acta
geologica
polonica

Vol. 32, No. 3-4 Warszawa 1982

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Middle-Polish glaciations (Odranian, Wartanian) in southern Central Poland

ABSTRACT: In southern Central Poland the glacial sediments allow to divide the Middle-Polish (Riss) Glaciation into two glaciations: Odranian (= Dnieper) and Wartanian (= Moscow), separated by the Lublinian (= Odintsovo) Interglacial. Within the Odranian Glaciation two pre-maximum stadials were distinguished: Liwiec and Krzna stadials and the maximum Kamienna (= Radomka) Stadial. The stadials are separated by two interstadials (Zbójno, Podlesie) with palynologic records and corresponding in German Democratic Republic to the *Dömnitz-Warmzeit* and *Treene(?)-Warmzeit*.

INTRODUCTION

The term "Middle-Polish (Riss) glaciations" means two glaciations: Odranian (= Riss *I*, Dnieper Glaciations, Saale *1* and *2*) and Wartanian (= Riss *II*, Moscow Glaciation, Saale *3*), separated by the Lublinian (= Odintsovo, Rügen) Interglacial (Środoń 1969; Różycki 1978, 1980).

The area of southern Central Poland supplies the most convincing data for such a subdivision, firstly due to relatively close maximum extents of these glaciations (Text-fig. 1) and so, a nearby occurrence of glacial landscapes of different ages. There are also numerous sites of organogenic sediments of the Mazovian (Holstein, Mindel *II*/Riss *I*) Interglacial in this area and discovered lately, localities of sediments and paleosoils of the Lublinian Interglacial (Text-fig. 1). In this part of Poland, the subdivision of glaciations and interglacials into smaller climatostratigraphic units as well as the oscillatory retreat of the Scan-

dinavian icesheets have been recognized (Różycki 1961, 1964a; Lindner 1970a, b), the same as the erosive action of the Scandinavian icesheets (Lamparski 1971, Lindner & Ruszczyńska-Szenajch 1979).

MAZOVIAN INTERGLACIAL

In southern Central Poland the Mazovian Interglacial is marked by organogenic series (Text-fig. 1), deposited either in glacial lakes (Podgórze, Falęcice, Białobrzegi), or inside river valleys (Barkowice Mokre, Olszewice, Sewerynów). These series are overlain by tills of the Krzna and Kamienna (= Radomka) stadials of the Odranian Glaciation (Różycki 1978, 1980; Lindner 1978, 1979, 1980, 1981, 1982).

The occurrence of organogenic series in these localities (Rühle 1952, 1956; Jurkiewiczowa & Mamakowa 1960; Różycki 1964a; Wysoczański-Minkowicz 1966; Jurkiewiczowa & *al.* 1973; Lindner 1981b) and palynologic analysis (Sobolewska 1952, 1956; Jurkiewiczowa & Mamakowa 1960; Wróblewska 1970; Jurkiewiczowa & *al.* 1973) allow their age differentiation (Text-fig. 4). Basing on that and on the recently presented opinion on a possible separation of these series by a glacial episode (Janczyk-Kopikowa & *al.* 1980, 1981), the authors treat both such parts of the Mazovian Interglacial as the equivalents of two separate units: the older — Radom one and the younger — Opoczno one (Text-fig. 4). Further investigations should, however, explain if the younger (Opoczno) unit, as a cooler one, does not represent the earliest part of the Odranian Glaciation (*cf.* Lindner 1981b). After Wysoczański-Minkowicz (1980), the paleofloras of the earlier part of the interglacial represent the Podlasian Interglacial whereas the paleofloras of the younger interglacial correspond to the real Mazovian Interglacial; glacial episode that separates these interglacials is placed within the South-Polish glaciations and unproperly named the Krzna Glaciation. A distinct bipartity of the Mazovian (Holstein) Interglacial is also pointed out by Šibrava (1969), basing on an analysis of interglacial floras in the Moravian Gate localities; he includes into the earlier part of the interglacial the localities Muglinov and Skřečoň whereas the locality Stronava is connected with its younger part.

The earlier phase of the Mazovian Interglacial should be correlated with the 13*th* ^{18}O horizon within the deep-sea sediments, dated for about 500 000—472 000 years B.P. (*cf.* Shackleton & Opdyke 1973). A cooling (glaciation?) within this interglacial is marked in deep-sea sediments by the 12*th* horizon dated for about 472 000—400 000 years B.P. whereas the younger phase of this interglacial corresponds probably to the 11*th* horizon of deep-sea sediments, dated for about 400 000—367 000 years B.P. (*cf.* Shackleton & Opdyke 1973).

ODRANIAN GLACIATION

LIWIEC STADIAL

The first distinct climatic cooling during the anaglacial part of the Odranian Glaciation is indicated by silts with a boreal flora (Text-fig. 4), preserved above the interglacial fluvial series near Witaszyn on the

Pilica River (Ciuk & Rühle 1952, Różycki 1972, Lindner 1981) as well as similar silts in the sections Romanów (Jurkiewiczowa & *al.* 1973, Lindner 1981) and Żabieniec (Sarnacka 1977, Lindner 1981). The deposition of these silts resulted from damming the interglacial pre-Vistula and pre-Pilica valleys by the advancing icesheet during the older pre-

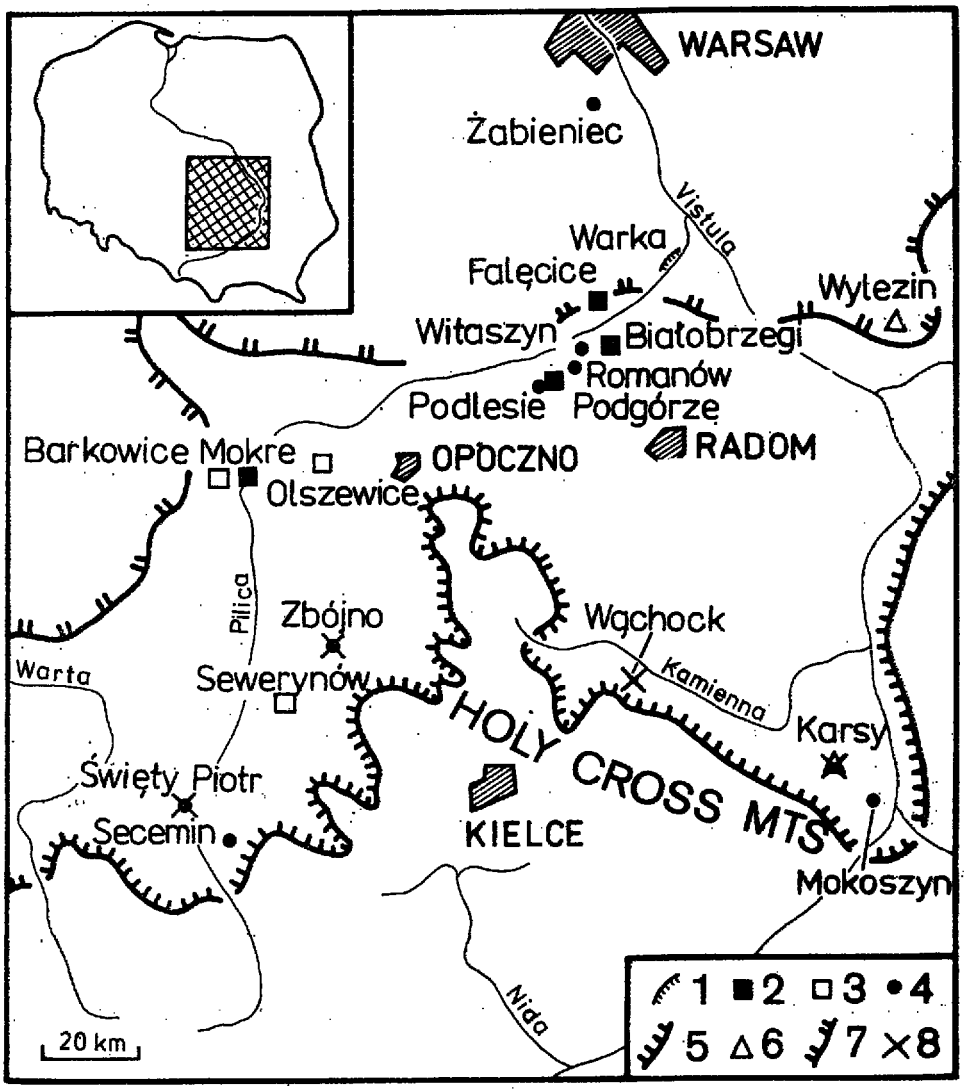


Fig. 1. Location sketch of Middle Pleistocene localities of organogenic sediments in southern Central Poland

1 exposures described in the paper (*cf.* Text-fig. 3), **2** localities of organogenic sediments of the older (Radom) part of the Mazovian Interglacial, **3** localities of organogenic sediments of the younger (Opoczno) part o the Mazovian Interglacial, **4** localities of organogenic sediments of the anaglacial part of the Odranian Glaciation, **5** maximum extent of the Odranian Glaciation, **6** localities of organogenic sediments of the Lublin Interglacial, **7** maximum extent of the icesheet of the Wartanian Glaciation, **8** sites with thermoluminescence (*TL*) dated sediments

-maximum stadial of the Odranian Glaciation. Close to Warsaw, the icesheet front must have occupied the lower part of the Liwiec drainage basin (Lindner & Brykczyńska 1980). During the Liwiec Stadial (Text--fig. 4) the silts were deposited, overlain by organogenic sediments at Zbójno and dated by the thermoluminescence method for about 388 000 years B. P. (Lindner & Brykczyńska 1980) whereas at Święty Piotr they are dated for about 389 700 years B. P. (Prószyński 1980). At the same time the sands of the Wąchock sections were deposited, dated for 352 000 years B. P. (Lindner & Prószyński 1979).

In German Democratic Republic this cooling is defined as the *Fuhne--Kaltzeit* (Cepek 1967) whereas in the Soviet Union as the intra-Likhvin cooling (Nikiforova & *al.* 1980). In deep-sea sediments it corresponds to the *10th* ^{18}O horizon dated for about 367 000—347 000 years B. P. (*cf.* Shackleton & Opdyke 1973).

ZBÓJNO INTERSTADIAL

In the Witaszyn area the silts of the Liwiec Stadial have been cut to a depth of several metres, and the formed valley was then filled with sands (Różycki 1964b, Lindner 1981).

The erosion was certainly connected with a distinct amelioration of climatic conditions during the Zbójno Interstadial (Lindner & Brykczyńska 1980). In the Zbójno section (Text-fig. 4) the interstadial is represented by peats within a buried valley and overlain by tills of the Krzna Stadial. The palynologic data show that during the Zbójno Interstadial there were considerably milder climatic conditions than during the period favorable for deposition of organogenic sediments at Witaszyn. During the interstadial optimum there were linden-hornbeam ferests with *Corylus, Quercus* and *Picea.*

This warming corresponds with the period *Dömnitz-Warmzeit* in German Democratic Republic (*cf.* Cepek 1967) and with the *9th* ^{18}O horizon in deep-sea sediments, dated for about 347 000—297 000 years B. P. (*cf.* Shackleton & Opdyke 1973). In the Soviet Union this horizon is connected with the final warming during the Likhvin Interglacial (*cf.* Nikiforova & *al.* 1980).

KRZNA STADIAL

The till, underlain in the Pilica valley area by fluvial and organogenic sediments of the Zbójno Interstadial and by organogenic series of the Mazovian Interglacial, represents after Rühle (*in* Jurkiewiczowa & *al.* 1973) the younger pre-maximum stadial, the Krzna Stadial. The extent of tills proves that the icesheet occupied a considerable part of Central Poland (Text-fig. 2*A*).

In the upper valley reach of the middle Pilica river the icesheet front slightly overpassed the Przedbórz parallel and resulted in the formation of the Koniecpol proglacial lake (*cf.* Czarnik 1966). Further to the est the icesheet of the Krzna Stadial closed the valleys of pre--Czarna Sulejowska and pre-Czarna Pilczycka, favored formation of the

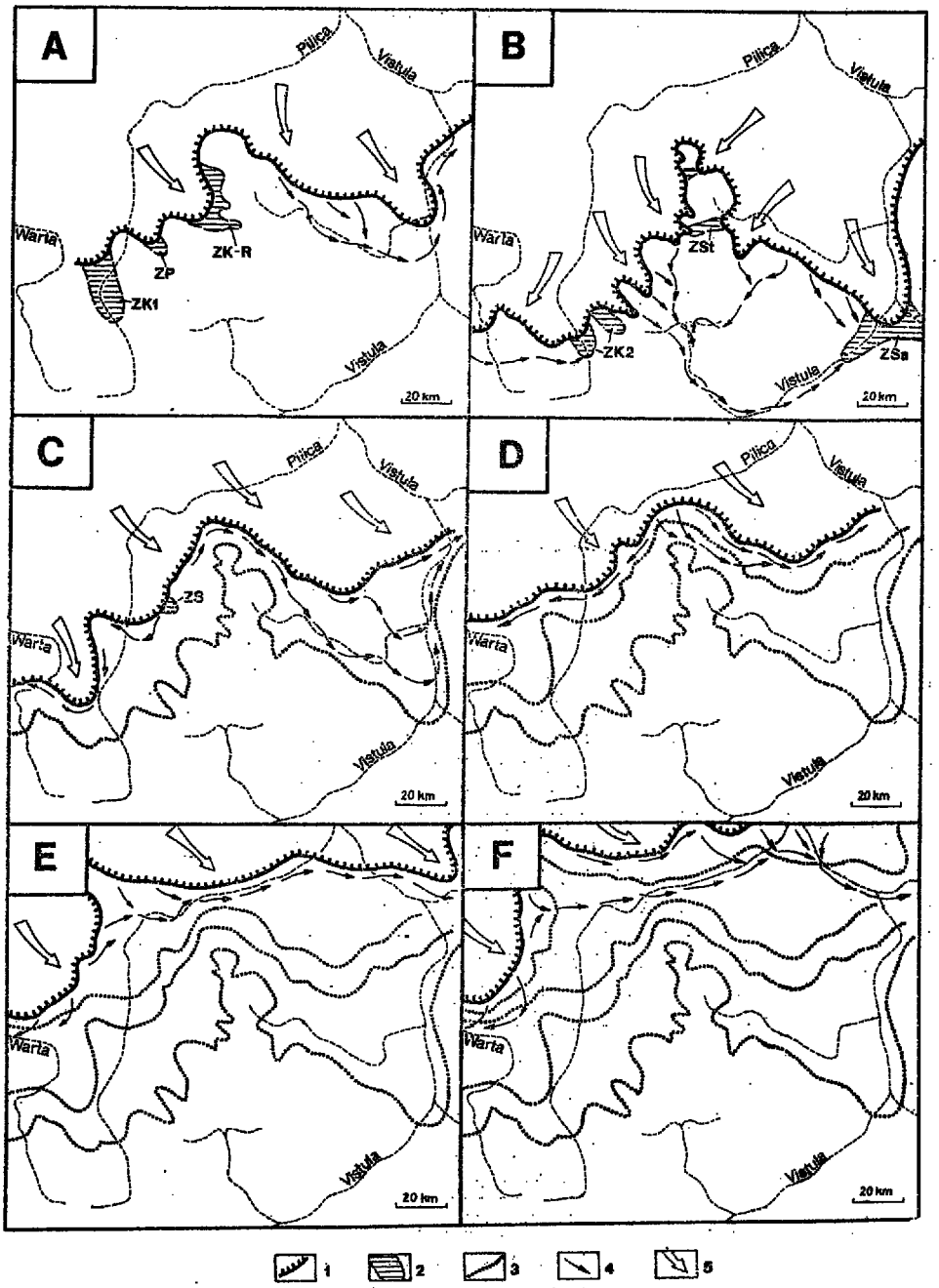


Fig. 2. Some paleogeographical elements of southern Central Poland during the Odranian and Wartanian glaciations, based on the data presented by Różycki (1961, 1972), Czarnik (1966), Ruszczyńska-Szenajch (1966), Baraniecka (1971), Laskowska-Wysoczańska (1971), and by the authors (*cf.* Text-fig. 4)

ODRANIAN GLACIATION: A — Krzna Stadial, B — Kamienna Stadial (maximum — Gowarczów Phase), C — Kamienna Stadial (older post-maximum — Wieniawa Phase), D — Kamienna Stadial (younger post-maximum — Odrzywół Phase); WARTANIAN GLACIATION: E — Pilica Stadial (maximum — Warka Phase), F — Pilica Stadial (post-maximum — Grójec) *1* icesheet extent, *2* ice-dammed lakes, *3* traces of icesheet extent, *4* fluvioglacial outwash, *5* directions of icesheet movement (*after* Lamparski 1971; Różycki 1976; Lindner 1971, 1976, 1978) Ice-dammed lakes: ZK1 — older Koniecpol, ZK2 — younger Koniecpol, ZP — Pilczyca, ZK-R — Końskie — Radoszyce, ZSt — Stąporków, ZSa — Sandomierz, ZS — Starzechowice

Pilczyca and the older Końskie-Radoszyce proglacial lakes (Text-fig. 2*A*). In the northern and north-eastern margin of the Holy Cross Mts a fluvioglacial runoff from the icesheet front, reaching probably as far as the mouth of Kamienna (*cf.* Pożaryska 1948, Radłowska 1963), entered firstly the pre-Kamienna valley and then, through the Ożarów area into the pre-Vistula valley. The further water track ran towards the northern slopes of the Lublin Upland (Text-fig. 2*A*).

In German Democratic Republic this cooling can be correlated with the *Saale-Kaltzeit s. str.* = Saale *1* (*cf.* Cepek 1967).

PODLESIE INTERSTADIAL

In southern Central Poland this period is mainly represented by sands with inserts of silts or by clays and silts with floristic remains, overlain by tills of the Kamienna (= Radomka) Stadial in the Podlesie section (Lindner 1981).

The pollen analysis (Mamakowa *in:* Jurkiewiczowa & *al.* 1973) proves that these sediments contained mainly the pollens of *Pinus* with a small admixture of *Betula* and *Picea*. According to E. Rühle (*in:* Jurkiewiczowa & *al.* 1973) these sediments correspond to the so-called Łuków Interstadial (Rühle 1969). A great similarity of this interstadial to the earlier part of the Mazovian Interglacial of Falęcice, Podgórze, Białobrzegi and Ferdynandów (*cf.* Janczyk-Kopikowa 1975) seems to exclude such interpretation (*cf.* Lindner 1981).

In the southern part of the Radom Plain and in the eastern margin of the Holy Cross Mts, this interstadial is marked by a destruction of glacial sediments of the Krzna Stadial. In the upper part of the Middle Pilica valley a considerable erosion occurred during the Podlesie Interstadial, and resulted in a dissection of the sediments of the earlier Koniecpol proglacial lake and in a fluvial accumulation of the pre-Pilica (Czarnik 1966).

In German Democratic Republic this warming is known (*cf.* Cepek 1967) as the *Treene(?)-Warmzeit.*

KAMIENNA STADIAL

During this maximum stadial for which the authors call the name Kamienna (= Radomka) Stadial, the icesheet of the Odranian Glaciation occupied almost the whole area of the western, northern and eastern margin of the Holy Cross Mts; afterwards it deposited 1—4 retreat till horizons (Text-fig. 4), corresponding to glacial phases of this stadial (Różycki 1961, 1964a, b, 1972; Lindner 1970, 1971, 1977, 1979, 1980; Grzybowski 1972; Lewandowski 1977, 1980; Zieliński 1980). In the lower Pilica valey area the till of the Kamienna Stadial is underlain by the sediments of the palynologically documented Podlesie Interstadial (Lindner 1981). But further to the south, it is underlain by the lower older loess, deposited during this stadial (*cf.* Pożaryska 1948, Różycki 1961).

Cartographic-geologic data, boreholes and a paleogemorphologic analysis of this area prove that during the pre-maximum (Końskie) phase of this stadial, the icesheet occupied a smaller area, *ca* 5—15 km from its limit during the maximum phase (*cf.* Lindner 1971, 1977, 1980). But a separate till horizon, the phase is documented by proglacial lake sediments deposited in the river valleys. In the upper reach of the Middle Pilica valley these sediments are represented, among others, by lower brown silts of the younger Koniecpol ice-dammed lake (Czarnik 1966) whereas in the western margin of the Holy Cross Mts by clays and silts of the older Końskie-Radoszyce proglacial lake (Lindner 1971).

During the pre-maximum (Święty Piotr) interphase an area, 10—25 km wide, was deglaciated and peats at the locality Święty Piotr near Koniecpol were deposited (Czarnik 1966). The palynologic analysis proves that during the interphase there was a tundra environment with slightly dense pine-birch forests at the climatic optimum (Niklewski 1966). The diatomologic analysis suggests that the diatoms of that time were similar to the ones that predominate now in Greenland and Spitsbergen (Marciniak 1975). Possibly, the final part of this interphase is also represented by a dryas flora at the locality Mokoszyn near Sandomierz (Text-fig. 4), analyzed by Szczepanek (1960).

During the pre-maximum (Gowarczów-Łopuszno) phase the icesheet of the Kamienna Stadial advanced again southwards and reached the north-eastern slopes of the Polish Jura; it dammed the Pilica valley to the south of Koniecpol and so, formed the younger Koniecpol proglacial lake (Text-fig. 2*B*.) Further to the east it occupied a considerable part of the Włoszczowa Basin (Kwapisz 1978, 1980; Szajn 1978), the Łopuszno basin as far as the Wierna Rzeka valley (Lindner 1977) and encirled the Przysucha-Niekłań Mts reaching their north-eastern slopes up to 300—330 m a.s.l. (Lindner 1971). Some valleys and depressions contained at that time the ice-dammed lakes (Text-fig. 2*B*). The icesheet during the maximum phase overpassed also the Kamienna valley (Text-fig. 2*B*) and occupied the whole north-eastern part of the Opatów Upland; then, it deposited the separate till horizon (Kosmowska-Suffczyńska 1972, Lindner 1982). According to Laskowska-Wysoczańska (1980) it could even enter the Sandomierz Depression.

Thermoluminescence datings of the sediments in the Wąchock section on the Kamienna River prove that the till of the maximum phase is there underlain by the sands, dated for 352 000 years B. P. and overlain by lacustrine deposits of 245 000 ± 45 000 B. P. (Lindner & Prószyński 1979). These data define well a chronostratigraphic position of the till and so, the age of the maximum extent of the icesheet of the Odranian (= Dnieper) Glaciation if taking into account that in the

European part of the Soviet Union the maximum of this glaciation is dated for 290 000—250 000 years B. P. (Zubakov 1978). In German Democratic Republic the maximum stadial of this glaciation is probably (*cf.* Cepek 1967) represented by *Fläming-Kaltzeit* = Saale *2.*

In deep-sea sediments the time interval corresponding with the maximum part of the Odranian Glaciation (Krzna Stadial, Podlesie Interstadial, Kamienna Stadial) is represented by the *8th* ^{18}O horizon dated for about 297 000—251 000 years B. P. (*cf.* Shackleton & Opdyke 1973). Also in the Soviet Union, this horizon is correlated with the Dnieper Glaciation (*cf.* Nikiforova & *al.* 1980).

At the maximum extent of the icesheet during the maximum phase of the Kamienna Stadial, a fluvioglacial outflow in the western and central part of the Holy Cross region ran southwards to the Nida valley and then, to the Vistula valley (Text-fig. 2*B*). In the eastern part of the area there was a marginal outflow, running to the Koprzywianka drainage basin and then, towards the created Sandomierz ice-dammed lake (*cf.* Samsonowicz 1922, Laskowska-Wysoczańska 1971, Mycielska-Dowgiałło 1978).

A deglaciation of the area occurred gradually (Różycki 1964b; Lindner 1977, 1982) what is expressed by several marginal terraces, resulting from a depositional action of proglacial and extraglacial waters running along the icesheet front (Lindner 1970).

During the older post-maximum (Wolanów) interphase an area, 20—25 km wide, became deglaciated (Różycki 1961, 1972; Lindner 1971).

A renewed icesheet advance during the older post-maximum (Wieniawa) phase resulted in the formation of a terminal icesheet zone at a distance of 10—60 km from the maximum phase limit (Text-fig. 2*C*). But a separate till horizon (Text-fig. 4) the icesheet extent is marked by distinct rows of terminal moraines and fluvioglacial plains, being mainly the marginal valleys. Only in the western margin of the Holy Cross Mts an ice-dammed lake (Laskowska-Wysoczańska & Nunberg 1982) was formed (Text-fig. 2*C*).

During the younger post-maximum (Przytyk) interphase the area occupied by the icesheet of the Kamienna Stadial has decreased (Różycki 1961, 1972), for about 30—50 km but then, during the younger post-maximum (Odrzywół) phase it stopped at a distance of 7—40 km from its limit during the older phase (Text-fig. 2*D*). During the Odrzywół Phase a fluvioglacial outwash was mainly of a marginal type. In the western margin of the Holy Cross Mts it ran towards the Warta valley, whereas in the northern and eastern margins it was oriented eastwards, to the Vistula valley (Text-fig. 2*D*).

LUBLINIAN INTERGLACIAL

A continued deglaciation of southern Central Poland during the Lublinian Interglacial (= *Rügen-Warmzeit*, = Odintsovo Interglacial), previoulsy defined as the Pilica Interstadial (*cf.* Ruszczyńska-Szenajch 1966a, b; Różycki 1967, 1972; Wysoczański-Minkowicz 1966) or the Wylezin Interstadial (*cf.* Rühle 1970), resulted in a development of erosive-denudation and weathering processes as well as in a lacustrine deposition. In the Wąchock section on the Kamienna river this accumulation is represented by lake sands and silts, underlain by a till and thermoluminescence dated for 245 000±45 000 years B. P. (Lindner & Prószyński 1979).

In the lower Pilica drainage basin a distinct fluvial valley was formed (Ruszczyńska-Szejnach 1966b). Fluvial sands of marginal valley fragments are noted in numerous exposures of the Pilica edge, among others near Warka (layer 4 in Text-fig. 5), and they contain much plant detritus. According to the palynologic analysis (Sobolewska *in:* Karaszewski 1952), the detritus contains numerous pollens of *Pinus*, *Alnus* and also *Corylus* up to 11%, what suggests a washing of the interglacial peatbogs nearby.

The interglacial climatic environment in this area is well recognized by the lately discovered locality of organogenic sediments at Karsy near Ożarów (Kosmowska-Suffczyńska & Szczepanek 1982). A primary phase of pine-birch forests was there noted, then a spruce and alder predomination phase with an increased content of warm-loving trees (*Quercus, Ulmus, Tilia, Fraxinus*) as well as the final phase with an admixture of a hornbeam and a fir were distinguished. Mineral sediments that overlay the organogenic deposits, were thermoluminescence dated by Prószyński (1980) for 188 000—190 000 years B. P. This age may support to place the locality Karsy in a slightly later chronostratigraphic position (Text-fig. 4).

This interglacial is also well characterized by paleosoils of many loessy sections in this area (*cf.* Jersak 1973) and in the Pilica valley (Konecka-Betley & Ruszczyńska-Szenajch 1977) as well as by organogenic sediments in the lower Vistula valley (Makowska 1977). In the Lublin Upland the bone pieces of this period have been dated by Dr. T. Wysoczański-Minkowicz by FCI/P method for 230 000—250 000 years B. P. (Dolecki 1981).

In German Democratic Republic the *Rügen-Warmzeit* (Cepek 1967) is the age-climatic equivalent of this period. The travertines of that time, noted at Bilzingsleben by Erfurt, contain remains of *Homo erectus* as well as o plants, snails and vertebrates, dated by $^{230}Th/^{234}U$ method for 228 000+17 000 — 12 000 years B. P. (Harmon & *al.* 1980, Głazek & *al.* 1980). In the Soviet Union this period corresponds to the Odintsovo Interglacial, dated for 236 000±25 000 to 227 000± ±28 000 years B. P. (Sudakova & Aleshinskaya 1974). In deep-sea sediments it is recorded as the *7th* ^{18}O horizon, dated for about 251 000—195 000 years B. P. (*cf.* Shackleton & Opdyke 1973, Nikiforova & *al.* 1980).

WARTANIAN GLACIATION

The following advance of the Scandinavian icesheet during the Wartanian Glaciation (previously treated as the Warta Stadial) resulted in its coming to the northern edge of the Lower Pilica valley (Ruszczyńska-

-Szenajch 1966a, b; Grzybowski 1966b; Wysoczański-Minkowicz 1966). Consequently, the maximum stadial of the Wartanian Glaciation can be named in this area the Pilica Stadial (Text-fig. 4).

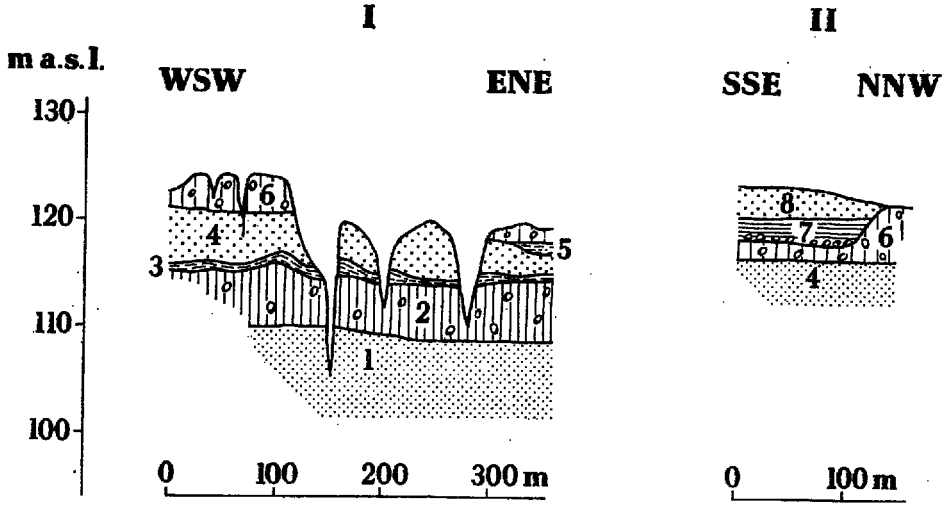


Fig. 3. Two exposures of Pleistocene sediments in the western part of Warka (exposure II about 500 m to NW off the exposure I)

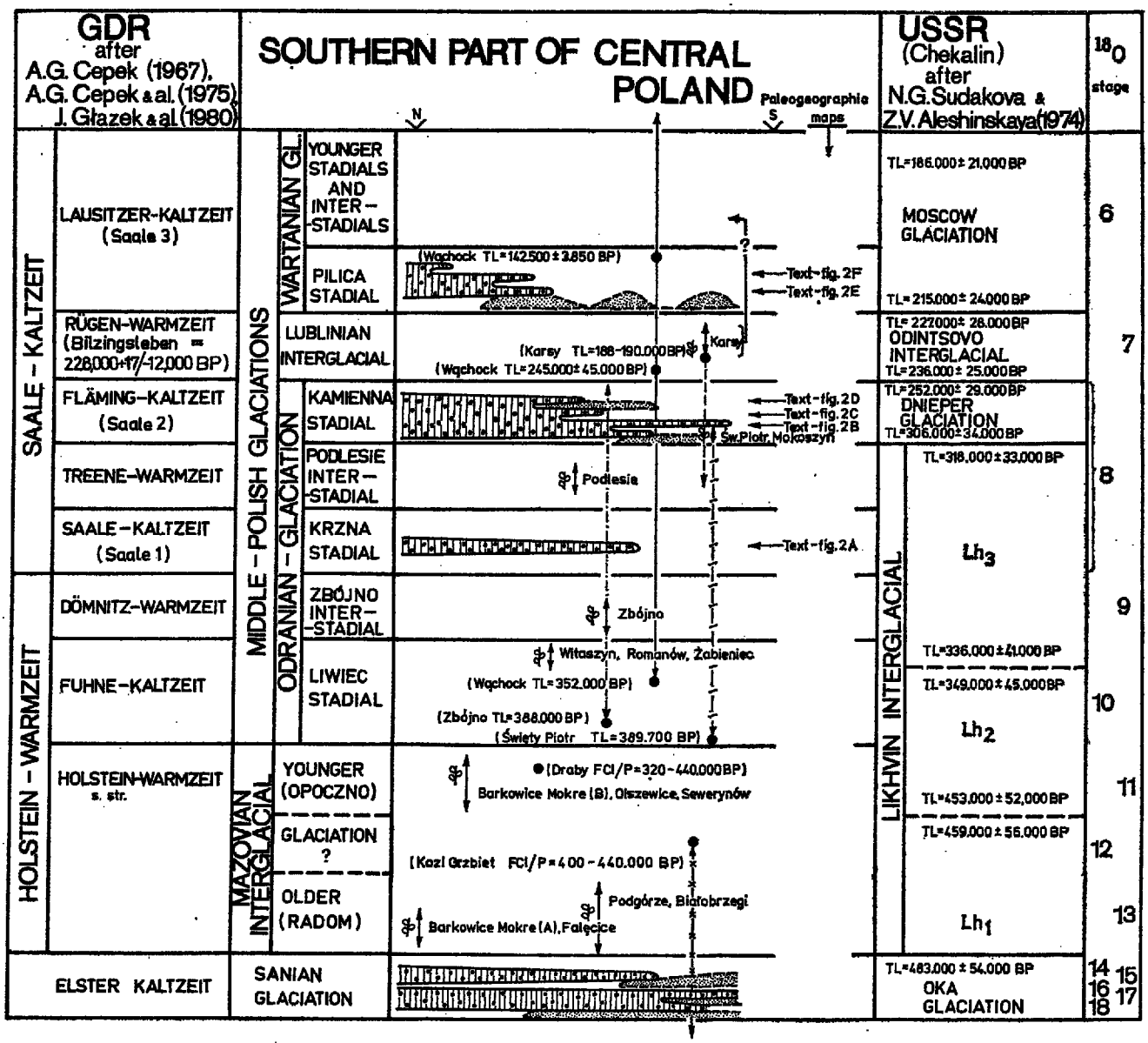
Younger part of the Mazovian Interglacial or the Podlesie Interstadial within the Odranian Glaciation: 1 fluvial sands with gravels; Odranian Glaciation — Kamienna Stadial: 2 till, 3 proglacial lake clays and silts; Lublinian Interglacial: 4 fluvial sands; Wartanian Glaciation — Pilica Stadial: 5 upper older loess (subaqueous at the bottom, subaeral at the top), 6 till, 7 proglacial lake clays (with erosive pavement at the bottom), 8 fluvioglacial sands

The anaglacial part of the Wartanian Glaciation in the Holy Cross region (Jersak 1973) as well as in the Pilica valley area (Karaszewski 1952, Grzybowski 1966b) is marked by deposition of the older loess (layer *5* in Text-fig. 3). The equivalent aeolian sands and dusts in the Wąchock section, are thermoluminescence dated for 142 550±3 650 years B. P. (Lindner & Prószyński 1979).

During the older, maximum phase of the Pilica Stadial, named the Warka Phase (Różycki 1972), the icesheet dammed partly the Pilica valley to the east of Warka (Text-fig. 2*E*) where a small proglacial lake was formed (Rosłaniec-Chodnikiewicz 1966). After a till deposition (layer *6* at Text-fig. 3), the icesheet front retreated several dozen kilometres northwards. Local terminal moraines, eskers (Dudek 1966, Grzybowski 1966b, Rosłaniec-Chodnikiewicz 1966) and kames (Sarnacka 1966) were formed during this retreat.

During the post-maximum Rawa Mazowiecka Interphase (according to the nomenclature of Różycki, 1972), an erosion developed at the deglaciated areas (Grzybowski 1966b). During the younger phase, named by

Main stratigraphic units of the younger Middle Pleistocene



1 tills, 2 loesses, 3 localities of organogenic sediments, 4 chronostratigraphic extent of the Zbójno section, 5 chronostratigraphic extent of the Wąchock section, 6 chronostratigraphic extent of the Święty Piotr section, 7 chronostratigraphic extent of the Karsy section, 8 chronostratigraphic extent of the Kozi Grzbiet section, 9 samples with absolute datings (FCl/P and TL) after Głazek & *al.* (1976), Lindner & Prószyński (1979), Lindner & Brykczyńska (1980) and Prószyński (1980); the ^{18}O horizons after Shackleton & Opdyke (1973)

Różycki (1972) the Grójec Phase, the icesheet again reached the present Pilica valley (Text-fig. 2*F*) but 10—30 km further to the north than during the Warka Phase. In the icesheet forefield the ice-dammed lakes were formed at that time (*e.g.* a successive lake at Warka, represented by layer 7 in Text-fig. 3). The icesheet standstill and retreat are connected with a fluvioglacial accumulation (layer *8* in Text-fig. 3). The retreating icesheet of the Grójec Phase deposited a till horizon, separated locally from a till of the Warka Phase by the interphasal sediments. Further retreat stages during the Grójec Phase resulted in exposing of the Grójec eskers from under the ice (Michalska 1977, Baraniecka 1977). They were exposed probably in the same time as the eskers of the Widawka drainage basin (*cf.* Baraniecka & Sarnacka 1971).

After a retreat of the icesheet, probably to the Warsaw area, there began its next southward advance; this phase of the Pilica Stadial was named by Różycki (1972) the Mszczonów Phase.

In German Democratic Republic the Wartanian Glaciation is defined as *Lausitzer-Kaltzeit* = Saale *3* (cf. Cepek 1967, Głazek & *al.* 1980). In the Soviet Union it corresponds to the Moscow Glaciation of the time interval from 215 000±24 000 to 186 000±21 000 years B. P. (Sudakova & Aleshinskaya 1974) or even to 152 000±16 000 years B. P. (Zubakov 1978). In deep-sea sediments this glaciation (*cf.* Nikiforova & *al.* 1980) is marked by the *6th* ^{18}O horizon, dated for about 195 000—128 000 years B. P. (*cf.* Shackleton & Opdyke 1973).

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ZLODOWACENIA ŚRODKOWOPOLSKIE W POŁUDNIOWEJ CZĘŚCI POLSKI ŚRODKOWEJ

(Streszczenie)

Przedmiotem pracy są osady i formy zachowane w południowej części Polski Środkowej (*patrz* fig. 1—4) a upoważniające do podziału zlodowacenia środkowopolskiego na dwa odrębne zlodowacenia: Odry (= dnieprowskie) i Warty (= moskiewskie) oddzielone interglacjałem lubelskim (= odincowskim). W obrębie zlodowacenia Odry wyróżniono dwa stadiały przedmaksymalne: Liwca i Krzny oraz stadiał maksymalny Kamiennej (= Radomki). Stadiały te oddzielone są dwoma udokumentowanymi palinologicznie interstadiałami: Zbójna i Podlesia, odpowiadającymi zapewne na obszarze NRD *Dömmitz-Warmzeit* oraz *Treene(?)-Warmzeit.* Interglacjał lubelski charakteryzują profile palinologiczne z Wylezina i Karsów oraz stanowiska gleb kopalnych. Zlodowacenie Warty reprezentowane jest przez osady stadiału maksymalnego (Pilicy).
