POLSKA AKADEMIA NAUK · KOMITET NAUK GEOLOGICZNYCH

PAŃSTWOWE WYDAWNICTWO NAUKOWE · WARSZAWA

acta geologica polonica

Vol. 24, No. 4 Warszawa 1974

LECH TELLER

The Silurian of the margin of the East European platform in the region of Miastko-Chojnice (NW Poland)

ABSTRACT: A description is given of the lithologo-faunistical characters, as well as of the stratigraphy and sedimentary-tectonic development of the Silurian deposits identified in 8 boreholes in the Miastko-Chojnice region. Evidence has been obtained for the presence of the complete profile of the Silurian deposits belonging to the Caledonian sedimentary megacycle which, in the area under discussion, does not end before the Gedinnian. After the folding of the Silurian sediments during the Erian phase of the Caledonian orogeny they were at least twice subjected to erosion and are unconformably covered by various members of the late Paleozoic.

INTRODUCTION

The presence of Silurian sediments in the Miastko-Chojnice region has been ascertained by the Oil Prospecting Survey between 1963—1972 during prospective drilling for oil and gas. Borehole Chojnice *3* drilled in 1963—1964 to the SE of the town so called, was the first one to yield faunally documented Silurian. Deposits of the same age have been found in three other boreholes (Stobno *1*, *2* and *3*) drilled between 1966 and 1968, as well as in borehole Nicponie *1* drilled in 1971.

Borehole Lutom *1* from which a profile of the Lower Silurian sediments has been obtained between 1965—1966, is situated farther north. The next two Silurian profiles have been obtained in 1971—1972 in boreholes Wierzchocina *1* and Wierzchocina *4*, lying SE of Miastko (Fig. 1).

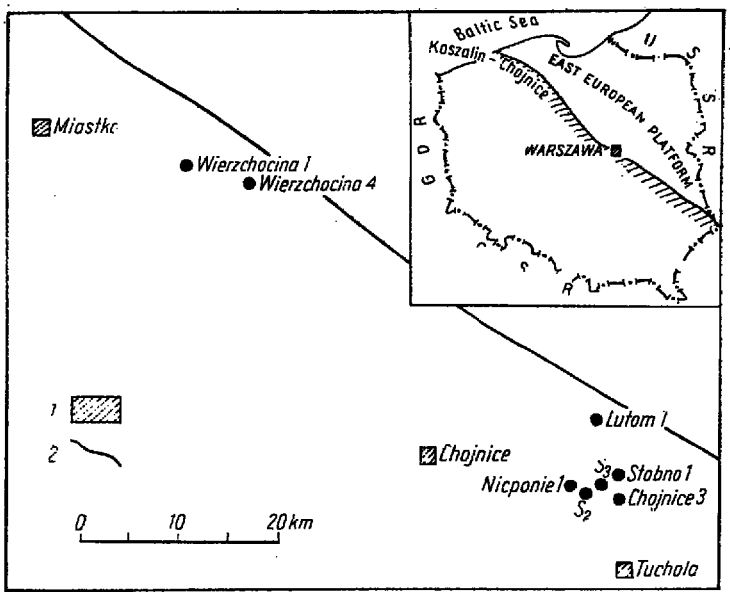


Fig. 1

Sketch-map showing localization of the boreholes in the Miastko-Chojnice region
1 miogeosyncline, *2* Tornquist line

All these Silurian profiles are fragmentary and represent various members, their feature in common being strong tectonic disturbance, and big dips ranging from 0 to 90 degrees.

The Silurian is unconformably overlain by sediments of the late Paleozoic. In the profiles of Chojnice *3*, Stobno *2* and Stobno *3*, also in Nicponie *1* occur various members of the Lower or Middle Devonian; in profile Stobno *1* the basal anhydrite of the Werra cyclothem; in profile Lutom *1* the basal conglomerate of the Zechstein, and in profiles Wierzchocina *1* and *4* the basal limestones of the Werra cyclothem.

The Silurian sediments have not been pierced in any of the profiles here mentioned and their relation to the older deposits is not known.

The material on which the present paper is worked out has been collected by the writer himself or with the co-operation of his fellow-workers from the Laboratory of Stratigraphy of the Institute of Geological Sciences at the Polish Academy of Sciences in Warsaw. As a rule, the samples have been taken during the drilling of boreholes, only a few of the cores are from the core-storeroom of the Oil Research Survey at Piła. One part of the results of the above investigations has been published in 1968 in co-operation with K. Korejwo, the remainder is given in the present paper.

Research studies on Prepermian sediments from boreholes in the NW of Poland are under way since 1965 in the Laboratory of Stratigraphy, in co-operation with the Geological Research Bureau for Oil Industry "Geonafta".

The materials documenting the Silurian sediments are kept in the archives of the above named Laboratory.

Acknowledgements. The writer's cordial thanks for friendly co-operation and access to the required materials are due to Dr P. Karnkowski, Head Geologist of the Union for Oil Mining, to L. Cimaszewski, M. Sc., Head Geologist of the Petroleum Research Survey at Piła, also to A. Łobza, M. Sc., and B. Sikorski, M. Sc. Most grateful thanks are also conveyed to the whole staff of the Laboratory of Stratigraphy, particularly to K. Korejwo, D. Sc., for her co-operation and B. Żbikowska, M. Sc. for identifying the ostracod fauna.

LITHOLOGO-FAUNISTIC CHARACTERS OF SILURIAN SEDIMENTS

The fragmentary state of the Silurian profiles obtained by drilling, and their incomplete coring, handicap a closer lithological description. From among the 8 profiles faunally documenting the Silurian sediments, those from borehole Lutom *1* (552 m) and Stobno *2* (397.5 m) are the thickest ones. In the remaining profiles the thickness ranges from 28 m (Nicponie *1*) to 120.7 m (Stobno *3*) and it is apparent everywhere (Table 1).

Table 1

	Borehole	Total drilled apparent thickness	Coring	Per cent of coring in relation to the total thickness	Approximate real thickness
1	Lutom 1	552.0 m	218.3 m	39.54	150–200 m
2	Chojnice 3	79.5 m	46.0 m	57.85	50 m
3	Stobno 1	45.3 m	7.5 m	1.65	30 m
4	Stobno 2	397.5 m	76.0 m	19.02	350 m
5	Stobno 3	120.7 m	8.0 m	0.66	100 m
6	Nicponie 1	28.0 m	6.7 m	2.39	20 m
7	Wierzchocina 1	56.0 m	7.3 m	1.30	50 m
8	Wierzchocina 4	54.0 m	5.0 m	9.26	40 m

Llandoverian

This stage is represented by alternating siltstones and grey, grey-greenish mudstones, locally lightgrey with fine-grained dispersed mica and numerous vertical cracks and slickensides. The relation of siltstones to mudstones varies in the particular sectors of the profile but the latter are distinctly predominant. A sedimentary series with such a development has been found only in the Lutom *1* column at a depth of 2464—

3016 m without being pierced. It is tectonically strongly disturbed, the dips ranging from 10 to 90°. Its real thickness may be estimated at c. 150—200 m, not excluding a re-folding.

Both in the siltstones and mudstones there was an abundant graptolite-bearing fauna from which index forms have been identified for three graptolite zones (Teller & Korejwo 1968a).

Wenlockian

This stage is developed as darkgrey siltstones, here and there distinctly microlaminated. Slickensides and cracks are numerous. A fragmentary profile of sediments of this age has been found under the Zechstein in borehole Wierzchocina 4 at a depth of 1949—2003 m (54 m). The sediments here are rather strongly disturbed, the dips being up to 45°, so that the real thickness is c. 40 m. The Upper Wenlockian is documented by the presence of few but characteristic graptolites among which the following have been identified:

at a depth of 1967—1973 m
Monograptus flemingi (Salt.) — numerous
Pristiograptus dubius (Suess),

at a depth of 1998—2001 m
Monograptus (Testograptus) testis (Barr.)
Monograptus flemingi (Salt.)

also isolated rhabdosome fragments belonging to genus *Cyrtograptus*.

Ludlovian

Sediments of this age have been found only in columns Nicponie *1* and Wierzchocina *1*. In the former borehole, at a depth of 2994—3022 m (28 m) they are represented by grey siltstones strongly slickensided and crumpled, with dips up to 70°. The graptolites they have yielded were few and poorly preserved. The forms identified among them are:

at a depth of 3010—3012 m
Bohemograptus bohemicus tenuis (Bouček), and

at a depth of 3017—3019 m
Pristiograptus sp.

The Ludlovian sediments in profile Wierzchocina *1* display a somewhat different type of development. Namely, in the two cores from 1929.5—1941.0 m (56 m) lightgrey, slightly sandy dolomites have been

reached with a 4 cm thick intercalation of unfossiliferous darkgrey siltstone; towards the top the dolomites pass into darkgrey siltstones with distinct platy jointing, and into greygreenish siltstones intercalated by brick-coloured ones. Numerous slickensides and cracks are present throughout this column, the dips ranging from 15 to 20°. The following graptolites have been identified from the meagre fauna here:

Monograptus cf. *uncinatus* Tullb.
Pristiograptus ex gr. *dubius* (Suess)
Monograptus sp. and *Retiolites* sp.

Postludlovian

The Postludlovian sediments are represented by darkgrey siltstones with intercalations of very thin fine-crystalline limestones also organogenic ones bearing an abundant fauna of lamellibranchs, brachiopods and ostracods, also sporadical trilobite fragments. The whole series is strongly cracked, slickensided and contains calcite veins. This type of sediments has been encountered in column Chojnice *3* at a depth of 2965.0—3044.5 m (79.5 m), Stobno *1* 2485.0—2530.3 m (45.3 m), Stobno *2* 2792.5—3190.0 m (397 m) and Stobno *3* 2850.0—2970.7 m (120.7 m).

The tectonic disturbance is so strong that it is hardly possible to determine the dip angles and the real thickness of the deposits. Column Stobno *2* is the only exception; the dips there are small (up to 15°) and the whole column is but slightly disturbed.

In columns Chojnice *3* and Stobno *1*, a fairly abundant non-graptolite fauna and isolated graptolite remains have been found (Teller & Korejwo 1968c). The meagre ostracod fauna in column Chojnice *3*, examined by Żbikowska (1974), has allowed to determine the presence of the following forms:

at a depth of 2970.0—2974.7 m
Nodibeyrichia tuberculata (Klöden)
Frostiella sp., *Hemsiella* sp., *Amygdalella* sp.,
Kuresaaria sp.

at a depth of 2987.1—2991.6 m
Neobeyrichia cf. *buchiana* (Jones)
Healdianella sp.

Among the ostracod fauna the following forms have been identified from column Stobno *1*:

at a depth of 2490.5—2496.5 m
Hemsiella cf. *hemsiensis* Martinsson
Scipionis profundigenus Martinsson
?Neobeyrichia sp.

at a depth of 2519.3—2530.0 m
Hemsiella cf. *hemsiensis* Martinsson
Parabolbina baltica Martinsson
Scipionis sp.

The non-graptolite fauna present in column Stobno *3* is very poorly preserved and specifically hardly determinable, except for the ostracods among which the following have been identified:

at a depth of 2886.5—2890.5 m
Parabolbina cf. *ventica* Gajlite
Hemsiella cf. *hemsiensis* Martinsson
Neobeyrichia cf. *regnans* Martinsson
Healdianella magna Neckaja

at a depth of 2958.0—2962.0 m
Healdianella magna Neckaja
Neobeyrichia sp.

In the column Stobno *2* lamellibranchs are the dominant fauna. They occur in association with an abundance of ostracods, few brachiopods (chiefly from the genera *Orbiculoidea, Lingula, Chonetes* and *Camarotoechia*), fragmentary trilobites, isolated tentaculites and crinoid stems. No graptolites have been found. Ostracod remains are the only ones which have been analysed and identified among the fauna here encountered, viz.

at a depth of 2800.0—2920.0 m
Amygdalella subclusa Martinsson
Healdianella magna Neckaja
Kloedenia wilckensiana (Jones)
Macrypsilon salterianum (Jones) — abundance
Nodibeyrichia gedanensis Martinsson — abundant
Kuresaaria sp., *Scipionis* sp.

at a depth of 2920.0—3015.0 m
Amygdalella subclusa Martinsson
Healdianella magna Neckaja
Kloedenia wilckensiana (Jones)
Macrypsilon salterianum (Jones)
Neobeyrichia gedanensis Martinsson
Nodibeyrichia buchiana (Jones) — abundant
Hemsiella dalmaniana (Jones)
Sleia sp. — abundant, *Kuresaaria* sp.

at a depth of 3015.0—3150.0 m
Amygdalella subclusa Martinsson
Healdianella magna Neckaja
Neobeyrichia buchiana (Jones)
Nodibeyrichia tuberculata (Klöden) — abundant
Kuresaaria sp., *Hemsiella* sp., *Kloedenia* sp., *Sleia* sp.

STRATIGRAPHY OF THE SILURIAN SEDIMENTS

The Silurian sediments from the 8 boreholes in the Miastko-Chojnice region, columns Lutom *1* and Stobno *2* excepted, have been inadequately cored (*comp.* Table 1), handicapping their stratigraphic determination. Moreover, the Silurian deposits have not been pierced in anyone of these boreholes and their relation to older sediments is not known. On the other hand, in the top there is no transition into younger sediments because these overlie the Silurian in all the profiles, sometimes with a fairly great sedimentary lacuna. Though the fauna here is scarce and as a rule poorly preserved yet it enables a closer age determination of the sediments and the recognition of the presence in the area here discussed of all the Silurian stages (Table 2).

Llandoverian

Sediments of this stage are represented only in the column Lutom *1* and their presence is reliably indicated by the relatively abundant graptolite fauna, worked out by Teller & Korejwo (1968a). It allows to differentiate only three graptolite zones of the lower part of the Upper Llandoverian. Going from top to bottom they are:

Spirograptus turriculatus Zone
Rastrites linnaei Zone
Monograptus sedgwicki Zone

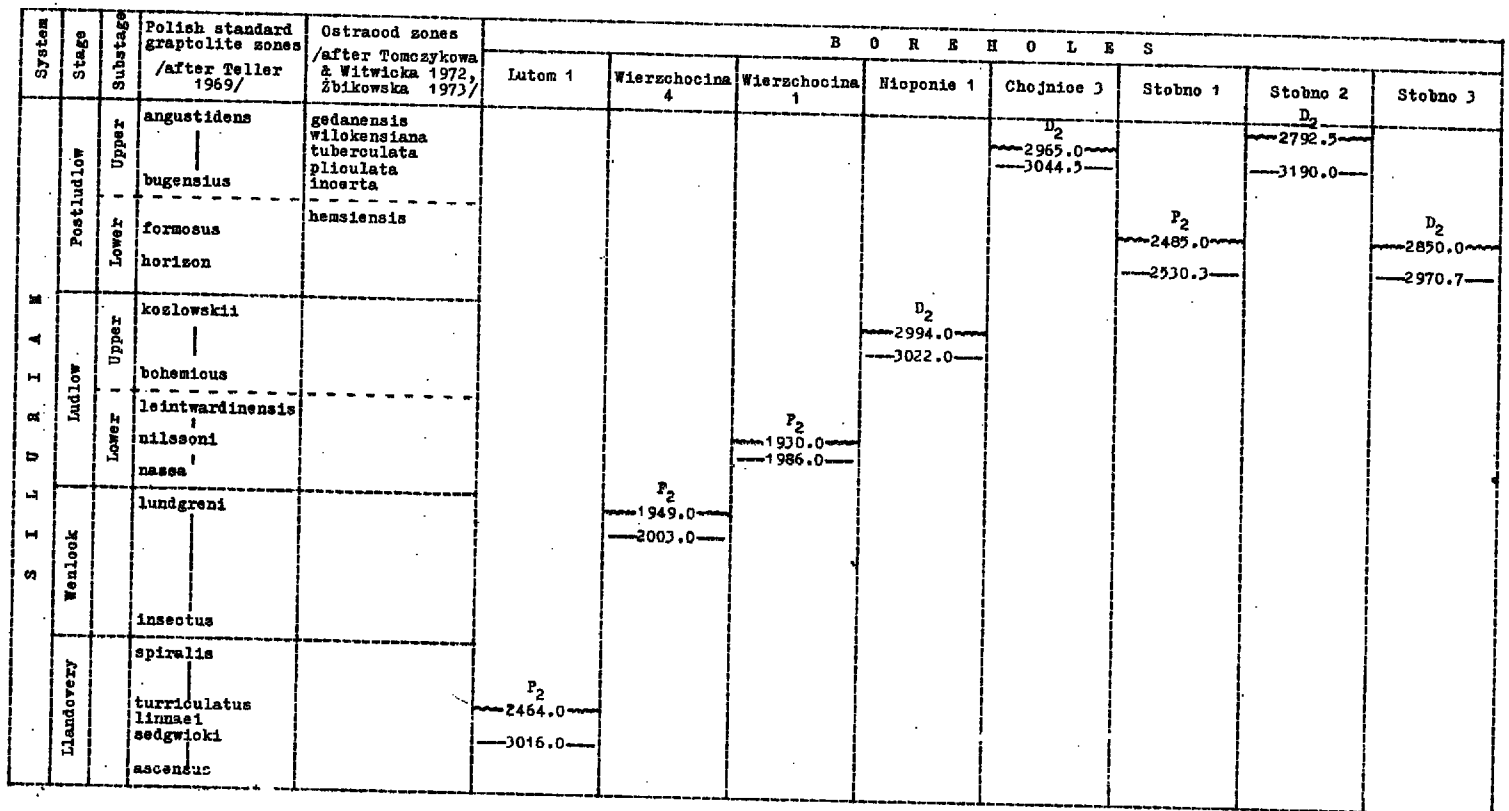
The thickness of the particular zones can hardly be established because of the whole series being strongly tectonically disturbed, it seems, however, that they may be even up to 80 m. The Upper Llandoverian members have been removed from column Lutom *1* by erosion, indicating in the top a direct contact of the Silurian with the Permian, while the lower members have not been pierced.

Wenlockian

The uppermost member of this age, the *Cyrtograptus lundgreni* Zone, has been observed in column Wierzchocina *4*. It is documented by such forms as: *Monograptus (Testograptus) testis* (Barr.), *Monograptus flemingi* (Salter), *Pristiograptus dubius* (Suess) and *Cyrtograptus* sp. characterizing the assemblage of that zone. In this column there are no Silurian members younger than the above zone since the Wenlockian is overlaid by the Zechstein basal limestone while the older members have not been reached.

Table 2

Correlation of the Silurian in the Miastko-Chojnice region with the Polish standard graptolite zones and the ostracod zones



For all Polish standard graptolite zones see Teller 1969

Ludlovian

Ludlovian sediments occur in columns Wierzchocina *1* and Nicponie *1*. Their paleontological evidence is rather poor since the only graptolites are those in the assemblages of the particular zones. The presence of the lower members of the Lower Ludlovian is shown in column Wierzchocina *1* where such forms as *Monograptus* cf. *uncinatus* Tullb., *Pristiograptus* ex gr. *dubius* (Suess) and *Retiolites* sp. have been found between 1930.0—1941.0 meters.

In Poland, the first of these species is confined to the *Neodiversograptus nilssoni* Zone (Teller 1969) while the two other ones have a wider range, being very common in the Lower Ludlovian. Hence, the presence of the *N. nilssoni* Zone may be undoubtedly accepted.

In column Nicponie *1* the scarce graptolite remains reliably indicate the presence of 20 m of the Upper Ludlovian (*comp.* Teller's 1969 division) because of the presence of *Bohemograptus bohemicus tenuis* (Bouček). In the Silurian of Poland this form extends from the *Saetograptus leintwardinensis* to *Neocucullograptus kozlowskii* Zones, *i.e.* practically all the Upper Ludlovian. *Pristiograptus* ex gr. *dubius* (Suess), a species without index value has been found side by side with the above form.

Postludlovian

The presence of the Postludlovian sediments is documented mainly by an ostracod fauna, since the other faunas are on the whole in a poor and fragmentary state of preservation (lamellibranchs, scarce brachiopods, fragmentary trilobites and rare graptolites having a great vertical range).

The Lower Postludlovian is documented by an ostracod fauna in columns Stobno *1* and Stobno *3*, while such forms as: *Parabolbina* cf. *ventica* Gajlite, *P. baltica* Martinsson, *Hemsiella* cf. *hemsiensis* Martinsson, *Neobeyrichia* cf. *regnans* Martinsson, *Scipionis profundigenus* Martinsson, are included in the assemblage characterizing the *Hemsiella hemsiensis* Zone (Żbikowska 1973a). In Poland this corresponds to the upper part of the horizon with *Monograptus formosus* (Teller 1969), all of which has been referred to the Lower Postludlovian. Within the graptolite subdivision of Lithuania, however, it is an equivalent of the *Monograptus balticus* and *Monograptus formosus* Zones (Paškevičius 1973). *Healdianella magna* Neckaja, likewise found in column Stobno *3*, is without greater value since its vertical range in Lithuania and Latvia (Gajlite & *al.* 1967) is known to extend from the *Lobograptus scanicus* Zone through the Upper Postludlovian.

Hence, it may be reasonably accepted that in both the above columns only certain members representing the upper part of the Lower Postludlovian have been reached.

In two more columns (Stobno *2* and Chojnice *3*) the youngest Silurian sediments in the region under discussion have been encountered. Specially noteworthy is column Stobno *2* where a 397.5 m thick complex represents — as is indicated by ostracod remains — the Upper Postludlovian. Three ostracod zones have been here differentiated by Żbikowska (1973b), partly also known within the area of the Łeba elevation (Tomczykowa & Witwicka 1972).

At a depth of 3150.0—3015.0 m there occurs *Nodibeyrichia tuberculata* (Klöden) which is an index taxon for the Zone known under the same name and which characterizes the middle part of the Upper Postludlovian. This species appears en masse at a depth of 3090.0—3028.0 m. Side by side scarce other forms have been encountered belonging to the assemblage of the *N. tuberculata* Zone, namely: *Neobeyrichia buchiana* (Jones), *Sleia* sp., *Kloedonia* sp., *Hemsiella* sp., but also *Amygdalella subclusa* Martinsson, *Healdianella magna* Neckaja and *Kuresaaria* sp., forms whose vertical range extends over several zones.

At a depth of 3015.0—2920.0 m the presence has been ascertained of the *Kloedenia wilckensiana* Zone. Its index form occurs en masse in the 2970.2—2976.4 m interval in association with *Neobeyrichia buchiana* (Jones) and *Sleia* sp. Rare specimens of *Hemsiella dalmaniana* (Jones) and *Nodibeyrichia tuberculata* (Klöden) have been encountered in the lower part of the zone, while *Macrypsilon salterianum* (Jones) and *Nodibeyrichia gedanensis* Martinsson make their appearance in the upper part. *Amygdalella subclusa* Martinsson, *Healdianella magna* Neckaja and *Kuresaaria* sp. also occur throughout the interval.

On the basis of its index form, the *Nodibeyrichia gedanensis* Zone has been differentiated at a depth of 2920.0—2792.5 m, in association with *Macrypsilon salterianum* (Jones), *Kloedenia wilckensiana* (Jones), *Healdianella magna* Neckaja, *Amygdalella subclusa* Martinsson, *Kuresaaria* sp. and *Scipionis* sp.

The *K. wilckensiana* and *N. gedanensis* Zones characterize the upper part of the Upper Postludlovian while in what regards the graptolite division, the whole Stobno *2* column approximately corresponds to the upper part of the *Pristiograptus chelmiensis* Zone in the bottom part to the *Monograptus angustidens* Zone in the top. The latter zone may be incomplete because the Silurian is directly overlain by sediments very probably belonging to the upper part of the Lower or Middle Devonian (Łobanowski 1968).

On correlating the Stobno *2* column with the Baltoscandia area, it may reasonably be accepted that — in Esthonia — it corresponds to the upper part of the Kaaugatuma horizon and the whole Ohesaare horizon

(Kaljo 1970), in Lithuania and Latvia to the upper parts of the Minijaski beds also to the Juraski beds (Paškevičius 1973), and in Podolia to the Dzwinogrod subhorizon of the Skala (Nikiforova & *al.* 1972).

The ostracod fauna from Chojnice *3* column has allowed more closely to determine the age of Silurian sediments, so far referred to the Lower Ludlovian (Teller & Korejwo 1968c). The following forms have been identified among the ostracods found at a depth of 2970.0—2991.6 m: *Nodibeyrichia tuberculata* (Klöden) and *Neobeyrichia* cf. *buchiana* (Jones), *Frostiella* sp., *Hemsiella* sp., *Amygdalella* sp., *Kuresaaria* sp. and *Healdianella* sp. Hence, this part of the borehole represents a fragment of the *N. tuberculata* Zone from the middle part of the Upper Postludlovian.

SEDIMENTARY AND TECTONIC DEVELOPMENT

The Silurian sediments differentiated in boreholes of the Miastko-Chojnice region are a part of the structural area of Koszalin-Chojnice which runs along the SW margin of the East European platform in its NW part. They occur under a thick cover of younger sedimentary deposits and the fragmentary character of the columns obtained from 8 boreholes heavily impedes the reconstruction of the full facial development in the Silurian sedimentary basin. However, there are certain features distinguishing the sediments here discussed from those occurring both within the East European platform and other regions of Poland.

One of the typical features are the differences in the character of the lithological development, readily seen in the Llandoverian column Lutom *1*. The thick, flysch-like series of lightgrey mudstones and darker siltstones, occurring in alternation, clearly differs from sediments of the same age from the platform area (Teller 1969). This indicates its formation in a zone of strong lability extending along the margin of the platform. The lability was long-lasting as is indicated by analogous and very thick Ordovician sediments which have also been differentiated in the area under investigation (Teller & Korejwo 1967, Bednarczyk 1974). Indeed, it was not confined only to the Koszalin-Chojnice region, since similar deposition has also been noted in Rugia (Franke 1967, Jaeger 1967).

The lithological development of the Wenlockian and Ludlovian sediments from the three fragmentary profiles here mentioned do not, in principle, deviate from that known in other regions of Poland. Some differences cannot be excluded but at present they are hardly determinable.

On the other hand, the lithological character of the Postludlovian sediments does not seem to differ much from that well known from the Łeba elevation. Naturally, thick carbonate layers are missing while there

is an increase in the amount of siltstones with thin subordinate carbonate intercalations. This results from the tapering and wedging out of the carbonate intercalations to the S and SW, *i.e.* along the directions of the increasing depth of the sedimentary basin.

Another essential feature of the Silurian sediments from the Miastko-Chojnice region is their much greater thickness as compared with that in the other profiles of Poland. The total thickness of the Silurian profile from the area here discussed is not known and there exists but little probability that it will be exactly ascertained. Its rather great thickness may be reasonably supposed, in the first place, on the basis of Lutom *1* column where a 552 m thick series apparently represents only three graptolite zones of the Middle Llandoverian. The approximate real thickness may be accepted as ranging between 150 and 200 meters. In none of the numerous Llandoverian profiles known throughout Poland does the thickness of only three graptolite zones attain this figure. For example, within the East European platform the total thickness of the Llandoverian is up to 50 m, similarly as in the Holly Cross Mts where it is *c.* 60 m (Teller 1969). In other regions these values are still lower. In thickness, the Lutom *1* column comes closer to the profiles known from the classic occurrence areas of that age, namely of the Caledonian geosyncline of Wales (Cocks & *al.* 1971).

In what concerns the thickness of the Wenlockian and Ludlovian, no reasonable suppositions are possible owing to the fragmentary data now available. This problem has a different aspect in regard to the Postludlovian sediments. A series of this age, reached in column Stobno *2*, with an apparent thickness of 397.5 m, is rather weakly disturbed so that its real thickness may be reasonably accepted as being *c.* 350 m. However, it represents only the three uppermost ostracod zones of the Upper Postludlovian, both, the bottom and the top zone being incomplete. Sediments of this age known from many boreholes in the Baltoscanian area of the East European platform (Tomczykowa & Witwicka 1972) are by these two authors believed to be up to 600 m thick. The thickness of the two uppermost zones of the Upper Postludlovian is said to be up to 150 m, *i.e.* at least 50 m less than in the Stobno *2* column.

Actually, in other regions of Poland, the Postludlovian thicknesses are likewise fairly great and in the silty-mudstone facies they reach a figure of 500 m (the Rzepin series in the Holy Cross Mts), as is also the case in the graptolite facies (Ruda Lubycka and Chełm boreholes — Teller 1964).

Strong folding and tectonic disturbance are another feature distinguishing the Silurian and Ordovician sediments of the Miastko-Chojnice region from the deposits of the platform area. In all the profiles the dips are rather strong, ranging from 15 to 90°, with the predominance of the 45—70° dips. In some cases the value of the dips can hardly be deter-

mined. Moreover, the sediments are badly cracked and many slips and slickensides are observable. Neither can the re-folding be excluded in column Lutom *1*.

The above differences concerning the facial development, thickness and degree of tectonic disturbance in the Silurian sediments of the Miastko-Chojnice region, as compared with those in other Polish areas, indicate their formation under different conditions of sedimentation, also that, after deposition, they had been subjected to different tectonic processes. The Lower Silurian basin stretched throughout NW Poland and it was strongly differentiated. Its part covering the area of the East European platform was characterized by calm sedimentation and facial development as well as by uniformity in thickness of deposits.

On the other hand, in the marginal area, near to the platform, the above basin, similarly as during the Ordovician, displayed strong lability of its bottom, the sedimentation of deposits being fairly rapid and turbulent, with a flysch-like character of the miogeosynclinal type. The material brought into the basin was probably transported from the south or south-west, possibly also from the west, from the eroded islands situated within the Caledonian eugeosyncline whose sediments are today deeply buried under a Mesozoic and late Paleozoic cover.

The Taconian phase which led to stronger erosion of the elevated areas was probably responsible for the increasing amounts of material brought during the Lower Silurian into the here discussed miogeosynclinal area.

During the Wenlockian and the Lower Ludlovian, both in the platform area and in the miogeosyncline, sedimentation took place under calm conditions and with the predominance of the silty-marly facies. During the Upper Ludlovian and the Lower Postludlovian, however, the lability of the bottom increased. This may have been a reflection of the Ardennian phase and, within the marginal part of the platform it led to the formation of a thick silty-mudstone series. The character of sediments of this age in the miogeosyncline is not known, but it may be supposed that they did not differ from analogous sediments of the adjacent region in the platform. Another return to conditions of calm sedimentation accompanied by a shallowing of the basin occurred in the Postludlovian. At that time, a shallow-neritic, marly-limy facies, abounding in organic life, dominated throughout NW Poland. The limestone intercalations which are thicker in the marginal parts of the basin to the north, thin out to the south and become scarce. Most probably this type of sedimentation persisted through the Gedinnian. A confirmation of the sedimentary continuity of the Silurian sediments through the Upper Postludlovian is provided by the recent stratigraphic data from column Stobno *2* as well as by Łobanowski's (1968) observations in column Miastko *1*.

In the latter column Łobanowski differentiates in its lower part,

within the 2461.6—2570.0 m interval — said to correspond to the Lower Devonian or Eifelian? — 7 conglomeratic layers from 0.2 to 1.6 m thick. These conglomerates contain pebbles of Silurian rocks. On the fauna they bear Łobanowski has assigned them to the Upper Ludlovian.

From among the available archival material, ostracods in cherry-coloured and grey limestone pebbles in two conglomerate layers from a depth of 2464.6—2469.4 m have been analysed.

The following ostracods have been differentiated (Żbikowska 1974) in a cherry-coloured pebble representing organogenic limestone abounding in *Chonetes* sp. and *Camarotoechia* sp.: *Nodibeyrichia tuberculata* (Klöden), *Neobeyrichia buchiana* (Jones), *Frostiella pliculata* (Martinsson), *Berolinella* sp. and *Kuresaaria* sp.

The specimen of *N. tuberculata* (Klöden) indicates that the pebble here considered comes from the *N. tuberculata* Zone characteristic of the middle part of the Upper Postludlovian.

The grey pebble represents fine crystalline limestones with *Orthoceras* sp., *Chonetes* sp., *Nodibeyrichia gedanensis* Martinsson, *Kloedenia wilckensiana* (Jones), *Macrypsilon salterianum* (Jones) and *Amygdalella* sp.

All the above named ostracods belong to the assemblage of the *N. gedanensis* Zone indicating the uppermost part of the Upper Postludlovian.

The presence in the conglomerate here considered of Upper Postludlovian pebbles reliably indicates that the Uppermost Silurian sediments were eroded in result of the upheaval of the area under discussion. This event could have taken place only during the final stage of the orogenic cycle of Caledonian folding, indicated by the Erian phase. Speculations concerning the presence of the Caledonian fold zone in the region here discussed are made in papers of numerous authors (Pożaryski 1957; Gaertner 1959, 1960; Kölbel 1959, 1963; Znosko 1962, 1963, 1964, 1965; Teller & Korejwo 1968a, b, c; Dadlez 1971, 1974).

In result of the Erian phase, sediments of the early Paleozoic, laid down in the Caledonian miogeosyncline, were strongly folded and partly overthrust to the N and NE onto the rigid East European platform. An analogous age for the Caledonian folding of the Silurian and Gedinnian sediments in the substratum of the Masovian-Lublin depression is accepted by Żelichowski (1972). This suggests that the Erian phase affected the whole area of the Caledonian miogeosyncline developed along the SW margin of the platform.

The currently accepted Ardennian phase (Teller & Korejwo 1968) supposed to have been the chief event in the folding of this area has not been confirmed.

The folding of the early Paleozoic sediments prior to the Middle Devonian or after the Gedinnian is likewise suggested by their unconformable occurrence under a cover of the late Paleozoic. In the area here

discussed, various Silurian members are covered by the Lower? and Middle Devonian, or by sediments of the Upper Permian. A similar picture is observable in the folded Ordovician sediments of the Koszalin--Chojnice region (Bednarczyk 1974). They occur in unconformity, either under the Middle and Upper Devonian, the Carboniferous or even the Zechstein.

The erosion of the elevated areas probably began in the upper part of the Lower Devonian or the lower part of the Middle Devonian. It must have affected not only the youngest Silurian but also its older members and may have removed the Gedinnian sediments, too, but no reliable evidence is so far available. Namely, it is not excluded that the Gedinnian rocks may have persisted somewhere, similarly as neither have all the Upper Postludlovian sediments been removed.

The Lower (Emsian) or Middle Devonian transgression was followed in the area under investigation by the deposition of thick carbonate series of Devonian or Lower Carboniferous age. The latter shows much stronger facial differentiation and some signs of volcanism.

In result of the Variscan orogeny, the Koszalin-Chojnice region was cut up into blocks by a dense system of longitudinal and transversal faults, varying in amplitude. The next erosion peneplained their varied morphology and uncovered members both of the early and late Paleozoic which had been flooded by the Zechstein sea.

CONCLUSIONS

On the ground of available material it may be concluded that, during the early Paleozoic, the region Koszalin-Chojnice was a part of the geosyncline extending NW-SE and representing a branch of the Caledonian geosyncline of North Europe. During the Caledonian sedimentary megacycle, continuing from the Cambrian to the Gedinnian, siltstone--mudstone flysch-like sediments, many hundred meters thick, were laid down within the miogeosyncline forming along the SW margin of the Precambrian East European platform. They were strongly folded during the Erian phase terminating the Caledonian megacycle of folding. The eugeosynclinal sediments are deeply burried under a thick cover of the Paleozoic and Mesozoic and have not so far been more accurately investigated.

The complete Silurian profile of as yet indeterminate thickness differs in its lithological development from others so far known in Poland. It has developed up to and including the Gedinnian. The Upper Silurian (Postludlovian) shallowing of the sedimentary basin, well indicated on the platform by the Beyrichia limestone facies, also involved the area of the miogeosyncline with an analogous facies.

Some members of the Silurian have been removed before the Middle Devonian. During the Variscan orogeny, the area here discussed was cut up into blocks while another pre-Zechstein erosion attacked the Silurian and even Ordovician deposits. The next transgression does not, however, invade the area before the Zechstein.

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SYLUR BRZEŻNEJ STREFY PLATFORMY WSCHODNIOEUROPEJSKIEJ W REJONIE MIASTKO—CHOJNICE (NW POLSKA)

(Streszczenie)

STRESZCZENIE: W pracy przedstawiono charakterystykę litologiczno-faunistyczną oraz stratygrafię i rozwój sedymentacyjno-tektoniczny osadów sylurskich napotkanych w 8 wierceniach w rejonie Miastko-Chojnice (fig. 1, tab. 1). Na podstawie dostępnych danych przyjąć można, że rejon ten w starszym paleozoiku wchodził w obręb geosynkliny biegnącej od NW ku SE, a stanowiącej odgałęzienie geosynkliny kaledońskiej Europy Północnej. W trwającym od kambru aż po żedyn kaledońskim megacyklu sedymentacyjnym powstały, w rozwijającej się wzdłuż SW brzeżnej strefy prekambryjskiej platformy wschodnioeuropejskiej miogeosynklinie, wielusetmetrowej miąższości osady ilasto-mułowcowe, fliszopodobne. Uległy one intensywnemu zafałdowaniu w fazie eryjskiej, kończącej kaledoński megacykl fałdowy.

Pełny, lecz na razie o nie ustalonej miąższości, profil osadów sylurskich odbiega swym wykształceniem litologicznym od dotychczas znanych z obszaru Polski i charakteryzuje się konsekwentnym rozwojem facjalnym zapewne aż po żedyn włącznie (tab. 2). Górnosylurskie (postludlowskie) spłycenie basenu sedymentacyjnego, dobrze zaznaczone na platformie facją wapienia beyrichiowego, objęło swym zasięgiem także obszar miogeosynkliny, gdzie rozwinięta jest analogiczna facja.

Różne ogniwa syluru usunięte zostały częściowo już przed środkowym dewonem. W czasie orogenezy waryscyjskiej omawiany obszar pocięty został na bloki, a ponowna erozja przedcechsztyńska dotarła aż do osadów sylurskich, a nawet ordowickich. Kolejna transgresja wkracza dopiero w cechsztynie.

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