the value of the ISI index narrowly ranging from 134 to 135, the value of the isopolarity index of the holotype equalling 145 (Kisielevsky 1967, p. 40). In the examined material some specimens of a higher value of the isopolarity index (ISI = 140—162) appeared. The observed state of preservation of the spirals endings at the summit as well as breadth and height of the interspiral ridges were also variable.

Occurrence. The upper part of the Lower Triassic of the East European Platform (Kisielevsky 1969a; Saidakovsky & Kisielevsky 1972, 1985), the Olenekian of GDR (Kozur 1974c), the Schilfsandstein and Lower Rhaetic of the Polish Lowland.

Auerbachichara baskuntschakiensis Kisielevsky 1967

Pl. XI, figs 4, 5

1967 *Auerbachichara baskuntschakiensis* Kisielevsky sp. nov.; Kisielevsky, p. 41, Pl. I, figs 8, 9.

Material. Over 150 specimens.

Remarks. The examined material presented a relatively high variability of shape of gyrogonites (ISI = 140—155) and of morphology of the apical pole.

The considerable differentiation of morphology of the apical pole is an effect of a various state of preservation of the spirals endings at the summit.

Occurrence. The upper part of the Lower Triassic of the East European Platform (Kisielevsky 1969a; Saidakovsky 1973; Saidakovsky & Kisielevsky 1972, 1985) and of Kazakhstan (Kisielevsky 1984) as well as the Middle Buntsandstein, Upper Gypsum Keuper and Lower Rhaetic of the Polish Lowland.

Auerbachichara kisielevskyi Saidakovsky 1968
Pl. IX, fig. 4

1968 *Auerbachichara kisielevskyi* Saidakovsky, sp. nov.; Saidakovsky, p. 103, Pl. 15, figs 16, 17.

Material. 71 gyrogonites.

Remarks. Some specimens of *Auerbachichara kisielevskyi* Said. show a variability of the summit and base morphology. The examined material comprises both the specimens with a conical basal pole (Saidakovsky determined this shape of the base as sharply-oval) and the ones with poorly preserved spirals ends at the summit.

Occurrence. The upper part of the Lower Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985) and of Bulgaria (Saidakovsky 1968), as well as the Middle Buntsandstein and Lower Rhaetic of the Polish Lowland.

Auerbachichara rhaetica Bilan 1974
Pl. XI, fig. 3

1974 *Auerbachichara rhaetica* n. sp.; Bilan, p. 486, 487, Pl. I, fig. 3a, b. Text-fig. 3a—d.

Material. Over 250 gyrogonites.

Occurrence. Poland (the Lower Rhaetic).

Auerbachichara polonica Bilan 1974
Pl. XI, fig. 1

1974 *Auerbachichara polonica* n. sp.; Bilan, p. 487, 488, Pl. I, fig. 4a, b, Text-fig. 4a—c.

Material. Over 100 gyrogonites.

Remarks. The description of *Auerbachichara polonica* Bilan determines the variability range of the equatorial angle as 24—30°. The examined material comprises also some specimens showing a slightly lower value of the equatorial angle (EA = 18—30°).

Occurrence. Poland (the Upper Muschelkalk — Lower Rhaetic).

Auerbachichara arguta (Saidakovsky) n. comb.
Pl. XI, fig. 2

1968 *Maslovichara arguta* Saidakovsky, sp. nov.; Saidakovsky, p. 99—100, Pl. 15, figs 3, 4.

Material. 27 gyrogonites.

Description. Gyrogonites prolate (ISI = 168—178), ellipsoidal (ANI = = 50—56). LPA = 430—515 μm, LED = 252—305 μm. Maximum breadth in the middle of a gyrogonite or slightly below. Near the summit the spirals bend along the longitudinal axis forming their ends in the shape of rather low denticles. Apical opening star-shaped or irregularly-pentagonal, 65—80 μm in diameter. 7—8 laterally visible slightly concave, almost flat spirals. Equatorial angle 20—25°. Spirals breadth in the middle part of a gyrogonite 75—90 μm; SPI = 538—640. Interspiral ridges inconspicuous, rather low but broad, blunted, sutures inconspicuous. Basal pole rounded. Basal opening small, pentagonal.

Comparison. *Auerbachichara arguta* (Said.) differs from the similar in size species of the genus *Auerbachichara* in a considerable breadth of the spirals.

Remarks. Since Peck (1957) presented the description of *Stellatochara arguta* and the genus *Maslovichara* Saidakovsky was regarded as a synonym of *Stellatochara* Horn af Rantzien (Kozur 1973), the species *Maslovichara arguta* would be a secondary homonym. However, Peck described as *Stellatochara arguta* the gyrogonites lacking the basic character of the genus — the apical neck. Stating that those gyrogonites have a flat summit and a big apical opening, Grambast (1961) included them to the *Porochara* Mädler.

In the diagnosis of the genus *Auerbachichara* Kisielevsky & Saidakovsky the ends of the spirals at the summit are determined as a "pentadactyl fork" (Kisielevsky 1967, p. 38), or "isolated denticles" (Saidakovsky 1968, p. 102). The ends of the spirals of the specimens included to the *Auerbachichara arguta* (Saidakovsky) are only a little narrowed at the summit and do not form distinctly isolated denticles, then all the more they do not form the typical of *Stellatochara* Horn af Rantzien apical neck. Since the morphology of the summit of those specimens is more approximate to the *Auerbachichara* than to the *Stellatochara*, it was justified to include the species to the organ-genus *Auerbachichara*.

Occurrence. The Middle and Upper Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985) and of Kazakhstan (Kisielevsky 1984), the Anisian and Ladinian of Bulgaria (Saidakovsky 1968) and the Upper Triassic of the Polish Lowland.

Organ-genus *Altochara* Saidakovsky 1968

1968 *Altochara* Saidakovsky, gen. nov.; Saidakovsky, p. 103, 104.
(Type species: *Altochara continua* Saidakovsky 1968, p. 104, Pl. 15, figs 22, 23).

Altochara continua Saidakovsky 1968
Fig. 4

1968 *Altochara continua* Saidakovsky, sp. nov.; Saidakovsky, p. 104, Pl. 15, figs 22, 23.

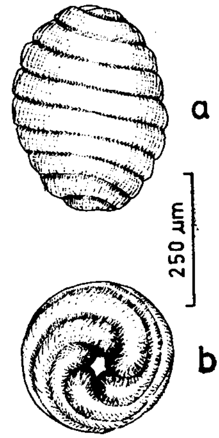


Fig. 4. *Altochara continua* Saidakovsky, a — lateral view, b — apical view

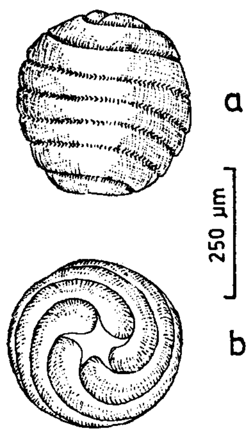


Fig. 5. *Altochara lipatovae* (Kisielevsky) Saidakovsky, a — lateral view, b — apical view

Material. 5 gyrogonites.

Occurrence. The Lower Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985), the Röt of Bulgaria and the Buntsandstein of GDR (Saidakovsky 1968) as well as the Middle Buntsandstein of the Polish Lowland.

Altochara lipatovae (Kisielevsky) Saidakovsky

Fig. 5

1969b *Porochara lipatovae* Kisielevsky sp. nov.; Kisielevsky, p. 28, 29, Pl. I, figs 6, 7.
1969e *Porochara lipatovae* Kisielevsky sp. nov.; Kisielevsky, p. 208, 209, Pl. I, figs A, a.
1968 *Altochara lipatovae* (Kisielevsky) Saidakovsky, comb. nov.; Saidakovsky, p. 105, Pl. 15, figs 24, 25.

Material. 2 gyrogonites.

Remarks. Saidakovsky (1968) gave the description of the genus *Altochara*, to which he included *Altochara lipatovae* (Kisielevsky). He introduced

Porochara lipatovae (Kisielevsky) with an erroneous date of its publishing into the list of the synonyms of that species. The description of *P. lipatovae* Kisielevsky was published in 1969 in two papers of Kisielevsky (1969b, 1969e). The fact that the change in the genus category of that species had been published earlier than its original description was a source of vaguenesses in the nomenclature.

Occurrence. The Lower Triassic of the European part of the USSR (Saidakovsky 1968, 1973; Saidakovsky & Kisielevsky 1985), the Röt of Bulgaria and the Buntsandstein of GDR (Saidakovsky 1968), as well as the Middle Buntsandstein of the Polish Lowland.

PHYLOGENY OF THE TRIASSIC CHAROPHYTES

The occurrence of charophytes was found (Fig. 6) in the Triassic sediments of Europe (Sweden, Poland, GDR, Bulgaria, the European part of the USSR), Asia (Kazakhstan, China) and North America (Arizona, Colorado). Attempts at the determination of phylogenetic affinities between *Charophyta* taxons of

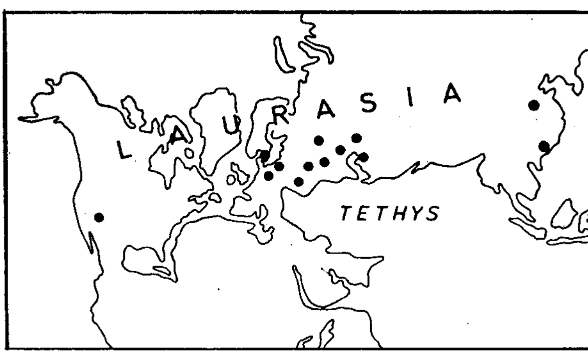


Fig. 6. Geographic distribution of Triassic *Charophyta*

various rank were made a. o. by Maslov (1957, 1963), Grambast (1959a, 1959b, 1964, 1966, 1974), Saidakovsky and Shaikin (1976), Feist and Grambast-Fessard (1984). Phylogenetic interpretations based upon preserved remains of charophytes (gyrogonites, utricles) from the nature of things have their bounds, though Grambast (1974) considered the charophytes to be one of the most convenient plant groups in phylogenetic studies.

The order *Charales* is the only one which has been noted in the paleontological record after the oldest representatives of the *Charophyta* died during Late Devonian and Early Carboniferous. The oldest member of the order is probably *Eochara* Choquette (the family *Eocharaceae* Grambast) from the Devonian. Grambast (1974) paid attention to the fact that in spite of their lesser importance in the Devonian, the *Charales* had then a much greater evolutionary potential than the other orders. Evolutionary progress in the *Charales* was manifested mainly in a progressive reduction and fixation of number of sinistrally coiled spirals (Grambast 1974). *Palaeochara* Bell (*Palaeocharaceae* Pia) from the Pennsylvanian have six spirals, while the other known of that age — *Stomochara* Grambast, *Horniella* Shaikin (*Porocharaceae* Grambast) and the younger ones, have a constant number of five spirals. The phylogenetic importance of the *Porocharaceae* is such, that they represent a common stock from which were derived the post-Paleozoic families (Grambast 1974).

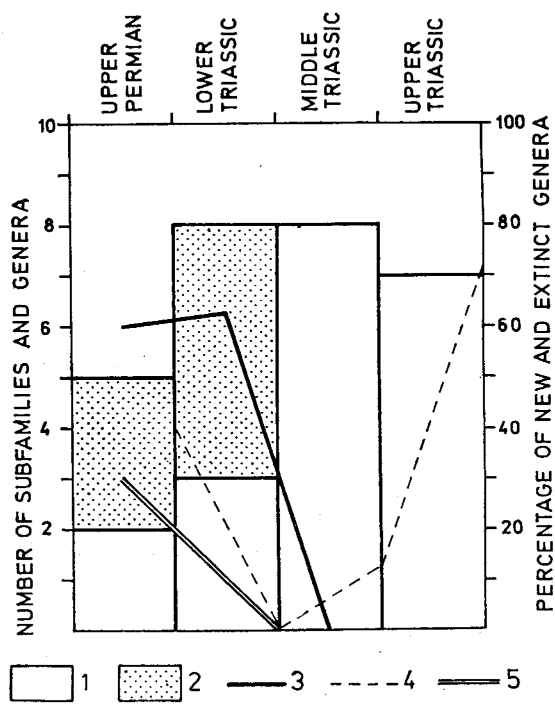


Fig. 7. Diagram of taxonomic diversity (subfamilies and genera) of Charophytes from the Upper Permian to the Upper Triassic. Percentage of new genera and subfamilies marked with dots in the central part of the columns, percentage of genera extinguished during or by the end of a given age interval marked with dots at the right edges of the columns (See "Taxonomic diversity (families and genera) of Charophytes through time" in Grambast 1974). 1 — number of genera having existed from the previous period, 2 — number of genera evolved in a given period, 3 — percentage of new genera, 4 — percentage of extinct genera of a given period, 5 — number of new subfamilies

The taxonomic diversity of genera and subfamilies of charophytes from the Upper Permian to the Upper Triassic is illustrated in Fig. 7. The diagram indicates that the Late Permian and Early Triassic were a period of adaptative radiation of charophytes, the higher categories (subfamilies) belonging to the *Porocharaceae* appeared relatively early, and the rate of their creation decreased with the radiation progress. This supports an opinion of Raup and Stanley (1984) about a characteristic pattern of adaptative radiation.

Variability of the apical pole morphology is a meaningful point in the discussion on phylogeny of the *Porocharaceae*. Maslov (1963) was of the opinion that evolutionary changes in the summit (from formation to declining of the apical opening) had two directions. Paleozoic gyrogonites with the apical opening were in the Mesozoic replaced by the gyrogonites whose apical opening was covered with the ends of thickening spirals which in the begining covered only the opening and finally took an immense part of the summit. This branch of charophytes died out in the Tertiary. Gyrogonites of the other evolutionary branch are characterized by spirals whose ends were not altering their thickness but their breadth to close the opening by converging along a broken line or at one point. This type of structure of the summit show the contemporary *Charoideae*.

Grambast (1974) observed that the morphology of contemporary gyrogonites having five sinistrally coiled cells was formed as early as in the Upper Carboniferous and is characteristic of the *Porocharaceae*. In spite of its long history, the family (whose representatives were still common in the Cretaceous and scarcer in the Lower Paleocene) is relatively uniform, and its diversity is distinctly manifested only in the summit morphology, the apical opening diminishing in time.

The tendencies of decreasing of the diameter of the apical opening were weak during the Triassic period. No general evolutionary changes in shape of the apical opening of the Triassic gyrogonites are recorded, either. Diversity in the summit morphology is reflected in the existence of four evolutionary branches — subfamilies and eight genera — "lineages" (written in inverted commas as refering to phylogeny in a complex meaning, assumed for simplification to be the real lineage — cf. Raup and Stanley 1978).

Porocharoideae

The *Porocharoideae* are particularly worthy of interest as the most stable and the only one known from the paleontological record of the age interval of the Upper Carboniferous — Upper Permian evolutionary branch of *Porocharaceae*. The *Porocharoideae* being the oldest subfamily of the *Porocharaceae*, are characterized by the most primitive summit structure, whose diversity allows three genera comprising probably the respective "lineages": *Porochara* Mädler, *Vladimiriella* Saidakovsky and *Stenochara* Grambast, to be distinguished in the Triassic records.

From among the Mesozoic representatives of the branch, the earliest gyrogonites of the paleontological record are those of *Porochara* (Upper Permian); *Vladimiriella* and *Stenochara* are somewhat later (Lower Triassic). A close morphologic similarity of the oldest representatives of the three "lineages" is striking, as well as their similarity to some of the Upper Permian *Stomochara*. Independently on differences manifested in the summit structure of the mentioned genera, they exhibit similarity in shape, size, number of laterally visible spirals, and commonly in the other taxonomical characters of the species category (situation of maximum diameter, equatorial angle, shape of the basal pole, its form, breadth of spirals and shape of their surface). In the later period (upper part of the Lower Triassic) differences between the forms of *Porochara* with a flat summit, *Stenochara* with its summit ended with a rather low, truncated projection and *Vladimiriella* with a rounded summit, became more conspicuous.

By the end of the Triassic period *Stenochara* and *Vladimiriela* died out, while *Porochara* along with representatives of younger lineages of the *Porocharoideae* was still present in the Jurassic and Cretaceous. The *Raskyellaceae* Grambast and *Characeae* Agardh probably originate from the *Porocharoideae.*

Auerbachicharoideae

Independently on differences in the summit structure the Lower Triassic representatives of the *Auerbachicharoideae* show an apparent similarity to some Upper Permian representatives of *Horniella.* For instance, a great similarity of *Altochara lipatovae* and *Horniella dwinensis* is worth of noting. The *Auerbachicharoideae* are distinct with their summit consisted of the spirals ends in the form of buckles (*Altochara*) or isolated denticles (*Auerbachichara*). Despite the lack of forms that could represent intermediate stages between the *Altochara* and *Auerbachichara* "lineages", the paleontological record as well as the character of the apical pole structure allow *Auerbachichara* to be regarded as having originated from *Altochara.*

Stellatocharoideae

Even the oldest representatives of the *Stellatocharoideae* show a considerable diversity of the genus character — morphology of the apical pole. The Upper Permian *Stellatochara sokolovi* is characterized by a distinct, high apical neck, slightly widened in its upper part, while the Lower Triassic *S. maedleriformis* = = *S. maedleri* has only a rather low apical projection.

Independently on the differences in the summit structure the Upper Permian *Stellatocharoideae* are similar to some Upper Permian *Porocharoideae,* in particular to *Stomochara ascidiiformis.* Saidakovsky and Shaikin (1976) suggested that *Stellatochara* (and *Maslovichara*) is affiliated to the genus *Leonardosia* Sommer, known from the Lower Permian sediments of a distant biogeographic province (Parana). No representatives of this taxonomically poorly known genus have been recorded from Laurasia so far, so the suggestion cited above raises doubts.

The gyrogonites of the *Clavatoraceae* Pia have maintained the apical neck ended with an opening, being characteristic of the *Stellatocharoideae,* though having additional calcareous envelopes — utricles. Grambast (1974) considered the *Clavatoraceae* as having originated from the *Stellatocharoideae.*

Clavatoritoideae

Gyrogonites of this evolutionary branch, being characterized by a conical, pointed (sometimes slightly blunted) summit and a rather small apical opening, appeared in the Upper Permian. Those forms are similar to some Upper Permian species of the genus *Stomochara.*

Not later than in the Lower Triassic, besides the forms belonging to the genus *Clavatorites*, appeared the gyrogonites of a similar summit structure but having the apical depression. The primitive Triassic forms of *Latochara acuta* have although a poorly marked apical depression, hence they can be regarded as intermediate forms between the *Clavatorites* and *Latochara* "lineages". The mentioned feature is distinct only in some species of the genus that come from the Jurassic and Cretaceous periods, for instance in *L. concinna* Peck and *L. collina* Peck.

Saidakovsky and Shaikin (1976) stated that *Latochara* is the ancestor of the genus *Saidakovskiella* Shaikin, whose gyrogonites have also a conical projection at the summit but unlike in *Latochara*, there is no apical opening in it. From such a point of view the *Latochara* — *Saidakovskiella* "lineage" represents a phylogenetic tendency towards declining of the apical opening.

The above statements suggest that the phylogenetic affiliations of the particular components of the family *Porocharaceae* are more or less likely determinable. The present knowledge of the Triassic charophytes allows only for a hypothetical determination of phylogenetic affiliations of particular genera

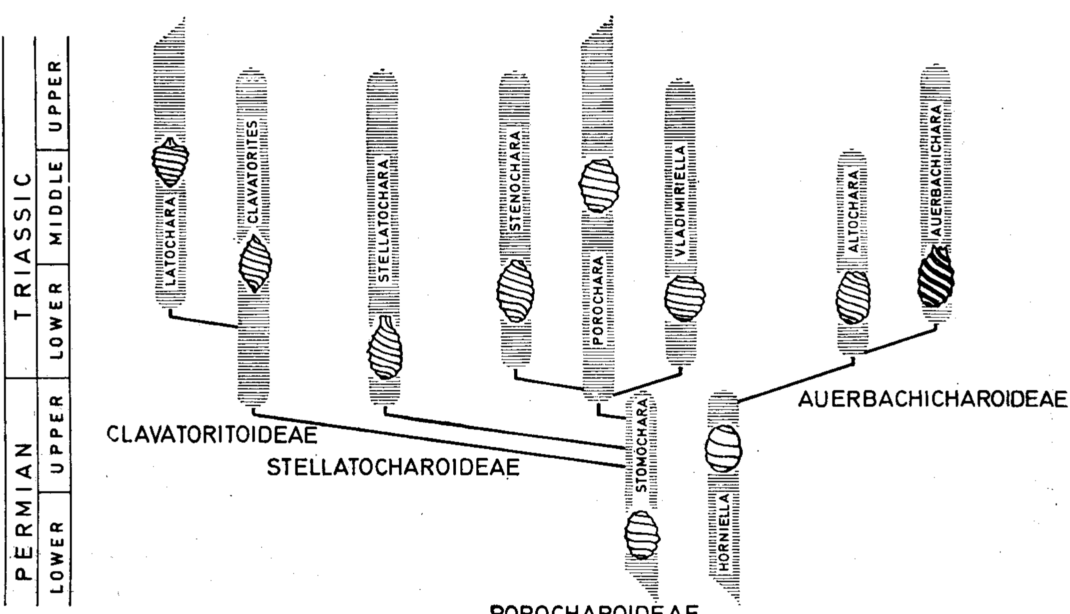


Fig. 8. Hypothetical phylogeny of Triassic *Charophyta*

found in the examined sediments. Basing on diversity in the morphology of the apical pole of gyrogonites and on the mentioned below stratigraphic ranges of the particular genera, a scheme (Fig. 8) has been drawn as an attempt at interpretation of phylogeny of the *Porocharaceae* in the Triassic period.

Subfamily *Porocharoideae* Grambast 1961

Organ-genus *Stomochara* Grambast 1961

First, Pennsylvanian (Desmoinesian): *Stm. moreyi* (Peck 1934) Gramb. 1962.
Last, Upper Permian (Tartarian): *Stm. lubrica* Said. 1968 (nomen nudum), *Stm. diserta* Said. 1968 (nomen nudum), *Stm. ascidiiformis* Kis. 1980, *Stm. acatalecta* Kis. 1980, *Stm. composita* Kis. 1980, *Stm. costata* Kis. 1980, *Stm. cybaea* Kis. 1980, *Stm. constricta* Kis. 1980.

Organ-genus *Horniella* Shaikin 1966

First, Pennsylvanian (Desmoinesian): *H. robertsi* (Peck 1934) Shaikin 1966.
Last, Upper Permian (Tartarian): *H. concinna* Kis. 1980, *H. dwinensis* Kis. 1980.

Organ-genus *Stenochara* Grambast 1962

First, Lower Triassic (Induan): *Stn. maedleri* (H. af R. 1954) Gramb. 1962, *Stn. karpinskyi* (Demin 1956) Koz. & Reinh. 1969.
Last, Upper Triassic (Rhaetic): *Stn. maedleri* (H. af R. 1954) Gramb. 1962, *Stn. elongata* (Said. 1962) Said. 1966a, *Stn. donetziana* (Said. 1960) Said. 1966a, *Stn. kisielevskyi* n. sp.

Organ-genus *Porochara* Mädler 1955

First, Upper Permian (Tartarian): *P. volgensis* Said. 1966b, *P. bachmutica* Said. 1966b.
Last, Upper Cretaceous (Maestrichtian): *P.* sp. Gramb. 1961.

Organ-genus *Vladimiriella* Saidakovsky 1971a

First, Lower Triassic (Induan): *V. globosa* (Said. 1960) Said. 1971a, *V. wetlugensis* (Said. 1962) Said. 1971a.
Last, Upper Triassic (Rhaetic): *V. wetlugensis* (Said. 1962) Said. 1971a, *V. decora* (Said. 1968) Said. 1971a.

Subfamily *Stellatocharoideae* Grambast 1962

Organ-genus *Stellatochara* Horn af Rantzien 1954

First, Upper Permian (Tartarian): *Maslovichara sokolovi* Said. 1966b.
Last, Upper Triassic (Rhaetic): *S. schneiderae* Said. 1962, *S. thuringica* Koz. & Reinh. 1969, *S. silesiana* n. sp.

Subfamily *Clavatoritoideae* Kozur 1973

Organ-genus *Clavatorites* Horn af Rantzien 1954

First, Upper Permian (Tartarian): *Cuneatochara amara* Said. 1968 (nomen nudum).
Last, Upper Triassic (Rhaetic): *Cl. acuminatus* (Said. 1962) Kozur 1974c, *Cl. cuneatus* (Said. 1962) Kozur 1974c.

Organ-genus *Latochara* Mädler 1955

First, Lower Triassic (Olenekian): *L. acuta* Said. 1962.
Last, Lower Cretaceous (Aptian): *L. bellatula* Peck 1957, *L. tenuicostata* Peck 1957.

Subfamily *Auerbachicharoideae* nov. subfam.

Organ-genus *Altochara* Saidakovsky 1968

First, Lower Triassic (Induan): *Al. continua* Said. 1968, *Al. lipatovae* (Kis. 1969) Said. 1968.
Last, Middle Triassic (Ladinian): *Al. delicata* Said. 1968.

Organ-genus *Auerbachichara* Kisielevsky & Saidakovsky 1967

First, Lower Triassic (Olenekian): *A. saidakovskyi* Kis. 1967, *A. achtubiensis* Kis. 1967, *A. starozhilovae* Kis. 1967, *A. baskuntschakiensis* Kis. 1967.
Last, Upper Triassic (Rhaetic): *A. baskuntschakiensis* Kis. 1967, *A. kisielevskyi* Said. 1968, *A. rhaetica* Bilan 1974.

DEVELOPMENT TENDENCIES OF THE TRIASSIC POROCHARACEAE

Analysing the development of charophytes in the Triassic it can be observed that in the Late Permian and Early Triassic some phase of their development was ended, corresponding to the occurrence of the oldest representatives of the family *Porocharaceae* which are the known since the Upper Carboniferous genera *Stomochara* and *Horniella*. By the end of the Permian those oldest representatives of the *Porocharoideae* died out, while the following representatives of the subfamily appeared.

The first phase of the development of the Triassic charophytes, that was the lower part of the Lower Triassic is characterized by a quantitative predominance of the *Porocharoideae* over the other subfamilies. In the Lower Triassic also the *Auerbachicharoideae* and scarce representatives of the *Stellatocharoideae* appeared, whose period of an intensive development began not earlier than in the upper part of the Lower Triassic and the Middle Triassic. Then occurred also the representatives of the *Clavatoritoideae*, though this subfamily was not very sucessive in the Triassic period. *Clavatorites* occurs in the almost whole profile of the Triassic, but never predominates over other genera. *Latochara* occurs sporadically, and the development of this genus was connected with the Jurassic and Cretaceous periods.

The second phase of the development of the Triassic charophytes corresponded to the uppermost part of the Lower Triassic and the Middle Triassic. Besides representatives of *Stellatochara*, predominating in that period, numerous representatives of *Stenochara* occurred together with less abundant representatives of *Clavatorites*, *Porochara* and *Vladimiriella*, that had been present since the first phase of development of these plants.

The third phase corresponding to the Upper Triassic was characterized by the highest number of species having been found. Representatives of *Stellatochara*, *Stenochara*, *Porochara*, *Auerbachichara* and *Clavatorites* were numerous, while those of *Vladimiriella* were less, though particular taxons were associated with environmental conditions being favourable for their development so predominating genera changed with corresponding alterations in those conditions.

After the early period of development of *Porocharaceae*, that corresponded to the Carboniferous and Permian, an intensive development began in the Late Permian and Early Triassic, being probably associated with spreading into new habitats (the stage of adaptative radiation). The fact, that all the genera of the Triassic charophytes appeared during the upper part of the Upper Permian and the lower part of the Lower Triassic, then almost at the same time, is worth of noting. By the end of the Triassic most of the genera of *Porocharaceae* (except of *Porochara* and *Latochara*) died out, and the following development phase of this flora was the Jurassic period. The phenomenon of a mass extinction of the *Porocharaceae* can be explain with declining of most of inland fresh-and brackish-water basins in the Late Triassic and Early Jurassic.

A BIOSTRATIGRAPHIC SUBDIVISION OF THE EPICONTINENTAL TRIASSIC OF POLAND ON THE BASIS OF CHAROPHYTES

Horn of Rantzien (1954) paid attention to a stratigraphic importance of Triassic charophytes since he had found their genus and species differentiation in the zones distinguished by Brotzen (1950) in the Triassic of the Höllviken II profile (Scania).

Saidakovsky (1962, 1966a) distinguished seven charophyte zones in the Triassic of the southern part of the East European Platform, while Kisielevsky (1969a) in relation to the scheme based on differentiation of ostracod assemblages (Rykov et al. 1965) elaborated a biostratigraphical subdivision of the Triassic of the NW part of the Caspian depression basing upon differentiation of the charophyte flora. In the newest subdivision of the Triassic of the East European Platform (Saidakovsky & Kisielevsky 1985) four charophyte zones (Table 8) were distinguished.

Kozur (1974b, 1975) in the sediments of the Lower Triassic of GDR found the occurrence of charophyte assemblages corresponding to the assemblages of

Table 8. Comparison of charophyte subdivisions of the Triassic (correlation of a subdivision of the Muschelkalk of Poland with the chronostratigraphic division after Kozur 1975)

DONBASS — Saidakovsky 1962

UPPER	RHAETIAN	VII-Clavatoraceae
UPPER	CARNIAN-NORIAN	VI-Characeae
LOWER	OLENEKIAN	V-Stellatochara dnjeprovica
LOWER	OLENEKIAN	IV-Stenochara donetziana
LOWER	INDUAN	III-Porochara triassica
LOWER	INDUAN	II-Sphaerochara globosa
LOWER	INDUAN	I-Sphaerochara karpinskyi

CASPIAN DEPRESSION — Kisielevsky 1969

UPPER		
UPPER		VI-Stellatochara dnjeprovica ?
MIDDLE	LADINIAN	V-Stellatochara hoellvicensis, Maslovichara magna, Stenochara saratoviensis
MIDDLE	ANISIAN	IV-Stellatochara dnjeproviformis, Maslovichara incerta
MIDDLE	OLENEKIAN	III-Porochara triassica, Sphaerochara wetlugensis
MIDDLE	OLENEKIAN	II-Porochara movschovichii, Porochara lutkevichii
LOWER	INDUAN	I-Sphaerochara globosa, Porochara belorussica

EUROPEAN PART USSR — Saidakovsky 1973

UPPER	RHAETIAN	VII-Maslovichara lipatovae
UPPER	KEUPER	VI Stellatochara • hoellvicensis
MIDDLE	LADINIAN	V-Stellatochara dnjeprovica
MIDDLE	ANISIAN	IV-Stenochara donetziana
MIDDLE		III-Porochara triassica
LOWER		II-Sphaerochara globosa
LOWER		I-Sphaerochara karpinskyi

EAST EUROPEAN PLATFORM — Saidakovsky, Kisielevsky 1985

UPPER		IV-Stellatochara hoellvicensis, Stenochara pseudoovata
MIDDLE	LADINIAN	IV-Stellatochara hoellvicensis, Stenochara pseudoovata
MIDDLE	ANISIAN	III-Stellatochara dnjeproviformis, Stenochara donetziana
MIDDLE	OLENEKIAN	II-Porochara triassica, Auerbachichara baskuntschakiensis
LOWER	INDUAN	I-Vladimiriella wetlugensis, Altochara continua

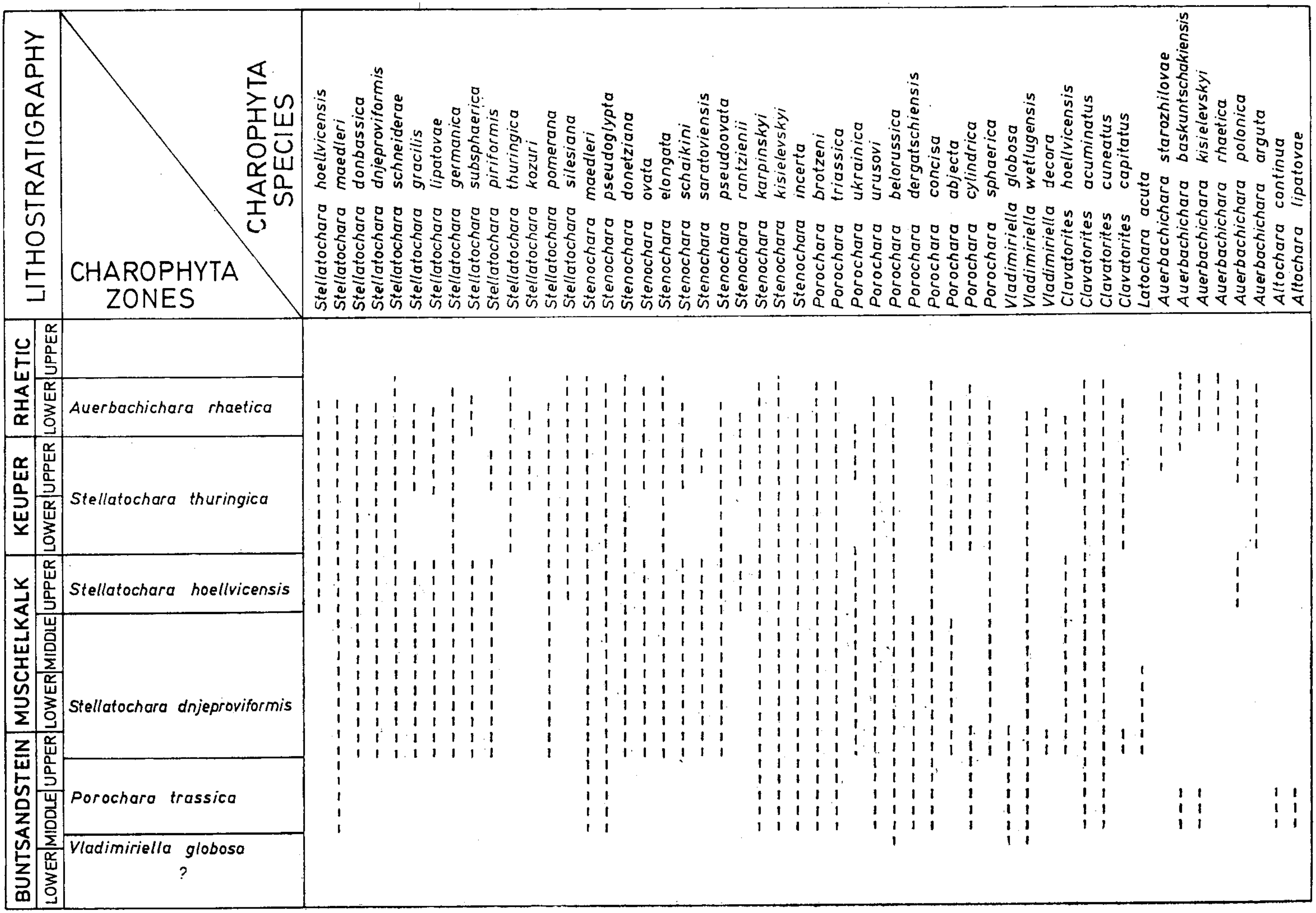
CORRELATION OF THE GERMANIC TRIASSIC WITH THE TETHYAN — Kozur 1975 (generalized)

UPPER	RHAETIAN		RHÄTKEUPER (ko)	
UPPER	NORIAN	SEVATIAN	STEINMERGELKEUPER (km_4)	
UPPER	NORIAN	ALAUNIAN		
UPPER	NORIAN	LOWER NORIAN		
UPPER	CARNIAN	TUVALIAN	OBERER GIPSKEUPER (km_3)	
UPPER	CARNIAN	JULIAN	SCHILFSANDSTEIN (km_2)	
UPPER	CARNIAN	CORDEVOLIAN	UNTERER GIPSKEUPER (km_1)	
MIDDLE	LADINIAN	LONGOBARDIAN	LETTENKEUPER (ku)	Stellatochara lipatovae A.-Z.
MIDDLE	LADINIAN	LONGOBARDIAN	OBERER HAUPTMUSCHELKALK (mo_3)	Stellatochara germanica A.-Z.
MIDDLE	LADINIAN	FASSANIAN	MITTLERER HAUPTMUSCHELKALK (mo_2)	Stellatochara sellingii Z.; Stellatochara hoellvicensis hoellvicensis A.-Z.
MIDDLE	ANISIAN	ILLYRIAN	UNTERER HAUPTMUSCHELKALK (mo_1)	Stellatochara hoellvicensis hoellvicensis A.-Z.
MIDDLE	ANISIAN	ILLYRIAN	MITTLERER MUSCHELKALK (mm_1) (mm_2) (mm_3)	Stellatochara hoellvicensis dnjeproviformis A.-Z.
MIDDLE	ANISIAN	ILLYRIAN	SCHAUMKALK i.e.S. (mu_{2x})	
MIDDLE	ANISIAN	PELSONIAN	(mu_2)	
MIDDLE	ANISIAN	PELSONIAN	TEREBRATEL-ZONE ($mu_{2\tau}$)	
MIDDLE	ANISIAN	PELSONIAN	($mu_{1\gamma}$)	
MIDDLE	ANISIAN	BITHYNIAN	($mu_{1\beta}$)	↓
MIDDLE	ANISIAN	AEGEANIAN	($mu_{1\alpha}$)	?
MIDDLE	ANISIAN	AEGEANIAN	OBERRÖT (so_2)	?
LOWER	OLENEKIAN		UNTERRÖT ($so_{1\beta}$)	↑
LOWER	OLENEKIAN		SOLLING-FOLGE ($so_{1\alpha}$)	
LOWER	OLENEKIAN		HARDEGSEN-FOLGE (sm_3)	Porochara triassica A.-Z.
LOWER	JAKUTIAN		DETFURTH-FOLGE (sm_2)	A.-Z. with Stenochara globosa and Porochara belorussica
LOWER	JAKUTIAN		VOLPRIEHAUSEN-FOLGE (sm_1)	
LOWER	BRAHMANIAN	GANDARIAN	OBERE-FOLGE (su_3)	
LOWER	BRAHMANIAN	ELLESMERIAN	UNTERE-FOLGE (su_2)	
LOWER	BRAHMANIAN	ELLESMERIAN	BRÖCKELSCHIEFER (su_1)	

POLISH LOWLAND — Bilan (this paper)

RHAETIC	UPPER	
RHAETIC	LOWER	Auerbachichara rhaetica
KEUPER	UPPER	Stellatochara thuringica
KEUPER	LOWER	
MUSCHELKALK	UPPER	Stellatochara hoellvicensis
MUSCHELKALK	MIDDLE	Stellatochara dnjeproviformis
MUSCHELKALK	LOWER	
BUNTSANDSTEIN	UPPER	Porochara triassica
BUNTSANDSTEIN	MIDDLE	Vladimiriella globosa ↓ ?
BUNTSANDSTEIN	LOWER	

Table 9. Stratigraphic range of the species of *Charophyta* in the Triassic of Poland and a proposed biostratigraphic subdivision



the zones distinguished in the Triassic of the European part of the USSR, while in the Middle Triassic he distinguished five charophyte zones: the *Stellatochara hoellvicensis dnjeproviformis* Assemblage-zone, *Stellatochara hoellvicensis hoellvicensis* Assemblage-zone, *Stellatochara sellingii* Zone, *Stellatochara germanica* Assemblage-zone, *Stellatochara lipatovae* Assemblage-zone (Table 8).

A comparison of stratigraphic ranges of some species in various regions suggests that they may differ. In a number of cases it cannot be excluded that a stratigraphic range of particular taxons does not reflect evolution of the charophyte flora, but has been paleoecologically determined; in other cases differentiation of the vertical range of species is an effect of errors in correlation of subdivisions of the East European Triassic with the chronostratigraphic subdivision; in yet other cases it may result from insufficiently rich material. A wide distribution of charophytes, time differentiation of their assemblages, and a precised age interval of index species, justify their usefulness either for purposes of local age correlations or for regional parallelizations, as well as even for intercontinental parallelizations (of sediments of continental facies).

The subdivision proposed by author (Tables 8 and 9) and related to the subdivisions given by Saidakovsky (1962, 1966a, 1973), Kisielevsky (1969a), Kozur (1974b, 1975), and Saidakovsky and Kisielevsky (1985),

Table 10. Charophyte zones related to some lithostratigraphic subdivisions of the Buntsandstein of North and North-eastern Poland (correlation of subdivisions after Szyperko-Śliwczyńska 1980)

<table>
<tr><th rowspan="2">CHAROPHYTA ZONES</th><th colspan="9">LITHOSTRATIGRAPHY</th></tr>
<tr><th colspan="3">WESTERN POMERANIA
Szyperko-Teller 1982 (generalized)</th><th>NORTH-EASTERN POLAND
Szyperko-Śliwczynska 1979</th><th colspan="5">EAST-EUROPEAN PLATFORM
Fuglewicz 1973, 1980</th></tr>
<tr><td></td><td rowspan="9">BUNTSANDSTEIN</td><td rowspan="2">UPPER</td><td rowspan="2">BARWICE FORMATION</td><td rowspan="2">ROETIAN</td><td rowspan="9">BUNTSANDSTEIN</td><td rowspan="3">UPPER</td><td rowspan="3" colspan="2">Meridional Megacyclothem</td><td rowspan="3">RÖT</td></tr>
<tr><td rowspan="4">Porochara triassica</td></tr>
<tr><td rowspan="4">MIDDLE</td><td rowspan="2">POŁCZYN FORMATION</td><td>ELBLĄG FORMATION</td></tr>
<tr><td>MALBORK FORMATION</td><td rowspan="4">MIDDLE</td><td rowspan="6">Boreal Megacyclothem</td><td>Cyclothem Ic</td><td>SUPRA-OOLITIC BEDS</td></tr>
<tr><td rowspan="2">POMERANIA FORMATION</td><td rowspan="2">LIDZBARK FORMATION</td><td rowspan="3">Cyclothem Ib</td><td rowspan="2">UPPER-OOLITIC BEDS</td></tr>
<tr><td rowspan="4">Vladimiriella globosa
↓
?</td></tr>
<tr><td rowspan="3">LOWER</td><td>BALTIC FORMATION</td><td rowspan="3">BALTIC FORMATION</td><td>INTER-OOLITIC BEDS</td></tr>
<tr><td rowspan="2">REWAL FORMATION</td><td rowspan="2">LOWER</td><td rowspan="2">Cyclothem Ia</td><td>LOWER-OOLITIC BEDS</td></tr>
<tr><td>SUB-OOLITIC BEDS</td></tr>
</table>

Table 11. Charophyte zones related to some lithostratigraphic subdivisions of the Muschelkalk of Poland (correlation of subdivisions after Senkowiczowa 1979)

<table>
<tr><th rowspan="3">CHAROPHYTA ZONES</th><th colspan="7">LITHOSTRATIGRAPHY</th></tr>
<tr><th colspan="4">FORE-SUDETIC MONOCLINE</th><th rowspan="2">NORTH-SUDETIC DEPRESSION
Milewicz, Wójcik 1973</th><th rowspan="2">WESTERN POMERANIA
Gajewska 1971</th><th rowspan="2">PERI-BALTIC SYNECLISE WESTERN PART
Dadlez et al. 1976</th></tr>
<tr><th colspan="3">SOUTH-EASTERN PART
Kłapciński 1959</th><th>NORTH-WESTERN PART
Senkowiczowa 1973</th></tr>
<tr><td rowspan="4">Stellatochara hoellvicensis</td><td rowspan="12">MUSCHELKALK</td><td rowspan="4">UPPER</td><td>BORUSZOWICE BEDS</td><td rowspan="3">CERATITES BEDS</td><td rowspan="6">?</td><td rowspan="3">UPPER SERIES</td><td rowspan="12">LĘBORK BEDS</td></tr>
<tr><td>KOLONIA WILKOWICE BEDS</td></tr>
<tr><td>WILKOWICE BEDS</td></tr>
<tr><td>TARNOWICE BEDS</td><td>GLAUKONITIC BEDS
M.TRANSVERSA BEDS</td><td>LOWER SERIES</td></tr>
<tr><td rowspan="8">Stellatochara dnjeproviformis</td><td rowspan="2">MIDDLE</td><td>UPPER MEMBER</td><td rowspan="2">undivided</td><td rowspan="2">undivided</td></tr>
<tr><td>LOWER MEMBER</td></tr>
<tr><td rowspan="6">LOWER</td><td>KARCHOWICE BEDS</td><td>M.ORBICULARIS BEDS</td><td rowspan="3">FOAM LIMESTONE BEDS</td><td rowspan="3">SERIES C</td></tr>
<tr><td>TEREBRATULA BEDS</td><td rowspan="2">FOAM LIMESTONE BEDS</td></tr>
<tr><td>GÓRAŻDŻE BEDS</td></tr>
<tr><td>UPPER GOGOLIN BEDS</td><td rowspan="2">CRUMPLED BEDS</td><td rowspan="2">CRUMPLED BEDS</td><td rowspan="2">SERIES B</td></tr>
<tr><td>LOWER GOGOLIN BEDS</td></tr>
<tr><td></td><td>MARLY BEDS</td><td>MYOPHORIA BEDS</td><td>SERIES A</td></tr>
</table>

bases upon ranges of species recorded from profiles of various parts of the country. The definitions of two lowest zones (Buntsandstein — Table 10) base upon the species ranges determined in relatively scarce profiles situated in the NE and N part of the country. The following two zones (Röt — Muschelkalk — Tables 10 and 11) are elaborated basing upon the species ranges determined in scarce profiles located in peripheral parts of the basin. The fact that charophytes are limited to peripheral parts of the basin is determined by their preference of biotopes of favourable bathymetric environmental conditions. A specific character of the mentioned zones is their discontinuity, reflected in a discontinuous range of taxons, including index fossils. Alterations of environmental conditions effected in the occurrence of charophyte assemblages in relatively narrow intervals of a profile, separated with sections lacking gyrogonites. Charophytes occur in several to some scores meters thick profile intervals separated with differently long sections lacking those microfossils (Lower Triassic), or are present only in single samples (Middle Triassic). Other organic remains as megaspores, ostracods, phyllopods, fish teeth, appear in similar intervals. The uppermost two zones (Table 12) are defined basing upon relatively numerous data. In the Keuper and Rhaetic sediments the gyrogonite-lacking intervals

Table 12. Charophyte zones related to some lithostratigraphic subdivisions of the Keuper and Rhaetic of Poland (correlation of subdivisions after Senkowiczowa 1979, 1980)

<table>
<tr><th rowspan="3">CHAROPHYTA ZONES</th><th colspan="6">LITHOSTRATIGRAPHY</th></tr>
<tr><th colspan="4">POLISH LOWLAND</th><th colspan="2">UPPER SILESIAN COAL BASIN</th></tr>
<tr><th colspan="3">WESTERN PART
Keuper-Szyperko-Śliwczyńska 1960; Rhaetic-Kopik 1967, 1973</th><th>CENTRAL PART
Deczkowski 1977</th><th>NORTH-EASTERN MARGIN
Grodzicka-Szymanko, Orłowska-Zwolinska 1972</th><th>EASTERN MARGIN
Bilan 1976a (generalized)</th></tr>
<tr><td></td><td rowspan="4">RHAETIC</td><td>UPPER</td><td rowspan="2">ZBĄSZYNEK BEDS</td><td rowspan="2">ZBĄSZYNEK BEDS</td><td>CYCLOTHEM R II</td><td>erozion
HIGHER PART OF RHAETIC SEDIMENTS</td></tr>
<tr><td rowspan="3">Auerbachichara rhaetica</td><td rowspan="3">LOWER</td><td rowspan="3">CYCLOTHEM R I</td><td rowspan="3">erosion
GRABOWA FORMATION</td></tr>
<tr><td>JARKOWO BEDS</td><td rowspan="2">JARKOWO BEDS</td></tr>
<tr><td>DRAWNO BEDS</td></tr>
<tr><td rowspan="4">Stellatochara thuringica</td><td rowspan="4">KEUPER</td><td rowspan="3">UPPER</td><td>UPPER GYPSUM SERIES</td><td>UPPER GYPSUM SERIES</td><td>hiatus</td><td>erosion</td></tr>
<tr><td>REED SANDSTONE</td><td>REED SANDSTONE</td><td>REED SANDSTONE</td><td>BOLESŁAW FORMATION</td></tr>
<tr><td>LOWER GYPSUM SERIES
Grendzdolomit</td><td>LOWER GYPSUM SERIES</td><td>LOWER GYPSUM KEUPER AND GRENZDOLOMIT</td><td rowspan="2">CHRZANÓW FORMATION
erosion</td></tr>
<tr><td>LOWER</td><td>LETTENKOHLE BEDS</td><td>LOWER KEUPER</td><td>hiatus</td></tr>
</table>

of a profile are usually comparatively shorter than in the Lower and Middle Triassic. A characteristic "discontinuity" of species ranges caused by changes in environmental conditions (cf. the chapter "Paleoecology of the Triassic charophytes") may be differentiated in character, not only between different regions but also within one sedimentary basin. Considering a differentiated number and thickness of the charophyte-lacking intervals of a profile, it is unjustified to distinguish barren intrazones and interzones.

Charophyte assemblages of the Triassic display their variability being in a considerable part an effect of environmental conditions. As a result, different parts of a profile may have assemblages of a similar species composition (cf. the chapters: "Differentiation of charophyte assemblages" and "Occurrence of charophyte assemblages"). Hence, it seems unjustified to distinguish assemblage zones representing in a high degree particular environmental conditions, instead of distinguishing of partial range zones, whose limits are precised by the occurrence of index species. The proposed subdivision comprises six zones: the *Vladimiriella globosa* Partial-range-zone, *Porochara triassica* Partial-range-zone, *Stellatochara dnjeproviformis* Partial-range-zone, *Stella-*

tochara hoellvicensis Partial-range-zone, *Stellatochara thuringica* Partial-range--zone, and *Auerbachichara rhaetica* Range-zone (Table 9).

Because of discontinuity in the charophyte occurrence ranges of the distinguished zones have been determined with various precision. Because gyrogonites have not been found close to the limits of lithostratigraphical units, the limits of the zones are determined only conventionally. These limits agree with the limits of the lithostratigraphical units, or lie within them, the barren intervals of a profile being the intervals of correlation error.

Vladimiriella globosa Partial-range-zone

Index species. *Vladimiriella globosa* (Saidakovsky) Saidakovsky 1971a, p. 119 = *Tolypella globosa* Saidakovsky 1960, p. 56, Pl. I, fig. 4a = *Sphaerochara? globosa* (Saidakovsky) Saidakovsky 1966a, pp. 137—138, Pl. IV, figs 11—13.

Definition. The range of the zone corresponds to the part of the *Vladimiriella globosa* stratigraphic range that does not overlap the stratigraphic range of *Porochara triassica* (Said.). Besides the index species, *Vladimiriella wetlugensis* (Said.) and *Porochara belorussica* Said. occur in the zone.

Stratigraphy. The *Vladimiriella globosa* Zone has been determined only in the Olsztyn IG-2 borehole (depth of 1566.5 m and 1563.5 m) in the lower part of the sediment complex refered to as the Lidzbark Formation (Szyperko-Śliwczyńska 1979, 1980). Szyperko-Śliwczyńska regarded the Lidzbark Formation as the lowermost part of the Middle Buntsandstein. The sediments, determined as upper oolitic beds (Fuglewicz 1973), corresponding to the distinguished by Znosko (1973) complexes 6 and 7, were included by Fuglewicz (1980) to the middle part of the Middle Buntsandstein. The sediments comprise megaspores of the *Trileites polonicus* — *Pusulosporites populosus* Zone (Fuglewicz 1980) and ostracods of the *Lutkevichinella mazurensis* Zone (Styk 1982).

Lithology. The lower part of the Lidzbark Formation profile comprises sandy rocks (sandstones, silty sandstones, sandy mudstones) and grey, greyish-green, greyishviolet, scarcer red, claystone-mudstone, mostly calcareous, locally with numerous streaks, and intercalations of limestones (Szyperko-Śliwczyńska 1979).

Remarks. The described zone corresponds to the *Sphaerochara? globosa* Zone (Saidakovsky 1962, 1966a, 1973) and *Sphaerochara globosa* — *Porochara belorussica* Zone (Kisielevsky 1969a) compared with the ostracod zone of the oval *Darwinula* (Rykov et al. 1965) and with the zones: I — *Sphaerochara? karpinskyi* and II — *Sphaerochara globosa* of the subdivision given by Saidakovsky (1962). Those zones were distinguished within the Vetluga Group, whose age is determined as the Induan (Saidakovsky 1966; Kisielevsky 1969a). Kozur (1975) in the sediments (Volpriehausen — Folge, Detfurth — Folge) determined as the Jakutian in GDR found the following species: *Porochara* *belorussica* Said., *P. lipatovae* Kis., *Stellatochara maedleriformis* Said., *Stenochara globosa* (Said.), *Stn. latzkovae* Kis., *Stn. maedleri* (H. af R.) and *Stn. pseudoglypta* (H. af R.). He compared that assemblage to the charophyte assemblage of the upper part of the Vetluga Group. Kozur (1974b) stated that the border between the *Stenochara globosa* and *Porochara belorussica* Assemblage-zone (=*Sphaerochara globosa* and *Porochara belorussica* Zone — Kisielevsky 1969a) and the *Porochara triassica* Assemblage-zone (= *Porochara triassica* Zone — Saidakovsky 1966a) corresponds to the Jakutian/Olenekian border.

The occurrence of the typical species of the *Vladimiriella globosa* Zone in the sediments of the lower part of the Lidzbark Formation allows this part to be compared, in only a general respect, with the upper part of the Vetluga Group. A more detailed correlation is excluded, since the upper limit of the zone has been only approximately determined in one profile from Poland and the lower limit has not been determined yet. Movshovich and Kozur (1975) parallelized the Vetluga Group with the Lower and Middle Buntsandstein of GDR.

Geographic distribution. The *Vladimiriella globosa* Zone is widely distributed in the Lower Triassic of the European part of the USSR and in GDR.

Porochara triassica Partial-range-zone

Index species. *Porochara triassica* (Saidakovsky) Grambast 1961, p. 201 = *Aclistochara triassica* Saidakovsky 1960, pp. 55—56, Pl. I, fig. 3a, b.

Definition. The range of the zone corresponds to that part of the stratigraphic range of *Porochara triassica*, which does not overlap the range of *Stellatochara dnjeproviformis* Said. Besides the index species the following ones occur in the zone: *Stellatochara maedleri* H. af R., *Stenochara maedleri* (H. af R.), *Stn. pseudoglypta* (H. af R.), *Stn. karpinskyi* (Demin), *Stn. kisielevskyi* n. sp., *Stn. incerta* n. sp., *Porochara brotzeni* (H. af R.), *P. urusovi* Said., *P. dergatschiensis* Kis., *P. concisa* Said., *P. cylindrica* Kis., *Clavatorites acuminatus* (Said.), *Cl. cuneatus* (Said.), *Auerbachichara baskuntschakiensis* Kis., *A. kisielevskyi* Said., *Altochara continua* Said., *Al. lipatovae* (Kis.). There occur also: *Vladimiriella globosa* (Said.), *V. wetlugensis* (Said.) and *Porochara belorussica* Said.

Stratigraphy. The species of the *Porochara triassica* Zone have been found in the upper part of the Lidzbark Formation (the boreholes: Bartoszyce IG-1, depth of 1013.0 m, 995.0 m, 990.0 m; Gołdap IG-1, depth of 778.0 m; Nidzica IG-1, depth of 2029.0 m) in the Malbork Formation (the boreholes: Bartoszyce IG-1, depth of 985.0 m, 964.0 m; Udryń IG-1, depth of 616.0 m, 610.5 m, 601.0 m; Gołdap IG-1, depth of 772.0 m, 767.0 m, 697.5 m; Pasłęk IG-1, depth of 1238.0 m) and in the Połczyn Formation (the Debrzno IG-1 borehole, depth of 1915.0 m).

The Malbork Formation, previously determined as the Lower Warmia series (Szyperko-Śliwczyńska 1962, 1973; Dadlez & Szyperko-Śliwczyńska 1965) comprises, according to Szyperko-Śliwczyńska (1979, 1980), the middle part of the Middle Buntsandstein. The Malbork Formation corresponds to the distinguished by Znosko (1973) in the Suwałki district complexes 8—10 and to the supra-oolitic beds from the subdivision of Fuglewicz (1973). The supra-oolitic beds comprise, according to Fuglewicz (1980), the upper part of the Middle Buntsandstein. Also the Połczyn Formation, defined by Szyperko-Teller (1982) and determined previously as the Połczyn series (Szyperko-Śliwczyńska 1973, 1976) comprises, according to its author, the upper part of the Middle Buntsandstein.

Lithology. The upper part of the Lidzbark Formation comprises mudstone-claystone rocks: grey, greyishgreen, greyishviolet, less commonly red, mostly calcareous, partly with intercalations of oolitic limestones (Szyperko-Śliwczyńska 1979). The profile of the Malbork Formation comprises sandstone-mudstone-claystone sediments, being calcareous and predominatly brick red. Sandstones occur mainly in the lowermost part of the profile, represented by fine-grained sandstones, sometimes of diagonal bedding, as well as mudstones and claystones. A monotonous claystone-mudstone complex with irregular concretionary carbonate intergrowths lies upward (Szyperko-Śliwczyńska 1979). The Połczyn Formation consists of a complex of alternate fine-grained sandstones and mudstone-claystone rocks (Szyperko-Teller 1982). Brick red and pinkishred, less commonly white and green, sandstones are often diagonally bedded, partly calcareous, sometimes contain gravels of mudstone-claystone rocks. The mudstone-claystone rocks are usually calcareous, brownishred, locally contain calcareous concretionary aggregates.

Discussion. The described zone corresponds to the *Porochara triassica* Zone (Saidakovsky 1962, 1966a, 1973), compared (Kisielevsky 1969a) with the zones: II — *Porochara movschovichii* and *P. lutkevichii*, and III — *Porochara triassica* and *Sphaerochara wetlugensis*. The range of those zones corresponds, according to Kisielevsky (1969a) to the Baskunchak Group (Olenekian) and the ostracod *Gerdalia* and elongate *Darwinula* Zone (Rykov et al. 1965). In the newest charophyte subdivision (Saidakovsky & Kisielevsky 1985) this unit is determined as the *Porochara triassica* and *Auerbachichara baskuntschakiensis* Zone.

Szyperko-Teller (1982) compared the Lidzbark Formation with the Pomorze Formation of the West Pomerania as well as with the Volpriehausen-Folge of GDR. The Połczyn Formation of the West Pomerania was associated by that author with the uppermost parts of the Buntsandstein of the Polish-German Lowland, that is with the Malbork Formation and the Elbląg Formation (NE Poland) as well as with the Detfurth-Folge, Hardegsen-Folge and partly Solling-Folge GDR. The border between the *Stenochara globosa* and *Porochara belorussica* Assemblage-Zone and the *Porochara triassica* Assemblage-zone corresponds, according to Kozur (1975), to the border between the Detfurth-Folge and the Hardegsen-Folge, whereas in the Olsztyn IG-2 profile, the border between the *Vladimiriella globosa* Partial-range-zone (corresponding to the

Stenochara globosa and *Porochara belorussica* Assemblage-zone) and the *Porochara triassica* Partial-range-zone (corresponding to the *Porochara triassica* Assemblage-zone) lies within the Lidzbark Formation. This allows to suppose that the Lidzbark Formation and the correlated with it Pomorze Formation (Szyperko-Teller 1982) at least in part correspond to the Detfurth-Folge and Hardegsen-Folge. The Malbork Formation and the Elbląg Formation (correlated with the Połczyn Formation-Szyperko-Śliwczyńska 1979) are, on the contrary, comparable with the upper part of the Hardegsen-Folge and, at least in part, with the Solling-Folge.

The question of accuracy of the determination of the upper limit of the zones — *Porochara triassica* (after the subvision of Saidakovsky) and — *Porochara triassica*, *Sphaerochara wetlugensis* (after the subdivision of Kisielevsky), raises some doubts. Both authors identified the limit with the Olenekian/Anisian border. In the stratotypic profile of the Baskunchak Group, Saidakovsky and Kisielevsky (1972) found variation in the species composition and distinguished three charophyte assemblages. They considered that the differentiation of the assemblages is of a local importance and regarded the three distinguished assemblages as corresponding to the *Porochara triassica* Zone. *Maslovichara gracilis*, *M. incerta*, *Stellatochara dnjeproviformis*, and *Stenochara ovata*, found in the upper part of this group (Movshovich 1967 — vide Saidakovsky & Kisielevsky 1972) were regarded as erroneously determined, moreover Saidakovsky and Kisielevsky in the charophyte assemblage of those sediments found the occurrence of *Stenochara donetziana*, the index species of the following zone of the subdivision of Saidakovsky (1962, 1966a, 1973).

The occurrence of *Tirolites cassianus* (Shevyrev 1968) within the Bogdo Formation allows that formation to be parallelized (Movshovich & Kozur 1975) with the Lower part of the Olenekian and the lower part of the Upper Buntsandstein of GDR (Kozur 1974a, 1974b). The following unit of the Baskunchak Group — the Enotaevka Formation, corresponding to the middle part of the Upper Buntsandstein contains the charophytes that indicate according to Kisielevsky (vide Movshovich & Kozur 1975, p. 107) the Lower Anisian development of its upper part. The border between the *Porochara triassica* Zone and the charophyte zone of the Anisian lies thus probably within the upper part of the Enotaevka Formation, corresponding to the Lower Röt (Movshovich & Kozur 1975).

The *Porochara triassica* Zone in the northern part of Poland comprises the sediments of the upper part of the Middle Buntsandstein, the upper limit of the zone having not been precisely determined yet. Since the lower limit of the *Stellatochara dnjeproviformis* Zone lies within the Röt sediments, the *Porochara triassica* Zone may comprise the sediments of the lower part of the Upper Buntsandstein (in the sediments of the Elbląg Formation no determinable gyrogonites have been found). Also Kozur (1974c) did not define the border between the *Porochara triassica* Assemblage-zone and *Stellatochara hoellvicensis dnjeproviformis* Assemblage-zone.

Remarks. The index species of the described zone occurs in both the *Porochara triassica* Zone of the Saidakovsky's subdivision (1962, 1966a, 1973) and the corresponding (according to Kisielevsky 1969a) zones: II — *Porochara movschovichii* and *P. lutkevichii*, and III — *Porochara triassica* and *Sphaerochara wetlugensis*. Thist fact justifies distinguishing of both the widely geographically distributed *Porochara triassica* Zone and the located in the lower part of it *Porochara movschovichii, P. lutkevichii* Subzone, whose geographic distribution is limited (NW part of the Caspian Depression).

Geographic distribution. The *Porochara triassica* Zone is widely distributed in many regions of the southern part of the East European Platform, the western part of Kazakhstan, the Röt of the Kaliningrad district, GDR and Bulgaria (Saidakovsky 1973), as well as in the North Poland.

Stellatochara dnjeproviformis Partial-range-zone

Index species. *Stellatochara dnjeproviformis* Saidakovsky 1966, p. 119—120, Pl. I, figs 11—13 (synonyms: *Maslovichara incerta Saidakovsky* 1966a, p. 122, 123, Pl. II, figs 5, 6; *Maslovichara brevicula* Saidakovsky 1968, p. 95, 96, Pl. 15, figs 1, 2).

Definition. The range of the zone corresponds to that part of the stratigraphic range of *Stellatochara dnjeproviformis*, that does not overlap the range of *Stellatochara hoellvicensis* H. af. R. Besides the index species, the zone comprises the following: *Stellatochara donbassica* (Demin), *S. schneiderae* Said., *S. gracilis* (Said.), *S. lipatovae* (Said.), *S. germanica* Koz. & Reinh., *S. subsphaerica* Koz. & Reinh., *S. piriformis* Koz. & Reinh., *S. pomerana* n. sp., *Stenochara donetziana* (Said.), *Stn. ovata* (Said.), *Stn. elongata* (Said.), *Stn. schaikini* Said., *Stn. saratoviensis* Kis., *Stn. pseudoovata* Said., *Porochara ukrainica* Said., *P. abjecta* Said., *P. sphaerica* Kis., *Vladimiriella decora* (Said.), *Clavatorites hoellvicensis* H. af R., *Cl. capitatus* (Said.), *Latochara acuta* Said. There appear also numerous species known from both the *Porochara triassica* Zone and *Vladimiriella globosa* Zone (Table 9).

Stratigraphy. The species of the described zone have been found in the Röt sediments (the boreholes: Człuchów IG-2, depth of 2153.4 m, 2098.5 m; Brda 7, depth of 1315.0 m, 1306.0 m, 1305.0 m; Debrzno IG-1, depth of 1794.0 m, 1792.5 m; Klosnowo IG-1, depth of 1555.4 m; Krynica Morska IG-1, depth of 740.0 m, 736.0 m; Ełk IG-1, depth of 751.5 m; Ostrów Mazowiecka IG-1, depth of 1168.9 m, 1163.0 m; Brańsk IG-1, depth of 580.0 m; Okuniew IG-1, depth of 1802.0 m; Żebrak IG-1, depth of 1012.5 m), the Röt/Muschelkalk border sediments (the Prabuty IG-1 borehole, depth of 1526.0 m), the Lower Muschelkalk (the U-107 borehole, depth of 31.0 m) and the Middle Muschelkalk (the Jamno 3 borehole, depth of 1190.0 m, 1174.5 m). The lower limit of the *Stellatochara dnjeproviformis* Zone range lies then within the Röt sediments, determined (Senkowiczowa 1958; Senkowiczowa & Szyperko-Śliwczyńska 1972) as sediments of alternate near-shore marine and brackish facies. The upper limit is located probably in the top part of the Middle Muschelkalk.

Lithology. The upper part of the profile of the sediments regarded as Röt in the NE part of the country (Szyperko-Śliwczyńska 1979) is composed of alternate layers of claystones, mudstones and sandy mudstones, with knobs of limestones and intercalations of nodular limestones. There occur also intercalations of sandstones, detritus of carbonized plants, scales of fishes, and fragments of phyllopod and bivalve shells. The Röt of the West Pomerania, determined as the Barwice Formation (Szyperko-Teller 1982) is composed of clastic rocks, mostly calcareous, varicoloured, containing predominantly grey intercalations of carbonate rocks, and concretionary aggregates of anhydrite.

The Lower Muschelkalk of the North Sudetic Depression was divided (Milewicz & Wójcik 1973) into *Myophoria* Beds (clayey marls and marly limestones with porous limestone at the top), Lower Crumpled Beds (clayey marls and crystalline crumpled limestones with a *Spiriferina* layer at the top), Upper Crumpled Beds (grey limestones with irregular surface of layers), and Foam Limestone Beds (oolitic limestones interbedded of banded limestones).

The Middle Muschelkalk of the NE part of the West Pomerania consists of grey, less commonly brownishred and brownishviolet dolomitic-clayey sediments, partly with tiny pockets of sulfates (Gajewska 1971).

Remarks. The described zone corresponds to the *Stenochara donetziana* Zone of the subdivision given by Saidakovsky (1962, 1966a, 1973) and to the *Stellatochara dnjeproviformis*, *Maslovichara incerta* Zone of that given by Kisielevsky (1969a), as well as to the *Stellatochara hoellvicensis dnjeproviformis* Assemblage-zone of the Kozur's subdivision (1974b). The sediments containing charophytes of the *Stellatochara hoellvicensis dnjeproviformis* Assemblage-zone were compared by Kozur (1975) to the upper part of the *Diplopora* Dolomite and the Lower Tarnowice Beds of the Upper Silesia (Assmann 1944), the Dolomite Beds and Supra-dolomite Beds of the margin of the Holy Cross Mts (Senkowiczowa 1961), as well as to some particular complexes of the Middle Muschelkalk of the Fore-Sudetic Monocline and the northern part of the country (the subdivision of Senkowiczowa & Szyperko-Śliwczyńska 1961).

The index species of the *Stenochara donetziana* Zone corresponding to the Anisian (Saidakovsky 1973) appears already in the *Porochara movschovichii*, *P. lutkevichii* Zone (Kisielevsky 1969a) and in sediments included into the *Porochara triassica* Zone (Saidakovsky & Kisielevsky 1972). For these reasons *Stellatochara dnjeproviformis* has been accepted as the index species of the described zone. This species was regarded by Saidakovsky (1966a) as the "index fossil" of zone IV, and by Kisielevsky (1969a) as one of two index species of zone IV, the other one being regarded as a synonym of *S. dnjeproviformis* (Kozur & Reinhardt 1969; Bilan & Krawczyk 1975). In the newest charophyte subdivision (Saidakovsky & Kisielevsky 1985) this unit was determined as *Stellatochara dnjeproviformis*, *Stenochara donetziana* Zone.

Geographic distribution. The *Stellatochara dnjeproviformis* Zone is widely distributed in many regions of the East European Platform, the western part of Kazakhstan, GDR and Poland.

Stellatochara hoellvicensis Partial-range-zone

Index species. *Stellatochara hoellvicensis* Horn af Rantzien 1954, pp. 44—47, Pl. IV, figs 1—3 (synonym — *Stellatochara dnjeprovica* Saidakovsky, 1960, p. 53, 54, Pl. I, fig. 1a, b).

Definition. The range of the zone corresponds to the part of that stratigraphic range of *Stellatochara hoellvicensis*, that does not overlap the range of *S. thuringica* Koz. & Reinh. Besides the index species the zone comprises the following: *Stellatochara silesiana* n. sp., *Stenochara rantzienii* Said. and *Auerbachichara polonica* Bilan. There appear also numerous species known from earlier defined zones (Table 9).

Stratigraphy. *Stellatochara hoellvicensis* has been found in the Upper Muschelkalk (the boreholes: Wężowice IG-1, depth of 2078.0 m—2092.0 m; 2072.0 m — 2077.0 m; Książ IG-2, depth of 1427.5 m; Sopot IG-1, depth of 637.8 m; Kętrzyn IG-2, depth of 982.9—989.1 m).

Lithology. The Upper Muschelkalk of the Fore-Sudetic Monocline in its NW part consists of (Senkowiczowa 1973): *Myophoria transversa* Beds (limestones with scarce grains of quartz and plagioclases and with anhydrite filling pores in the rock; intercalations consist of sandy limestones laminated of marls), Glauconitic Beds (crystalline limestones with numerous faunal remains and grains of glauconite, containing intercalations of oolitic limestones, sandstones and mudstones, and, in parts, of detrital limestones), and *Ceratites* Beds (fine-crystalline limestones with glauconite, organodetrital, dolomitic and sandy limestones, and mudstones). In the SE part of the Monocline, Senkowiczowa (1979) included to the Upper Muschelkalk the upper part of the Tarnowice Beds (limestones and dolomitic limestones with fauna) and the following ones, distinguished by Kłapciński (1959): Wilkowice Beds (a conglomerate of coarse-crystalline limestone), Kolonia Wielkowice Beds (limestones and dolomites, and calcareous dolomites), and Boruszowice Beds (clayey marls with intercalations of marly dolomites).

Within the East European Platform (Mazury-Suwałki Elevation) the Middle and Upper Muschelkalk is composed of clayey-sandy sediments (Senkowiczowa 1973). In the western part of the Peri-Baltic Syneclise, the Middle Triassic occurs in the southern part and is represented in lowest part by the typical facies of the Muschelkalk and upward by variegated mudstone-claystone, marly and marly-dolomitic sediments (Dadlez et al. 1976). In some parts (the area in between the Lębork meridian and the Bay of Puck), immediately upon the Lower Triassic and under the sediments of the uppermost Middle Jurassic or the Upper Cretaceous, the Lębork Beds lie (Dadlez et al. 1976), formed as sands and fine-grained sandstones with clayey intercalations and interbeds of fine-grained conglomerates.

Discussion. Saidakovsky (1962, 1966a) distinguished the *Stellatochara dnjeprovica* Zone, which was correlated by Kisielevsky (1969a) with *Stellatochara hoellvicensis*, *Maslovichara magna*, *Stenochara saratoviensis* Zone. Those zones are comparable to the described charophyte zone. It seems justified to regard *Stellatochara hoellvicensis*, being widely distributed in the sediments of the upper part of the Middle Triassic, as the index species of the zone. This species is mentioned as the first among the three index species of the zone V of the Kisielevsky's subdivision (1969a) while the index fossil of the zone V of the Saidakovsky's subdivision (1962, 1966a, 1973) is its synonym (Kozur & Reinhardt 1969; Bilan & Krawczyk 1975).

In the sediments of the ostracod *Gemmanella* Zone, determined as Keuper in the NW part of the Caspian Depression (Rykov et al. 1965), Kisielevsky (1969a) distinguished the *Stellatochara dnjeprovica?* Zone, and within Zavolzhe Saratovske and the Caspian Depression Saidakovsky (1973) distinguished the *Stellatochara hoellvicensis* Zone. Kisielevsky (1969a, p. 23) recorded, that in the *Stellatochara dnjeprovica?* Zone numerous species occur being characteristic of the Middle Triassic. The age of the sediments of the *Gemmanella* Zone is determined as the Upper Triassic (Lipatova 1967) or Middle Triassic (Sokolova 1973). Movshovich and Kozur (1975) elaborated the ostracod fauna of the so called *Gemmanella* layers of the Caspian Depression and found two ostracod assemblages in the lower part of those layers. They indicated that one of the assemblages contains forms being characteristic of the upper part of the Middle and the lower part of the Upper Muschelkalk, compared by Kozur (1972a, 1974a, 1974b) to the Upper Illyrian. The other ostracod assemblage contains forms being characteristic of the lower part of the *Ceratites* Beds, parallelized by Kozur to the Uppermost Illyrian and Lower Fassanian. Movshovich and Kozur (1975) compared the upper part of the *Gemmanella* Beds to the Upper Muschelkalk and Lower Keuper. They concluded that the *Gemmanella* Beds cover a part of the Upper Anisian (Middle and Upper Illyrian) and the Ladinian.

In the light of the above data the charophyte zones: VI — *Stellatochara dnjeprovica?* Zone (Kisielevsky 1969a) and VI — *Stellatochara hoellvicensis* Zone (Saidakovsky 1973) should be related to the upper part of the Middle Triassic. Hence, the *Stellatochara hoellvicensis* Zone = zone V — *Stellatochara dnjeprovica* Zone (Saidakovsky 1962, 1966a) = zone V — *Stellatochara hoellvicensis*, *Maslovichara magna*, *Stenochara saratoviensis* Zone (Kisielevsky 1969a) = zone VI — *Stellatochara dnjeprovica?* Zone (Kisielevsky 1969a).

Remarks. Kozur (1974a, 1974b) distinguished the *Stellatochara hoellvicensis hoellvicensis* Assemblage-zone comprising the Lower Fassanian with the Uppermost Illyrian (the lower limit — the Mittlerer Muschelkalk/Unterer Hauptmuschelkalk border), and the *Stellatochara sellingii* Zone, whose upper limit corresponds to the Fassanian/Langobardian border. Kozur did not precise the border between the two zones. The above lying *Stellatochara germanica* Assemblage-zone comprises the Langobardian excluding its uppermost part (Kozur 1974b). In the examined profiles of the Triassic of Poland no determinable specimens of *Stellatochara sellingii* have been found, whereas the range of *S. germanica* covers a wide age interval: Röt — Lower Rhaetic, so there are no bases for distinguishing of zones of these index species.

Geographic distribution. The *Stellatochara hoellvicensis* Zone is distributed in many regions of the European part of the USSR, Kazakhstan, GDR, the Polish Lowland, South Sweden and, probably, China (Zhongshan).

Stellatochara thuringica Partial-range-zone

Index species. *Stellatochara thuringica* Kozur & Reinhardt 1969, pp. 377, 378, Pl. I, fig. 9a, b, c.

Definition. The range of the zone corresponds to that part of the stratigraphic range of *Stellatochara thuringica*, that does not overlap the range of *Auerbachichara rhaetica* Bilan. Besides the index species, the following ones occur in the zone: *Stellatochara kozuri* Bilan, *Auerbachichara starozhilovae* Kis., *A. baskuntschakienis* Kis., *A. arguta* (Said.); there appear also numerous species known from the earlier defined zones (Table 9).

Stratigraphy. The *Stellatochara thuringica* zone comprises the Keuper sediments. The species of this zone have been found in few samples of the Lower Keuper (the boreholes: Wężowice IG-1, depth of 389.0 m, 363.0 m, 355.0 m; Białobrzegi IG-1, depth of 2055.2 m—2058.0 m) and of the Lower Gypsum Keuper (the boreholes: Wężowice IG-1, depth of 321.0 m, 311.0 m, 285.5 m, 279.5 m, 271.5 m; Białobrzegi IG-1, depth of 2017.7—2022.7 m) as well as in numerous samples of the Schilfsandstein (a. o. the boreholes: Wężowice IG-1, Szymonków IG-1, Lubliniec IG-1, ZK 9—2, BKR-32) and of the Upper Gypsum Keuper (a. o. the boreholes: Wężowice IG-1, Drołtowice I, BK-93, Krośniewice IG-1). The charophyte assemblage of the described zone is particularly well represented in the Keuper profile of the Wężowice IG-1 borehole.

Lithology. The Lower Keuper (Lettenkohle) of the Polish Lowland consists of grey, in the top part sometimes variegated claystones, and sandstones with rich detritus of carbonized plants, sometimes with thin coal sheds. A dolomitic complex (Grenzdolomit) with a rich fauna of bivalves, being included to either the Lower (a. o. Szyperko-Śliwczyńska 1960) or the Upper Keuper (Orłowska-Zwolińska 1972; Grodzicka-Szymanko & Orłowska-Zwolińska 1972; Gajewska 1978) lies above.

The Lower Gypsum Keuper (Unterer Gipskeuper) is composed of variegate, most often reddishbrown, sometimes grey, claystones and marls with intercalations of dolomites, limestones and sandstones. The central part of the basin contains numerous aggregates, sometimes interbeds of gypsum and anhydrite (Szyperko-Śliwczyńska 1960).

The Reed Sandstone (Schilfsandstein) consists of grey and brown sandstones, grey and variegated claystones and mudstones, containing rich detritus of a carbonized plants (Szyperko-Śliwczyńska 1960; Gajewska 1978). At the eastern margin of the Upper Silesian Coal Basin, the sediments related to Schilfsandstein determined as Bolesław Formation (Bilan 1976a) consist of claystones with intercalations of mudstones, marls, limestones and sandstones.

The bottom of these sediments contains some carbonate conglomerates or breccias.

The Upper Gypsum Keuper (Oberer Gipskeuper) is represented by claystones, clayey marls, and variegate, usually reddishbrown, mudstones, with some intercalations of sandstones. The sediments of the central part of the basin contain intercalations of gypsum and anhydrite (Szyperko-Śliwczyńska 1960).

Remarks. Samples of the Keuper sediments of the Polish Lowland have been differentiated in respect of their species composition, those of the Lower Keuper and of the Lower Gypsum Keuper being usually poorer. Relatively few from among many species occurring in the Keuper sediments have been found in most samples. Here belongs mainly the index species of the described zone.

Kozur (1974b) distinguished the *Stellatochara lipatovae* Assemblage-zone, whose range covers the Lettenkeuper (Upper Langobardian excluding its uppermost part). A wide age range of the species found out in Poland (Röt — Lower Rhaetic) does not justify distinguishing of the *Stellatochara lipatovae* Zone in the Lower Keuper.

Geographic destribution. The Polish Lowland and probably GDR.

Auerbachichara rhaetica Range-zone

Index species. *Auerbachichara rhaetica* Bilan 1974, p. 486, 487, Pl. I, fig. 3a, b, Text--fig. 3a—d.

Definition. The range of the zone covers the sediments whose stratigraphic range corresponds to the range of *Auerbachichara rhaetica*. Besides the index species other numerous ones occur, known from the earlier defined zones (Table 9).

Stratigraphy. The *Auerbachichara rhaetica* Zone comprises the Lower Rhaetic sediments, including the Grabowa Formation (Bilan 1976a, 1976b, 1977) correlated with the cyclothem RI (Grodzicka-Szymanko 1971; Grodzicka-Szymanko & Orłowska-Zwolińska 1972), the lower part of the higher complex of Rhaetic sediments correlated with the cyclothem R II, as well as the Jarkowo Formation and the lower part of the Zbąszynek Formation (Dadlez & Kopik 1963; Deczkowski 1977; Senkowiczowa 1979). The index species of the described zone occurs in Lower Rhaetic sediments of numerous boreholes (a. o. Krasiejów V-8, Krasiejów V-6, SP-62, ZŁ 6—20, BJ-65, WB-11, ZŁ 6—4, Lubliniec IG-1, 96 TN, CW-62, 112 TN). The range of the described zone corresponds to the range of the ostracod *Clinocypris? silesia* = *Pulviella silesia* Zone (Bilan 1980).

Lithology. The complex of Rhaetic sediments of a large area of the Polish Lowland (Szczecin Basin, Łódź Basin, Fore-Sudetic Monocline) is composed of (Dadlez & Kopik 1963; Kopik 1973): Drawno Beds (variegated claystones with interbeds of fine-grained sandstones or, less commonly, dolomites, sometimes containing fine aggregates of gypsum and anhydrites), Jarkowo Beds (grey mudstones and sandstones and variegated dolomitic claystones with intercalations of dolomites, ooides and dolomitic gravel; the upper part of the complex contains local variegated clayey sediments, with intercalations of carbonate conglomerates) and Zbąszynek Beds (variegated claystones, nodular, sometimes in the type of clayey conglomerates containing fine gravel of dolomites and limestones as well as interbeds of conglomerates and scarce intercalations of bedded grey and variegated claystones, mudstones and sandstones).

The lower part of the Rhaetic of the eastern margin of the Upper Silesian Coal Basin, determined as the Grabowa Formation (Bilan 1976a) is represented by variegated claystones, commonly nodular with intercalations of carbonate-clayey conglomerates and breccias, less commonly of limestones, marls and sandstones. Above the Grabowa Formation the higher part of Rhaetic sediments lies, its lower part being composed of carbonate-clayey conglomerates with intercalations of sandstones, mudstones and claystones.

Discussion. Saidakovsky (1973) distinguished within the regarded as Rhaetic sediments of the Dnieper-Don depression and Fore-Caucasus the *Maslovichara lipatovae* Zone (zone VII), and gave eight species being characteristic of the zone. Six of them (*Maslovichara lipatovae* Said., *Stellatochara sellingii* H. af R., *Stenochara rantzienii* Said., *Cuneatochara angusta* Said., and *Sphaerochara decora* Said.) were regarded by that author as being characteristic of zones V and VI either, while the other two as occuring in: zones V and VI — *Cuneatochara capitata* Said., zones IV and V — *Stellatochara bulgarica* Said. (Saidakovsky 1968). The assemblage mentioned above does thus not contain any form being characteristic only for the Rhaetic.

Remarks. Bilan (1974) described from the Rhaetic sediments of the Cracow-Silesia area two species of the genus *Auerbachichara (A. polonica* and *A. rhaetica)* and found in those sediments several other species of the genus, occurring also in the Lower Triassic. Since the genus *Auerbachichara* was then recorded only from the Lower Triassic, the author considered the species of that genus to be characteristic of the Rhaetic of that area. Kotański (1977) mentioned the *Auerbachichara* as being characteristic of the Norian (Steinmergelkeuper) of the German Basin. Since *A. alyoshinii* and *A. bilanii* were described from the Middle Triassic (Kisielevsky & Aleshina 1979) and species of the genus *Auerbachichara* were found in the Upper Muschelkalk and Keuper of the Polish Lowland *(A. polonica, A. arguta, A. starozhilovae)*, the above opinions can be hardly regarded as true.

Geographic distribution. The Polish Lowland.

PALEOECOLOGY OF THE TRIASSIC CHAROPHYTES

Recent studies on distribution of organic remains in Triassic sediments showed close associations of some Triassic microfossils with various biotopes. The studies indicated a possible usefulness of charophytes in determining of environmental conditions and their changes associated with evolution of the epicontinental basin of the Triassic. Reconstruction of fossil biotopes needs knowledge of the conditions being vital for existence of the recent charophytes. The distribution and occurrence frequency of recent species are determined by characters of their environment among which physical, chemical and biotic controlling factors are distinguished.

Limiting factors

Physical factors

Depth. Charophytes overgrow the bottom of reservoirs in various zones depth, the main controlling factor being intensity of light. They are most distributed in the zone of submerged plants in lakes. They are included to the group of submerged producers and in numerous cases mark the Lower limit of the littoral zone of lakes. They may numerously inhabit shallow habitats, beginning from several centimeters deep, particular species showing the optimum development at various depth (Dąmbska 1964). Since the depth which charophytes occur at is determined by light conditions depending on transparency of water and degree of shading, ranges of particular species may oscillate within certain limits. Corillion (1949) distinguished four groups of species being able to adapt themselves to various amount of light. Charophytes growing near the lower limit of their occurrence breed not sexually but vegetatively.

Temperature. According to Dąmbska (1964) this factor relatively little affects the distribution and occurrence frequency of recent species. Most of the recent forms are much resistant to low temperature. In the temperate climate living specimens with generative organs are found in water covered with ice. On the other hand, some forms are known to dwell in hot springs.

Bottom. An important controlling factor is stability of substrate. Charophytes grow well on a stable substrate, while on a labile bottom, where sediments are moved by current or waves they grow poorly. Dąmbska (1964) emphasized that the water movement affects charophytes also immediately, tearing them off the bottom or breaking their fragile branches. Only few species appear in current waters, having in such special conditions immensly elongate internodes and branchlets. Dąmbska observed also that charophytes are apparently less developed near the eastern shore of lakes, which is more affected by waves.

Temporary dessication. Some species can inhabit temporarily drying out reservoirs. Oospores of such species can live through the period of unfavourable conditions connected with changes in the water level in the reservoir and its temporary dessication (Dąmbska 1964).

Chemical factors

Salinity. Recent charophytes numerously inhabit both freshwater and brackishwater reservoirs. They are found inshore a. o. in the Mediterranean, Black Sea, English Channel, and Atlantic (Gollerbach 1940, 1941, 1950; Froment 1954; Emberger & Magne 1956). They were also found in contemporary termporarily drying out inland reservoirs of a high salinity (Burne et al. 1980). Salinity is regarded as the most selectively affecting chemical factor (Dąmbska 1964), three groups of species having been distinguished basing on this factor: a — halophobes (entirely freshwater), 2 — euhalobionts (occurring entirely in salt water), 3 — euryhalobionts (living in both salt and fresh water).

Hydrogen-ion concentration. Recent charophytes live in water of pH ranging from above 5 to 9.5 (Olsen 1944; Corillion 1957), particular genera living in various pH ranges. Some forms are known to exhibit a relatively high tolerance to pH value, while some others cannot bear greater alterations in acidity of water.

Calcium content. According to Dąmbska (1964) numerous occurrence of recent species is associated with a considerable amount of calcium in water. She found out that a number of species occur entirely in a certain calcium content, the limits of their tolerance being indistinct to the extent that charophytes can live in water of a lower calcium content though they breed only vegetatively. Some forms are known to live in water being poor in calcium, or to avoid calcium (calcifuges).

Other chemical factors. It was found out that a considerable iron content plays some part in vegetation of certain species, and the species growing in waters of a high iron content were listed (Dąmbska 1964). Some sediments being a substrate of overgrowing charophytes were found to contain a small amount of hydrogen sulfide. The maximum content of hydrogen sulfide was determined at their localities and laboratory studies showed that specimens cultured in water containing hydrogen sulfide died out (Dąmbska 1964). It was also observed that recent growing charophytes absorbe strontium from water, while bottom sediments containing dead charophytes absorbe cesium from water and cumulate it (Kulikov et al. 1977; Kyansep-Romashkina 1980).

Biotic factors

Particular species and species assemblages occur in various types of reservoirs. They are most numerous in eutrophic lakes, some species prefering tiny reservoirs. In such conditions they commonly form "meadows" consisted of one or many species and sometimes occur together with vascular plants. "Meadows" of one species are most commonly formed in small reservoirs, also in artificial ones, where charophytes are the first plants to colonize the area. Some species find the optimum conditions for their development in muddy shallow zones of lakes, which they overgrow forming dense carpets, while in deep lakes they cover the bottom in the zone of submerged plants, predominating over other plant groups. They appear also in the zone of rooted plants with floating leaves. In eutrophic lakes representatives of the subfamily *Charoideae* predominate.

Charophytes are scarcer in oligotrophic lakes. The *Nitelloideae* appear more abundantly in such conditions, growing also rather commonly in streams. In oligotrophic lakes charophytes usually grow in clusters, particular species growing together with various assemblages of vascular plants. In dystrophic lakes charophytes appear exceptionally.

Differentiation of charophyte assemblages

Fossil charophytes are found mainly in sediments of freshwater and brackish basins. Some authors are convinced that they occur entirely in limnic and brackish biotopes (Hiltermann et al. 1977), but some others record their occurrence in marine environment (a. o. Karpinsky 1906; Peck 1946, 1953; Maslov 1966; Bilan & Golonka 1973). Hence, the occurrence of charophytes does not indicate particular environmental conditions. Charophytes may only play a part of one of elements in analysing of a biotope. To the most important limiting factors, that could be at least approximately interpreted in the sediments of the Epicontinental Triassic the following ones should be included: depth, salinity, iron compounds and calcium carbonate content, and redox potential. Some of the factors (calcium carbonate and iron compounds content, redox potential) are determinable basing on features of the sediment, the others (salinity, depth) are determined mainly basing on the occurrence of microfossils, including charophytes. Despite that the studied charophytes occur in some cases together with ostracods, molluscs, phyllopods, fish, and plant remains (mio- and megaspores), there are no sufficient bases for the factors controlling their vegetation to be determined.

Co-occurrence of charophytes with other organic remains allows their part in reconstruction of the environmental conditions to be determined. Kozur and Reinhardt (1969) determined frequencies of occurrence of particular groups of organisms, including charophytes, as being dependent on salinity (after the classification of Hiltermann 1949). The salinity conditions connected with the occurrence of certain ostracod species co-occurring with charophytes were precised (Wienholz & Kozur 1970; Bunza & Kozur 1971; Kozur & Mostler 1972) and the importance of various microfossils in analysing of the facial differentiation and of environmental conditions of the Triassic Basin was determined (Kozur 1971a, 1972b, 1972c). Kozur (1971b) considered that a numerous occurrence of the *Stenochara* and *Porochara* indicates the limnic or oligohaline-brackish conditions, while that of the *Stellatochara* — the mio- to mesohaline-brackish conditions. He determined also the salinity conditions associated with the occurrence of some species in the Middle Triassic (Kozur 1974b). Saidakovsky and Kisielevsky (1972) recorded the occurrence of the *Stellatochara* (and *Maslovichara*) in samples containing ammonites.

Knowledge of the conditions in which recent charophytes live allows to suppose that their numerous occurrence in the past was also connected with reservoirs of stable bottom little affected by wave and current action (low energy of environment). Hence, rich assemblages of well preserved gyrogonites are probably found in situ. On the contrary, in assemblages composed of unnumerous specimens the forms may be redeposited, since gyrogonites can be transported covering considerably long distances (cf. Berger 1983; Saidakovsky & Kisielevsky 1985).

The comparative analysis of the genus and species composition of the charophytes of the Epicontinental Triassic of Poland allows the following conclusions to be drawn:
- in one sample representatives of one, two, or less commonly, three genera predominate;
- some rich assemblages exist composed of numerous species and specimens, as well as some others consisted of scarce specimens of a few species;
- certain genera and species coexist with some others;
- some forms appear eurytopic, that is, they are present in most samples, while some others are stenotopic, that is connected with a particular assemblage.

The assemblages comprising a rich variety of specimens belonging to numerous species are in their occurrence connected with environmental conditions prefered by charophytes. In general, the occurrence of rich assemblages (independently on their genus composition) is associated with the optimum bathymetric conditions, while the predomination of particular genera in such rich assemblages is connected a. o. with favourable salinity conditions. On the other hand, the occurrence of stenotopic or eurytopic forms and the co-occurrence of some species indicate certain environmental conditions.

The species that appear only in assemblages of numerous specimens and species, one genus predominating, are probably stenotopic, mainly stenohaline forms. Their occurrence indicates both favourable conditions and a precisely determined salinity causing the predomination of that particular genus. In case of the mio-mesohaline-brackish biotopes these species are for instance: *Stellatochara piriformis*, *S. lipatovae*, *S. subsphaerica*, *Stenochara saratoviensis*, *Stn. rantzienii*, *Clavatorites hoellvicensis*, while in case of the limnic-oligohaline-brackish ones they are for instance: *Porochara dergatschiensis*, *P. ukrainica*, *P. concisa*, *Vladimiriella wetlugensis*. The species mentioned as characteristic of the limnic-oligohaline-brackish biotopes appear sometimes in the *Stenochara* and *Stellatochara* assemblage, but they have not been found to co-occur with the forms mentioned as characteristic of the mio-mesohaline-brackish biotopes. The two mentioned groups of species can by regarded as excluding each other.

Besides the mentioned stenotopic forms there are the species which appear in assemblages of various composition, as well as in impoverished ones indicating relatively unfavourable environmental conditions for charophytes. These are a. o.: *Stellatochara schneiderae*, *S. silesiana*, *Stenochara maedleri*, *Stn. donetziana*, *Clavatorites acuminatus* and *Cl. cuneatus*, which can be regarded as the most important eurytopic forms (euryhalobionts).

Studying the variability of a population it is usually assumed that at each moment of its existence the population shows the age variability of its individuals, the individuals being often differentiated in respect of, for instance, size. Genetic mechanisms are probably important in the process of maturation of the oospore; they determine its morphology and size. The gyrogonite is formed after the oospore has matured, and the size variability of the gyrogonite, being much associated with the wall thickness is hardly an effect of genetic mechanisms. In this case environmental conditions are essential. If these are favourable (small depth, preferable amount of calcium carbonate), gyrogonites will grow relativelly large (within the range of their infraspecific variability). The conditions of vegetation get worse with increase of depth, leading to the formation (especially in case of a small amount of calcium carbonate) of thinner oospore envelopes. *Stellatochara maedleri*, *S. thuringica*, *Stenochara maedleri*, *Stn. elongata*, *Stn. donetziana*, *Stn. kisielevskyi*, *Porochara brotzeni*, *P. triassica*, *P. cylindrica*, *Clavatorites acuminatus*, *Cl. cuneatus*, and *Auerbachichara baskuntschakiensis* belong to the species characterized by a relatively high size differentiation.

In spite of the infraspecific size variability of gyrogonites in some cases a relatively high differentiation of number of the spirals being visible in the lateral position of a specimen and of their breadth is observed. This kind of variability, found in *Stellatochara dnjeproviformis*, is probably of the ecophenotypic origin, being associated with adaptation to habitats differing in calcium content. Similar adaptative changes are exhibited by representatives of the genus *Ste-*

nochara (*Stn. maedleri*, *Stn. ovata*), *Clavatorites* (*Cl. acuminatus*, *Cl. cuneatus*) and other species from the genus *Stellatochara* (*S. schneiderae*, *S. pomerana*). No distinct variability of this kind has been found in representatives of the other genera.

Basing on the quantitative predomination of representatives of certain genera found in the studied sediments, the charophyte assemblages have been distinguished as follows:

Porochara and *Vladimiriella* Assemblage
Porochara and *Stenochara* Assemblage
Stenochara and *Stellatochara* Assemblage
Stellatochara Assemblage
Auerbachichara Assemblage

On the basis of the previously discussed results of the present studies and the observed regularities in the composition of the examined samples, the assemblages have been acknowledged biofacial indices allowing interpretation of the environmental conditions of the epicontinental basin of the Triassic.

Porochara and *Vladimiriella* Assemblage

The assemblage occurs in variegated, clayey, slightly calcareous sediments. The typical elements of the assemblage are: *Porochara triassica*, *P. belorussica*, *Vladimiriella globosa*, *V. wetlugensis*. There appear also: *Stenochara pseudoglypta*, *Stn. kisielevskyi* and *Porochara dergatschiensis*. A small number of samples containing representatives of this assemblage does not allow its variability to be determined. It is probable that the assemblage represents the limnic to the oligohaline-brackish conditions (though adaptations to the oligo-miohaline-brackish conditions cannot be excluded) characterized by a considerable content of iron compounds.

Porochara and *Stenochara* Assemblage

The assemblage occurs in variegated, calcareous claystones and mudstones. The typical feature of the assemblage is the occurrence of numerous specimens of *Porochara cylindrica*, *P. urusovi*, *P. brotzeni* and *Stenochara donetziana* besides the presence of some forms known from the *Porochara* and *Vladimiriella* Assemblage (*Porochara triassica*, *Stenochara pseudoglypta*, *Stn. kisielevskyi*, *Vladimiriella globosa*). If *Stellatochara silesiana*, *S. maedleri*, *Stenochara elongata*, *Stn. ovata*, *Porochara concisa*, *P. ukrainica*, *P. sphaerica*, *Auerbachichara baskuntschakiensis*, *A. kisielevskyi*, *Clavatorites acuminatus*, *Cl. cuneatus* appear besides the mentioned species, it will indicate probably more favourable bathymetric conditions of vegetation. The assemblage reduced to *Stenochara maedleri*, *Stn. kisielevskyi*, *Porochara triassica*, and *Clavatorites ocuminatus* indicates degradation of environmental conditions (increase of depth). The whole *Porochara* and *Stenochara* assemblage is associated with the limnic to miohaline-brackish conditions, of a relatively high content of iron compounds.

Stenochara and *Stellatochara* Assemblage

Gyrogonites of this assemblage occur in grey, less commonly variegated calcareous claystones and marls. There occur numerous representatives of the genera *Stenochara* and *Stellatochara*, from among which *Stellatochara hoellvicensis*, *S. lipatovae*, *S. thuringica*, *S. dnjeproviformis*, *S. germanica*, *S. subsphaerica*, *S. donbassica*, *S. pomerana*, *Stenochara saratoviensis*, *Stn. pseudoovata*, *Stn. rantzienii*, *Stn. ovata* can be regarded as characteristic together with the following representatives of other genera: *Vladimiriella decora*, *Porochara abjecta*, *Clavatorites hoellvicensis*. The assemblage represents probably the miomesohalinicum conditions of a reasonably high content of calcium carbonate and a slightly lower content of iron compounds. The reduction of the assemblage, manifested in elimination of many elements and predomination of such eurytopic forms as: *Stellatochara schneiderae*, *Stenochara maedleri*, *Stn. donetziana*, and *Clavatorites acuminatus*, indicates a habitat change (degradation of vegetation conditions) connected probably with increase of depth. Impoverished assemblages consisted mainly of representatives of the genus *Stellatochara* may indicate a higher salinity (meso- to pliohaline-brackish?). It is confirmable by the fact that the genus *Stellatochara* occurs in sediments containing the ammonite fauna (Saidakovsky & Kisielevsky 1972).

Stellatochara Assemblage

This is a conventional name of the assemblage that appears within dark grey and black, calcareous claystones. The typical elements of the assemblage are *Stellatochara kozuri* and *S. piriformis*, accompanied with *Stenochara saratoviensis*, *Stn. pseudoovata*, *Stn. donetziana*, *Stn. kisielevskyi*, *Stellatochara silesiana*, *Clavatorites acuminatus* and *Cl. cuneatus*. The assemblage appears in sediments deposited in reduction conditions. Such a habitat is indicated by dark colouration of both sediments and gyrogonites as well as the presence of pyrite. In such conditions the occurrence of numerous *Karnocythere germanica* and *Darwinula*, and in some cases *Lutkevichinella brotzenorum* indicates a labile salinity, ranging from the oligo- to mesohaline-brackish conditions. It seems that the dark colouration and the presence of sulfides in the mentioned sediments is associated with the reduction conditions existing under the surface of the deposition (a rich organic life in the reservoir). Above the sediments containing the assemblage species sometimes dark claystones occur, lacking any organic remains probably due to poisoning of the environment, caused with the reduction conditions at the bottom of the basin.

Auerbachichara Assemblage

Samples containing a great number of *Auerbachichara* come from sediments of the Lower Rhaetic. Species of this genus occur also in the Buntsandstein, Upper Muschelkalk and Keuper, though in those sediments they do not predominate over the other genera. The characteristic elements of the assemblage are: *Auerbachichara baskuntschakiensis*, *A. kisielevskyi*, *A. starozhilovae*, *A. rhaetica*, *A. polonica* and *A. arguta*, in some cases accompanied with: *Stenochara maedleri*, *Stn. elongata*, *Stn. donetziana*, *Stn. schaikini*, *Stn. kisielevskyi*, *Stn. karpinskyi*, *Stn. incerta*, *Porochara triassica*, *P. sphaerica*, *P. urusovi*, *P. concisa*, *Vladimiriella wetlugensis*, *Clavatorites acuminatus*, *Cl. cuneatus*. Also some representatives of *Stellatochara* may sometimes appear in the assemblage (mainly *S. schneiderae*, *S. thuringica* and *S. silesiana*). Saidakovsky and Kisielevsky (1972) were of opinion that the *Auerbachichara* do not co-occur with the *Stellatochara*. Their co-occurrence in the examined samples may result from the possible sampling of sediments representing altering environmental conditions or containing pseudo-associations. The fact that species being in various degree eurytopic occur in the discussed assemblage together with *Auerbachichara* is worth of interest. Such a co-occurrence makes the determination of the environmental conditions, that were responsible for the occurrence of that genus, difficult. The *Auerbachichara* are perhaps associated with oxidative conditions of an oligo-mesohaline-brackish basin of a relatively high content of iron compounds and their occurrence is probably connected with changes in content of some elements of environment, the changes being not discernible in the fossil state.

Occurrence of charophyte assemblages

The observed differentiation of the charophyte assemblages of the Epicontinental Triassic of Poland allows for no more than approximate interpretations of environmental conditions, however it is possible to determine the variability of some controlling factors, mainly salinity and depth. The previously underestimated role of charophytes in precising of depth alterations is worth of attention. Since their growth and the way of breeding depend on intensity of light, their occurrence in sediments may be an important criterion in paleogeographic reconstructions of near-shore zones of inland basins and depth changes. To determine the vertical and horizontal differentiation of environmental conditions it is necessary to study the succession of charophyte assemblages. The examined material comes from relatively unnumerous samples of the Lower and Middle Triassic as well as from numerous samples of the Upper Triassic. This "heterogeneity" of the material is a source of some limits of its interpretation. In the below remarks on succession of assemblages the subdivision was adopted corresponding with the previously distinguished phases of development of the charophyte flora in the Triassic.

Phase I

This phase comprises the Middle Buntsandstein (and perhaps the lower part of the Upper Buntsandstein). In the Middle Buntsandstein the occurrence of two charophyte assemblages: *Porochara* and *Vladimiriella* Assemblage and

Porochara and *Stenochara* Assemblage, is observed. The gyrogonites of both assemblages are characterized by their small size usually corresponding with the lowest values of the infraspecific variability range.

The occurrence of the mentioned assemblages allows for the determination of the at least temporarily functioning complex of controlling factors, that favoured the charophyte vegetation. The fact that gyrogonites were present in relatively scarce samples of the Middle Buntsandstein in comparison with, for instance, the Rhaetic samples, does not necessarily indicate that charophytes had occurred sporadically in the Middle Buntsandstein. However, it indicates that charophytes colonized particular habitats, and the lack of gyrogonites in a sediment does not mean that they had ceased to grow in a certain part of the reservoir. Such a lack may indicate no more than a change in environmental conditions having resulted in cease of generative in favour of vegetative breeding. In this context a simple occurrence of gyrogonites in a sediment does not indicate the phase of colonization of a given area, but may be a certain sere phase.

Phase II

This phase comprises the upper part of the Buntsandstein (Röt) and the Muschelkalk. In those sediments one of the distinguished charophyte assemblages — the *Stenochara* and *Stellatochara* Assemblage — occurs showing a relatively high differentiation. The differentiation manifested in the specimen number was mostly determined by depth, while that manifested in the number of both specimens and species seems to reflect changes in the complex of controlling factors. The assumption of relatively constant salinity and calcium carbonate content in the basin does not mean that these factors (and probably also others — undetermined) were somehow not alterable in peripheral zones of the basin.

Studying the differentiation of the species composition of the *Stenochara* and *Stellatochara* Assemblage it is probable that this differentiation has resulted a. o. from alterations in salinity, having ranged from mio- to meso-, or perhaps even from meso- to approximately pliohalinicum. Such a range of salinity in the peripheral (including the inshore lagoon zone) parts of the Röt — Muschelkalk basin is indicated by a relatively numerous occurrence of *Porochara* species in the Röt and the predomination of *Stellatochara* species in the Middle Muschelkalk.

Phase III

In the Upper Triassic four of the distinguished assemblages have been found as follows: the *Porochara* and *Stenochara* Assemblage, *Stenochara* and *Stellatochara* Assemblage, *Stellatochara* Assemblage, and *Auerbachichara* Assemblage. The previous two assemblages are numerous in both the Keuper and

Lower Rhaetic, the *Stellatochara* Assemblage has been found only in the Keuper, and the latter assemblage — only in the Lower Rhaetic. Besides the typical Keuper or Rhaetic assemblages, the other ones similar to the Lower and Middle Triassic assemblages appear then in the Upper Triassic.

Keuper

The Keuper sediments show a considerable differentiation of their charophyte assemblages, manifested in their genus and species composition as well as in the specimen number. In scarce samples of the Lower Keuper the poor assemblages have been found as follows: *Stenochara* and *Stellatochara* Assemblage, *Stellatochara* Assemblage, and *Porochara* and *Stenochara* Assemblage. The lack of charophytes in most samples of the Lower Keuper sediments as well as the presence in scarce samples of the assemblages composed mainly of eurytopic forms indicates, in general, unfavourable conditions of the charophyte vegetation. It is probable that the charophytes of the mentioned assemblages were growing in a basin whose salinity is difficult to be precisely determined, moreover besides salinity the most important factors determining the composition of the assemblages might have been also the following: calcium carbonate content, depth, oxidation-reduction potential, and perhaps, the character (lability?) of the bottom.

In the profiles of the Lower Gypsum Keuper the alternate occurrence of the *Porochara* and *Stenochara* Assemblage, *Stenochara* and *Stellatochara* Assemblage, and samples lacking gyrogonites, is observed. In the relatively poor assemblages occurring in these sediments, gyrogonites of the genus *Stenochara* prevail, and eurytopic forms are of a great importance. The composition of the assemblages found in these sediments suggests rather unfavourable environmental conditions (depth?) while the succession of the assemblages indicates distinct oscillatory changes in salinity. The vertical differentiation of the charophyte assemblages indicates that the changes were ranging from the approximately limnic to the mesohaline conditions, though the absence of gyrogonites in certain intervals of a profile indicates, in spite of other possible changes in environment, a temporary increase in salinity. The increase in salinity, connected with a shift of climate (from wet to dry) in the first sedimentary-climatic cycle of the Keuper (Szyperko-Śliwczyńska 1960) resulted in temporary symptoms of chemical sedimentation. Independently on the origin of the evaporite sediments of the Lower Gypsum Keuper (Gajewska 1978) repetitive changes in salinity seem to be the decisive factor controlling the composition of the charophyte assemblages, as well as, probably, their temporary elimination.

In the Schilfsandstein, besides the numerously represented *Stenochara* and *Stellatochara* Assemblage and *Porochara* and *Stenochara* Assemblage, the *Stel-*

latochara Assemblage can be found. In some profiles the differentiation of the assemblages is relatively small, since independently on quantitatively prevailing representatives of particular genera, eurytopic forms predominate in the composition of the assemblages. Other profiles show a more distinct vertical differentiation of the assemblages, being indicative of rather considerable changes in environmental conditions. In the profiles situated in the central part of the basin of the Polish area the amplitude of changes is lower than in the profiles of the peripheral parts of the basin. In the previous case (e. g. the boreholes Wężowice IG-1, Szymonków IG-1) a relatively small differentiation within the particular assemblages is observable, the assemblages being consisted mainly of eurytopic forms. In the other case a very distinct differentiation of the assemblages may be marked.

In the peripheral, Silesia-Cracow zone of the Schilfsandstein basin, the sedimentation of the lower member of the Bolesław Formation (Bilan 1976a) lasted in variable environmental conditions, which are indicated by the following facts:

— rather rarely observed cases of the co-occurrence of *Karnocythere germanica* and *Lutkevichinella brotzenorum* ostracods,
— the occurrence in particular samples of the assemblages composed entirely of ostracods, ostracods and phyllopods, entirely charophytes or the mixed — ostracod — charophyte ones,
— records of samples containing no organic remains,
— the differentiation of the species composition in particular samples,
— the occurrence in some samples of numerous fish remains, with their complete lack in others.

A relatively considerable differentiation of environmental conditions in those sediments is reflected in a high differentiation of the charophyte assemblages. The *Stellatochara* Assemblage appearing usually in the lower part of the Bolesław Formation profile, indicates the reduction conditions. A considerable differentiation recorded within the *Stenochara* and *Stellatochara* Assemblage and *Porochara* and *Stenochara* Assemblage indicates not only labile salinity conditions, ranging from the limnic to the approximately mesohaline, but also changes in depth chemical factors and a various character of bottom.

The change in the composition of the charophyte assemblages in the end of the Lower Gypsum Keuper and the beginning of the Schilfsandstein resulted from the change in climate, that began the second sedimentary-climatic cycle of the Keuper (Szyperko-Śliwczyńska 1960). In the wet climate, the differentiated conditions of the deltaic (Wurster 1964a, 1964b, 1965), fluvial (Gajewska 1978), and probably also lacustrine environment, cause a considerable differentiation of composition and succession of charophyte assemblages. The analysis of the assemblages in the Bolesław Formation profile allows for the statement that in the course of the development of those sediments, the amplitude of oscillations in salinity conditions in its lower part ranged from the limnic, to the mesohaline-brackish ones, while in the upper part the conditions became stable (approximately limnic).

In the profiles of the Upper Gypsum Keuper the alternate occurrence of the *Stenochara* and *Stellatochara* Assemblage, *Porochara* and *Stenochara* Assemblage, and samples containing no gyrogonites has been found. The succession of the assemblages indicates oscillatory changes in salinity, having ranged from the limnic, to the approximately mesohaline-brackish, conditions. The analysis of the composition of the charophyte assemblages of the Lower Gypsum Keuper and the Upper Gypsum Keuper shows that, in spite of some similarity, the assemblages of the Upper Gypsum Keuper contain sometimes a higher number of species. Besides numerous eurytopic forms, the following species are found in some samples: *Stellatochara lipatovae*, *S. thuringica*, *S. germanica*, *S. gracilis*, *S. schneiderae*, *Stenochara pseudoglypta*, *Stn. ovata*, *Porochara cylindrica*, or: *Stellatochara hoellvicensis*, *S. thuringica*, *S. schneiderae*, *Stenochara karpinskyi*, *Auerbachichara baskuntschakiensis*, and *A. polonica*.

The charophyte assemblages coming from the basin zone of an immense subsidence caused with movements of Zechstein salt (Marek 1967; Marek & Znosko 1972a, 1972b) show a slightly different character. Samples of the sediments of this zone (Krośniewice IG-1) contain scarce, generally poorly preserved gyrogonites, the assemblage composition (unnumerous eurytopic forms) allowing environmental conditions not to be determined, moreover there are no bases for regarding of their occurrence as the in situ one (the forms may be redeposited).

Rhaetic

The Rhaetic sediments show the highest differentiation of the charophyte assemblage composition. The assemblages: *Stenochara* and *Stellatochara*, *Porochara* and *Stenochara*, and *Auerbachichara*, show a considerable differentiation of their species composition and specimen number. The alternate occurrence of the mentioned assemblages indicates changes in salinity, while the differentiation of the species and specimens number indicates various bathymetric conditions, probably various substrate and labile chemical conditions of the environment in which they grew.

The occurrence of certain organic remains allows for the determination of salinity changes in the Rhaetic basin, ranging from the liminic to the approximately pliohaline-brackish conditions. The occurrence of gyrogonites was found within varicoloured claystones and calcareous mudstones, marls, clayey conglomerates, as well as in carbonate-clayey conglomerates and breccias (Lisów Breccia — Znosko 1954). The typical feature of the Lower Rhaetic sediments is a considerable part of elements of the eroded substrate (Dadlez 1967). The fact that in numerous samples gyrogonites are present on a secondary deposit, causes a poor discernibility of changes in environmental conditions.

Geographical distribution of charophyte assemblages

The composition analysis of charophyte assemblages coming from different sometimes very distant areas, indicates distinct regularities in development and differentiation of the charophyte flora in the Triassic period. Saidakovsky (1967) emphasizing the stratigraphic meaning of charophytes, found out that not only species but also genera are very important. Basing on the quantitative predomination of the species of certain genera he determinated the oldest zones I and II as the *Sphaerochara* Zones, zone III as the *Porochara* Zone, zone IV as the *Stenochara* and *Maslovichara* Zone, and zone V as the *Stellatochara* Zone. After the revision of some of the mentioned names of the genera *(Sphaerochara = Vladimiriella, Maslovichara = Stellatochara)* and of the *Porochara* Zone range (the upper limit of the *Porochara triassica* Partial-range-zone in Poland does not cover the upper part of the Upper Buntsandstein) it is evident that the Lower and Middle Triassic of the Polish part of the Central European Basin and that of the East European Basin show a well marked similarity in respect of the composition and succession of the predominant genera.

In the Lower Triassic sediments of various regions of the European part of the USSR (a. o. Saidakovsky 1966a, 1971b, 1973; Lipatova et al. 1969; Kisielevsky 1969a, 1969d; Lapkin et al. 1978), Kazakhstan (Kisielevsky & Kukhtinov 1978; Kukhtinov et al. 1978; Lipatova et al. 1984a, 1984b; Kisielevsky 1984) and China (Lu Hui-nan & Luo Qi-xin 1984) as well as of GDR (Kozur 1974b), the charophyte assemblages occur being comparable with those found in the Middle Buntsandstein of the Polish Lowland. Similarities are manifested mainly in the predomination of the genera *Porochara*, *Vladimiriella* and *Stenochara* within these assemblages. Recognizable, sometimes rather immense differences in the species composition, reflect probably more or less favourable environmental conditions.

The predomination of the genera *Stenochara* and *Stellatochara* characterizes not only the Röt and Muschelkalk sediments of Poland. These genera play also a considerable part in the assemblages of the Muschelkalk of GDR, and those of the Middle Triassic of the European part of the USSR and of Kazakhstan. In the charophyte assemblages of the Middle Triassic of China (Huang Ren-jin 1983), being characterized by the occurrence of relatively scarce species (including also those unknown in Europe) the most important are species of the genus *Stellatochara*.

The present state of knowledge of the charophyte flora of the Upper Triassic is not sufficient for the determination of the distribution of assemblages and for comparing of their differentiation in various regions of the continental facies. However, it is probable that a characteristic feature of the Upper Triassic assemblages in the other parts of the Central European Basin and of the East European Platform is their vertical and horizontal differentiation.

The differentiation of the composition of charophyte assemblages, resulting from changes in environmental conditions, as well as the occurrence of assemblages of a similar composition in sediments of various age, raises difficulties in determining of the vertical range of taxons, the limits of charophyte zones, and their correlation. On the other hand, occurrence of charophytes and differentiation of their assemblages may be an important criterion in paleogeographic reconstructions of changes in the coastline and depth of the continental basins of the Triassic.

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STRESZCZENIE

Opierając się na materiale pochodzącym z ponad 80 wierceń (Fig. 1), opracowano ramienice triasu epikontynentalnego Polski, należące do ośmiu rodzajów (*Stellatochara* Horn af Rantzien, *Stenochara* Grambast, *Porochara* Mädler, *Vladimiriella* Saidakovsky, *Clavatorites* Horn af Rantzien, *Latochara* Mädler, *Auerbachichara* Kisielevsky & Saidakovsky, *Altochara* Saidakovsky) i czterech podrodzin (*Stellatocharoideae* Grambast, *Porocharoideae* Grambast, *Clavatori-*

toideae Kozur, *Auerbachicharoideae* nov. subfam.) rodziny *Porocharaceae*. Wobec istniejących niejasności nomenklatorycznych, wątpliwości odnośnie indywidualizmu niektórych taksonów oraz poglądów kwestionujących podstawy obowiązującej klasyfikacji, przeprowadzono krytyczną ocenę podstaw taksonomii triasowych charofitów oraz cech diagnostycznych różnych kategorii taksonomicznych. Przeanalizowano rolę wielkości i kształtu girogonita (Fig. 2, tab. 1 i 2) oraz morfologii bieguna apikalnego w diagnostyce rangi kategorii. Zwrócono uwagę na określenia błędne i niejednoznaczne zawarte w dotychczas opracowanych opisach oraz określenia zbędne, niepotrzebnie poszerzające treść opisów i diagnoz. W badanych osadach stwierdzono występowanie 52 gatunków (Pl. I—XII, fig. 3—5, tab. 3—7), w tym czterech nowych (*Stellatochara pomerana* n. sp., *S. silesiana* n. sp., *Stenochara kisielevskyi* n. sp. i *Stn. incerta* n. sp.).

Porocharaceae stwierdzono w osadach triasu Europy, Azji i Ameryki Północnej (Fig. 6). Kluczowe znaczenie dla rozważań nad filogenezą tej rodziny ma zmienność morfologii wierzchołka girogonita. Przedstawiono zróżnicowanie taksonomiczne *Porocharaceae* w okresie od górnego permu do górnego triasu (Fig. 7), a na podstawie zmienności morfologii bieguna apikalnego oraz zasięgów stratygraficznych poszczególnych rodzajów opracowano schemat (Fig. 8) przedstawiający próbę interpretacji filogenezy *Porocharaceae* w okresie triasowym oraz wskazano prawidłowości rozwoju triasowych ramienic. Po wczesnym okresie rozwoju *Porocharaceae* przypadającym na karbon i perm, zaznacza się intensywny ich rozwój na przełomie permu i triasu. Pierwszy etap ich rozwoju w triasie, obejmujący niższą część triasu dolnego, charakteryzuje się dominacją *Porochara* i *Vladimiriella* nad pozostałymi rodzajami. Drugi etap przypada na najwyższą część triasu dolnego i trias środkowy. Obok dominujących w tym okresie *Stellatochara* licznie występują *Stenochara*, a przedstawiciele innych rodzajów pojawiają się w niewielkiej ilości. Etap trzeci przypadający na trias górny, charakteryzuje się występowaniem przedstawicieli różnych rodzajów związanych z określonymi warunkami środowiska, przy czym wraz ze zmianami warunków następują zmiany rodzajów dominujących. Z końcem triasu wygasa szereg rodzajów *Porocharaceae*, a okres jurajski rozpoczyna kolejne etapy rozwoju tej flory.

W nawiązaniu do istniejących podziałów opracowano schemat biostratygraficzny triasu epikontynentalnego Polski w oparciu o charofity (tab. 8 i 9). Ponieważ w zespołach charofitowych triasu zaznacza się zmienność wywołana w znacznym stopniu warunkami środowiska, w różnych częściach profilu występować mogą zespoły o podobnym składzie. Uznano, że w takim kontekście niecelowe jest wyróżnianie poziomów zespołowych, które reprezentują w znacznej mierze warunki paleośrodowiska, lecz poziomów ścieśnionych, których zasięg określony jest występowaniem gatunków uznanych za wskaźnikowe. W interwale obejmującym środkowy pstry piaskowiec — dolny retyk zdefiniowano pięć poziomów ścieśnionych (tab. 10—12): poziom *Vladimiriella globosa*, poziom *Porochara triassica*, poziom *Stellatochara dnjeproviformis*, poziom *Stel-*

latochara hoellvicensis, poziom *Stellatochara thuringica* i jeden poziom zasięgu — poziom *Auerbachichara rhaetica*.

Wymieniono czynniki ograniczające wegetację charofitów współczesnych, a jako najważniejsze czynniki środowiska możliwe do przybliżonej interpretacji w osadach triasu uznano: głębokość, zasolenie, zawartość związków żelaza i węglanu wapnia oraz potencjał oksydacyjno-redukcyjny. Opierając się na stwierdzonej dominacji ilościowej przedstawicieli określonych rodzajów, wyróżniono następujące zespoły: zespół z *Porochara* i *Vladimiriella*, zespół z *Porochara* i *Stenochara*, zespół ze *Stenochara* i *Stellatochara*, zespół ze *Stellatochara* i zespół z *Auerbachichara*. Określono związek wyróżnionych zespołów z danymi warunkami środowiska oraz ich rozprzestrzenienie w osadach triasu epikontynentalnego Polski. W środkowym pstrym piaskowcu występują: zespół z *Porochara* i *Vladimiriella* oraz zespół z *Porochara* i *Stenochara*. W recie i wapieniu muszlowym występuje jedynie zespół ze *Stenochara* i *Stellatochara*. W triasie górnym stwierdzono występowanie czterech z pośród wyróżnionych: zespołu z *Porochara* i *Stenochara*, zespołu ze *Stenochara* i *Stellatochara*, zespołu ze *Stellatochara* oraz zespołu z *Auerbachichara*, przy czym pierwsze dwa występują licznie w kajprze i dolnym retyku, trzeci wyłącznie w kajprze, a czwarty tylko w dolnym retyku. Zwrócono uwagę na podobne tendencje rozwoju flory charofitowej na znacznych obszarach Laurazji.

Szerokie rozprzestrzenienie ramienic w triasie, zróżnicowanie ich zespołów w czasie oraz określony zasięg wiekowy gatunków uznanych za wskaźnikowe, uzasadnia ich przydatność do celów zarówno lokalnych korelacji wiekowych, jak również paralelizacji regionalnych, a nawet międzykontynentalnych. Podyktowane zmianami warunków środowiska, zróżnicowanie składu zespołów oraz występowanie zespołów o podobnym składzie w osadach różnego wieku wywołuje trudności przy określaniu zasięgu wiekowego taksonów, granic popoziomów charofitowych, a także korelacji. Występowanie ramienic i zróżnicowanie ich zespołów stanowić może jednak ważne kryterium przy paleogeograficznych rekonstrukcjach zmian linii brzegowej i głębokości zbiorników kontynentalnych triasu.

Plate I

×108

Stellatochara hoellvicensis Horn af Rantzien

1. Specimen ZPAL. Ch 7—637,8/53; a — lateral view, b — apical view
2. Specimen ZPAL. Ch 7—637,8/52; a — lateral view, b — apical view
3. Specimen ZPAL. Ch 7—637,8/55 — lateral view
4. Specimen ZPAL. Ch 7—637,8/51 — lateral view

Stellatochara gracilis (Saidakovsky) n. comb.

5. Specimen ZPAL. Ch 7—637,8/61 — lateral view

Stellatochara maedleri Horn af Rantzien

6. Specimen ZPAL. Ch 59—79/23 — lateral view

Stellatochara germanica Kozur & Reinhardt

7. Specimen ZPAL. Ch 36—64,3/21 — lateral view

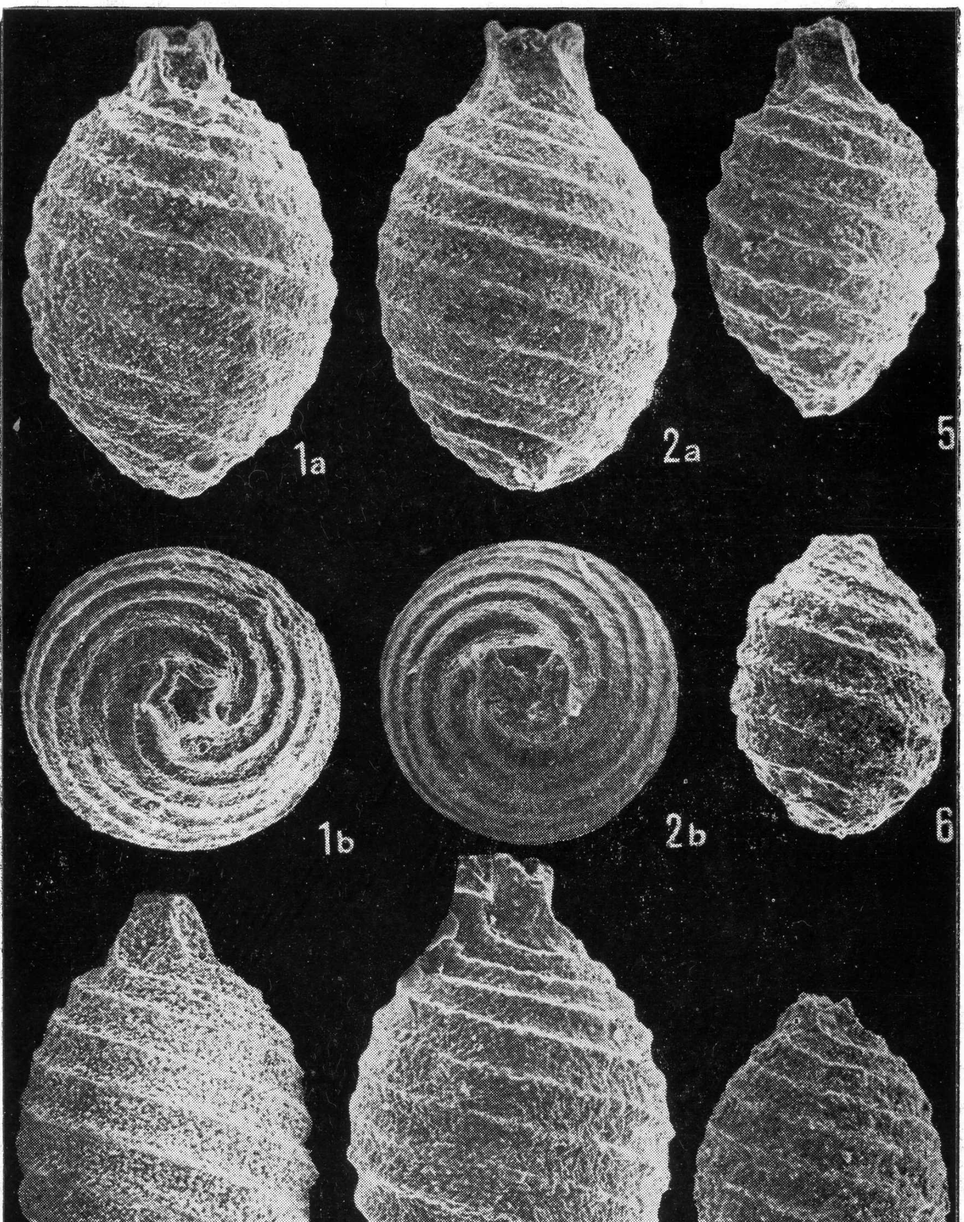

1a
2a
5
1b
2b
6
3
4
7

Plate II

×108

Stellatochara lipatovae (Saidakovsky) Kozur & Reinhardt

1. Specimen ZPAL. Ch 4—1306/32; a — lateral view, b — apical view
2. Specimen ZPAL. Ch 4—1306/33 — lateral view

Stellatochara dnjeproviformis Saidakovsky

3. Specimen ZPAL. Ch 7—637,8/58 — lateral view
4. Specimen ZPAL. Ch 24—1012,5/15 — lateral view
5. Specimen ZPAL. Ch 7—637,8/57; a — lateral view, b — apical view

Stellatochara thuringica Kozur & Reinhardt

6. Specimen ZPAL. Ch 42—69/24 — lateral view

Stellatochara piriformis Kozur & Reinhardt

7. Specimen ZPAL. Ch 7—637,8/56 — lateral view

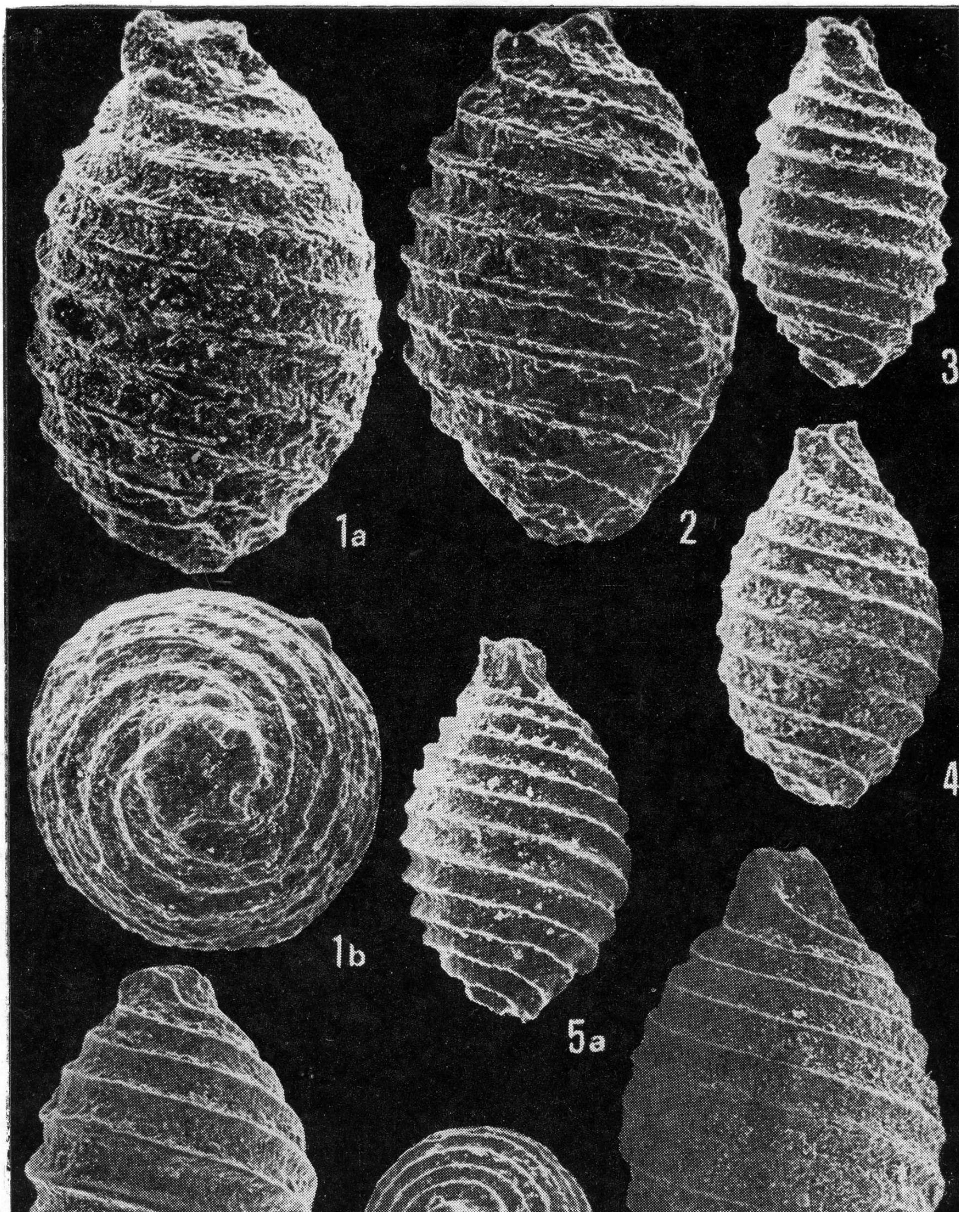

1a
2
3
4
1b
5a
6
5b
7

Plate III

$\times 108$

Stellatochara kozuri Bilan

1. Specimen ZPAL. Ch 74—81,5/4; a — lateral view, b — apical view

Stellatochara pomerana n. sp.

2. Holotype ZPAL. Ch 7—637,8/60; a — lateral view, b — apical view
3. Specimen ZPAL. Ch 4—1306/35 — lateral view
4. Specimen ZPAL. Ch 7—637,8/59 — lateral view

Stellatochara silesiana n. sp.

5. Specimen ZPAL. Ch 54—94,2/20 — lateral view
6. Holotype ZPAL. Ch 54—94,2/21; a — lateral view, b — apical view
7. Specimen ZPAL. Ch 42—66/23 — lateral view

Stellatochara donbassica (Demin) Saidakovsky

8. Specimen ZPAL. Ch 4—1306/34 — lateral view

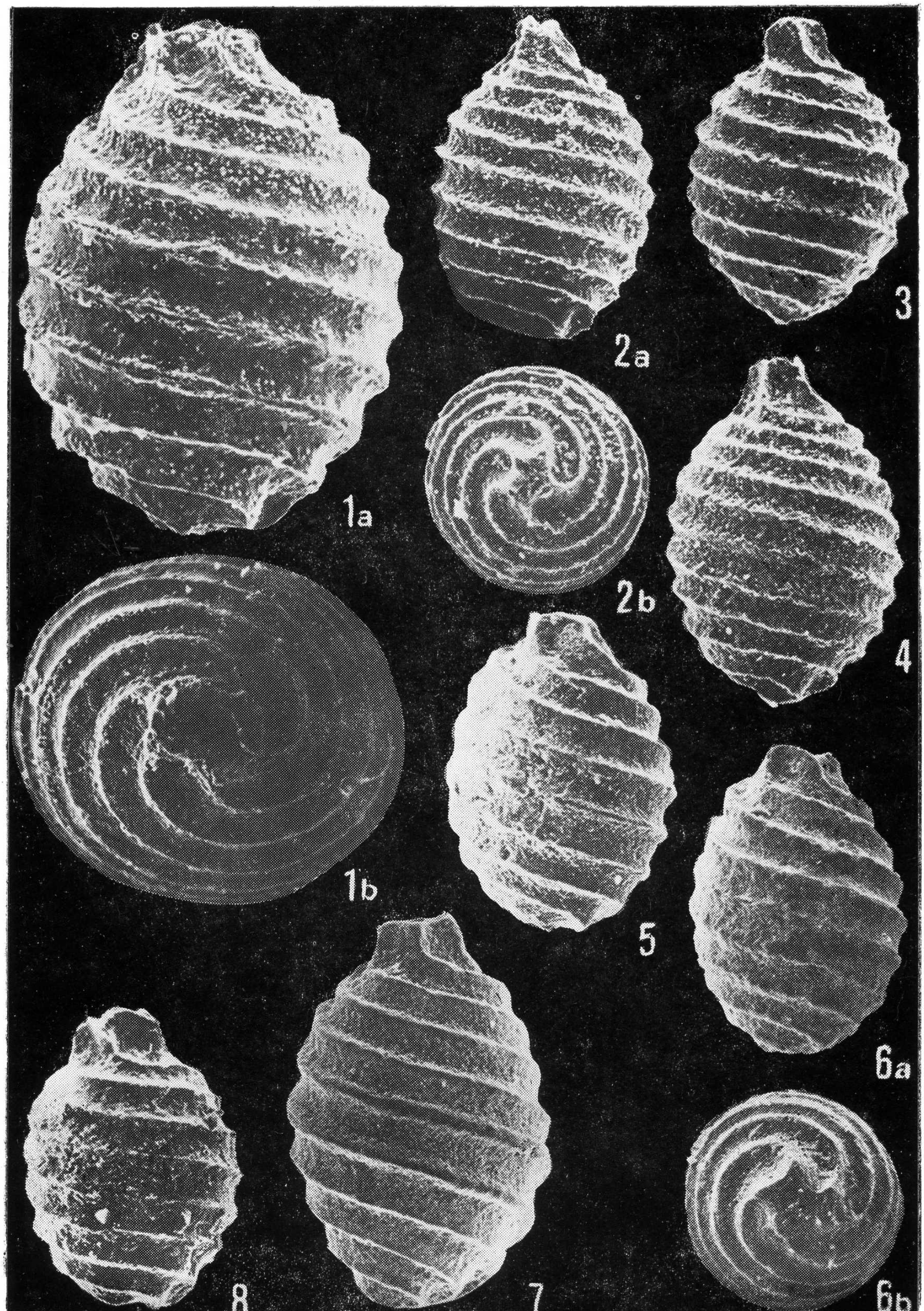

1a
1b
2a
2b
3
4
5
6a
6b
7
8

Plate IV

×108

Stellatochara subsphaerica Kozur & Reinhardt

1. Specimen ZPAL. Ch. 36—64,3/20 — lateral view

Stellatochara schneiderae Saidakovsky

2. Specimen ZPAL. Ch 62—108,2/4 — lateral view

Stenochara donetziana (Saidakovsky) Grambast

3. Specimen ZPAL. Ch 7—637,8/44; a — lateral view, b — apical view

Stenochara ovata (Saidakovsky) Saidakovsky

4. Specimen ZPAL. Ch 7—637,8/64 — lateral view

Stenochara karpinskyi (Demin) Kozur & Reinhardt

5. Specimen ZPAL. Ch 8—736/43 — lateral view

Stenochara kisielevskyi n. sp.

6. Specimen ZPAL. Ch 8—736/42 — lateral view
7. Holotype ZPAL. Ch 24—1012,5/13; a — lateral view, b — apical view
8. Specimen ZPAL. Ch 57—16,5/14 — lateral view
9. Specimen ZPAL. Ch 8—740/30 — lateral view

Stenochara schaikini Saidakovsky

10. Specimen ZPAL. Ch 59—79/22 — lateral view

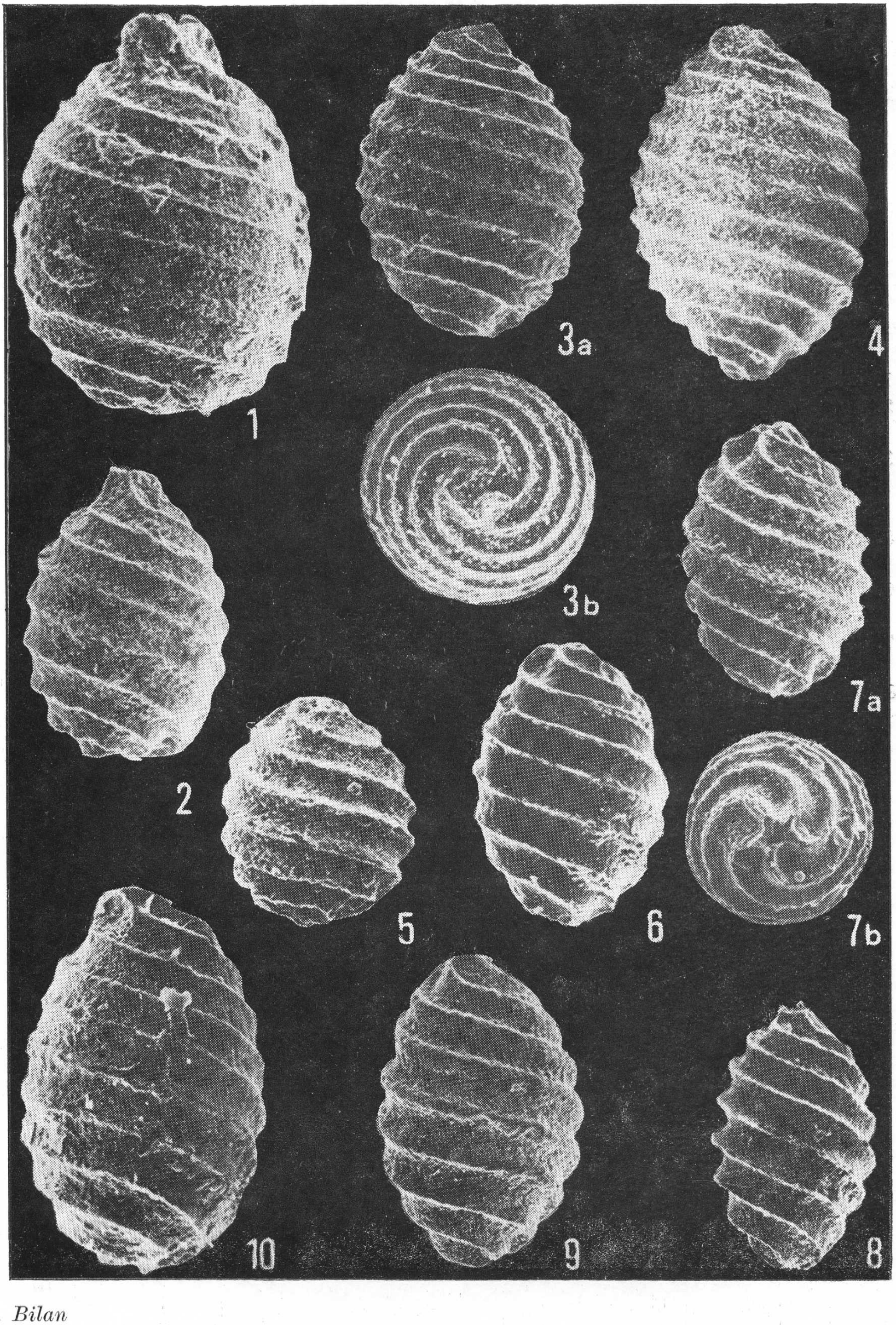

1
2
3a
3b
4
5
6
7a
7b
8
9
10

Plate V

×108

Stenochara pseudoovata Saidakovsky

1. Specimen ZPAL. Ch 7—637,8/47 — lateral view
2. Specimen ZPAL. Ch 35—183,8/23; a — lateral view, b — apical view

Stenochara pseudoglypta (Horn af Rantzien) Grambast

3. Specimen ZPAL. Ch 8—736/41 — lateral view
4. Specimen ZPAL. Ch 8—736/40 — lateral view

Stenochara saratoviensis Kisielevsky

5. Specimen ZPAL. Ch 4—1306/31 — lateral view

Stenochara maedleri (Horn af Rantzien) Grambast

6. Specimen ZPAL. Ch 7—637,8/45 — lateral view

Stenochara elongata (Saidakovsky) Saidakovsky

7. Specimen ZPAL. Ch 26—1711/22 — lateral view

Stenochara rantzienii Saidakovsky

8. Specimen ZPAL. Ch 35—183,8/24 — lateral view

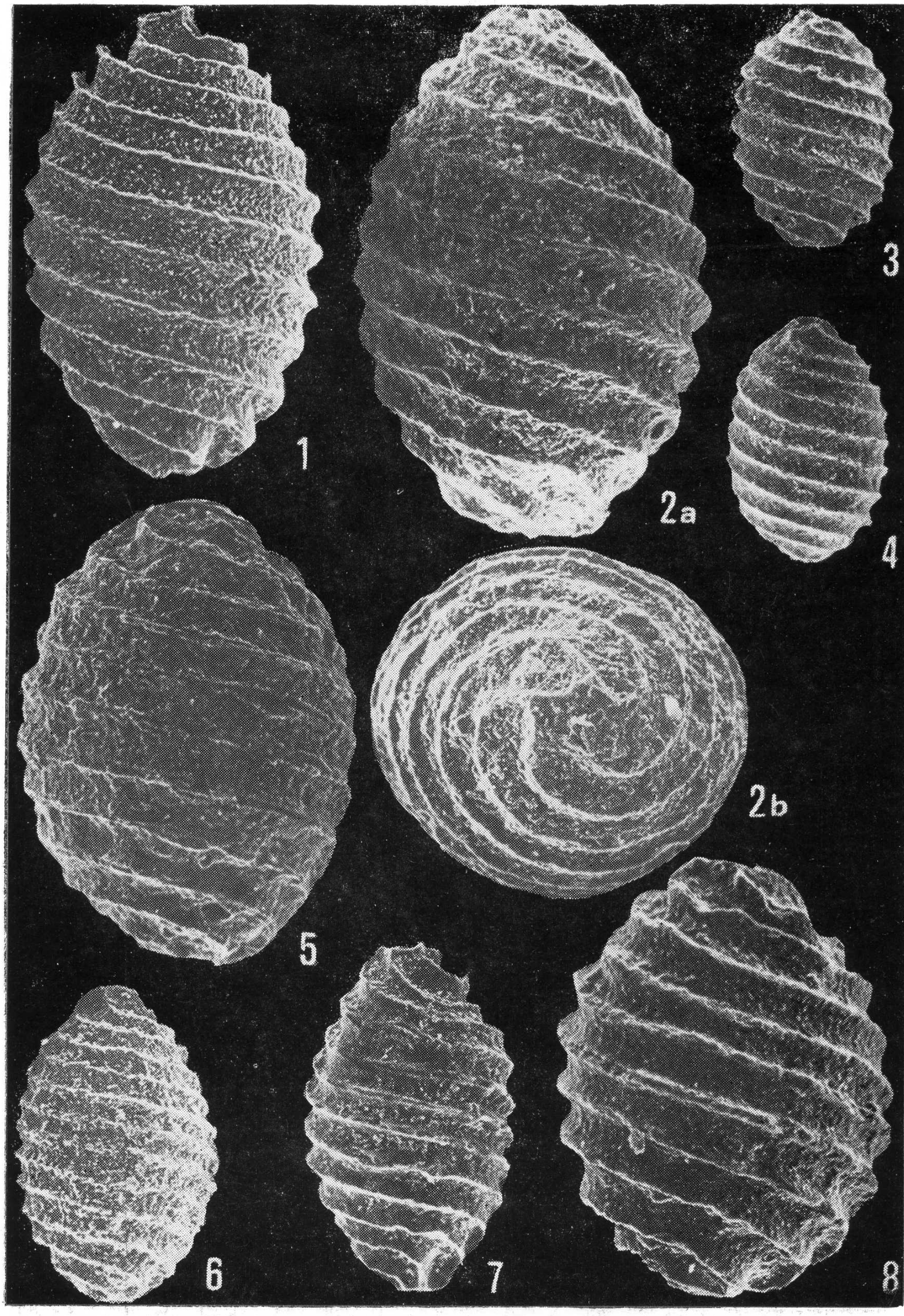

1
2a
3
4
2b
5
6
7
8

Plate VI

×108

Stenochara incerta n. sp.

1. Holotype ZPAL. Ch 42—74/19; a — lateral view, b — apical view
2. Specimen ZPAL. Ch 42—74/21 — lateral view

Porochara urusovi Saidakovsky

3. Specimen ZPAL. Ch 42—65/10 — lateral view

Porochara sphaerica Kisielevsky

4. Specimen ZPAL. Ch 30—109/12 — lateral view

Porochara concisa Saidakovsky

5. Specimen ZPAL. Ch 8—736/50 — lateral view

Porochara belorussica Saidakovsky

6. Specimen ZPAL. Ch 8—736/46; a — lateral view, b — apical view
7. Specimen ZPAL. Ch 8—736/45 — lateral view

Porochara dergatschiensis Kisielevsky

8. Specimen ZPAL. Ch 30—117/4 — lateral view

Porochara brotzeni (Horn af Rantzien) Grambast

9. Specimen ZPAL. Ch 8—736/51; a — lateral view, b — apical view

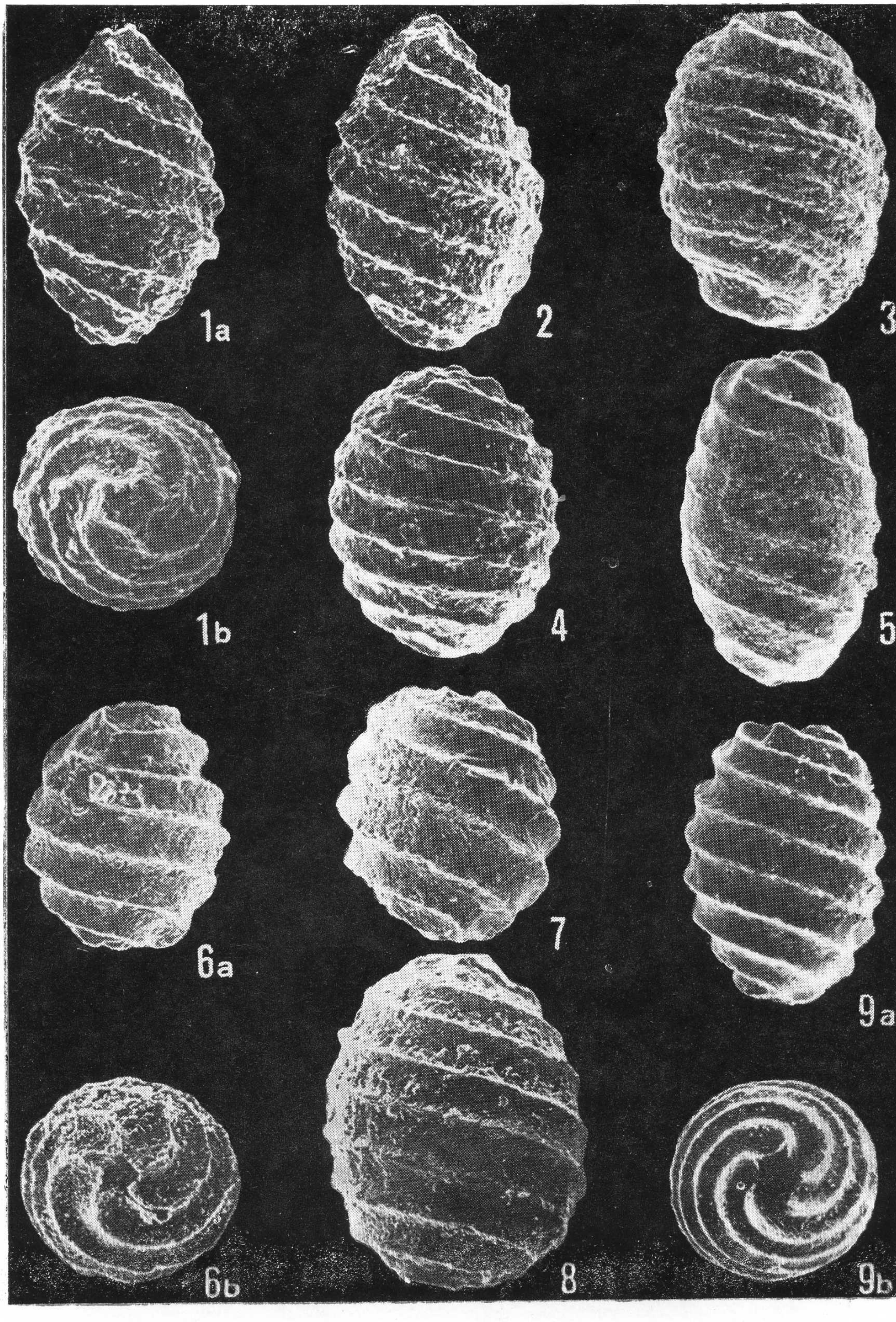

1a
2
3
1b
4
5
6a
7
9a
6b
8
9b

Plate VII

× 108

Porochara triassica (Saidakovsky) Grambast

1. Specimen ZPAL. Ch 8—736/47 — lateral view

Porochara abjecta Saidakovsky

2. Specimen ZPAL. Ch 7—637,8/63 — lateral view
3. Specimen ZPAL. Ch 7—637,8/62 — lateral view

Vladimiriella decora (Saidakovsky) Saidakovsky

4. Specimen ZPAL. Ch 35—183,8/26; a — lateral view, b — apical view
5. Specimen ZPAL. Ch 35—183,8/25 — lateral view

Porochara cylindrica Kisielevsky

6. Specimen ZPAL. Ch 8—736/49 — lateral view
7. Specimen ZPAL. Ch 8—736/48 — lateral view

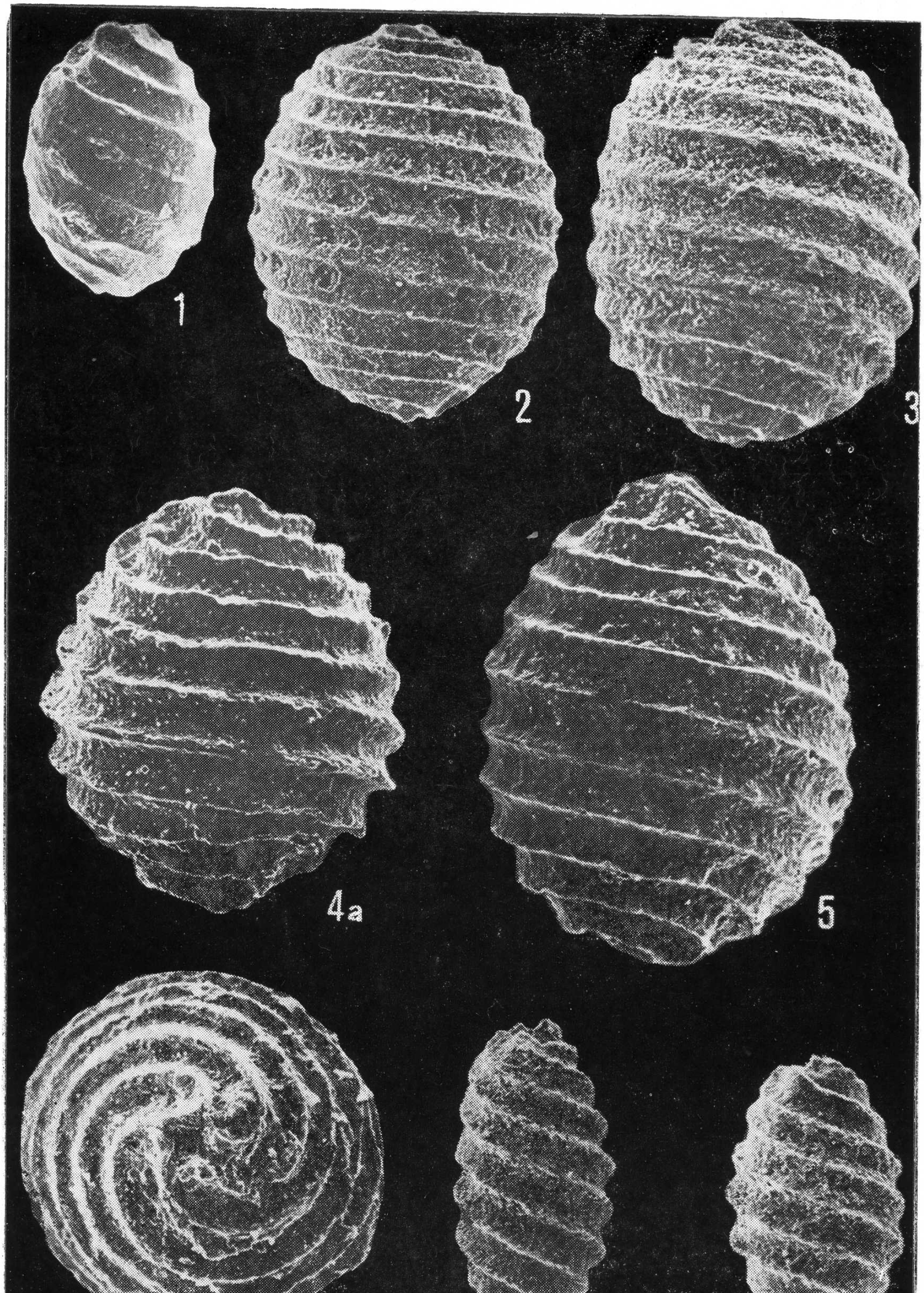

1
2
3
4a
5
4b
6
7

Plate VIII

× 108

Vladimiriella globosa (Saidakovsky) Saidakovsky

1. Specimen ZPAL. Ch 8—736/44 — lateral view

Vladimiriella wetlugensis (Saidakovsky) Saidakovsky

2. Specimen ZPAL. Ch 59—74/4; a — lateral view, b — apical view

Clavatorites cuneatus (Saidakovsky) Kozur

3. Specimen ZPAL. Ch 30—109/11; a — lateral view, b — apical view

Clavatorites hoellvicensis Horn af Rantzien

4. Specimen ZPAL. Ch 7—637,8/48; a — lateral view, b — apical view
5. Specimen ZPAL. Ch 7—637,8/54 — lateral view

Clavatorites acuminatus (Saidakovsky) Kozur

6. Specimen ZPAL. Ch 7—637,8/50 — lateral view

Latochara acuta Saidakovsky

7. Specimen ZPAL. Ch 8—740/31 — lateral view

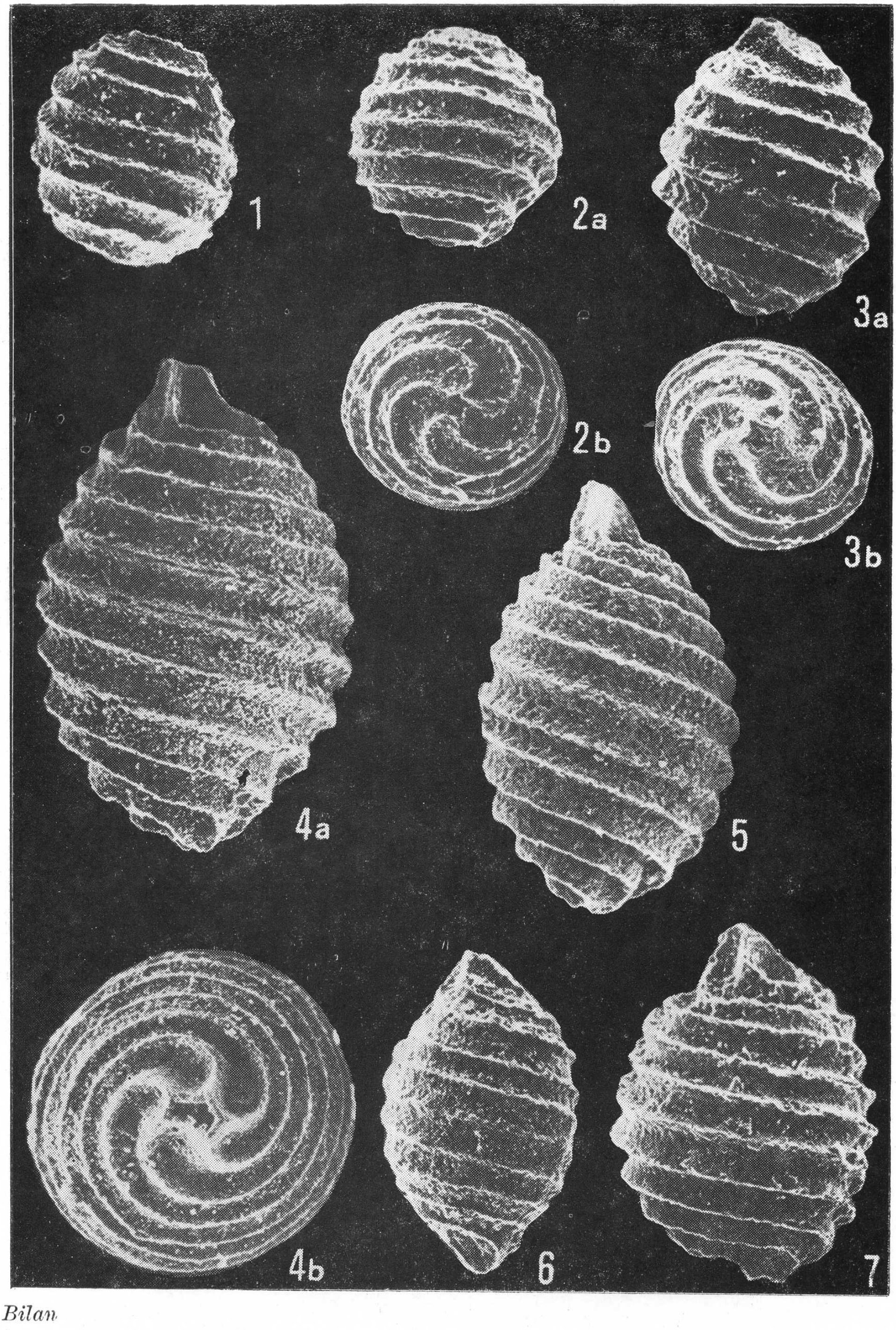

1
2a
3a
2b
3b
4a
5
4b
6
7

Plate IX

Clavatorites capitatus (Saidakovsky & Kisielevsky) Kozur

1. Specimen ZPAL. Ch 7—637,8/49; a — lateral view, b — apical view (× 108), c — apical view (× 500)

Auerbachichara starozhilovae Kisielevsky

2. Specimen ZPAL. Ch 47—78/25 — lateral view (× 108)
3. Specimen ZPAL. Ch 47—78/23 — lateral view (× 108)

Auerbachichara kisielevskyi Saidakovsky

4. Specimen ZPAL. Ch 34—5/8 — lateral view (× 108)

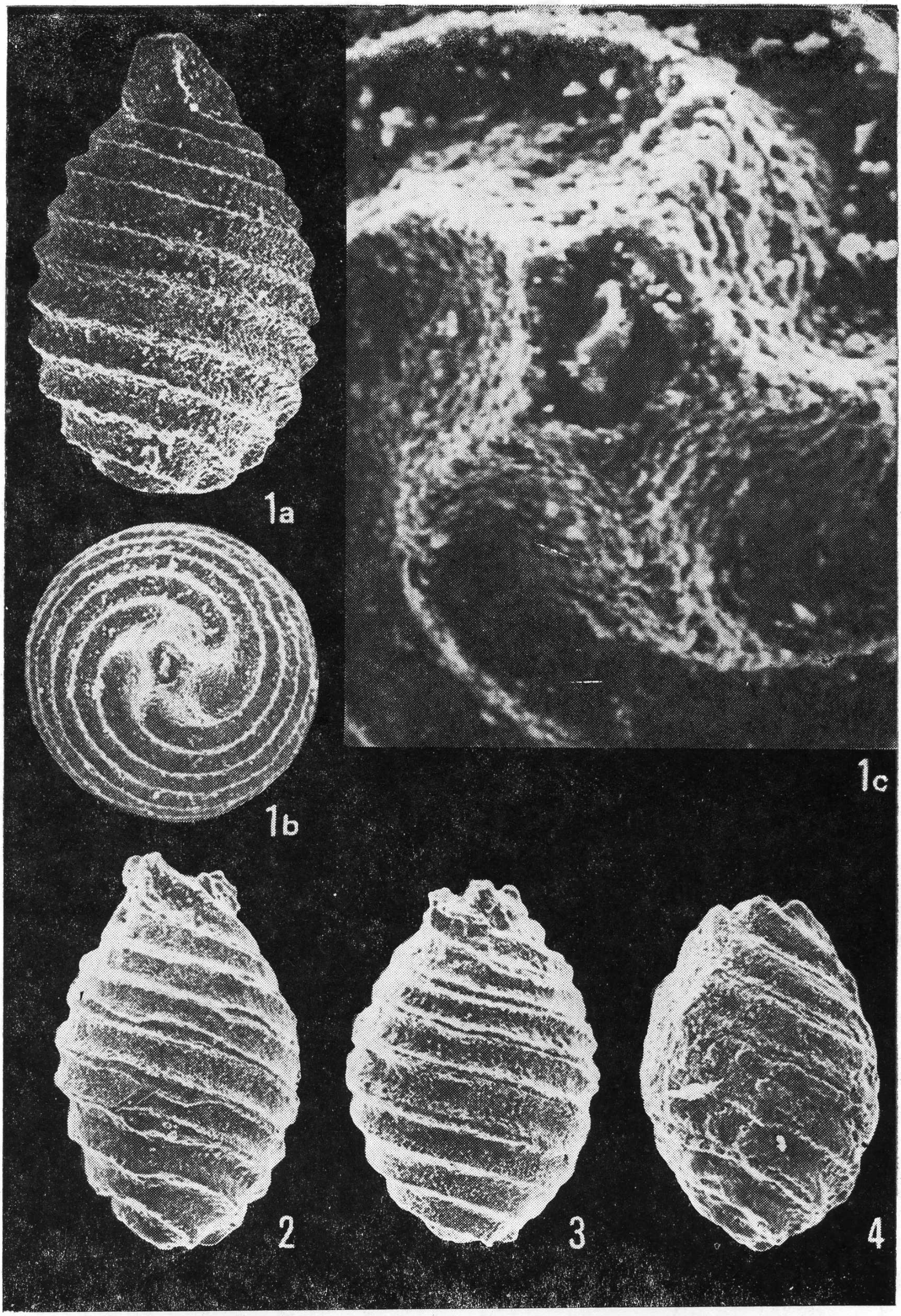

1a
1b
1c
2
3
4

Plate X

Auerbachichara starozhilovae Kisielevsky

1. Specimen ZPAL. Ch 47—78/24; a — lateral view, b — apical view (× 108), c — fragment of the surface of same specimen (× 500), d — apical view (× 500)

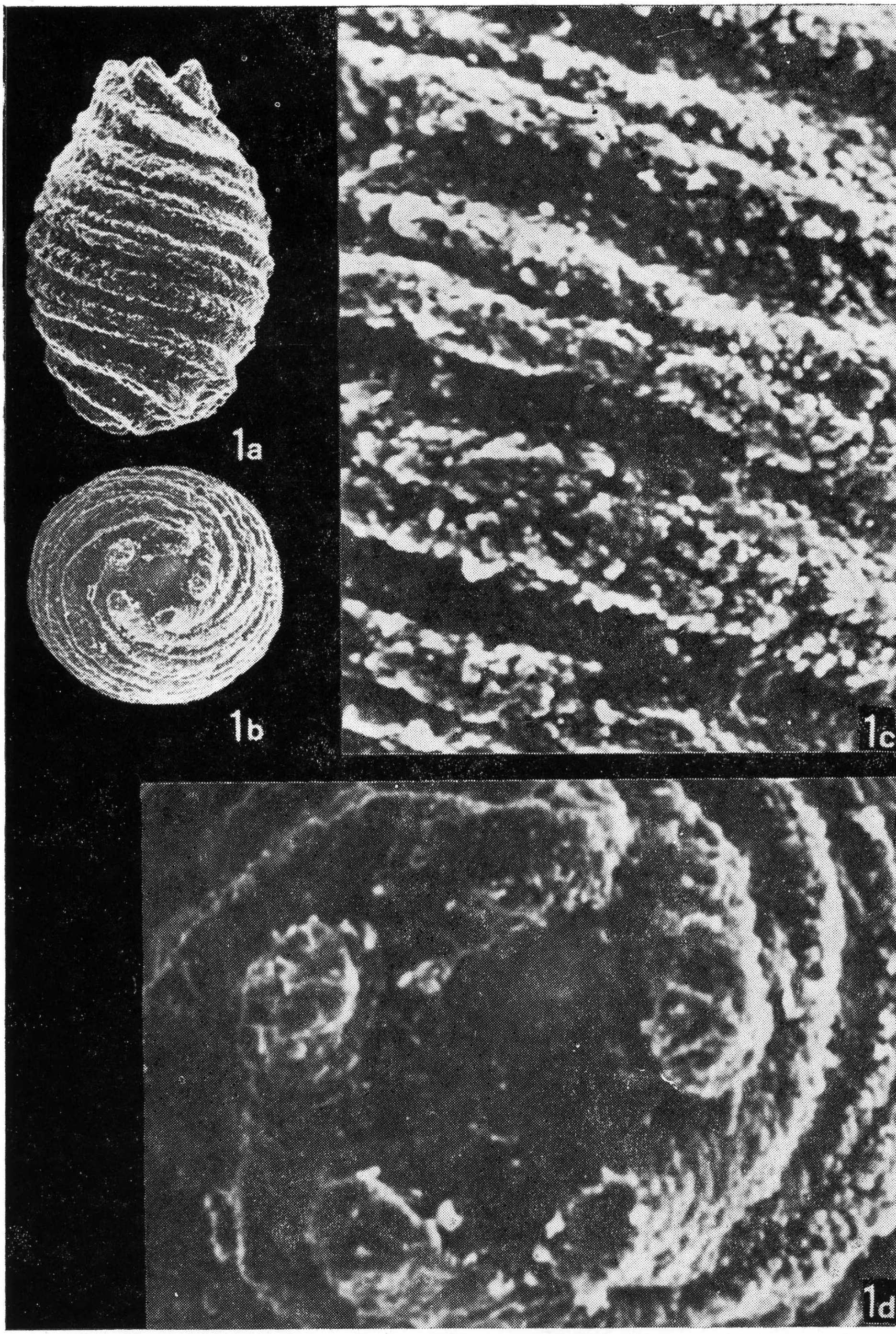

1a
1b
1c
1d

Plate XI

Auerbachichara polonica Bilan

1. Specimen ZPAL. Ch 47—78/24; a — lateral view, b — apical view (× 108), c — apical view (× 500)

Auerbachichara arguta (Saidakovsky) n. comb.

2. Specimen ZPAL. Ch 42—74/20; a — lateral view, b — apical view (× 108)

Auerbachichara rhaetica Bilan

3. Specimen ZPAL. Ch 39—33/27; a — lateral view, b — apical view (× 108)

Auerbachichara baskuntschakiensis Kisielevsky

4. Specimen ZPAL. Ch 12—778/20 — lateral view (× 108)
5. Specimen ZPAL. Ch 12—778/21; a — lateral view, b — apical view (× 108)

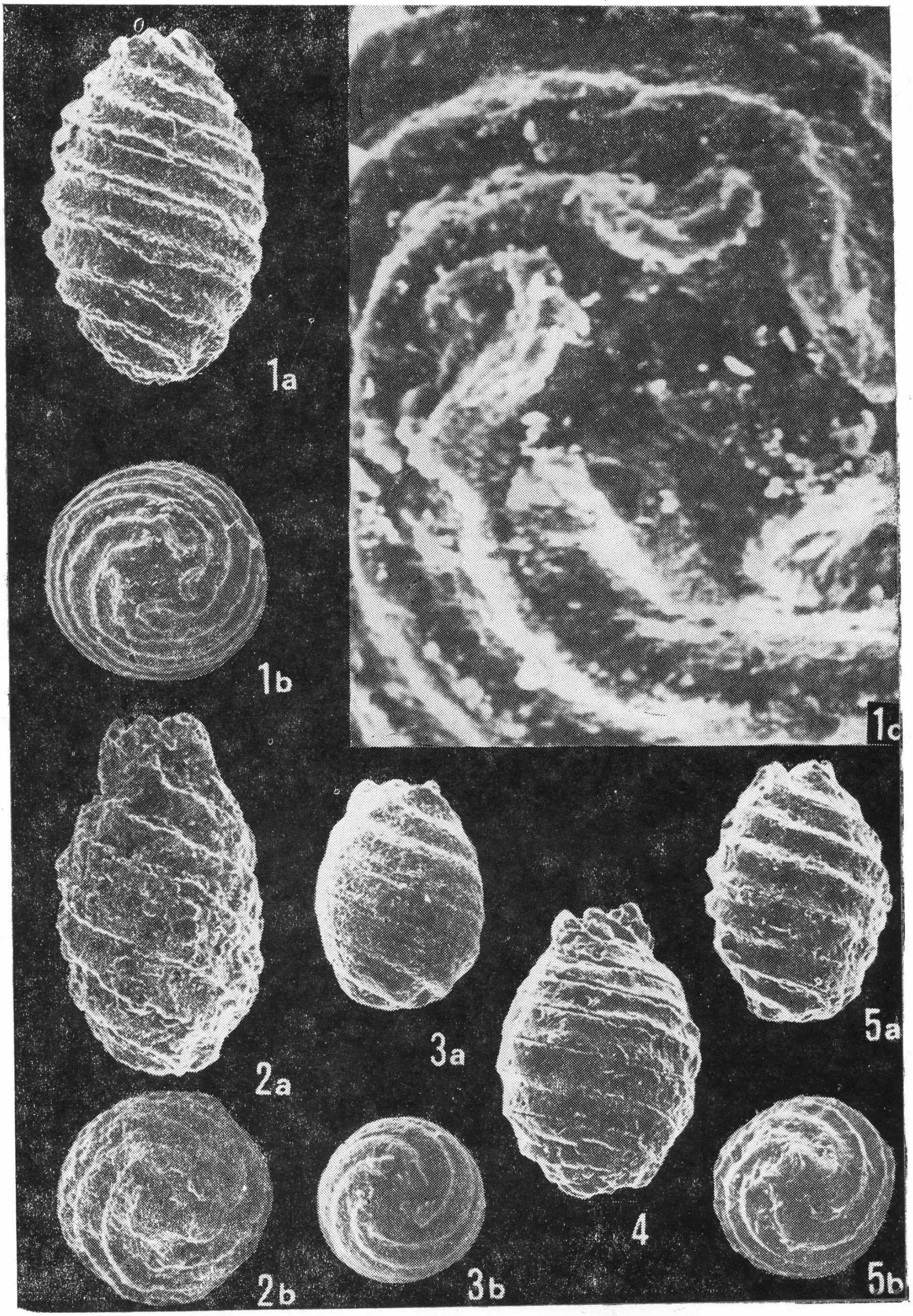
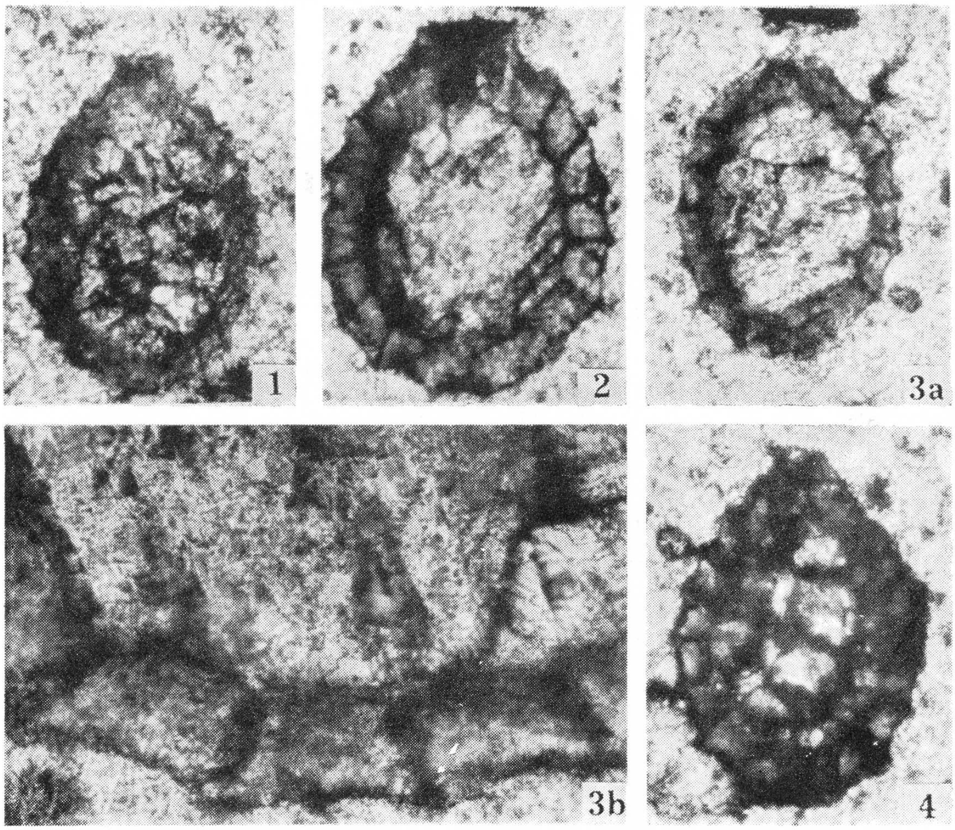

1a
1b
1c
2a
2b
3a
3b
4
5a
5b

Plate XII

1. *Stellatochara pomerana* n. sp. — longitudinal section through gyrogonite (× 108)
2. *Stellatochara silesiana* n. sp. — longitudinal section through gyrogonite (× 108)
3. *Stenochara kisielevskyi* n. sp. — longitudinal section through gyrogonite; a — × 108, b — × 350
4. *Stenochara incerta* n. sp. — longitudinal section through gyrogonite (× 108)


1
2
3a
3b
4