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GLIWICE RADIOCARBON DATES X

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The following list contains all age measurements of paleoenvironmental samples made from 1978 to the end of 1982 for the IGCP 158 Project "Paleohydrological changes in the temperate zone in the last 15,000 years," Subproject B "Lake and mire environments" (Berglund, 1979), initiated by Bjorn Berglund and Leszek Starkel in 1976. The aim of this project was to reconstruct environmental changes related to climate and human activity in the temperate zone of Asia, Europe, and North America. Broad environmental reconstructions will be based upon a network of reference sites representing the natural geographic regions, distinguished by their geology, climate, vegetation, and other natural factors, according to Berglund (1979). The subdivision of Poland into 29 paleoecological units according to Ralska-Jasiewiczowa (1982) is presented in table 1, and in figure 1 where reference sites dated by ^{14}C in our lab are also indicated.

In this paper, we present a list of ^{14}C dates from 12 reference sites (figure 1). The site at Lake Wielkie Gacno (subregion 11a, fig 1; Hjelmroos, 1981a,b; 1982) was ^{14}C dated in Lund (Håkansson, 1980). A brief report on the activities of the Polish Group of the IGCP 158B Project was given by Ralska-Jasiewiczowa (1981).

Ages are reported as conventional ^{14}C dates in years before AD 1950, uncorrected for isotopic fractionation and based on the Libby half-life of 5568 yr. Errors quoted ($\pm 1\sigma$) include estimated overall standard deviations of count rates of the unknown sample, contemporary standard and background (Pazdur & Walanus, 1979). The ANU Sucrose Secondary Radiocarbon Dating Standard was used as the modern reference standard, correlated with 95% of ^{14}C activity of NBS Oxalic Acid, normalized to $\partial^{13}C = -19‰$ wrt PDB, according to Polach (1979) and Currie and Polach (1980). Laboratory equipment and techniques have been described (Pazdur *et al*, 1982; 1983), the only exception being chemical pretreatment of peat samples. Unless otherwise stated, peat samples were pretreated only with HCl, as suggested by Håkansson (1976). Sample descriptions and comments are based on information provided by submitters.

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TABLE 1
Subdivision of Poland into paleoecological regions and subregions

1. Carpathians-Polish Carpathians
   a. Western Carpathians
      a_1. Western Beskids
      a_2. Tatra Mts
      a_3. Jasło-Sanok Depression and Dynów Foreland
      a_4. Low Beskid
   b. Bieszczady Mts
2. Sudetes
   a. Central Sudetes
   b. Eastern Sudetes
3. Silesia Lowland
4. Silesia-Little Poland Uplands
   a. Silesia-Cracow Upland
   b. Nida Basin and Miechów Upland
   c. Holy Cross Mts
5. Sandomierz Basin
6. Lublin-Wolhynia Uplands
   a. Lublin Upland
   b. Roztocze
7. Lublin Polesie
8. Mazovia-Podlasie Lowlands
   a. Mazovia-South Podlasie Lowlands
   b. North Podlasie Lowland
9. Northern Foreland of Little Poland Upland
10. Great Poland-Kujawy Lowlands
    a. Lubusz Lake District
    b. Poznań-Gniezno-Kujawy Lake Districts
11. Western Pomerania
    a. West Pomerania Lake District
    b. Szczecin Lowland
    c. Baltic Coastal Zone
    d. Baltic Shore
    e. Vistula Deltaic Area
12. Eastern Pomerania
    a. Dobrzyń Lake District
    b. Olsztyn Lake District
    c. District of Masurian Great Lakes
    d. Suwałki-Augustów Lake District

SAMPLE DESCRIPTIONS

PALEOENVIRONMENTAL SAMPLES

Region 1. Carpathians (fig 1)

a_2. Tatra Mts

Puścizna Rękowiańska profile PR series

Peat from Puścizna Rękowiańska bog, Orawa-Nowy Targ Basin, ca 12km W of Nowy Targ (49° 29′ N, 19° 49′ E), alt 654 to 658m asl; coll June 1980 and subm 1980 and 1982 by Andrzej Obidowicz, Inst Bot, Pol Acad Sci, Cracow. Earlier pollen studies of this site were made by Koperowa (1962); present palynol age determinations are by AO.

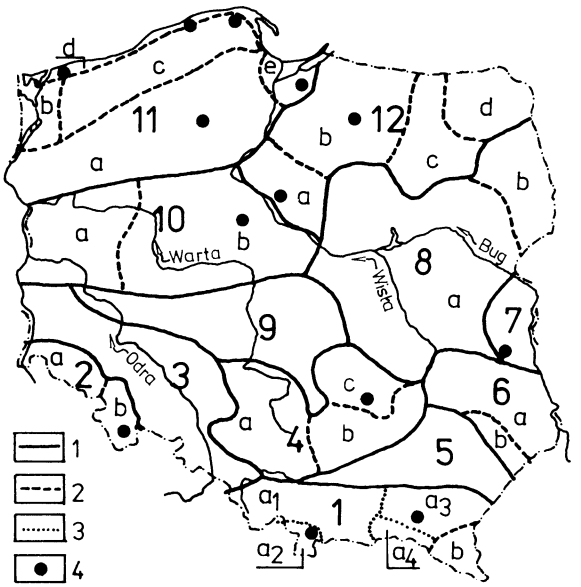

Fig 1. Subdivision of Poland into palaeoecological regions (Ralska-Jasiewiczowa, 1982). 1 ⊟—boundaries of main regions, 2 ⊟ and 3 ⊡—boundaries of sub-regions, 4 ⊙—location of ref sites.

Gd-1565. PR VII **3670 ± 70**

Brown medium decomposed *Sphagnum* peat, depth 3 to 3.1m, Sub-atlantic/Sub-boreal boundary.

Gd-2050. PR VI **4540 ± 150**

Same, depth 3.8 to 3.9m, Sub-boreal/Atlantic boundary.

Gd-1570. PR V **4890 ± 60**

Brown medium decomposed *Eriophorum-Sphagnum* peat, depth 4.4 to 4.5m, Atlantic period.

Gd-985. PR IV **7350 ± 160**

Dark-brown strongly decomposed *Eriophorum* peat, depth 5.6 to 5.7m, Atlantic period.

Gd-1501. PR III **8570 ± 90**

Dark-brown strongly decomposed fen peat with fragments of wood, depth 6.7 to 6.8m, Boreal period.

Gd-986. PR II **8800 ± 160**

Same, depth 6.8 to 6.9m, Boreal/Pre-boreal boundary.

Gd-1500. PR I **8960 ± 80**

Same, depth 7.1 to 7.15m, Pre-boreal period.

a_3. Jasło-Sanok Depression and Dynów Foreland

Ref area in Jasiołka R valley comprises 2 sites with lacustrine sediments, consisting of marl, peat, clay, and gyttja, studied by Antoni Wójcik, Geol Inst, Carpathian Branch, Cracow, and Krystyna Harmata and Kazimierz Szczepanek. Previous paleobot studies of this area by Szafer (1948) indicate late glacial and Holocene sediments.

Tarnowiec profile TAR series

Peat and wood from fossil lake sediments in Tarnowiec (49° 44′ N, 21° 32′ E), Jasiołka R terrace, alt 230m asl. Coll Aug 1979 and subm 1982 by Antoni Wójcik.

Gd-1483. TAR VIIA **2040 ± 50**

Clayey peat, depth 25 to 30cm. *Comment* (KS): deforestation of area, beginning of Sub-atlantic period.

Gd-966. TAR VIIB **1950 ± 60**

Duplicate run on same sample.

Gd-1484. TAR VI **3930 ± 60**

Brown peat, depth 56 to 60cm. *Comment* (KS): highest values of *Fagus* and *Abies* pollen, Sub-boreal period.

Gd-964. TAR V **4240 ± 90**

Peat with fragments of wood, depth 96 to 100cm. *Comment* (KS): pollen spectrum shows presence of beech and hornbeam forest, beginning of Sub-boreal period.

Gd-1482. TAR IV **5230 ± 80**

Peat with wood fragments, depth 1.3m. *Comment* (KS): large amounts of *Corylus, Tilia,* and *Ulmus* pollen, typical for Atlantic period, with unexpectedly large amounts of *Fagus* pollen.

Gd-1481. TAR III **9380 ± 80**

Peat, depth 1.55m. *Comment* (KS): pollen spectrum indicates pine forest with elm and spruce, typical for younger Pre-boreal period.

Gd-962. TAR II **9840 ± 100**

Wood fragments from marl layer at depth 1.8m. *Comment* (KS): presence of larch and Swiss stone pine (*Pinus cembra*) forests with pine, Pre-boreal period.

Gd-967. TAR I **11,190 ± 140**

Peat with marl and faunal remains, depth 2m. *Comment* (KS): pollen spectrum containing large amounts of *Pinus* pollen with *Pinus cembra, Larix, Betula nana,* and Gramineae, and Cyperaceae confirms Alleröd age. *Comment* (MFP): peat from depth 1.4 to 1.45m, this profile, was dated to 7930 ± 110; Gd-767 (R, 1983, v 25, p 854).

Region 2. Sudetes

b. Eastern Sudetes

Zieleniec profile ZL series

Peat from continuous profile at ref site Zieleniec (50° 21′ N, 16° 25′ E), Kłodzko Basin, 8km S of Duszniki Zdrój, S part of Lower Silesia, Bystrzyckie Mts, E Sudetes, alt 750m asl (Kuźniewski, 1959). Core taken Oct 1978 by Andrzej Obidowicz; samples subm 1979 by Magdalena Ralska-Jasiewiczowa; preliminary pollen analysis by Ewa Madeyska. Site was previously studied by Stark (1936) and Kuźniewski (1962).

Gd-658. ZL VI **2720 ± 80**

Undecomposed *Eriophorum* peat, depth 2.45 to 2.55m, end of Subboreal or beginning of Sub-atlantic period.

Gd-661. ZL V **3700 ± 60**

Light brown peat, medium decomposition, depth 3.25 to 3.35m, Subboreal period.

Gd-1092. ZL IV **5370 ± 70**

Well-decomposed *Eriophorum* peat, depth 5.05 to 5.15m, Atlantic period.

Gd-1091. ZL III **8390 ± 80**

Transitional peat layer with bark fragments, medium decomposition, depth 6.85 to 6.95m, younger part of Boreal period.

Gd-1090. ZL II **8700 ± 80**

Well-decomposed dark brown peat with wood fragment, depth 7.19 to 7.29m, older part of Boreal period.

Gd-1089. ZL I **8740 ± 100**

Well-decomposed dark brown peat, depth 7.29 to 7.38m, Pre-boreal period.

Region 4. Silesia-Little Poland Uplands

c. Holy Cross Mts

Słopiec profile II series

Peat from continuous profile Słopiec II taken from bog in small trough, probably oxbow lake, in Belnianka R valley, Słopiec village (50° 47′ N, 20° 47′ E), near Daleszyce, ca 20km E of Kielce, Daleszyce Basin, Holy Cross Mts, alt 248m asl. Coll Nov 1978 and subm 1979, 1980, and 1982 by Kazimierz Szczepanek, Inst Bot, Bot Garden, Jagellonian Univ, Cracow.

Gd-768. Słopiec II/7 **<120**

Light brown *Sphagnum-Eriophorum*-Ericaceae peat, depth 27.5 to 32.5cm, local pollen assemblage zone (PAZ) *Rumex*-Cerealia.

Gd-774. Słopiec II/18 **370 ± 60**

Transition between *Sphagnum-Eriophorum*-Ericaceae and *Sphagnum-Eriophorum* peat with distinct layer of Ericaceae shoots at 85cm, depth 82.5 to 87.5cm, PAZ *Cannabis-Fagus-Pinus,* overlying boundary with PAZ *Pinus-Betula-Quercus.*

Gd-701. Słopiec II/23 **480 ± 70**

Sphagnum-Eriophorum peat with pieces of wood, depth 107.5 to 112.5cm, PAZ *Pinus-Betula-Quercus.*

Gd-1157. Słopiec II/29 **1090 ± 60**

Brown swamp peat, depth 137.5 to 142.5cm, boundary of PAZ *Pinus-Betula-Quercus* and *Carpinus-Fagus-Abies.*

Gd-983. Słopiec II/33 **1940 ± 60**

Same, depth 162.5 to 167.5cm, PAZ *Capinus-Fagus-Abies.*

Gd-1241. Słopiec II/40 **2710 ± 60**

Same, depth 192.5 to 197.5cm, boundary of PAZ *Carpinus-Fagus-Abies* and *Alnus-Carpinus,* Sub-atlantic/Sub-boreal boundary.

Gd-775. Słopiec II/45 **3450 ± 80**

Same, depth 217.5 to 222.5cm, PAZ *Alnus-Carpinus.*

Gd-1158. Słopiec II/49 **3650 ± 50**

Same, depth 237.5 to 242.5cm, same PAZ, overlying boundary with PAZ *Corylus-Tilia-Picea.*

Gd-1505. Słopiec II/52 **4660 ± 70**

Same, depth 252.5 to 257.5cm, PAZ *Corylus-Tilia-Picea.*

Gd-1506. Słopiec II/55 **5710 ± 80**

Same, depth 267.5 to 272.5cm, same PAZ.

Gd-1507. Słopiec II/60 **6690 ± 80**

Same, depth 292.5 to 297.5cm, same PAZ, overlying boundary with PAZ *Corylus-Alnus.*

Gd-776. Słopiec II/70 **9090 ± 100**

Same, depth 342.5 to 347.5cm, boundary of PAZ *Corylus-Alnus* and *Pinus-Ulmus,* Atlantic/Boreal boundary.

Gd-703. Słopiec II/80 **9330 ± 150**

Brown swamp peat with numerous rhizomes and shoots of swamp plants and pieces of wood; depth 392.5 to 397.5cm, boundary of PAZ *Pinus-Ulmus* and *Salix-Betula.*

Gd-700. Słopiec II/81 **9620 ± 120**

Same, adjacent layer, depth 397.5 to 400cm, PAZ *Salix-Betula.*

Gd-702. Słopiec II/85 **10,080 ± 160**

Same, depth 417.5 to 422.5cm, same PAZ, overlying boundary with PAZ *Populus*-Polypodiaceae, overlying Pre-boreal/Younger Dryas boundary.

Gd-1508. Słopiec II/95 **10,090 ± 120**

Blackish-brown swamp peat with rhizomes of swamp plants and numerous seeds of *Menyanthes* and single pieces of wood; depth 467.5 to 472.5cm, PAZ *Larix-Juniperus-Pinus*.

Gd-704. Słopiec II/104 **10,280 ± 210**

Same, depth 512.5 to 515cm, basal layer of peat at contact with fine sands, same PAZ.

Region 7. Lublin Polesie

Reference site: Łukcze

Łukcze in W part of Łęczno Lake Dist, SW part of Lublin Polesie (Wilgat, 1953; Maruszczak, 1966) comprises small eutrophic Lake Łukcze and mire at W shore of lake (51° 30′ N, 23° E). Two profiles (TŁ & ŁIII), ca 10m apart and ca 20m from shore, were taken in May 1979, subm 1979 and 1981 by Krystyna Bałaga, Inst Earth Sci, Maria Curie Skłodowska Univ, Lublin.

Lake Łukcze has two parts linked by channel (Bałaga, 1982, fig 1, p 10–11), with NE, E, and S lake shores covered with alder, and fragments of devastated pine *Vaccinio myrtilli-Pinetum* forest and mixed *Pino-Quercetum* forest in SE part. From SW and NW, community of *Salici-Franguletum* connects lake with mire covered by fragments of *Caricetum lasiocarpae, C limosae, C diandrae,* and *Sphagnetum medio-rubelli.* Eleven local pollen assemblage zones were defined, 5 based on data from Łukcze TŁ and Łukcze III profiles.

Łukcze profile TŁ series

Profile TŁ consists of well-decomposed black-brown sedge-moss peat, max thickness 3.5m.

Gd-1175. Łukcze TŁ-1 **980 ± 50**

Depth 50 to 55cm, local PAZ Ł-10, transition between subzones e and f, with decreases of *Carpinus, Quercus, Plantago lanceolata, Rumex,* and *Urtica* pollen, and first appearance of *Secale cereale* pollen.

Gd-1178. Łukcze TŁ-2 **6420 ± 70**

Depth 90 to 95cm, local PAZ Ł-8 with dominance of *Ulmus, Quercus,* and *Corylus,* and first appearance of *Plantago lanceolata* and cereals. Dates first appearance of *Carpinus* and *Fagus.*

Gd-1179. Łukcze TŁ-3 **7790 ± 70**

Depth 165 to 170cm, boundary of local PAZs Ł-7 and Ł-8 with increase of *Quercus* and *Alnus* and decrease of *Pinus* pollen, and first appearance of *Pteridium aquilinum* spores.

Gd-1181. Łukcze TŁ-4 **10,900 ± 100**

Depth 250 to 255cm, boundary of local PAZs Ł-3 and Ł-4, with decrease in *Artemisia* pollen and empirical limit of *Ulmus* (after Bałaga, 1982, p 15), end of Younger Dryas period.

Gd-1182. Łukcze TŁ-5 **10,930 ± 90**

Depth 280 to 285cm, boundary of local PAZs Ł-2 and Ł-3 with increase of *Artemisia* and decrease of Gramineae pollen. *Comment* (KB): beginning of Younger Dryas period; date younger than expected.

Łukcze profile Ł-III series

Core Ł-III is composed of silt with some gray brown gyttja at base, overlain by sedge-moss peat, peaty gyttja, calcareous gyttja, and at top, sedge-moss brown peat of varying degrees of decomposition; max depth of organic sediments, 450cm.

Gd-1180. Łukcze Ł-III-1 **9080 ± 90**

Black-brown peaty gyttja, organic matter 91%, depth 250 to 260cm, boundary of local PAZs Ł-5 and Ł-6, at max rise of *Corylus*, end of calcareous gyttja sedimentation, beginning of Boreal period.

Gd-822. Łukcze Ł-III-2 **10,660 ± 210**

Black-gray detritus-calcareous gyttja, depth 340 to 350cm, organic matter content 52%, carbonate 9%, local PAZ Ł-3 with max rise of *Artemisia* pollen up to 30%. *Comment* (MFP): undersized, diluted, date is probably too old because of hard-water effect, indicated by presence of *Potamogeton* and *Myriophyllum* (Pazdur, 1982).

Gd-824. Łukcze Ł-III-3 **10,680 ± 190**

Black-brown peaty gyttja, depth 380 to 390cm, underlying calcareous gyttja, organic matter 72%, no carbonates. Local PAZ Ł-3, sample dates transition between peaty gyttja and detritus-calcareous gyttja and beginning of carbonate sedimentation. *Comment* (MFP): undersized, diluted.

Gd-825. Łukcze Ł-III-4 **11,160 ± 110**

Black-brown peaty gyttja, organic matter ca 70%, no carbonates, depth 400 to 410cm. Boundary of local PAZs Ł-2 and Ł-3. *Comment* (MFP): correlates fairly well with Gd-1182: 10,930 ± 90, and dates beginning of Younger Dryas period.

Gd-1183. Łukcze Ł-III-5 **12,330 ± 160**

Black-brown sedge moss peat with gyttja and silt, organic matter 35%, depth 425 to 430cm, boundary of local PAZs Ł-0 and Ł-1 with decrease in *Betula* and *Salix* pollen and increase in *Pinus* and Gramineae percentages, beginning of organic matter sedimentation and mire development.

Region 10. Great-Poland-Kujawy Lowlands

b. Poznań-Gniezno-Kujawy Lake District

Gopło profile GI series

Peat and gyttja from core taken in bog in subglacial channel, 500m SW of Gopło Lake shore, in Mielnica Duża village (52° 33′ N, 18° 30′ E), Kujawy Uplands, alt 78m asl. Organogenic sediments, 10.25m thick, overlying Pleistocene sands, are composed of detrital gyttja and basal peat layer, overlain by ca 8.5m thick series of calcareous gyttja with shells and upper peat layer. Coll March 1980 and subm by Barbara Jankowska, Inst Biol, Mikołaj Kopernik Univ, Toruń (Jankowska, 1981).

Gd-1263. Gopło G1 **460 ± 50**

Slightly decomposed peat, depth 20cm, 1.67% $CaCO_3$, weight loss on ignition (LWI) 76.8%.

Gd-1264. Gopło G2 **1010 ± 50**

Slightly decomposed peat, depth 60cm, 6.29% $CaCO_3$, LWI 83.3%.

Gd-798. Gopło G3 **1370 ± 60**

Well-decomposed black-brown peat, depth 120cm, 10.07% $CaCO_3$, LWI 52.8%.

Gd-799. Gopło G10 **13,040 ± 140**

Organic matter with fine sand, depth 10.15 to 10.25m, 2.51% of $CaCO_3$, LWI 0.19%. *Comment* (MFP): undersized, diluted.

General Comment (BJ): preliminary results of pollen analysis indicate Subatlantic age for upper peat layer and Oldest Dryas age for lowermost organic layer (Jankowska, 1981).

Region 11. Western Pomerania

c. Baltic Coastal Zone

Reference site: Żarnowiec

Żarnowiec covers three loci in neighborhood of Lake Żarnowiec, chosen to obtain pollen material representative of past local and regional plant cover. Two loci lie in extensive Lake Żarnowiec channel surrounded by moraine hills covered by beech and oak forest, representing regional features. Third locality representing local features is in Darżlubie Forest in tunnel valley of Lake Dobre (Latałowa, 1981a). For pollen analysis and ^{14}C dating 2 cores were taken with Russian "Instorf" corer 10cm diam. Eight pollen assemblage zones were distinguished, which can probably be applied regionally (Latałowa, 1981a,b; 1982a,b).

Żarnowiec profile Żar/76 series

Highly decomposed peat from core Żar/76, loc 1 (Latałowa, 1982a, p 51, fig 3) ca 2km S of lake shore in bog in Lake Żarnowiec tunnel valley (54° 43′ N, 18° 7′ E), alt 5m asl, Kaszuby Coast. Coll 1976 and subm 1978 by Małgorzata Latałowa, Dept Plant Ecol, Inst Biol, Gdańsk Univ, Gdynia. Present peatbog vegetation is devastated, meadow communities of *Cirsio-*

Polygonetum type are dominant, with swamp spp and some low-moor sp occurring in places.

Gd-685. Żar/76/45–50 **2400 ± 60**

From depth 45 to 50cm, Iron age settlement phase, pollen assemblage zone (PAZ) *Quercus-Carpinus.*

Gd-598. Żar/76/107–112 **3230 ± 70**

From depth 107 to 112cm, settlement phase of Early Bronze age, PAZ *Quercus-Corylus.*

Gd-1030. Żar/76/142–152 **4030 ± 60**

From depth 142 to 152cm, rational *Carpinus* limit, settlement phase of Neolithic period, PAZ *Quercus-Corylus.*

Gd-595. Żar/76/191–200 **5460 ± 60**

From depth 191 to 200cm, overlying first pollen of *Plantago lanceolata* and first settlement phase, PAZ *Quercus-Corylus,* close to boundary with PAZ *Tilia-Ulmus-Pinus.*

Gd-686. Żar/76/245–250 **6460 ± 100**

From depth 245 to 250cm, distinct increase of *Quercus,* Atlantic period, PAZ *Tilia-Ulmus-Pinus.*

Gd-596. Żar/76/288–298 **8090 ± 70**

From depth 288 to 298cm, somewhat below rational *Tilia* limit, Boreal/Atlantic boundary, just above boundary of PAZs *Tilia-Ulmus-Pinus* and *Corylus-Pinus.*

Gd-1029. Żar/76/343–352 **9070 ± 70**

From depth 343 to 352cm, rational *Corylus* limit, Pre-boreal/Boreal boundary, boundary of PAZ *Corylus-Pinus* and *Pinus* sub-zone of PAZ *Pinus-Betula.*

Gd-1031. Żar/76/387–397 **10,130 ± 120**

From depth 387 to 397cm, Late Glacial/Holocene boundary, decline of *Juniperus* and NAP marking boundary of PAZ *Juniperus-Pinus-Betula* with sub-zone *Pinus-Betula-Filipendula* of PAZ *Pinus-Betula.*

Darżlubie Forest profile PDarż/78 series

Slightly decomposed peat from loc 3 in Darżlubie Forest, peat bog in tunnel valley of Lake Dobre, core PDarż/78 taken ca 1km SW of lake shore (54° 42′ N, 18° 10′ E), ca 6km SE of loc 1, alt 80m asl. Coll and subm 1978 by Małgorzata Latałowa. Lake valley is ca 100m wide with slopes somewhat raised and grown over with pine and oak-pine woods, wet meadow communities of order *Molinietalia* cover surface of peat bog with typical low-moor and transition bog sp.

Gd-1032. PDarż/78/23–33 **1120 ± 50**

From depth 23 to 33cm, decrease of *Carpinus* and expansion of *Fagus,* expansion of Early Medieval settlement, PAZ *Pinus-Fagus-Juniperus,* overlying boundary with PAZ *Quercus-Carpinus.*

Gd-599. PDarż/78/87–98 **2310 ± 60**

From depth 87 to 98cm, below rational *Fagus* limit, Sub-boreal/Sub-atlantic boundary PAZ *Quercus-Carpinus.*

Gd-1033. PDarż/78/113–123 **2770 ± 60**

From depth 113 to 123cm, expansion of *Carpinus,* distinct decrease of *Quercetum Mixtum,* first appearance of Lusation culture settlement indicators, PAZ *Quercus-Carpinus.*

Gd-1058. PDarż/78/183–193 **4030 ± 70**

From depth 183 to 193cm, rational *Carpinus* limit (?), first pollen of *Plantago lanceolata,* Neolithic settlement phase, PAZ *Quercus-Corylus.*

Gd-1124. PDarż/78/201–205 **5070 ± 70**

From depth 201 to 205cm, decrease of *Ulmus,* distinct increase of *Quercus* and *Corylus,* PAZ *Tilia-Ulmus-Pinus.*

Gd-1125. PDarż/78/220–225 **6780 ± 80**

From depth 220 to 225cm, distinct change in local vegetation, very strong increase of concentration of sporomorphs, PAZ *Tilia-Ulmus-Pinus.*

Gd-625. PDarż/78/253–263 **7900 ± 110**

From depth 253 to 263cm, just below rational *Tilia* limit and Boreal/Atlantic boundary, PAZ *Corylus-Pinus,* underlying boundary with PAZ *Tilia-Ulmus-Pinus,* marked by fall in *Corylus* percentage.

Gd-626. PDarż/78/303–313/a **8890 ± 100**

From depth 303 to 313cm, changes in local vegetation, PAZ *Corylus-Pinus,* Boreal period.

Gd-1113. PDarż/78/303–313/b **8780 ± 90**

Duplicate run on 2nd portion of same sample.

Gd-1126. PDarż/78/327–332 **9170 ± 110**

From depth 327 to 332cm, increase of *Ulmus* and *Quercus,* decrease of heliophytes, *Pinus* sub-zone of PAZ *Pinus-Betula,* underlying boundary with PAZ *Corylus-Pinus. Comment* (ML): upper boundary of PAZ *Pinus-Betula* is synchronous in profiles Żar/76, PDarż/76 and PDarż/78 and falls at 9100 BP.

Gd-1154. PDarż/78/332–337 **8990 ± 90**

From depth 332 to 337cm, control run on sample from adjacent level.

Gd-1059. PDarż/78/350–358 **9080 ± 90**

From depth 350 to 358cm, rational *Corylus* limit, Pre-boreal/Boreal boundary.

Gd-1060. PDarż/78/373–381 **9840 ± 110**

From depth 373 to 381cm, decrease of *Juniperus,* boundary of PAZ *Pinus-Betula* and *Juniperus-Pinus-Betula. Comment* (ML): this boundary in profile Żar/76 is dated to 10,130 ± 120 BP; Gd-1031, above.

General Comment (ML): pollen diagrams from Lake Żarnowiec area differ considerably despite fact that loci are within 5km of one another. This results from local (loc 3) *vs* regional (loc 1) types of pollen spectra. Nevertheless, pollen assemblage zones are parallel and should have regional applications. Seven settlement phases were distinguished based on cultural indicators and plants related to human activity. First 3 phases correspond to Neolithic, 4th to II/III period of Bronze age, phases 5 and 6 correspond to Kaszubian Group of Lusatian and East Pomeranian cultures (Halstatt C and D). Last, 7th phase corresponds to Early Middle age habitation.

d. Baltic Shore

Reference site: Niechorze

Niechorze, in W part of Western Pomerania, consists of two profiles with peat and peaty slime deposits; 1st in cliff ca 1.7km W of Niechorze village (54° 5′ N, 15° 3′ E), 2nd in small bog ca 1.8km SW of 1st profile. Samples coll April 1978 and subm by Krystyna Kopczyńska-Lamparska, Inst Fundamental Geol, Warsaw Univ, Warsaw.

Niechorze Cliff I series

Peat and peaty slime deposits from small lake basin exposed in cliff cut mainly in two horizons of Vistulian tills (Kopczyńska-Lamparska, 1974). Organic deposits overlying fluvioglacial sands and silts continue 30m along cliff and about same distance to S, their thickness in cliff is 2.85m and decreases to 0.5m at lake shore, 17m S of cliff. Present samples taken from profile ca 1m from profile studied in 1974 (Kopczyńska-Lamparska, 1976, figs 2 & 3; Pazdur, Pazdur, & Zastawny, 1979, p 168–169; Brykczyńska, 1978).

Gd-1111. Niechorze I-1 **3340 ± 60**

Peat, depth 32 to 37cm.

Gd-1099. Niechorze I-3 **5910 ± 80**

Peaty silt, uppermost layer overlain by peat, depth 42 to 49cm.

Gd-1112. Niechorze I-7 **9330 ± 120**

Peaty silt overlying series of silts with mollusk shells, depth 72 to 79cm.

Gd-782. Niechorze I-8:sol **13,430 ± 150**

Peaty silt with mollusk shells, lowermost part of layer, depth 160 to 164cm. *Comment* (MFP): alkali-soluble fraction dated.

Gd-1245. Niechorze I-8:ins **12,260 ± 120**

Same sample, insoluble fraction.

Gd-1107. Niechorze I-9 **11,880 ± 110**

Peat, uppermost part of peat layer overlying peaty silt, depth 191 to 193cm.

Gd-1108. Niechorze I-10 **11,980 ± 130**

Peaty, lowermost part of same layer.

Gd-1109. Niechorze I-11 **12,150 ± 100**

Peaty silt, depth 195 to 201cm.

Gd-673. Niechorze I-12 **12,010 ± 150**

Peaty silt, lowermost part of same layer, depth 201 to 210cm.

General Comment (MFP): Gd-782 and -1245 older than expected probably due to hard-water effect.

Niechorze profile s1 series

Peat from profile s1 from bog developed above lacustrine deposits in small basin on morainic plateau.

Gd-1096. Niechorze s1-2 **3660 ± 60**

Depth 1 to 1.15m.

Gd-1097. Niechorze s1-4 **4330 ± 80**

Depth 2 to 2.15m.

Gd-1098. Niechorze s1-5 **4600 ± 70**

Depth 2.55 to 2.7m.

Reference area: Gardno-Łeba Lowlands

Gardno-Łeba Lowlands are separate, morphologically and genetically differentiated physiographic unit in central part of Western Pomerania, bordered in N part by Baltic Sea shoreline and in S part by diluvial plateau, with three coastal lakes in N part, where sand bars are partly covered by migrating dunes. Gardno-Łeba Lowlands are under supervision of Słowiński Natl Park. Ref area is represented by 5 sites, 3 in coastal sand bars and 2 in large mires SW of Łebsko Lake, studied by Kazimierz Tobolski, Inst Quaternary Research, Adam Mickiewicz Univ, Poznań (Tobolski, 1982, fig 1, p 132).

Sarbsko Bay Bar series

Wood from individual trunks (*Quercus* sp, id by Kazimierz Tobolski) from top series of organic sediments on beach or in dune cliff on Sarbsko Bay Bar near Łeba-Neptun (54° 46′ N, 17° 34′ E), ca 1km E of Łeba R mouth to Baltic. Coll May 1978 and subm by Kazimierz Tobolski for studies of post-Littorina succession of local vegetation in Sarbsko Bar (Tobolski, 1979; 1981, p 104–106; 1982; Tobolski *et al,* 1980).

Gd-573. Łeba-Neptun 1/78 **1220 ± 50**

From outer part of horizontal oak trunk, 55cm diam, with 160 annual rings, lying on oak forest humus horizon containing 62% of *Quercus* pollen grains, overlain by coastal dune sands, depth ca 85cm. *Comment* (KT): date confirms earlier dating of humus horizon, thought to be rejuvenated due to younger humic acids penetration or rootlets (1430 ± 140: Gd-418, R, 1979, v 21, p 165). This horizon was previously expected to be of late Subboreal age or slightly younger.

Gd-1008. Łeba-Neptun 2/78 **1060 ± 50**

From outer part of horizontal root of oak trunk with ca 120 annual rings found on surface of organic sediments, ca 10m W of trunk 1/78.

Gd-1006. Łeba-Neptun 3/78 **1120 ± 50**

From outer part of root of oak trunk with ca 100 annual rings, from surface of organic sediments, ca 5m E of trunk 1/78.

General Comment (KT): dating of Łeba-Neptun oak trunks proves that destruction of oak forest occurred in 9th century AD. Decay of primary oak forests was gradual and took place at different times, which, compared with fossil soils in area, argues for anthropogenic causes of changes within primary vegetation of bar areas.

Gardno Bay Bar series

Wood from outer part of individual trunks of *Quercus* sp forming two oak cemeteries related to subfossil peat layers on beech in E part of Gardno Bay Bar (54° 41′ N, 17° 8′ E). Coll May 1978 and subm by Kazimierz Tobolski.

Gd-1005. MG-1/78 **2130 ± 50**

From *in situ* trunk, diam 70cm.

Gd-1004. MG-2/78 **2860 ± 50**

From *in situ* trunk, diam 120cm, found ca 350m W of trunk 1/78.

General Comment (KT): dates indicate non-uniform decay of oak forests over this area. First date refers to period when oak trees were destroyed in central part of Łeba Bar; 2nd one is related to older events from earlier period of Bronze age (Tobolski *et al,* 1980). Other date of interest to problem was obtained on oak charcoals from fossil soil near Czołpino, same area (Gd-421; 3340 ± 130, R, 1979, v 21, p 165; Borówka & Tobolski, 1979).

Łeba Bay Bar series

Wood and bark fragments related to fossil soil levels in area of mobile coastal dunes, central part of Łeba Bay Bar (54° 45′ N, 17° 24′ E). Coll and subm 1978 by Kazimierz Tobolski. Dated as part of complex systematic studies including paleo- and phytogeography of Gardno-Łeba Lowlands (Tobolski, 1981, p 93–100), evolution of coastal dunes (Tobolski, 1975; 1980; 1981, p 100–103), decay of pine and beech forests (Wojterski, 1964; Tobolski, 1979), partly in connection with IGCP 158B project.

Gd-570. MŁ-4/78 **290 ± 50**

Wood from outer part of partly rotten trunk (*Pinus silvestris*) found *in situ* in vertical position in tree cemetery ca 800m NE of Łącka Dune culmination, Div 7 of Protection Circle. Trunk had 21cm diam, 20 annual rings, with insect burrows; most of surface had no remaining bark.

Gd-571. MŁ-5/78 **250 ± 50**

Wood from outer part of trunk (*Pinus silvestris*) found *in situ* in vertical position, E part of tree cemetery on Łącka Dune, Div 7 of Protection Circle. Trunk had 20cm diam, 30 annual rings; outer rings had insect burrows.

Gd-572. MŁ-6/78 **210 ± 50**

Wood from outer part of trunk of *Pinus silvestris* found *in situ* in vertical position in NE part of tree cemetery, Div 9 of Protection Circle, ca 200m W of tourist rte from Łebsko Lake to seashore. Trunk had 26cm diam, 42 annual rings; outer rings had insect burrows to 3 cm depth.

Gd-1034. MŁ-7/78 **390 ± 50**

Wood from outer part of basal fragment of *Quercus robur,* id by Kazimierz Tobolski, found at surface of fossil soil level no. 14, according to Tobolski (1975). Outcrops of this level occur in Divs 8 and 9 of Protection Circle.

Gd-1038. MŁ-8/78 **250 ± 50**

Bark from basal part of highly rotten trunk (*Fagus silvatica*), same fossil soil level.

General Comment (KT): results of ^{14}C dating of pine tree cemeteries agree with historical documents cited by Kobendzina (1976) which indicate increasing human activity from beginning of 17th century AD. Other dates confirm earlier opinions (Tobolski, 1975) concerning occurrence in historical time of pine and broad leaf forests with *Fagus* sp dominating.

Kluki profile 74 series

Peat from coastal bog belonging to vast peatland complex extending throughout N area of Gardno-Łeba Lowlands, profile Kluki/74 in Słowiński Natl Park, 0.5km E of Kluki village (54° 40′ N, 17° 19′ E) in marshy forest *Vaccinio uliginosi—Pinetum,* alt 2.1m asl. Organic deposits, 6.7m thick, overlie medium-grained sands with thin layer of detritus gyttja at base

of organic series. N part of Gardno-Łeba Lowlands is ref area representative of geobot unit defined by Czubiński (1950) as Coastal Region (Tobolski, 1981, p 90–93). Core Kluki/74 studies include palynol, carpol, geochem analyses, and physical sediment analysis. Core 74 coll 1974; samples subm 1978 to 1982 by Kazimierz Tobolski.

Gd-1305. Kluki/74/25–30cm **230 ± 50**
Sphagnum-wood peat.

Gd-565. Kluki/74/60–65cm **860 ± 60**
Sphagnum peat.

Gd-1306. Kluki/74/80–85cm **1350 ± 60**
Carex peat.

Gd-1307. Kluki/74/100–105cm **1530 ± 50**
Carex peat.

Gd-564. Kluki/74/120–125cm **1750 ± 50**
Carex peat.

Gd-1308. Kluki/74/170–174cm **2120 ± 50**
Transition peat.

Gd-1321. Kluki/74/190–195cm **3080 ± 50**
Carex peat.

Gd-563. Kluki/74/240–245cm **3860 ± 70**
Carex peat.

Gd-1330. Kluki/74/275–280cm **4680 ± 60**
Carex peat.

Gd-1315. Kluki/74/310–315cm **4910 ± 90**
Juncus peat.

Gd-1331. Kluki/74/340–345cm **5050 ± 50**
Juncus peat.

Gd-562. Kluki/74/380–385cm **5300 ± 70**
Transition between *Cladium* and *Juncus* peat.

Gd-855. Kluki/74/430–435cm **6050 ± 120**
Carex peat.

Gd-1323. Kluki/74/460–465cm **6670 ± 60**
Carex peat.

Gd-1587. Kluki/74/505–510cm **7400 ± 60**

Cladium peat.

Gd-1322. Kluki/74/540–545cm **8130 ± 80**

Cladium peat.

Gd-547. Kluki/74/575–580cm **8370 ± 110**

Cladium peat.

Gd-1329. Kluki/74/630–635cm **9110 ± 70**

Cladium peat.

Gd-548. Kluki/74/660–665cm **9870 ± 110**

Carex peat with gyttja.

General Comment (KT): according to palynol and ^{14}C data, beginning of organic deposition can be assigned to older part of Pre-boreal period. Since then, few distinctive minerotrophic phytocenoses contributed to deposition of various peat layers. Oligotrophication began ca 1000 yr BP. Modern bog pine forests phytocenosis growing on bog is estimated to be very young; most probably this pine stand constitutes first tree generation (Tobolshi, 1982, p 133).

Kluki KL/2 series

Peat from supplementary profile taken ca 2.5km N of profile Kluki/74. Coll and subm 1981 by Kazimierz Tobolski.

Gd-1291. Kluki KL/2/2/150–155cm **3790 ± 60**

Gd-830. Kluki KL/2/1/205–210cm **5950 ± 130**

e. Vistula Deltaic area

Druzno profile 1a series

Peat and gyttja from basal series of organogenic sediments, profile 1a, in Druzno Lake basin (54° 10′ N, 19° 30′ E), ca 10km SSE of Elbląg, Żuławy. Coll March 1979 by Kazimierz Więckowski and Joanna Zachowicz; subm 1979 by JZ, Inst Meteorol and Water Management, Gdynia. Lake Druzno is in central part of catchment basin of Elbląg R, surrounded by Malbork Żuławy, Vistula Lagoon, and Elbląg Upland, in depression 1.8m below sea level. Lake is shallow, max depth 3m, lake basin filled with layer of gyttja, 6 to 8m thick (Mikulski, 1955). Present studies include palynol, diatom, physical and chemical analyses (Przybyłowska-Lange, 1976; Zachowicz, 1981; Zachowicz, Przybyłowska-Lang & Nagler, 1982).

Gd-1131, Druzno 1a-1 **6440 ± 50**

Black-brown peat with fragments of undecomposed leaves and twigs, depth 625 to 635cm.

Gd-1128. Druzno 1a-2 **6390 ± 140**

Wood from tree trunk, 10cm diam, depth 646 to 655cm.

Gd-1132. Druzno 1a-3:sol **7050 ± 70**

Brown-gray coarse detritus gyttja, depth 679 to 688cm, alkali-soluble fraction.

Gd-715. Druzno 1a-3:ins **6430 ± 180**

Same sample, insoluble fraction. *Comment:* undersized, diluted.

Gd-1136. Druzno 1a-4:sol **8990 ± 80**

Well-decomposed brown peat, depth 712 to 722cm, alkali-soluble fraction.

Gd-716. Druzno 1a-4:ins **8760 ± 220**

Same sample, insoluble fraction. *Comment:* undersized, diluted.

Gd-1137. Druzno 1a-5 **11,290 ± 110**

Black-brown peat with sand, lowermost layer, depth 858 to 866cm.

Region 12. Eastern Pomerania

a. Dobrzyń Lake District

Reference site: Lake Steklin

Steklin is in SW part of Dobrzyń Lake dist (Dobrzyń Moraine Plateau), ca 23km ESE of Toruń, comprising Lake Steklin (52° 58′ N, 19° E) and peat bog in W part of Lake channel (Noryśkiewicz, 1982).

Gd-1115. Lake Steklin 920–928 **11,630 ± 110**

Silt with plant detritus, depth 920 to 928cm, lowermost part of basal deposits of total thickness, 940cm, W part of Lake Steklin. Coll Feb 1978 and subm 1979 by Bożena Noryśkiewicz, Inst Biol, Mikołaj Kopernik Univ, Toruń.

Steklin peatbog series

Peat from profile taken at W part of Lake Steklin channel. Coll and subm 1980 by Bożena Noryśkiewicz.

Gd-840. Steklin 110cm **750 ± 90**

Gd-841. Steklin 230cm **1870 ± 60**

Gd-842. Steklin 340cm **2330 ± 120**

Gd-1303. Steklin 420cm **4470 ± 60**

b. Olsztyn Lake District

Reference site: Woryty

Woryty profile 80s series

Gyttja and peat from continuous profile of organic sediments with variable content of $CaCO_3$ filling bipartite overgrown channel lake in Woryty village (53° 45′ N, 20° 10′ E), center of subregion 12b, ca 17km WSW of Olsztyn, 2km WNW of Gietrzwałd, hilly area bordered by Pasłęka, Old Pasłęka, and Giłwa Rivers, close to settlement complex of Lusatian culture from IV–VI periods of Bronze age (Dąbrowski, 1981; Dąbrowski & Mogielnicka-Urban, 1976). Core Woryty 80 coll 1974 by Kazimierz Więckowski and Magdalena Ralska-Jasiewiczowa (Cieśla, Ralska-Jasiewiczowa, & Stupnicka, 1978), and core Woryty 80s coll 1979 by G Digerfeldt and T Persson and MRJ. Six samples from core 80 were subm and dated in Cambridge (Ralska-Jasiewiczowa *et al,* ms in preparation), chronology of core 80s is based on 17 ^{14}C dated samples, 5 dated in Lund (R, 1981, v 23, p 392–393; Pawlikowski *et al,* 1982) and 12 in Gliwice. Thirteen local pollen assemblage zones (PAZ) were distinguished, some with subzones based on cluster analysis (Gordon & Birks, 1972).

Gd-1190. Woryty 80s/136–139cm **2080 ± 80**

Swamp peat with gyttja, PAZ W-12, high *Carpinus* pollen percentage, subzone W-12b, decrease in pollen concentration and increase in NAP pollen percents with predominant Gramineae, *Artemisia, Plantago lanceolata,* and *Rumex acetosella. Comment* (MRJ): this subzone reflects entry of new cultural group into Woryty area.

Gd-1192. Woryty 80s/176–179cm **2320 ± 60**

Same, just below upper boundary of PAZ W-11. *Comment* (MRJ): lower boundary of PAZ W-11 can be dated to ca 3500 BP. Pollen spectrum shows long-lasting settlement phase of Late Bronze Lusatian culture with dominance of pastoral economy.

Gd-1191. Woryty 80s/316–319cm **3960 ± 70**

Dark brown peaty gyttja with some silt, PAZ W-10.

Gd-1193. Woryty 80s/406–409cm **5120 ± 80**

Dark-brown gelatinous sapropelic sediment, lower boundary of PAZ W-10. *Comment* (MRJ): first pollen grains of cereals indicate presence of human settlement near lake, deciduous forest became more open, dominated by oak with abundant hazel understory.

Gd-727. Woryty 80s/426–429cm **5890 ± 90**

Same, PAZ W-9. *Comment* (MRJ): rise in pollen concentration, probably resulting from decreased sedimentation rate.

Gd-1194. Woryty 80s/476–479cm **6460 ± 70**

Same, PAZ W-10. *Comment* (MRJ): slow decrease in *Ulmus* and increase in *Quercus* pollen values between 6460 BP and 5120 BP with change in sediment suggest lowered water level in lake and indicate phase of warm but drier climate.

Gd-731. Woryty 80s/586–589cm **8040 ± 170**

Gray-olive slightly porous detritus gyttja with calcium carbonate, PAZ W-8 with dominant pollens of *Pinus* and *Alnus*. *Comment* (MFP): undersized, diluted.

Gd-1198. Woryty 80s/616–619cm **8440 ± 110**

Dark-brown dy-like silty sediment, overlying lower boundary of PAZ W-8.

Gd-800. Woryty 80s/665–678cm **10,320 ± 220**

Gray-olive silty gyttja with some $CaCO_3$ and patches of partly disintegrated shells, PAZ W-7. *Comment* (MRJ): older than expected.

Gd-1265. Woryty 80s/810–820cm **11,210 ± 90**

Dark-brown gelatinous calcareous gyttja, top of layer. *Comment* (MRJ): older than expected.

Gd-801. Woryty 80s/868–885cm **10,450 ± 300**

Black ferruginous gyttja with mollusk shells. *Comment* (MFP): undersized, diluted.

Gd-802. Woryty 80s/920–930cm **10,430 ± 300**

Gray ferruginous gyttja, top of layer. *Comment* (MFP): undersized, diluted.

General Comment (MRJ): dates Gd-800, -801, and -1265 were not taken into account in establishing absolute chronology of profile 80s.

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