DE GRUYTER
OPEN

Acta Palaeobotanica 54(1): 3–33, 2014
DOI: 10.2478/acpa-2014-0001

Plant remains from the Polish Triassic. Present knowledge and future prospects

GRZEGORZ PACYNA

Department of Palaeobotany and Palaeoherbarium, Institute of Botany, Jagiellonian University, Lubicz 46, 31-512 Kraków, Poland; e-mail: grzegorz.pacyna@uj.edu.pl

Received 12 November 2013; accepted for publication 4 March 2014

ABSTRACT. The Triassic plant macrofossils of Poland are very poorly known. There are few Triassic rock exposures here, they contain very few plant specimens, there is little scientific interest in the subject, and the rare plant remains found in drill cores are of low stratigraphical significance. The Lower Triassic macroflora is surprisingly poorer taxonomically than coeval European floras, and only single specimens have been found. The flora of the Middle Triassic is even poorer as a result of the Muschelkalk sea transgression. Only the Upper Triassic floras contain many specimens and taxa. The Upper Triassic macrofloras from Polish territory are well known since the early 19th century. Pioneering descriptions of these floras were given by Goeppert and Raciborski. From the Polish Triassic, the seed fern *Lepidopteris ottonis* (index species for the Rhaetian stage) and *Neocalamites lehmannianus* (sphenopsid species typical of almost all European Upper Triassic and Lower Jurassic floras) were described for the first time ever. In the 20th century only single specimens were described from outcrops and drill cores. Barbacka revised *Lepidopteris ottonis* specimens from old collections and described some new material. Palynological research on Triassic strata in Poland intensified from the 1970s on. That work has produced spore-pollen and megaspore zonations for Triassic strata in Poland, but the correlation of the dispersed spores and pollen grains with their parent plants is low. The Polish Triassic flora is comprised of ferns, lycopsids, sphenopsids, cycads, bennettitaleans, ginkgoaleans and conifers. This flora is taxonomically poorer than equally old and geographically close European floras. All available data about Polish Triassic plants fossils are critically summarised in this paper for the first time. The biostratigraphical and lithostratigraphical correlations of Polish Triassic floras with other European Triassic floras are outlined. New macrofloral assemblages for the Lower and Middle Triassic and macrofloral assemblage zones for the Upper Triassic are proposed for Poland. Recent new finds of taxonomically rich, abundant and well-preserved floras accompanying vertebrate remains in Silesia provide an opportunity for comprehensive research on Polish Triassic floras. This should improve our perception of their taxonomy and allow them to be described in evolutionary and palaeoecological contexts.

KEYWORDS: fossil plants, biostratigraphy, *Lepidopteris* zone, Triassic, Krasiejów, Poland

INTRODUCTION

The Triassic was one of the most important periods because it witnessed dynamic evolutionary changes and the formation of modern ecosystems for the first time in the history of life on Earth (Fraser 2006, Sues & Fraser 2010). It is also the period in which floras were restored after the most devastating extinction in Earth's history, at the Permian-Triassic boundary (Taylor et al. 2009). Floras that originated during this period would occur through almost the entire Mesozoic era and would be the source of food for herbivorous dinosaurs (King 1996, Sues 2000). Yet the Triassic floras of the Northern Hemisphere are rare and poorly known (Meyen 1987). In this circumstance, each new site with plant macroremains and each new piece of information may fill a gap in our understanding of Triassic palaeoecology and evolution, locally and globally. The well-described localities of floras of this age are few (Kustatscher & van Konijnenburg-van Cittert 2005, 2008, Roghi et al. 2006, van Konijnenburg-van Cittert et al. 2006, Kustatscher et al. 2012) but the information they provide forms our knowledge of the taxonomic composition of Triassic floras, particularly that of gymnosperms. Very intensive radiative processes occurred in this group at that time, leading to the appearance of new groups, possibly including the angiosperms (Anderson & Anderson 1997, 2003). The Triassic is an exceptionally interesting period as it saw the evolution of conifers (Miller 1977, Grauvogel-Stamm 1978, Rothwell et al. 2012). The oldest representatives of some modern families appeared in the Upper Triassic. The stages of transformation from primitive Votziales into evolutionarily advanced families of modern conifers in the Triassic are not yet fully documented (Miller 1977, Rothwell et al. 2012).

Problems of stratigraphy make it difficult to identify evolutionary events in the Triassic. Thick sequences of strata without good index fossils are difficult to correlate regionally and globally, hampering the task of distinguishing evolutionary processes and sequences of terrestrial organisms (Hunt & Lucas 1991, Lucas 1998, Rayfield et al. 2005, Lucas et al. 2007b, Kozur & Bachmann 2008). Plant micro- and macrofossils have proved useful in Triassic biostratigraphy, especially in palynological zonation (Dobruskina 1988, 1994, Fijałkowska-Mader 1999, Lucas 2006, 2007, Cirilli 2010, Kürschner & Herngreen 2010). Ash (1980, 1987) proposed a macrofossil plant biostratigraphy for the Upper Triassic Chinle Group in North America. Unfortunately not a single species is shared by the North American and European Upper Triassic floras, so an exact correlation is almost impossible.

Little is known about the Triassic floras of Poland (Lilpop & Kostyniuk 1957, Orłowska-Zwolińska & Senkowiczowa 1970, Reymanówna 1986). There are only a very few descriptions of macroremains (Goeppert 1844, 1846a, Raciborski 1890a), written mainly in the 19th century. They require a modern revision incorporating current nomenclature and meeting today's standards of description for fossil plants (Tab. 1). Palynological research on Triassic strata in Poland intensified beginning in the 1970s. It produced a useful palynological biostratigraphic scheme for the Polish Triassic, proposed by Orłowska-Zwolińska (1985). A comparable scheme based on plant macrofossils is proposed here (Tab. 2).

New prospects for research on Triassic floras in Poland were opened by discoveries of localities with well-preserved floral remains in the 1990s and early 21st century. Krasiejów, Patoka and Lipie Śląskie-Lisowice are new fossil plant sites found during excavation of the bones of large land vertebrates. These localities have yielded numerous plant remains. Besides expanding our knowledge of Triassic floras in Poland, a full description of the macroflora from these localities will help reconstruct the palaeoenvironment of the animals at those sites. Equipped with knowledge of the flora that co-occurred with dinosaurs, we can more fully characterise those ecosystems, including the plant-animal interactions.

This paper gives an overview of the Triassic plant taxa of Poland, and summarises the data on diversity reported in historical documents.

HISTORICAL SUMMARY OF RESEARCH ON TRIASSIC FLORAS IN POLAND

Goeppert (1836, 1841–1846, 1844, 1845, 1846a, b) was the first to describe the plant fossils of the Polish Triassic. His pioneering works on the Upper Triassic flora of Silesia gave descriptions of new taxa later regarded as index or very common taxa in many European Triassic floras. Goeppert's research was quite advanced for his time; for example, he described and illustrated anatomical details of the *Lepidopteris ottonis* cuticle (Goeppert 1846a). Such depth of approach was rare in early palaeobotany. Goeppert erroneously determined the age of the flora as Middle Jurassic, though some specimens he described (wood fragments) are indeed Middle Jurassic in age. Next, Roemer (1867, 1870), then the foremost expert on Silesian geology, corrected the age given by Goeppert to Upper Triassic (Rhaetian). Roemer compared the Silesian flora described by Goeppert with the German Keuper floras described by Schenk (1867). Roemer showed Goeppert's original specimens to Schenk, the top expert on floras of the Triassic-Jurassic boundary. Schenk studied Goeppert's specimens and described new specimens collected by Roemer, including some new taxa (Schenk 1867, Roemer 1867, 1870). Roemer also gave the first complete description of the Triassic geological setting in Silesia (Roemer 1862, 1863, 1867, 1870). Roemer (1870) discovered another Upper Triassic flora in Upper Silesia, preserved in crenogenic limestones known as the Woźniki Limestone. Rich collections of fossil plants have been assembled from this limestone since then (Różycki 1930, Reymanówna 1986, Szulc et al. 2006, Szulc & Becker 2007) but not described. Kunisch (1886) and Michael (1895) described some plant remains from the Muschelkalk of Upper Silesia. In 1890, Raciborski described the Rhaetian flora from the Tatra Mountains at the Czerwone Żlebki locality (Raciborski 1890a, b, c).

Then research on Triassic plants in Poland came to a virtual halt. Some specimens discovered by geologists studying the geology of the Holy Cross Mountains at the beginning of the 20th century were noted in the literature (Czarnocki 1925, 1931, Samsonowicz 1929) but without descriptions or illustrations. After the Second World War, stratigraphical research by geologists produced new macroremains from drill cores and outcrops, only some of which have been described (Bocheński 1957, Piwocki 1970, Pawłowska 1979, Fuglewicz 1980b, Reymanówna 1986, Barbacka 1991, Brzyski & Heflik 1994, Barbacka & Wcisło-Luraniec 2002, 2003, Ociepa et al. 2008, Barbacka et al. 2009). Barbacka revised the *Lepidopteris ottonis* specimens from old collections and described some new materials (Barbacka 1980, 1991, Reymanówna & Barbacka 1981).

Palynological research on Triassic strata in Poland accelerated starting from the 1970s (Pautsch 1958, 1971, 1973, Orłowska-Zwolińska 1967, 1971, 1976, 1977, 1983, 1984, 1985, 1986, 1988, Marcinkiewicz 1962, 1969, 1971, 1976, 1978, 1981, 1992a, b, c, Fuglewicz 1973, 1979a, b, 1980a, b, Dybova-Jachowicz & Laszko 1980, Fuglewicz & Śnieżek 1980, Rdzanek 1982, Marcinkiewicz & Orłowska-Zwolińska 1985, 1994, Fuglewicz & Marcinkiewicz 1986, Fijałkowska 1989, 1990, 1992a, b, 1994a, b, 1995, Fijałkowska & Uchman 1993, Krupnik & Ziaja 2010, Pieńkowski et al. 2012, Fijałkowska-Mader 2013). From the outset these studies focused on biostratigraphy. Palynological research became especially useful in determining the age of nonmarine sediment sequences not bearing other index fossils. The investigations bore fruit in useful spore-pollen and megaspore zonations for Triassic strata in Poland (Marcinkiewicz 1971, 1978, 1992c, Fuglewicz 1980b, Orłowska-Zwolińska 1983, 1985, Fijałkowska-Mader 1999). The Permian-Triassic and Triassic-Jurassic boundaries have been well delineated based on palynological data (Orłowska-Zwolińska 1967, Marcinkiewicz 1962, 1969, 1971, Fijałkowska 1990, 1992a, 1994a, 1995, Pieńkowski et al. 2012, Fijałkowska-Mader 2013). However, the correlation between the parent plants and the dispersed spores and pollen grains requires much more study.

Recent finds of taxonomically rich, abundant and well-preserved floras accompanying vertebrate remains in Silesia have opened an opportunity for new research on Polish Triassic floras. The research on these localities is only just beginning (Dzik & Sulej 2007, Staneczko 2007, Dzik et al. 2008a, b, Wawrzyniak & Ziaja 2009, 2010, Wawrzyniak 2010a, b, c, Barbacka et al. 2012, Pacyna et al. 2013a, b).

COMPOSITION AND EVOLUTION OF PLANT ASSEMBLAGES IN THE POLISH TRIASSIC, AND THEIR STRATIGRAPHICAL VALUE

LOWER AND MIDDLE TRIASSIC (BUNTSANDSTEIN, MUSCHELKALK AND LOWER KEUPER)

Lower Triassic floras worldwide are rare and taxonomically impoverished as a result of the greatest extinction in Earth's history at the Permian-Triassic boundary (Looy et al. 1999, Grauvogel-Stamm & Ash 2005). This is also true for the Polish Triassic localities. The Permian-Triassic boundary has been documented palynologically from several Polish boreholes (Fijałkowska 1990, 1992a, 1994a, 1995, Fijałkowska-Mader 2013).

Plant macrofossils from the Polish Lower and Middle Triassic are exceptionally few in number of specimens and number of taxa (Tab. 1). Most recorded findings are from the Holy Cross Mountains (Czarnocki 1925, 1931, Samsonowicz 1929, Bocheński 1957, Lilpop & Kostyniuk 1957). Some are from Silesia (Kunisch 1886, Michael 1895b), the Tatra Mountains (Limanowski 1901), and boreholes from various regions of Poland (Fuglewicz 1980b). Only rare lycopsid, sphenopsid, conifer, and possibly seed fern remains have been identified so far (Tab. 1). Intensive new research on invertebrate and vertebrate tracks, which are very numerous and taxonomically diverse in the Holy Cross Mountains, has, surprisingly, provided only single new fossil plant specimens

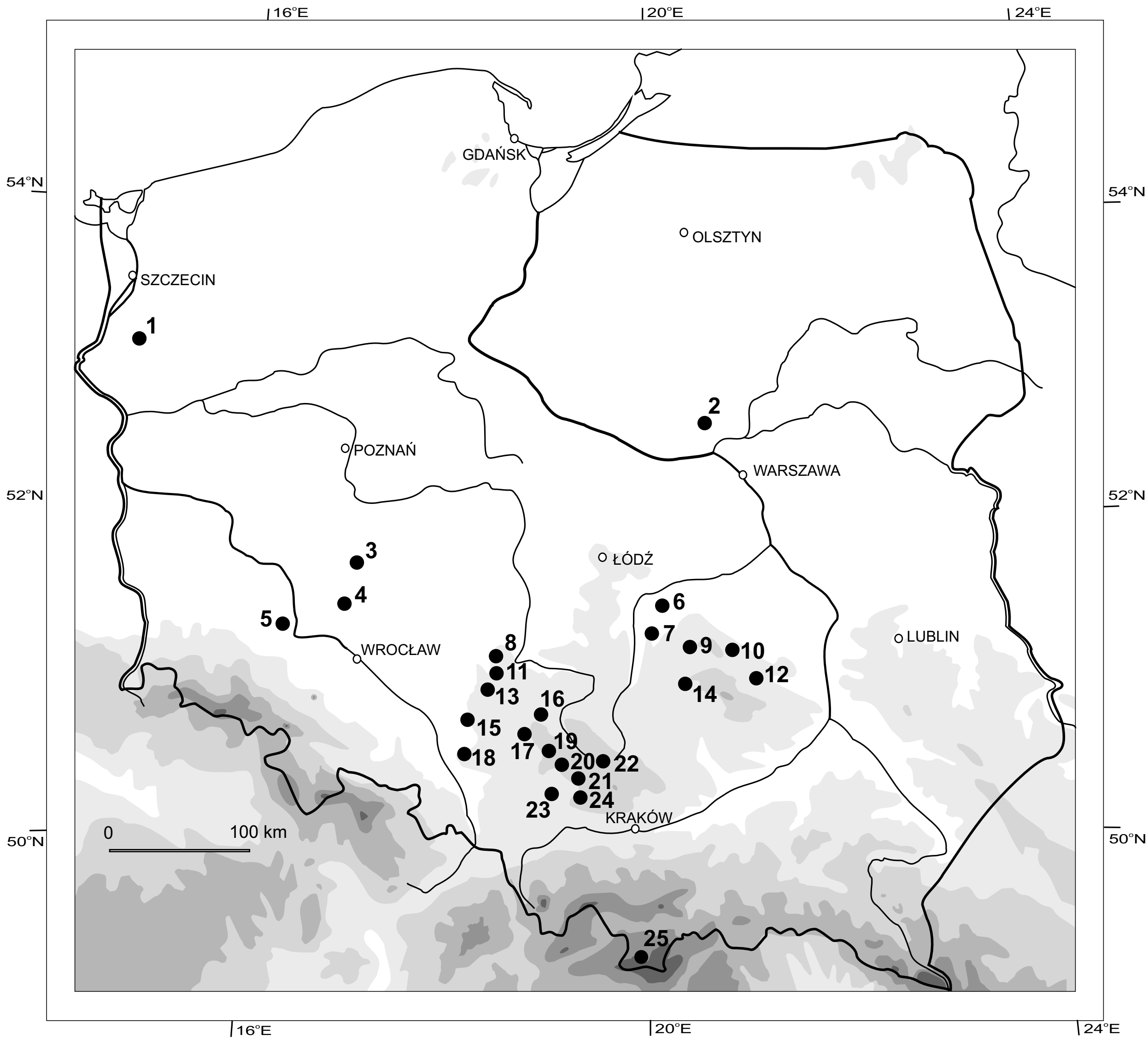

Fig. 1. Macrofossil and selected microfossil plant localities from the Polish Triassic. **1** – Chabowo 2 borehole; **2** – Gradzanowo 1 and 3 boreholes; **3** – Gostyń 46 G borehole; **4** – Kołaczkowice near Rawicz; **5** – Otyń IG-1 borehole; **6** – Studzianna borehole; **7** – Radoszyce 3 borehole; **8** – Wieluń; **9** – Pałęgi; **10** – Ratajów; **11** – Gorzów Śląski area (Lofkowitz, Sumpen); **12** – Majków area; **13** – Kluczbork area (Biadacz, Dobiercice, Gosław, Maciejów); **14** – Gacki 1, 3 and 4 boreholes; **15** – Krasiejów; **16** – Patoka; **17** – Lipie Śląskie-Lisowice; **18** – Krapkowice; **19** – Ligota near Woźniki; **20** – Woźniki; **21** – Myszków-Nowa Wieś; **22** – Kamienica Polska; **23** – Tarnowskie Góry; **24** – Poręba and Marciszów near Zawiercie; **25** – Czerwone Żlebki

(Karaszewski 1966, 1976, Gradziński et al. 1979, Fuglewicz et al. 1981, Senkowiczowa 1982, Mader & Rdzanek 1985, Fuglewicz et al. 1990, Gradziński & Uchman 1994, Machalski & Machalska 1994, Ptaszyński 1996, 2000a, b, Kuleta et al. 2001, 2005, 2006, Ptaszyński & Niedźwiedzki 2002, 2004, 2006, Niedźwiedzki et al. 2007, 2013, Niedźwiedzki & Ptaszyński 2007, Brusatte et al. 2011). In France, by contrast, well-preserved and taxonomically rich flora and fauna are known from coeval and similarly geologically structured Anisian strata – Grés a Voltzia (Grauvogel-Stamm 1978).

The palynological record of Lower Triassic plants in Poland is better than the record from macroremains (Fuglewicz 1973, 1979a, b, 1980a, b, Marcinkiewicz 1976, 1992c, Orłowska-Zwolińska 1977, 1984, 1985, 1988, Rdzanek 1982, Fijałkowska 1994b, Fijałkowska & Uchman 1993, Fuglewicz & Marcinkiewicz 1986). A biostratigraphical scheme was proposed based on palynology (Fuglewicz 1980b, Orłowska-Zwolińska 1985, Marcinkiewicz 1992c, Fijałkowska-Mader 1999) but the correlation of the dispersed spores and pollen grains with their parent plants is low. Lower Triassic vertebrate bone fossils are very rare in Poland (Borsuk-Białynicka et al. 1999, Borsuk-Białynicka & Evans 2009, Sulej & Niedźwiedzki 2013).

Buntsandstein-type facies (mostly terrestrial) were replaced by fully marine facies in the Anisian as a result of the Muschelkalk sea transgression (Eck 1865, Marek & Pajchlowa 1997, Nawrocki & Szulc 2000, Szulc & Becker 2007, Kowal-Linka & Bodzioch 2012). Because of this, the flora of the Muschelkalk in Poland, as all over Europe, is even poorer than for the Lower Triassic. Palaeontological research on the Muschelkalk strata in Poland has a long history (Eck 1865), and rich marine vertebrate fauna have been described (Roemer 1870, Gürich 1884, Tarlo 1959, Lis & Wójcik 1960, Rieppel & Hagdorn 1997, Chrząstek & Niedźwiedzki 1998, Rieppel 2000, Bardziński et al. 2008, Chrząstek 2008). Macroscopic plant remains are almost entirely absent, however (Goeppert 1846b, Kunisch 1886, Michael 1895), and the palynological record is meager (Orłowska-Zwolińska 1977, 1985, 1986, 1988, Marcinkiewicz 1992a). Only calcified algae are well known from these strata (Raciborski 1892, 1927, Szulc & Becker 2007), some even rock-forming (Diplopora Beds). From the Muschelkalk sea regression in the Lower Keuper (Ladinian), rich swamp vegetation is known in Germany (Mader 1995), but in Poland only isolated horsetail remains have been described (Pawłowska 1979, Barbacka et al. 2009, Sulej et al. 2011b). Lilpop (in Raciborski 1927) noted the discovery of the Lettenkohle flora from Piekoszów in the Holy Cross Mountains. This flora consisted of cycadaleans and conifers and was never illustrated or even preliminarily described.

Recently an interesting new locality was found at the Pałęgi claypit in the Holy Cross Mountains (Kuleta et al. 2006, Żyła et al. 2013). There, Lower/Middle Triassic sediments (latest Olenekian–early Anisian, Upper Buntsandstein) crop out with numerous well-preserved remains of crustaceans and insects, and invertebrate and vertebrate tracks. Miospores from the fossiliferous level are abundant and typical of the *Voltziacaesporites heteromorpha* zone (Żyła et al. 2013). Macrofossil plant remains were also found there but they are not very well-preserved; some remains were recognised as horsetail stems (Kuleta et al. 2006, Żyła et al. 2013) and others were indeterminable. In the collection from this locality held in the W. Szafer Institute of Botany, Polish Academy of Sciences, none of the plant remains could be determined even approximately (pers. observ.). This fossil assemblage is similar in age to the famous Grés à Voltzia.

UPPER TRIASSIC (MIDDLE AND UPPER KEUPER)

The Upper Triassic stratigraphy of Poland is confused, as it uses local stratigraphic divisions poorly correlated with the Germanic Basin stratigraphy accepted in Europe (Znosko 1955, Szyperko-Śliwczyńska 1960, Dadlez & Kopik 1963, Senkowiczowa 1966, 1970, Marcinkiewicz 1969, 1971, 1978, Grodzicka-Szymanko 1971, Grodzicka-Szymanko & Orłowska-Zwolińska 1972, Kotlicki 1974, Gajewska 1978, Czapowski & Romanek 1986, Pieńkowski 1988, Marek & Pajchlowa 1997). The first descriptions of Upper Triassic strata in Poland, given by Romer (1862, 1863, 1867, 1870), were based on the German geological tradition and correspond to the rest of the Germanic Basin. Unfortunately, Samsonowicz (1924, 1929) then proposed a local stratigraphical division for the Polish Upper Triassic, a division somewhat similar to that used in France. Polish geologists used stratigraphical nomenclature typical of the German part of the Germanic Basin but differing in meaning from that used in Germany: for example, Rhaetian sensu polonico (Znosko 1955, Mader 1997, Marek & Pajchlowa 1997, Kozur & Bachmann 2008, Franz 2009). This is the source of so much confusion in the geological literature, especially that created by foreign authors unfamiliar with the Polish local tradition. It is clear that the Polish Triassic sedimentary basin is part of the Germanic Basin (Mader 1997, Franz 2009), but because it is a marginal part of this basin, and because of local variability in the facies typical of the Germanic Basin, the stratigraphical correlations are difficult (Racki 2010). This is the Polish share in the global problems of Triassic stratigraphy as discussed above (Szulc et al. 2006, Szulc & Becker 2007).

The Upper Triassic macro- and microflora from Poland are well known but many descriptions are outdated (Goeppert 1836, 1841–1846, 1844, 1845, 1846a, b, Raciborski 1890a, b, c, Orłowska-Zwolińska & Senkowiczowa 1970, Reymanówna 1986) and new discoveries have yet to be described (Dzik & Sulej 2007, Dzik et al. 2008a, b, Niedźwiedzki & Sulej 2008, Ociepa et al. 2008, Wawrzyniak & Ziaja 2009, 2010, Wawrzyniak 2010a, b). A comparison of the available data with floras described thus far from Germany (Linck 1950, Kräusel 1952, Mägdefrau 1953, 1956, 1963, Kelber & Hansch 1996, Axsmith & Taylor 1997, Kelber & van Konijnenburg-van Cittert 1997, Kelber 1998, 2005, Arndt 2002, Kelber & Nitsch 2005) can yield useful stratigraphical conclusions. I propose such a correlation, for the first time in the Polish palaeontological literature, in Table 2. Many data on Polish Upper Triassic palynology have been gathered (Pautsch 1958, 1971, 1973, Orłowska-Zwolińska 1967, 1971, 1976, 1983, 1984, 1985, 1986, 1988, Marcinkiewicz 1969, 1971, 1978, 1981, 1992b, Fuglewicz 1980a, Fuglewicz & Śnieżek 1980, Marcinkiewicz & Orłowska-Zwolińska 1985, 1994, Fuglewicz & Marcinkiewicz 1986, Fijałkowska 1989, 1992b, Pieńkowski et al. 2012). Well-grounded biostratigraphical schemes have been proposed (Marcinkiewicz 1971, 1978, Orłowska-Zwolińska 1983, 1985, Fijałkowska-Mader 1999). The Triassic-Jurassic boundary has been identified based on palynological data (Orłowska-Zwolińska 1967, Marcinkiewicz 1969, 1971, Pieńkowski et al. 2012, Pacyna 2013).

The Carnian flora – *Voltzia* floral assemblage zone

One of the most significant discoveries in Polish palaeontology was the Krasiejów locality, found in the 1990s (Dzik et al. 2000, Dzik 2001, 2003a, b, Sulej 2003, 2004). This is the most important Triassic Polish vertebrate locality, of international repute (Sues & Fraser 2010, Jagt-Yazykova et al. 2012). For our understanding of the evolution of Triassic ecosystems the Krasiejów locality is among the world's key sites, as seen in publications about its fauna (Dzik 2001, 2003a, b, 2008, Sulej 2002, 2005, 2007, 2010, Dzik & Sulej 2004, 2007, Lucas et al. 2007a, Fostowicz-Frelik & Sulej 2010, Mazurek & Słowiak 2009, Olempska 2004, 2011, Piechowski & Dzik 2010, Skawina & Dzik 2011). Taxonomically, the fossil assemblage of this locality is the richest in the Polish Triassic and one of the richest in the European Triassic (Sulej 2003, 2004, Dzik & Sulej 2004, 2007, Lucas et al. 2007a, Sues & Fraser 2010). The precise age, stratigraphy and taphonomy of this locality are the subject of debate but plausible solutions to these issues have been offered (Kotlicki & Kubicz 1974, Bilan 1975, Kłapciński 1993, Dzik et al. 2000, Dzik 2001, Szulc 2005, Szulc & Becker 2007, Gruszka & Zieliński 2008, Bodzioch & Kowal-Linka 2012). Its rich invertebrate fauna consists of conchostracans (Olempska 2004, 2011, Kozur & Weems 2010), bivalves (Skawina 2010, 2013, Skawina & Dzik 2011), crustaceans and insects (Dzik & Sulej 2007, Dzik 2008). The site's superbly preserved vertebrates include fish (Dzik & Sulej 2007), temnospondyls (Sulej 2002, 2007, Sulej & Majer 2005, Barycka 2007, Konietzko-Meier & Wawro 2007, Konietzko-Meier & Klein 2013, Konietzko-Meier & Sander 2013, Konietzko-Meier et al. 2013), a phytosaur (Butler et al. 2014), a rauisuchian (Sulej 2005, Brusatte et al. 2009), an aetosaur (Sulej 2010, Desojo et al. 2013) and a dinosauromorph (Dzik 2003a, Dzik & Sulej 2004, Mazurek & Słowiak 2009, Fostowicz-Frelik & Sulej 2010, Piechowski & Dzik 2010).

Numerous charophyte oogonia have been described (Zatoń & Piechota 2003, Zatoń et al. 2005) but unfortunately this locality contains no palynological record. This prevents the use of palynological biostratigraphy here. The macroflora of this site has not yet been described in detail. Preliminary information has been given (Dzik 2003b, Dzik & Sulej 2004, 2007) and a detailed report is in preparation (Pacyna & Zdebska in prep.). The macroflora assemblage from Krasiejów consists predominantly of conifers (*Pseudohirmerella* sp., *Glyptolepis keuperiana*, *Voltzia* spp., *Pachylepis quinquies*, *Desmiophyllum* spp., new taxa), and rare ferns (*Sphenopteris schoenleiniana*) and bennettitaleans (*Pterophyllum* sp.). This taxonomically poor flora is not well-preserved (cuticular details not recognisable). Xeromorphic features of the plants indicate rather dry climatic conditions. The most taxonomically similar flora was described by Mägdefrau (1953, 1956, 1963) from the Coburger Sandstein (=*Semionotus* Sandstein) at Haßfurt am Main. It could be useful in determining the age of the Krasiejów fossil assemblage. The Coburger Sandstein corresponds to the Kieselsandstein and Blasensandstein (Mader 1990), now referred to as the Hassberge Formation (Kozur & Weems 2010), whose age is estimated as Late Carnian (Middle Tuvalian). Thus, Late Carnian age is proposed here for the Krasiejów fossil assemblage. A full description of the Krasiejów macroflora will improve our knowledge of the Triassic floras of Poland and the palaeoenvironment of the animals at this site.

The fossil assemblage from the Woźniki claypit may be similar in age to the Krasiejów assemblage. Norian Woźniki Limestone has been identified without doubt above the fossiliferous level (Sulej et al. 2011a). Besides invertebrate and vertebrate remains, characean gyrogonites and conifer shoots similar to those discovered in Krasiejów have also been found (Sulej et al. 2011a, T. Sulej pers. comm. 2011).

The Norian flora – *Brachyphyllum* floral assemblage zone

There are some Upper Triassic localities in Silesia with taxonomically very poor floras whose most characteristic feature is the occurrence of *Brachyphyllum*-like shoots. These floras are distinguished here as Norian (=Lower Rhaetian sensu polonico) in age, based on palynological and geological data (Szulc et al. 2006, Szulc & Becker 2007). Floras of the Norian stage are seldom preserved and are extremely rare all over the world. The taxonomic composition of the younger (Rhaetian) and older (Carnian) floras indicate that rapid evolutionary changes took place just then, especially within the conifers. Modern conifer families probably originated during this time.

The first such flora was identified by Roemer (1870) in crenogenic limestones in the northern part of Upper Silesia (Ligota, Myszków, Poręba), called the Woźniki Limestone. Rich collections of fossil plants have since been assembled from it (Różycki 1930, Reymanówna 1986) but unfortunately not described. The plants are preserved as voids or casts in the limestone (Szulc et al. 2006, Szulc & Becker 2007). Besides the most numerous *Brachyphyllum* shoots along with seed scales and male cones probably belonging to the same plant, rare fern and bennetitalean leaves and sphenopsid shoots have been found in this flora (Tab. 3). During his examination of the Roemer collection, Raciborski found some liverwort remains which he described as the new species *Palaeohepatica roemeri* (Raciborski 1892, 1893, Wcisło-Luraniec 1984) but this species was never illustrated and requires revision.

Patoka is an Upper Silesian locality newly discovered by T. Sulej and G. Niedźwiedzki, with a rather homogeneous but very interesting flora of the same type as in the Woźniki Limestone (Barbacka et al. 2012). The assemblage from Patoka is also dominated by branches of *Brachyphyllum*, but unlike the Woźniki Limestone the flora from Patoka is very well-preserved, with anatomical details. Besides *Brachyphyllum* branches and leaves, *Pachylepis* seed scales whose cuticle matches some of the *Brachyphyllum* leaves were found. There is also another new type of ovulate scale with two oval lobes – probably the place of ovule attachment – and one reduced lobe between them, in one plane. The scales also show cuticular structure similar to the mass of *Brachyphyllum* leaves in the same rock slabs. Together with the branches and scales was one ovule whose shape and size suggest that it might be associated with the scales. The ovule is oval and has an exposed micropylar beak. Pollen grains were found inside the ovule. The same type of pollen grain has been found in well-preserved male cones. The *Brachyphyllum*-type conifers are accompanied by fragments of cf. *Czekanowskia* leaves, isolated seeds of unknown affiliation, and gymnosperm wood. Adaptations to dry climate are obvious in the cuticle structure of all the plants from the Patoka locality (compare Preto et al. 2010).

Yet another locality, Poręba, was recently discovered; it may represent the same floral assemblage (Sulej et al. 2012). A very interesting assemblage of turtles, aetosaurs, and coelophysoid dinosaurs was found at this locality. In the flora, *Brachyphyllum* shoots and conifer trunks, ginkgoalean (?) leaves and sporomorphs were identified (Sulej et al. 2012). The Marciszów-Zawiercie locality could also be Norian in age; besides, the remains of freshwater bivalves, vertebrate (dicynodontid) bones, and tracks assignable to archosaurs and dicynodonts, only palynomorphs and equisetalean remains are known to derive from that site (Szulc et al. 2006, Budziszewska-Karwowska et al. 2010, Racki 2010, Skawina & Dzik 2011, Sadlok & Wawrzyniak 2013). Also Norian in age are rocks exposed in a claypit in Wyszyna Machorowska near Radoszyce in the northwestern part of the Holy Cross Mountains. At that site, apart from a vertebrate burrow system some plant remains were recognised (Tałanda et al. 2011).

The Rhaetian flora – *Lepidopteris ottonis* floral assemblage zone

It was from the Upper Silesian Kluczbork area (Biadacz, Dobiercice, Gosław, Maciejów) that Goeppert (1836, 1841–1846, 1844, 1845, 1846a) described the first Polish Triassic macroflora. It was also the first Rhaetian flora described in Europe. Then Schenk (1867) and Roemer (1867, 1870) published new data for this flora, based mostly on new specimens. Plant remains were preserved in sideritic nodules along with fish (Michael 1893, 1894, 1895a, Gallinek 1894). Goeppert's papers (1836, 1846a) described for the first time the seed fern *Lepidopteris ottonis* (the index species for the Rhaetic stage) and *Neocalamites lehmannianus*, a sphenopsid species typical of almost all European Upper Triassic and Lower Jurassic floras. This flora is not very diversified; besides the taxa listed earlier, fern and bennettitalean or cycad leaves have been described (Tab. 3). The flora requires reworking in the context of current taxonomy, nomenclature rules, and standards of description. As is already clear from Schenk's (1867) revision, some species described by Goeppert are junior synonyms of previously described species, some new species were described from small, badly preserved remains, and species in some genera are oversplit (e.g. *Pterophyllum*). Needed is a comparison of the revised taxa from this flora with taxa from the new Silesian Rhaetian floral localities. Gothan (1909a) and Barbacka (Barbacka 1980, 1991, Reymanówna & Barbacka 1981) revised the *Lepidopteris ottonis* specimens from the Goeppert and Roemer collections and described some new material. In the old collection, Barbacka (1991) recognised a *Peltaspermum rotula* cupulate disc and several isolated seeds that belong to *Lepidopteris ottonis*.

The Lipie Śląskie-Lisowice locality was discovered at the beginning of the 21st century in an active claypit (Dzik et al. 2008a, b, Niedźwiedzki & Sulej 2008). Remains of theropods and dicynodonts were found together there, an interesting finding from biogeographical and evolutionary points of view (Dzik et al. 2008a, b, Niedźwiedzki & Sulej 2008, Niedźwiedzki et al. 2011, 2012). Fossils of other archosaurs, temnospondyls, fish, a mammal-like tooth, conchostracans and bivalves, and invertebrate and vertebrate tracks were also identified (Dzik et al. 2008a, b, Gorzelak et al. 2010, Świło 2010, Skawina & Dzik 2011, Świło et al. 2014). Plant remains from the Lipie Śląskie-Lisowice claypit were first noted in the early 1980s (Fuglewicz & Śnieżek 1980, Marcinkiewicz 1981) but only megaspores were preliminarily described. Current research on this locality has yielded many different well-preserved plant macroremains (Dzik et al. 2008a, b). Staneczko's finding of cf. *Lepidopteris ottonis* isolated cuticles (Staneczko 2007, Ociepa et al. 2008) and also palynological data (Dzik et al. 2008a, b) confirm the Rhaetian age of this fossil assemblage. Cycad leaves and cones, ginkgoalean leaves, conifer wood, twigs, seed scales, male cones, and seeds have also been preliminarily described (Dzik et al. 2008a, b, Marynowski & Simoneit 2009, Wawrzyniak & Ziaja 2009, 2010, Wawrzyniak 2010a, b, c, d, e, 2011, Jarzynka & Wawrzyniak 2012). The macroflora from Lipie Śląskie-Lisowice is surprisingly advanced, with many taxa, mainly of cycads and conifers similar to younger Jurassic taxa (Harris 1932, 1935, 1937), but there are also some taxa, especially of conifers, with obvious evolutionary roots in older Triassic Silesian floras, especially at Krasiejów and Patoka. These facts and the richness of the well-preserved taxa place this flora among the most interesting Rhaetian floras of Europe (compare Harris 1926, Kelber & Hansch 1996, Kelber & van Konijnenburg-van Cittert 1997, Kelber 1998).

In the Tatra Mountains the Upper Triassic strata are developed in Keuper facies typical of the Germanic Basin. In Czerwone Żlebki (West Tatras, Czerwone Wierchy Massif), Raciborski (1890a, b, c) discovered and then described an interesting Rhaetian flora. The plant remains are not well-preserved and the cuticular details are not suitable for preparation. The occurrence of the endemic horsetail species *Equisetum chalubinskii* is this flora's most characteristic feature. Other horsetails, ferns and conifers are rare in this flora (Tab. 1). Later researchers (Reymanówna 1984, 1986, Michalík et al. 1976, 1988) attempted to find new plant remains at this locality but without success. In the M. Reymanówna collection (W. Szafer Institute of Botany, Polish Academy of Sciences) from Czerwone Żlebki there are no determinable plant remains. Nor has the flora of Czerwone Żlebki been revised since its original description. Geologists and palaeobotanists have long awaited a modern revision of this flora (Reymanówna 1984, Niedźwiedzki 2011, Lintnerová et al. 2013). Such a revision would improve our grasp of Tatra Upper Triassic palaeoecology, a key element of the complex geological history of the Tatra Mountains and the palaeogeographic connections between the Germanic Basin and the Alpine Tethys Ocean. Those relationships can be determined from the similarities or differences in the taxonomic composition of the flora. Important dinosaur ichnotaxa were discovered at this site and described recently (Niedźwiedzki 2005, 2008, 2011, Niedźwiedzki & Sulej 2007). That discovery gives a further reason for studying the flora of that place.

Some other plant macroremains have been found in the Upper Triassic strata of other Tatra localities but as a rule they are badly preserved (Raciborski 1892, Limanowski 1901, Uchman pers. comm. 2012) and have never been properly described or illustrated.

There are other plant fossil localities originally proposed as Rhaetian in age but these claims remain unconfirmed. Roemer (1866) identified a *Lepidopteris ottonis* specimen in Mierzęcina (Miedzieczo in Roemer's paper) near Kielce but as Barbacka (Reymanówna & Barbacka 1981, Barbacka 1991) showed this specimen belongs to an unidentified fern. Lilpop (in Raciborski 1927) noted the discovery of a new Keuper or Rhaetian flora in iron ore mines in Biała Góra near Bliżyn (Holy Cross Mountains). This flora, however, was never illustrated or even preliminarily described. The above mentioned plant remains probably derive from Lower Jurassic strata widely outcropping in this area (Pieńkowski 2004, Pacyna 2013), but not from Keuper or Rhaetian strata, as Roemer (1866) and Lilpop (Lilpop in Raciborski 1927) originally proposed.

A macrofloristic zonation of the strata of the Triassic-Jurassic boundary in Europe was proposed by Nathorst (1910) and developed by Harris (1931, 1937). As currently understood, the occurrence of *Lepidopteris ottonis* marks the Rhaetian stage in nonmarine strata of the European Triassic. The known stratigraphic range of *Lepidopteris ottonis* coincides with the *Riccisporites tuberculatus* palynological zone. It is standard practice in Polish geology and palaeontology to refer the source strata to the Rhaetian when *Lepidopteris ottonis* remains are found in drill cores (Piwocki 1970, Barbacka 1980, 1991, Reymanówna & Barbacka 1981, Staneczko 2007, Ociepa et al. 2008). During palynological examination of strata from the *Corollina meyerana* zone (Norian), Marcinkiewicz and Orłowska-Zwolińska (1985, 1994) noted cuticle fragments which they determined to be cf. *Lepidopteris ottonis*. On this basis they suggested that the range of the *Lepidopteris ottonis* zone might overlap the *Corollina meyerana* and *Riccisporites tuberculatus* palynological zones, thus the Norian and Rhaetian. They had only small cuticle fragments, however; Norian macroremains of *Lepidopteris ottonis* have not thus far been discovered anywhere. The genus *Lepidopteris* Schimper 1869 is known in the Germanic Basin from the beginning of the Upper Triassic (Schimper 1869, Gothan 1909a, b, c, Antevs 1914). *Lepidopteris stuttgardiensis* (Jäger 1827) Schimper 1869 and *Lepidopteris brevipinnata* Mägdefrau 1953 have been described from the Schilfsandstein strata – Lower-Middle Carnian (Jäger 1827, Schimper 1869, Gothan 1909b, Mägdefrau 1953). The cuticle structure of these species is not known. *Lepidopteris ottonis* is known from Rhaetian strata but no species of *Lepidopteris* has been described from the Norian. Because the cuticular differences among *Lepidopteris* species from the Upper Triassic of Europe cannot be compared at present, the question of extending the *Lepidopteris ottonis* zone to the Norian on the basis of isolated cuticle fragments cannot be settled. The Norian specimens of *Lepidopteris* may belong to a species undescribed as yet. The inter- and intraspecific variation of the cuticle in *Lepidopteris* is very poorly known. Some authors have suggested that *Lepidopteris stuttgariensis* and *L. ottonis* belong to the same species (Kelber & van Konijnenburg-van Cittert 1997, Kiritchkova 2006, 2008) but this has not been shown with certainty. The type specimen of *Lepidopteris ottonis*, described by Goeppert (1836) from Wieluń, has not been found in Polish collections (Barbacka 1980, 1991, Reymanówna & Barbacka 1981) and its whereabouts are not known, so the typification proposed by Kiritchkova (2006, 2008) is unwarranted.

COMMENTS TO TABLES

Poland was partitioned by foreign powers three times in the second half of the 18^{th} century, ultimately ending Poland's existence as an independent country for more than a century. Poland was split between Prussia, the Austro-Hungarian Empire and Russia. Mostly German-speaking scientists were working in Silesia during that time, and the official place names were in German. Below is a list of those localities in Silesia; their current names are paired with their pre-1945 German names. It was not possible to establish the current Polish names of some localities, especially when the papers used vernacular German names of localities in the Russian partition (e.g. in Goeppert 1846a). Table 1 includes comments on the nomenclatural status of taxa and the status of specimens described from Poland. Synonyms are also given. The original published names of boreholes, horizons and age determinations are given in Table 1; Table 2 correlates the strata. References for the main localities are listed in Table 4.

Explanation of symbols and abbreviations in Table 1

* – papers containing an illustration of a given taxon
^ – papers in which a given taxon was described as new to science based on specimens from Polish territory

MAIN LOCALITIES OF TRIASSIC GEOLOGICAL OUTCROPS WITH FOSSIL PLANTS PRESERVED IN UPPER SILESIA BEFORE 1945 (LOCALITY NAMES AFTER ROSPOND 1951)

Polish – German

Biadacz – Ludwigsdorf
Bogdańczowice – Wüttendorf
Byczyna – Pitschen
Dobiercice – Wilmsdorf
Gorzów Śląski – Landsberg
Gosław – Goslau
Helenowo – Hellewald
Kluczbork – Kreuzburg, Kreu(t)zburg
Krapkowice – Krappitz
Kujanowice – Ober Kunzendorf
Ligota – Ellguth
Lubliniec – Lublinitz
Maciejów – Matzdorf
Nowa Wieś Oleska – Neudorf
Panoszów (=Ponoszów) – Ponoschau (=Ponnoschau, Hegersfelde)
Patoka – Klinkerwerk (=Patoka, Kreis Lublinitz)
Sternalice – Sternalitz (=Ammern)
Szubin – Schubin
Tarnowskie Góry – Tarnowitz
Woźniki – Woischnik
Zakrzów – Sacrau
Zborowskie – Zborowsky

German – Polish

Ellguth – Ligota
Goslau – Gosław
Hellewald – Helenowo
Landsberg – Gorzów Śląski
Lublinitz – Lubliniec
Ludwigsdorf – Biadacz
Klinkerwerk (=Patoka, Kreis Lublinitz) – Patoka
Krappitz – Krapkowice
Kreuzburg, Kreu(t)zburg – Kluczbork
Matzdorf – Maciejów
Neudorf – Nowa Wieś Oleska
Ober Kunzendorf – Kujanowice
Pitschen – Byczyna
Ponoschau (=Ponnoschau, Hegersfelde) – Panoszów, Ponoszów
Sacrau – Zakrzów
Schubin – Szubin
Sternalitz (=Ammern) – Sternalice
Tarnowitz – Tarnowskie Góry
Wilmsdorf – Dobiercice
Woischnik – Woźniki
Wüttendorf – Bogdańczowice
Zborowsky – Zborowskie

Table 1. Triassic plant macroremains described so far from Poland

Taxon as originally described, selected nomenclatural synonyms	Botanical affinity, taxon validity, taxonomical synonyms	Location	Horizon, age	References, comments
Alethopteris insignis (Lindley & Hutton 1833–1835) Goeppert 1836 (=*Pecopteris insignis* Lindley & Hutton 1833–1835, basonim)	Pterophytina, according to Harris (1961) *Pecopteris insignis* is synonym of *Cladophlebis denticulata* (Brongniart 1834) Schimper 1874; Goeppert's (1846a) specimen is small and hardly determinable	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1846a*, Schenk 1867, Roemer 1867
Araucarioxylon Kraus 1870 ***Araucarioxylon*** sp.	Coniferales	Poręba near Zawiercie (Upper Silesia)	Upper Triassic – Lower Jurassic, Rhaetico – Liassic	Brzyski & Heflik 1994*

Table 1. Continued

Taxon as originally described, selected nomenclatural synonyms	Botanical affinity, taxon validity, taxonomical synonyms	Location	Horizon, age	References, comments
Brachyphyllum Brongniart 1828 ***Brachyphyllum*** sp.	Coniferales	Patoka (Upper Silesia)	Jarkowo/Zbąszynek Beds; Upper Triassic, Norian	Barbacka et al. 2012
		Lipie Śląskie-Lisowice (Upper Silesia)	Wielichowo Beds; Upper Triassic, Rhaetian	Dzik et al. 2008a, b (as *Hirmeriella* twigs), Wawrzyniak & Ziaja 2010, Jarzynka & Wawrzyniak 2012
Calamites Brongniart 1828 ***Calamites*** sp.	Equisetales	Ratajów (north part of Holy Cross Mts.)	Upper Buntsandstein, Röt; Lower Triassic	Samsonowicz 1929 (record without description or illustration)
Cladophlebis roesserti (Presl in Sternberg 1838) Saporta 1872 (=*Asplenites roessertii* (Presl in Sternberg 1838) Schenk 1867)	Pterophytina, valid species	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Roemer 1867, 1870, Schenk 1867
		Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Reymanówna 1986
Cladophlebis roesserti forma ***parvifolia*** Raciborski 1890	Pterophytina, specimens need revision	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*^, b, c
Calamites lehmannianus Goeppert 1846a (=*Neocalamites hoerensis* (Schimper 1869) Halle 1908 *sensu* Halle 1908) (=*Schizoneura hoerensis* (Hisinger 1840) Schimper 1869)	Equisetales, valid taxon, valid name – ***Neocalamites lehmannianus*** (Goeppert 1846a) Weber 1968	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1845, 1846a^*, Schenk 1867, Roemer 1867 (as *Equisetites arenaceus* (?)), 1870*, (older synonym of *Neocalamites hoerensis* (Schimper 1869) Halle 1908 *sensu* Halle 1908 according to Weber 1968)
Camptopteris jurassica Goeppert 1846a (=*Aspidium jurassicum* (Goeppert 1846a) Ettingshausen 1865)	Pterophytina, Dipteridaceae, synonym of ***Clathropteris meniscoides*** (Brongniart 1824) Brongiart 1828	Maciejów (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1846a^, 1841–1846*, Roemer 1867, Schenk 1867 (most probably synonymous with *Clathropteris platyphylla* = *C. meniscoides*)
Carpolithes cardiocarpoides Goeppert 1846a	Gymnosperm seed	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1846a^*
Clathropteris muensteriana (Presl in Sternberg 1838) Schenk 1867 (=*Camptopteris münsteriana* Presl in Sternberg 1838)	Pterophytina, Dipteridaceae, synonym of ***Clathropteris meniscoides*** (Brongniart 1824) Brongiart 1828	Dobiercice, Maciejów (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Schenk 1867, Orłowska-Zwolińska & Senkowiczowa (1970) erroneously listed *Clathropteris münsteri* (sic) based on Lilpop & Kostyniuk (1957); using this species name they ascribed it to Goeppert (1845, 1846a), which is incorrect
		Ligota near Woźniki (Upper Silesia)	Woźniki Limestone; Upper Triassic, Norian	Roemer 1870* (as *Clathropteris Münsteriana*)
Clathropteris platyphylla Goeppert 1846	Pterophytina, Dipteridaceae, synonym of ***Clathropteris meniscoides*** (Brongniart 1824) Brongiart 1828 (Harris 1931)	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Harris 1931, Reymanówna 1986

Table 1. Continued

Taxon as originally described, selected nomenclatural synonyms	Botanical affinity, taxon validity, taxonomical synonyms	Location	Horizon, age	References, comments
Coniopteris lobata (Oldham & Morris 1863) Halle 1913 (=*Pecopteris lobata* Oldham & Morris 1863)	Pterophytina, probably valid species referable to genus *Coniopteris* (Harris 1961)	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c (as *Pecopteris lobata*), Reymanówna 1986
Czekanowskia Heer 1876 cf. ***Czekanowskia*** sp.	Czekanowskiales	Patoka (Upper Silesia)	Jarkowo/ Zbąszynek Beds; Upper Triassic, Norian	Barbacka et al. 2012
Desmiophyllum Lesquereux 1878 ***Desmiophyllum*** sp.	Coniferales	Krasiejów (Opole Silesia)	Drawno Beds?; Upper Triassic, Upper Carnian	Dzik & Sulej 2007*
Dicranopteris roemeriana Schenk 1867	Pterophytina, species needs revision	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Schenk 1867^* (as *Dicranopteris Römeri* in text, as *Dicranopteris Römeriana* in plate caption), Roemer 1870 (as *Dicranopteris Roemeriana*)
Dictyophyllum aff. ***dunkeri*** Nathorst 1878	Pterophytina	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Reymanówna 1986 (poorly preserved small leaf fragment)
Equisetites arenaceus (Jaeger 1827) Schenk 1864	Equisetales, valid taxon	Majków area (north part of Holy Cross Mts.)	Lower Keuper, Lettenkohle; Middle Triassic, Ladinian	Samsonowicz 1929 (as *Calamites arenaceus*, record without description or illustration)
Equisetum chałubińskii Raciborski 1890	Equisetales, valid taxon, proper taxon orthography ***Equisetum chalubinskii*** Raciborski 1890	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a^*, b, c, Reymanówna 1986. Species very similar to *Equisetites muensteri* Sternberg 1833; should properly be referred to genus *Equisetites*
Equisetum an ***bunburyanum***? Zigno 1856	Equisetales, specimens need revision	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Reymanówna 1986
Equisetites Sternberg 1833 ***Equisetites*** sp./ ***Equisetum*** sp.	Equisetales, specimens never illustrated or revised	Western Holy Cross Mts.	Lower Buntsandstein; Lower Triassic	Czarnocki 1925 (only record, without description or illustration)
		Western Holy Cross Mts.	Lower Keuper, Lettenkohle; Middle Triassic, Ladinian	Czarnocki 1925 (only record, without description or illustration)
		Nowa Wieś (Upper Silesia)	Woźniki Limestone; Upper Triassic, Norian	Różycki 1930, Znosko 1955 (only record, without description or illustration)
		Kołaczkowice near Rawicz (Lower Silesia)	Wielichowo Beds; Upper Triassic, Rhaetian	Piwocki 1970 (only record, without description or illustration)
Ginkgoites acosmia Harris 1935	Ginkgoales, valid taxon	Gradzanowo 3 borehole (Central Poland)	Upper Triassic, Rhaetian	Barbacka & Wcisło-Luraniec 2002*, 2003*
Glossopteridium czarnockii Bocheński 1957	*Incertae sedis*, originally stated as Glossopteridales, specimen probably lost	Radoszyce 3 borehole (Holy Cross Mts.)	Middle Buntsandstein; Lower Triassic	Bocheński 1957^* (original proposed species name *Glossopteridium J. Czarnockii*)
Knorripteris mariana (Michael 1895) Potonié 1897 (=*Knorria mariana* Michael 1895)	Pterophytina – fern stem, older synonym of *Adelophyton jutieri* Renault 1900 according to Hörich (1910)	Krapkowice (Upper Silesia)	Lower Muschelkalk, Chorzów beds; Middle Triassic	Michael 1895b^*, Potonié 1897*, Hörich 1910* (description of specimen anatomy; Hörich questioned age determination of specimen by Michael)

Table 1. Continued

Taxon as originally described, selected nomenclatural synonyms	Botanical affinity, taxon validity, taxonomical synonyms	Location	Horizon, age	References, comments
Lepidopteris ottonis (Goeppert 1836) Schimper 1869 (=*Alethopteris ottonis* Goeppert 1836, basonim) (=*Pecopteris ottonis* (Goeppert 1836) Goeppert 1846a) (=*Aspidites ottonis* Schenk in Roemer 1867) (=*Asplenites ottonis* (Goeppert 1836) Schenk 1867)	Pteridospermopsida, Peltaspermales, valid taxon	Biadacz, Dobiercice, Gosław, Maciejów (Upper Silesia)	Wilmsdorfer Schichten/ Gorzów Beds; Upper, Triassic, Rhaetian	Goeppert 1846a*, Schenk 1867, Roemer 1867, 1870*, Gothan 1909a*, Harris 1932, Marcinkiewicz 1969, Reymanówna & Barbacka 1981*, Barbacka 1991*
		Wieluń (Upper Silesia)	Upper Triassic, Rhaetian	Goeppert 1836^*
		Kołaczkowice borehole near Rawicz (Lower Silesia)	Wielichowo Beds; Upper Triassic, Rhaetian	Piwocki 1970*
		Gostyń 46 G borehole (Central Poland)	Zbąszynek/Jarkowo Beds; Upper Triassic, Rhaetian *sensu polonico*, Norian?	Marcinkiewicz & Orłowska-Zwolińska 1985, 1994 (only isolated cuticules determined as cf. *Lepidopteris ottonis*)
		Gradzanowo 1 borehole (Central Poland)	Wielichowo Beds; Upper Triassic, Rhaetian	Barbacka 1980, Barbacka 1991*
		Gradzanowo 3 borehole (Central Poland)	Wielichowo Beds; Upper Triassic, Rhaetian	Marcinkiewicz & Orłowska-Zwolińska 1994 (only isolated cuticules determined as cf. *Lepidopteris ottonis*)
		Chabowo 2 borehole (Western Pomerania)	Upper Triassic, Rhaetian	Ociepa et al. 2008
		Lipie Śląskie-Lisowice, (Upper Silesia)	Upper Triassic, Rhaetian	Staneczko 2007*, Wawrzyniak & Ziaja 2009 (only isolated cuticules), Wawrzyniak 2010b
Neocalamites Halle 1908 ***Neocalamites*** sp.	Equisetales	Gacki 1 borehole (Holy Cross Mts.)	Lower Keuper, Lettenkohle; Middle Triassic, Ladinian	Pawłowska 1979*
		Studzianna borehole (Holy Cross Mts.)	Lower Keuper, Lettenkohle; Middle Triassic, Ladinian	Barbacka et al. 2009, Barbacka et al. in prep. (as *Neocalamites merianii* (Brongniart 1828) Halle 1908)
Neuropteris sp. conf. ***N. remota*** Presl in Sternberg 1838	Pterophytina, valid name *Cladophlebis remota* (Presl in Sternberg 1838) Zeiller 1911	Ligota near Woźniki (Upper Silesia)	Woźniki Limestone; Upper Triassic, Norian	Roemer 1870*
Pachylepis quinquies (Linck 1951) Kräusel 1952 (=*Voltzia*? *quinquies* Linck 1951)	Coniferales, valid species	Krasiejów (Opole Silesia)	Drawno Beds?; Upper Triassic, Upper Carnian	Dzik & Sulej 2007*
Pachylepis Kräusel 1952 ***Pachylepis*** sp.	Coniferales	Patoka (Upper Silesia)	Jarkowo/Zbąszynek Beds; Upper Triassic, Norian	Barbacka et al. 2012
Pagiophyllum sp.	Coniferales	Lipie Śląskie-Lisowice (Upper Silesia)	Wielichowo Beds; Upper Triassic, Rhaetian	Wawrzyniak & Ziaja 2010
Palaeohepatica roemeri Raciborski 1892 (=*Hepaticites roemeri* (Raciborski 1892) Oostendorp 1987	Hepaticopsida, species never illustrated or revised. Type specimen found by M. Reymanówna in Wrocław Uniwersity collection (Wcisło-Luraniec 1984).	Ligota near Woźniki (Upper Silesia)	Woźniki Limestone; Upper Triassic, Norian	Raciborski 1892, 1893 (original Roemer label identification – *Thaumatopteris Münsteri ß. longissima*), Wcisło-Luraniec 1984, Oostendorp 1987 (she referred

Table 1. Continued

Taxon as originally described, selected nomenclatural synonyms	Botanical affinity, taxon validity, taxonomical synonyms	Location	Horizon, age	References, comments
	Harris (1942) referred type species of genus *Paleohepatica* Raciborski 1889 – *P. rostafinskii* Raciborski 1889 to genus *Thallites* Walton 1925 as *Thallites rostafinskii* (Raciborski 1889) Harris 1942			species *Palaeohepatica roemeri* to genus *Hepaticites* and provided its diagnosis in English based on Raciborski's description in Polish (1892)
Palissya braunii Endlicher 1847	Coniferales, valid species	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Reymanówna 1986
Pecopteris (Brongniart 1822) Sternberg 1825 ***Pecopteris*** sp.?	Pterophytina or Pteridospermopsida, genus erroneously identified	Gacki 4 borehole (South-eastern Holy Cross Mts.)	Muschelkalk, transitional beds; Middle Triassic, Ladinian	Pawłowska 1979*
Peltaspermum rotula Harris 1932	Pteridospermopsida, Peltaspermales, valid taxon	Dobiercice (Upper Silesia)	Gorzów Beds; Upper Triassic, Rhaetian	Barbacka 1991* (cupulate disc and isolated seeds)
Pinites jurassicus Goeppert 1846a (=*Peuce jurassica* (Goeppert 1846a) Endlicher 1847)	Coniferales, probably valid species, specimens need revision, according to Seward (1919) could be referable to genus *Cedroxylon*	Kamienica Polska (in original paper misspelt as Kaminika Polska) (north part of Upper Silesia)	Upper Triassic (Rhaetian) or (Middle? – Oolite) Jurassic	Goeppert 1846a*^, Mercklin 1852, 1855, Schenk 1867, Schimper 1870–1872, Seward 1919, Jongmans & Dijkstra 1973
Pinites pertinax Goeppert 1846a (=*Peuce pertinax* (Goeppert 1846a) Endlicher 1847) (=*Cedroxylon pertinax* (Goeppert 1846a) Kraus in Schimper 1870–1872)	Coniferales, probably valid species, specimen needs revision	Sumpen, Gorzów Śląski (?) (north part of Upper Silesia)	Upper Triassic (Rhaetian) or (Middle?) Jurassic	Goeppert 1846a^*, Endlicher 1847, Mercklin 1855, Schenk 1867, Schimper 1870–1872, Seward 1919, Jongmans & Dijkstra 1973
Pinites Lindley & Hutton 1831 ***Pinites*** sp.	Coniferales	Lofkowitz, Sumpen (?) (Upper Silesia)	Keuper; Upper Triassic	Roemer 1867, 1870
Pleuromeia cf. ***sternbergi*** (Münster 1839) Corda 1852	Isoetales, specimens never illustrated or revised	North-west part of Holy Cross Mts.	Upper Middle Buntsandstein; Lower Triassic	Czarnocki 1931 (only record without description)
Pleuromeia Corda 1852 ***?Pleuromeia***	Isoetales	Otyń IG-1 borehole (Fore-Sudetic Monocline)	Supra-Oolitic Beds, Middle Buntsandstein; Lower Triassic	Fuglewicz 1980b* (strobile with megaspores *Pusulosporites* Fuglewicz 1973 *in situ*)
Pseudohirmerella Arndt 2002 ***Pseudohirmerella*** sp. n.	Coniferales	Krasiejów (Opole Silesia)	Drawno Beds?; Upper Triassic, Upper Carnian	Dzik & Sulej 2007*
Pterophyllum braunianum Goeppert 1844	Bennettitales	Gosław (Upper Silesia)	Wilmsdorfer Schichten, Keuper; Upper Triassic, Rhaetian	Schenk 1867, Roemer 1870* (as synonym of *Pterophyllum oeynhausianum* Goeppert 1844)
Pterophyllum carnallianum Goeppert 1844	Bennettitales	Biadacz, Dobiercice, Gosław (Upper Silesia)	Wilmsdorfer Schichten, Keuper; Upper Triassic, Rhaetian	Goeppert 1844^*, 1845, 1846a, Schenk 1867*, Roemer 1867, 1870* (as synonym of *Pterophyllum propinquum* Goeppert 1844
Pterophyllum compressum Lundblad 1950	Bennettitales	Extra-Carpathian area of Poland	Wielichowo beds; Upper Triassic, Rhaetian	Marcinkiewicz 1969 (only isolated cuticules)

Table 1. Continued

Taxon as originally described, selected nomenclatural synonyms	Botanical affinity, taxon validity, taxonomical synonyms	Location	Horizon, age	References, comments
Pterophyllum cf. ***jaegeri*** Brongniart 1828	Bennettitales	Gacki 3 borehole (South-eastern Holy Cross Mts.)	Lower Keuper, Lettenkohle; Middle Triassic, Ladinian	Pawłowska 1979*
Pterophyllum muensteri (Presl in Sternberg 1838) Goeppert 1844 (=*Nilssonia muensteri* (Presl in Sternberg 1838) Schimper in Zittel 1880)	Cycadales, synonym of *Nilsonia acuminata* (Presl in Sternberg 1838) Goeppert 1844	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Schenk 1867, Roemer 1870, Raciborski 1892 (Raciborski referred this specimen to *Ptilozamites nilsonii*)
Pterophyllum oeynhausianum Goeppert 1844	Bennettitales	Biadacz (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1844^*, 1845, 1846a, Schenk 1867, Roemer 1867, 1870
Pterophyllum propinquum Goeppert 1844	Bennettitales	Biadacz (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1844^*, 1845, 1846a, Schenk 1867*, Roemer 186
Pterophyllum Brongniart 1828 ***Pterophyllum*** sp.	Bennettitales	Krasiejów (Opole Silesia)	Drawno Beds?; Upper Triassic, Upper Carnian	Dzik & Sulej 2007
		Nowa Wieś (Upper Silesia)	Woźniki Limestone; Upper Triassic, Norian	Znosko 1955 (only record, without description or illustration)
Schizoneura hoerensis (Hisinger 1840) Schimper 1869	Equisetales, synonym of ***Neocalamites lehmannianus*** (Goeppert 1846a) Weber 1968	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Reymanówna 1986
Sphaerococcites blandowskianus Goeppert 1846b	*Nomen dubium*, originally stated as alga, most probably trace fossil	Tarnowskie Góry (Upper Silesia)	Muschelkalk; Middle Triassic	Goeppert 1845, 1846b^*, Eck 1865
Stachyotaxus septentrionalis (Agardh 1823) Nathorst 1886	Coniferales, illustrated by Dzik et al. (2008a), remains most probably belong to genus *Elatocladus*	Lipie Śląskie-Lisowice (Upper Silesia)	Wielichowo Beds; Upper Triassic, Rhaetian	Dzik el al. 2008a*, b, Świło et al. 2014
Taeniopteris gigantea Schenk 1867	Cycadales	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Schenk 1867^*, Roemer 1867, 1870*
Voltzia krappitzensis Kunisch 1886	Coniferales, species needs revision	Krapkowice (Upper Silesia)	Muschelkak; Middle Triassic, Anisian	Kunisch 1886^*
Voltzia Brongniart 1828 ***Voltzia*** sp.	Coniferales, specimens never illustrated or revised	North-west part of Holy Cross Mts.	Upper Middle Buntsandstein; Lower Triassic	Czarnocki 1931 (only record, without description)
Widdringtonites Endlicher 1847 ***Widdringtonites*** sp.	Coniferales	Czerwone Żlebki (Tatra Mountains)	Tomanová Formation; Upper Triassic, Rhaetian	Raciborski 1890a*, b, c, Reymanówna 1986
Xylomites irregularis Goeppert 1846a	Originally stated as epiphyllous fungi on leaves	Dobiercice (Upper Silesia)	Wilmsdorfer Schichten; Upper Triassic, Rhaetian	Goeppert 1846a^*, Roemer 1870 (as fungi on *Pterophyllum carnallianum* leaf fragments)

Table 2. Proposed approximate zonation and correlation of Triassic floras of Poland

Age	Germanic Triassic division (Kozur & Bachmann 2008, Franz 2009, Kozur & Weems 2010)	Polish Triassic division (Orłowska-Zwolińska 1985, Mader 1997, Fijałkowska-Mader 1999)	German/French floral assemblages (Dobruskina 1988, 1994, Kelber 1998)	Polish macrofloral assemblages and assemblage zones (here proposed)
Rhaetian	Upper Keuper/ Rhätkeuper/ Exter Formation	Upper Rhaetian sensu polonico/ Wielichowo Beds and perhaps Upper (most) Zbąszynek Beds (?)	Rhät-Flora/ *Lepidopteris ottonis* zone	*Lepidopteris ottonis* zone
Norian	Middle Keuper/ Steinmergelkeuper/ Arnstadt Formation	Lower Rhaetian sensu polonico/Zbąszynek Beds, Jarkowo Beds (Grabowa Formation), Drawno Beds	Stubensandstein/ Burgsandstein Flora	*Brachyphyllum* zone
Carnian	Middle Keuper/ Upper Gipskeuper/ Weser Formation	Upper Keuper sensu polonico/Upper Gipskeuper	Coburger Sandstein Flora	(Younger) *Voltzia* zone
	Middle Keuper/ Schilfsandstein/ Stuttgart Formation	Upper Keuper sensu polonico/Schilfsandstein	Schilfsandstein Flora	Lack of macroscopic plant remains in Poland
Upper Ladinian	Middle Keuper/ Lower Gipskeuper/ Grabfeld Formation	Upper Keuper sensu polonico/Lower Gipskeuper and Grenzdolomit	Gipskeuper Flora	Lack of macroscopic plant remains in Poland
	Lower Keuper/ Lettenkeuper/ Erfurt Formation	Lower Keuper/ Sulechów Beds	Unterkeuper (Lettenkohle) Flora	Equisetales-flora
Middle and Lower Ladinian Upper Anisian	Upper Muschelkalk	Upper Muschelkalk	Lack of macroscopic plant remains in Germanic Basin	Lack of macroscopic plant remains in Poland
Middle Anisian	Middle Muschelkalk	Middle Muschelkalk		
	Lower Muschelkalk	Lower Muschelkalk		
Lower Anisian/ Upper Buntsandstein- Röt	Upper Buntsandstein-Röt	Upper Buntsandstein-Röt	Grés à *Voltzia* flora	(Older) *Voltzia*-flora
Scytian/ Lower and Middle Buntsandstein	Middle Buntsandstein	Middle Buntsandstein	*Pleuromeia*-flora	*Pleuromeia*-flora
	Lower Buntsandstein	Lower Buntsandstein		

CONCLUSIONS AND FUTURE PROSPECTS

The Triassic floras of the Northern Hemisphere are rare and poorly known. Each new site with plant macroremains fills a gap in our knowledge of plant evolution in this period (Kustatscher & van Konijnenburg-van Cittert 2005, Roghi et al. 2006, van Konijnenburg-van Cittert et al. 2006, Kustatscher & van Konijnenburg-van Cittert 2008, Kustatscher et al. 2012). Good, complete descriptions of the floras of Upper Triassic localities in Poland will help researchers study Triassic ecosystems in Poland and worldwide, and will be useful in analysing the evolution of floras in the Triassic. Some taxa found in Poland may have large implications for reconstruction of the gymnosperm phylogeny, particularly for conifers. These floras will also fill in the palaeoecological and palaeoenvironmental background of the vertebrates, especially the dinosaurs at Polish localities. A better understanding of the dinosaurs' environment will help expand our knowledge about their biology and explain their evolutionary success. Such interdisciplinary dinosaur research has been very intense lately, particularly in North America (Sampson 2012), but has not included the dinosaurs of Poland; they have yet to take their rightful place in the European Triassic.

The very few descriptions of the Triassic floras of Poland come mainly from the 19th century. They require modern revisions incorporating current nomenclature and meeting current standards of fossil description. Expert investigations begun in the 19th century were not continued in the 20th century, except for a very few

Table 2. Continued

Palynological zones (spores and pollen grains) in Poland (Orłowska-Zwolińska 1985)	Megaspore zonation in Poland (Marcinkiewicz 1978, 1992)	Most typical plant macrofossil taxa in Poland	Localities in Poland	Evolutionary events in Polish macroflora
Riccisporites tuberculatus	*Trileites pingius*	*Lepidopteris ottonis*, *Neocalamites lehmannianus*, *Pterophyllum* spp.	Kluczbork area (Goeppert's sideritic nodules flora) Lipie Śląskie-Lisowice, Czerwone Żlebki	During stage rise of floral biodiversity, growing similarity to Lower Jurassic floras
Corollina meyeriana		*Brachyphyllum*, *Pterophyllum*, *Equisetites*	Poręba, Patoka, Woźniki Limestone (Ligota, Myszków, Poręba), Marciszów-Zawiercie	Appearance of modern conifer families (*Brachyphyllum* leaves appearing)
Hiatus in pollen zones in Poland, upper *Camerosporites secatus* zone in German part of Germanic Basin		*Voltzia*, *Glyptolepis*, *Desmiophyllum*, *Pseudohirmerella*, *Pachylepis*, *Sphenopteris schoenleiniana*	Krasiejów, Woźniki claypit	Decrease of diversity and extinction of Voltziales
Aulisporites astigmosus	*Narkisporites harrisi*			
Porcelispora longdonesis				
Heliosaccus dimorphus	*Dijkstraisporites beutleri*	*Neocalamites merianii*	Holy Cross Mountains	Floras very rare and impoverished in Poland
Hiatus				
Tsugaepollenites oriens				
Perotrilites minor				
Voltziacaesporites heteromorpha	*Trileites validus*	*Voltzia*, ferns and equisetalean remains	Krapkowice, Pałęgi	Floras very rare and impoverished in Poland
Densoisporites nejburgii	Hiatus	*Pleuromeia* and equisetalean remains only	Holy Cross Mountains	Floras very rare and impoverished in Poland
	Talchirella daciae			
	Trileites polonicus			
	Hiatus			
Lundbladispora obsoleta-Protohaploxypinus pantii	*Otynisporites eotriassicus*			

papers and excerpts in publications on stratigraphy. There is a good record of Polish Lower and Middle Triassic floras in the palynological data but not in data on macroremains. Upper Triassic macrofloras are better known but their descriptions are outdated. Most determinations of macroremains from the Polish Triassic should be revised. The plants described by Goeppert (1836, 1844, 1845, 1846a) were revised by Schenk alone (1867). Later only *Lepidopteris ottonis* was redescribed (Barbacka 1991). As is clear from Schenk's (1867) revision, some species Goeppert described are junior synonyms of previously described species, some new species were described from small, badly preserved remains, and species in some genera are oversplit (e.g. *Pterophyllum*).

Palynological research on Triassic strata in Poland intensified in the 1970s and produced a useful palynological biostratigraphic scheme for the Polish Triassic (Orłowska-Zwolińska 1985). New palynological data gathered from Poland fits this scheme perfectly (Fijałkowska-Mader 1999). Orłowska-Zwolińska's scheme is congruent with Western European palynological biostratigraphy (Fijałkowska-Mader 1999, Cirilli 2010, Kürschner & Herngreen 2010). Correlating dispersed spores and pollen grains with their parent plants in Triassic floras presents great difficulties not just in Poland but worldwide. The true botanical affiliation of even index taxa such as *Ricciisporites tuberculatus* is disputed (Mander et al. 2012). This presents problems, as broad palaeoecological conclusions are based on this palynological data (e.g. Dzik et al. 2008b). The newly discovered floras, especially those in Krasiejów, Patoka and Lipie Śląskie-Lisowice, contain

Table 3. Complete taxonomical composition of Upper Triassic macrofloral assemblage zones here proposed for main localities

Age	Assemblage zones (here proposed)	Formation/ Beds	Locality	Floral assemblage composition
Rhaetian	*Lepidopteris ottonis* assemblage zone	Wilmsdorfer Schichten	Kluczbork area (Goeppert's sideritic nodule flora) Biadacz, Dobiercice, Gosław, Maciejów (Upper Silesia)	*Neocalamites lehmannianus*, *Alethopteris insignis*, *Cladophlebis roesserti*, *Clathropteris meniscoides* (=*Camptopteris jurassica* =*Clathropteris muensteriana*), *Carpolithes cardiocarpoides*, *Dicranopteris roemeriana*, *Lepidopteris ottonis*, *Peltaspermum rotula*, *Pterophyllum braunianum*, *Pterophyllum carnallianum*, *Pterophyllum muensteri*, *Pterophyllum oeynhausianum*, *Pterophyllum propinquum*, *Taeniopteris gigantea*, *Xylomites irregularis*
		Wielichowo Beds	Lipie Śląskie-Lisowice (Upper Silesia)	*Lepidopteris ottonis*, *Brachyphyllum* sp., *Pagiophyllum* sp., *Cheirolepidiaceae*
		Tomanová Formation	Czerwone Żlebki (Tatra Mountains)	*Neocalamites lehmannianus*, *Equisetum chalubinskii*, *Equisetum* an *bunburyanum*, *Cladophlebis roesserti*, *Cladophlebis roesserti* forma *parvifolia*, *Clathropteris meniscoides* (=*Clathropteris platyphylla*), *Dictyophyllum* aff. *dunkeri*, *Pecopteris lobata*, *Palissya braunii*, *Widdringtonites* sp.
Norian	*Brachyphyllum* assemblage zone	Woźniki Limestone	Woźniki area (Ligota, Myszków, Nowa Wieś, Poręba) (Upper Silesia)	*Clathropteris meniscoides* (=*Clathropteris muensteriana*), *Neuropteris* sp. conf. *N. remota*, *Palaeohepatica roemeri*, *Pterophyllum* sp., *Brachyphyllum* sp., *Equisetites muensteri*
Carnian	*Voltzia* assemblage zone	Upper Gipskeuper	Krasiejów (Opole Silesia)	*Sphenopteris schoenleiniana*, *Pterophyllum* sp., *Desmiophyllum* spp., *Glyptolepis keuperiana*, *Pachylepis quinquies*, *Pseudohirmerella* sp., *Voltzia* spp.

many new taxa yet to be described, and some of them could have great evolutionary importance. A complete description of the Woźniki limestone flora, which has been on record since the end of the 19th century, is urgently needed.

The Triassic is an exceptionally interesting period as it witnessed rapid evolution of conifers. The oldest representatives of modern conifer families occurred in the Upper Triassic (Rothwell et al. 2012). The stages of transformation from the primitive Votziales to evolutionarily advanced families of modern conifers in the Triassic are insufficiently documented. The newly discovered Silesian sites (Krasiejów, Patoka, Lipie Śląskie-Lisowice), containing Upper Triassic floras rich in conifer taxa, can shed new light on this poorly known stage of conifer evolution. The flora from Krasiejów contains relatively primitive conifers: they fall into the genus *Voltzia* based on twig morphology and into the genus *Glyptolepis* based on seed scales. Further research is needed to identify the Krasiejów conifers to species level based upon twig, seed scale, and pollen cone morphology, because these specimens represent genera and species new to science. The Krasiejów conifers hold clues to the evolution of these plants in the early Upper Triassic. In the flora of Patoka, which is slightly younger geologically, relatively advanced *Brachyphyllum*-type shoots characteristic of Jurassic or Cretaceous conifers are accompanied by a new type of seed scale which may have evolved from primitive *Voltzia*-type scales. This is a plant of evolutionary significance for modern conifers. Preliminary work indicates that it will be possible to fully reconstruct a conifer from Patoka with trunks, twigs, male and female cones – and pollen grains. Completely reconstructed extinct plants can be used in developing phylogenetic hypotheses. The discovery of a plant with primitive female cones accompanied by evolutionarily advanced shoots at the Patoka site may form the basis for erecting a new family of conifers and revising current views on the taxonomy of this group of plants. This find could also have far-reaching implications for the taxonomy of conifers.

The task of correlating Triassic floras worldwide is hampered by stratigraphical problems and regional differences in floral composition. Some approximate correlations are possible regionally on the continental scale, however. Such biostratigraphical and lithostratigraphical correlations of the Polish Triassic floras from the main localities with other well-known European Triassic floras are provided here (Tab. 2), and new macrofloral assemblages for the Lower and Middle Triassic and macrofloral assemblage zones for the Upper Triassic in Poland (Tabs 2 and 3), corresponding to Orłowska-Zwolińska's palynological zonation

Table 4. Main Polish Triassic macrofossil and selected microfossil plant localities with basic palaeobotanical, palaeozoological and geological references

Locality of fossil plant remains	References
Chabowo 2 borehole	Ociepa et al. 2008, Barbacka et al. in prep.
Czerwone Żlebki	Raciborski 1890a, b, c, Michalík et al. 1976, 1988, Reymanówna 1984, 1986, Niedźwiedzki 2005, 2008, 2011, Niedźwiedzki & Sulej 2007
Gacki 1, 3 and 4 boreholes	Pawłowska 1979
Gorzów Śląski area	Goeppert 1846a, Endlicher 1847, Mercklin 1855, Roemer 1867, 1870, Schenk 1867, Schimper 1870–1872, Seward 1919, Znosko 1955, Jongmans & Dijkstra 1973
Gostyń 46 G borehole	Marcinkiewicz & Orłowska-Zwolińska 1985, 1994
Gradzanowo 1 and 3 boreholes	Barbacka 1980, Barbacka 1991, Marcinkiewicz & Orłowska-Zwolińska 1994, Barbacka & Wcisło-Luraniec 2002, 2003
Holy Cross Mts.	Samsonowicz 1924, 1929, Czarnocki 1925, 1931, Fijałkowska 1989, 1992a, b, 1994a, b, Rdzanek 1982, Fijałkowska-Mader 1999
Kluczbork area (Biadacz, Dobiercice, Gosław, Maciejów)	Goeppert 1836, 1841–1846, 1844, 1845, 1846a, b, Roemer 1867, 1870, Schenk 1867, Michael 1893, 1894, 1895a, Gallinek 1894, Gothan 1909a, Znosko 1955, Orłowska-Zwolińska & Senkowiczowa 1970, Barbacka 1980, 1991, Reymanówna & Barbacka 1981, Mader 1997, Kiritchkova 2006, 2008
Kamienica Polska	Goeppert 1846a, Mercklin 1852, 1855, Schenk 1867, Schimper 1870–1872, Seward 1919, Jongmans & Dijkstra 1973
Kamień Pomorski IG 1 borehole	Pieńkowski 2004, Pieńkowski et al. 2012
Kołaczkowice near Rawicz	Piwocki 1970
Krapkowice	Kunisch 1886, Michael 1895b, Potonié 1897, Hörich 1910, Rieppel & Hagdorn 1997, Rieppel 2000
Krasiejów	Dzik et al. 2000, Dzik 2001, 2002, 2003a, b, 2008, Sulej 2002, 2003, 2004, 2005, 2007, 2010, Zatoń & Piechota 2003, Dzik & Sulej 2004, 2007, Olempska 2004, 2011, Sulej & Majer 2005, Szulc 2005, Zatoń et al. 2005, Barycka 2007, Konietzko-Meier & Wawro 2007, Lucas et al. 2007, Szulc & Becker 2007, Gruszka & Zieliński 2008, Brusatte et al. 2009, Fostowicz-Frelik & Sulej 2009, Mazurek & Słowiak 2009, Kozur & Weems 2010, Piechowski & Dzik 2010, Racki 2010, Skawina 2010, 2013, Sues & Fraser 2010, Skawina & Dzik 2011, Bodzioch & Kowal-Linka 2012, Desojo et al. 2013, Konietzko-Meier & Klein 2013, Konietzko-Meier & Sander 2013, Konietzko-Meier et al. 2013
Lipie Śląskie-Lisowice	Fuglewicz & Śnieżek 1980, Marcinkiewicz 1981, Staneczko 2007, Dzik et al. 2008a, b, Niedźwiedzki & Sulej 2008, Ociepa et al. 2008, Marynowski & Simoneit 2009, Gorzelak et al. 2010, Wawrzyniak & Ziaja 2009, 2010, Wawrzyniak 2010a, b, c, d, Racki 2010, Niedźwiedzki et al. 2011, 2012, Skawina & Dzik 2011, Świło et al. 2014
Majków	Samsonowicz 1929
Mechowo IG I borehole	Marcinkiewicz 1962
Otyń IG-1 borehole	Fuglewicz 1980b
Pałęgi	Kuleta et al. 2006, Żyła et al. 2013
Patoka	Znosko 1955, Barbacka et al. 2012
Poręba	Znosko 1955, Brzyski & Heflik 1994, Sulej et al. 2012
Radoszyce 3 borehole	Bocheński 1957
Ratajów	Samsonowicz 1929
Studzianna	Karaszewski 1962, Reymanówna 1986, Barbacka et al. 2009, Barbacka et al. in prep.
Wieluń	Goeppert 1836, Znosko 1955
Woźniki Limestone (Ligota, Myszków, Nowa Wieś, Poręba, Woźniki)	Roemer 1870, Raciborski 1892, 1893, Różycki 1930, Znosko 1955, Wcisło-Luraniec 1984, Reymanówna 1986, Szulc et al. 2006, Szulc & Becker 2007

(Orłowska-Zwolińska 1985), are proposed. The Lower and Middle Triassic floras are too poor in taxa for macrofloral assemblage zones to be defined. Only the Upper Triassic strata have a plant macrofossil record rich enough for assemblage zones to be delineated. Three macrofossil assemblage zones are proposed and defined here for the Polish Upper Triassic:

The ***Voltzia* assemblage zone**, in which *Voltzia* (sensu lato) leaf species predominate, with their seed scales *Glyptolepis*. *Pseudohirmerella*, *Pachylepis*, and a new genus. Coniferous foliage incertae sedis *Desmiophyllum*, is also present. *Pterophyllum* leaves are very rare. This zone comprises the Upper Gipskeuper strata and corresponds to the Carnian. In the palynological zonation of Poland there is a hiatus, but it corresponds to the upper *Camerosporites secatus* zone in other parts of Europe (Cirilli 2010, Kürschner & Herngreen 2010).

The ***Brachyphyllum* assemblage zone** is dominated by conifers with *Brachyphyllum*-type foliage, probably signalling the emergence of modern conifer families. Whole-plant reconstructions of those conifers are possible, based on new findings (wood, seed scales with ovules, male cones with pollen in situ, shoots). Other plant taxa are very rare; single fern leaves of *Cladophlebis* and *Clathropteris meniscoides*, and bennettitalean foliage *Pterophyllum* and *Equisetites muensteri* shoots have been found. This zone comprises the Lower Rhaetian sensu polonico (Zbąszynek, Jarkowo and Drawno beds) and corresponds to the Norian. In the palynological zonation of Poland it corresponds to the *Corollina meyeriana* zone.

The ***Lepidopteris ottonis* assemblage zone** (*Lepidopteris* zone of Harris 1937) is characterised by the index species *Lepidopteris ottonis* and very abundant *Neocalamites lehmannianus*, or locally *Equisetum chalubinskii* (Tatra Mountains). The genus *Pterophyllum* is widespread and species-rich. The ferns *Cladophlebis roesserti* and *Clathropteris meniscoides* were also found. There are conifers typical of the Triassic (*Pseudohirmerella*) with species more evolutionarily advanced than in the *Voltzia* assemblage zone, and species of Lower Jurassic type (*Palissya*). The plant assemblage is taxonomically rich and somewhat similar in composition to Lower Jurassic floras (pers. observ. of Lipie Śląskie-Lisowice flora). This zone comprises the Upper Rhaetian sensu polonico (Wielichowo Beds) and corresponds to the Rhaetian. In the palynological zonation of Poland it corresponds to the *Riccisporites tuberculatus* zone.

The abrupt change in flora at the Carnian-Norian boundary could be connected with the mass extinction observed in faunas worldwide (Benton 1994a, b), but this needs to be investigated more carefully, as new data based on the Polish Upper Triassic vertebrates may challenge this conclusion (Dzik et al. 2008a, b).

Full analyses of the floras from the Triassic sites in Poland will extend our knowledge (still very scant) of Triassic palaeoecosystems in Poland and generally in the Northern Hemisphere. Recent new finds of taxonomically rich, well-preserved floras with numerous specimens accompanying vertebrate remains in Silesia provide researchers studying Polish Triassic floras with an opportunity to upgrade the taxonomy and describe them in an evolutionary and palaeoecological context. The new research on these localities is in its infancy (Dzik & Sulej 2007, Staneczko 2007, Dzik et al. 2008a, b, Wawrzyniak & Ziaja 2009, Wawrzyniak 2010a, b, Barbacka et al. 2012, Pacyna et al. 2013a, b). Intensive research on plant remains from drill cores is also in progress (Ociepa et al. 2008, Barbacka et al. 2009, 2011, Krupnik et al. 2011, Pieńkowski et al. 2012). When good, comprehensive taxonomic descriptions have been completed, the floras from these sites may serve as reference floras for future evolutionary and palaeoecological studies of the world's Triassic plants.

ACKNOWLEDGMENTS

I thank J. Dzik and T. Sulej (Institute of Paleobiology, Polish Academy of Sciences) for allowing me to collect plant specimens at their research localities (Krasiejów, Patoka, Lipie Śląskie-Lisowice) and for lending their collection of fossil plants from Krasiejów for this research; J. Zaja and M. Barbacka (W. Szafer Institute of Botany, Polish Academy of Sciences) for discussions on Triassic palynology and stratigraphy, for help in compiling the literature and for making available fossil collections in their care for comparative study; B. Kietlińska-Michalik (Geological Museum, Polish Academy of Sciences) for kindly providing the M. Raciborski collection from Czerwone Żlebki for examination, and also some useful papers; G. Pieńkowski (Polish Geological Institute) for discussion on the age of Krasiejów flora; D. Zdebska (Jagiellonian University) for discussions and help with many problems during the preparation of this article; M. Popa and E. Kustatscher for their very useful comments and suggestions; M. Jacobs for skilful language correction; and A. Sojka for preparing Figure 1. I especially thank Editor-in-Chief L. Stuchlik for his help and encouragement during the work on this article. The project was financed by funds from the Polish National Science Centre (no. DEC-2012/05/B/NZ8/00990) and from the Jagiellonian University (no. DS/MND/WBiNoZ/IB/5/2012).

REFERENCES

ANDERSON H.M. & ANDERSON J.M. 1997. Why not look for Proangiosperms in the Molteno Formation? In: Herngreen G.F.W. (ed.), Proceedings 4th European Palaeobotanical and Palynological Conference. Meded. Nederl. Inst. Toegep. Geowetens. TNO, 58: 73–80.

ANDERSON J.M. & ANDERSON H.M. 2003. Heyday of the gymnosperms: systematics and biodiversity of the Late Triassic Molteno fructifications. Strelitzia, 15: 1–398.

ANTEVS E. 1914. *Lepidopteris ottonis* (Göpp.) Schimp. and *Antholithus zeilleri* Nath. Kungl. Sven. Vetensk. Handl., 51(7): 1–18.

ARNDT S. 2002. Morphologie und Systematik ausgewählter Mesozoischer Koniferen. Palaeontographica, B, 262: 1–23.

ASH S.R. 1980. Upper Triassic flora zones of North America: 153–170. In: Dilcher D. & Taylor. T (eds), Biostratigraphy of fossil plants. Dowden Hutchinson & Ross, Stroudsbourg.

ASH S.R. 1987. The Upper Triassic Red Bed Flora of the Colorado Plateau, Western United States. J. Ariz.-Nev. Acad. Sci., 22(1): 95–105.

AXSMITH B.J. & TAYLOR T.N. 1997. The Triassic conifer seed cone *Glyptolepis*. Rev. Palaeobot. Palynol., 96: 71–79.

BARBACKA M. 1980. Nowe polskie stanowisko paproci nasiennej *Lepidopteris ottonis* (The new locality of *Lepidopteris ottonis* in Poland): 108. XLV Zjazd Polskiego Towarzystwa Botanicznego, 10–13 września 1980, streszczenia wykładów i komunikatów, UMCS, Lublin. (in Polish).

BARBACKA M. 1991. *Lepidopteris ottonis* (Goepp.) Schimp. and *Peltaspermum rotula* Harris from the Rhaetian of Poland. Acta Palaeobot., 31(1,2): 23–47.

BARBACKA M. & WCISŁO-LURANIEC E. 2002. *Ginkgoites acosmia* Harris from the Polish Rhaetian. Acta Palaeobot., 42(1): 7–11.

BARBACKA M. & WCISŁO-LURANIEC E. 2003. Nowy przedstawiciel Ginkgoales z retyku Polski (summary: A new representative of the Ginkgoales from the Polish Rhaetian). Bot. Guideb., 26: 121–124.

BARBACKA M., OCIEPA A.M. & WCISŁO-LURANIEC E. 2011. Wstępne wyniki badań makroszczątków roślinnych z wiercenia Huta OP-1 (trias-jura) z północnego obrzeżenia Gór Świętokrzyskich: 76–77. In: Matyja B.A., Wierzbowski A. & Ziółkowski P. (eds), Jurassica IX. Materiały konferencyjne, Abstrakty, Małogoszcz, 06-08.09.2011. Polskie Towarzystwo Geologiczne, Polska Grupa Robocza Systemu Jurajskiego.

BARBACKA M., PACYNA G., ZIAJA J. & ZDEBSKA D. 2012. The new type of Late Triassic ovulate scales associated with *Brachyphyllum*-like leaves. In: Nishida H., Saito T. & Takahara H. (eds), 13th International Palynological Congress, 9th International Organisation of Palaeobotany Conference, August 23–30, 2012, Tokyo, Japan. Japanese Journal of Palynology, 58 special issue, Abstracts: IPC/IOPC 2012: 11.

BARBACKA M., FELDMAN-OLSZEWSKA A., JARZYNKA A., KRUPNIK J., OCIEPA A.M., WCISŁO-LURANIEC E. & ZIAJA J. 2009. Wstępne wyniki badań paleobotanicznych wiercenia Studzianna (trias-jura) z północnego obrzeżenia Gór Świętokrzyskich (summary: Preliminary results of the palaeobotanical investigations of Studzianna well cores (Triassic-Jurassic) from the northern part of Holy Cross Mts margin). In: Krobicki M. (ed.), Jurassica VIII, Vršatec 09–11.10.2009, Kwartalnik AGH Geologia, 35(3/1): 17–19. (in Polish).

BARDZIŃSKI W., SURMIK D. & LEWANDOWSKI M. 2008. Stanowisko kręgowców środkowego triasu koło Żyglina na Górnym Śląsku (Middle Triassic vertebrate locality near Żyglin in Upper Silesia, Poland). Prz. Geol., 56: 532–536. (in Polish).

BARYCKA E. 2007. Morphology and ontogeny of the humerus of the Triassic temnospondyl amphibian *Metoposaurus diagnosticus*. Neues Jahrb. Geol. Paläont., Abhandl., 243: 351–361.

BENTON M.J. 1994a. Late Triassic terrestrial vertebrate extinctions: stratigraphic aspects and the record of the Germanic Basin. Paleontol. Lomb., Nuova Serie, 2: 19–38.

BENTON M.J. 1994b. Late Triassic to Middle Jurassic extinctions among continental tetrapods: testing the pattern: 366–397. In: Fraser N.C. & Sues H.-D. (eds), In the shadow of the dinosaurs. Cambridge University Press, Cambridge.

BILAN W. 1975. Profil retyku w Krasiejowie koło Opola. Zeszyty Akademii Górniczo-Hutniczej, Geologia, 1(3): 13–20.

BODZIOCH A. & KOWAL-LINKA M. 2012. Unraveling the origin of the Late Triassic multitaxic bone accumulation at Krasiejów (S Poland) by diagenetic analysis Palaeogeogr., Palaeoclimat., Palaeoecol., 346–347: 25–36.

BOCHEŃSKI T. 1957. Preliminary report on the appearance in the Bunter Sandstone in bore-hole Radoszyce 3, of a plant of the *Glossopteris* type: *Glossopteridium J. Czarnockii* n. sp. Biul. Inst. Geol., 124: 181–191.

BORSUK-BIAŁYNICKA M. & EVANS S.E. (eds) 2009. Early Triassic vertebrate assemblage from karst deposits at Czatkowice, Poland. Palaeont. Pol., 65: 1–332.

BORSUK-BIAŁYNICKA M., COOK E., EVANS S.E. & MARYAŃSKA T. 1999. A microvertebrate assemblage from the Early Triassic of Poland. Acta Palaeont. Pol., 44: 167–188.

BRUSATTE S.L., NIEDŹWIEDZKI G. & BUTLER R. J. 2011. Footprints pull origin and diversification of dinosaur stem lineage deep into Early Triassic. Proc. Roy. Soc., B, 278: 1107–1113.

BRUSATTE S.L., BUTLER R.J., SULEJ T. & NIEDŹWIEDZKI G. 2009. The taxonomy and anatomy of rauisuchian archosaurs from the Late Triassic of Germany and Poland. Acta Palaeont. Pol., 54: 221–230.

BRZYSKI B. & HEFLIK W. 1994. Fragments of petrified, Rhaetico-Liassic coniferous trees of Poręba near Zawiercie. Bull. Pol. Acad. Sci., Earth Sci., 42(4): 303–310.

BUDZISZEWSKA-KARWOWSKA E., BUJOK A. & SADLOK G. 2010. Bite marks on an Upper Triassic dicynodontid tibia from Zawiercie, Kraków-Częstochowa Upland, southern Poland. Palaios, 25: 415–421.

BUTLER R.J., RAUHUT O.W.M., STOCKER M.R. & BRONOWICZ R. 2014. Redescription of the phytosaurs *Paleorhinus* (‘*Francosuchus*’) *angustifrons* and *Ebrachosuchus neukami* from Germany, with implications for Late Triassic biochronology. Zool. J. Linn. Soc., 170: 155–208.

CHRZĄSTEK A. 2008. Vertebrate remains from the Lower Muschelkalk of Raciborowice Górne (North-Sudetic Basin, SW Poland). Geol. Quart., 52: 225–238.

CHRZĄSTEK A. & NIEDŹWIEDZKI R. 1998. Kręgowce retu i dolnego wapienia muszlowego na Śląsku. Acta Univ. Wratisl., Pr. Geol.-Min., 64: 69–81.

CIRILLI S. 2010. Upper Triassic-lowermost Jurassic palynology and palynostratigraphy: a review. In: Lucas S.G. (ed.), The Triassic Timescale. Geol. Soc., London, Spec. Publ., 334: 285–314.

CZAPOWSKI G. & ROMANEK A. 1986. Litostratygrafia i środowisko sedymentacji osadów górnego triasu w rejonie Chmielnika (summary: Lithostratigraphy and sedimentary environmests of Upper Triassic rocks from the Chmielnik area). Prz. Geol., 11: 635–643.

CZARNOCKI J. 1925. Wyniki badań geologicznych dokonanych w r. 1924 na obszarze mezozoicznym zachodniej części gór Świętokrzyskich (Sur les résultats des recherches géologiques sur le terrain mésozoique dans la partie occidentale du Massif de Święty Krzyż). Posiedzenia Naukowe Państwowego Instytutu Geologicznego (Comptes-Rendus des Séances du Service Géologique de Pologne), 11: 11–14. (in Polish).

CZARNOCKI J. 1931. Sprawozdanie z badań wykonanych w pn.-zachodniej części gór Świętokrzyskich, między Radoszycami i Łączną pod Suchedniowem (Compte-rendu des recherches géologiques effectuées dans la partite NO du Massif de Ste-Croix). Posiedzenia Naukowe Państwowego Instytutu Geologicznego (Comptes-Rendus des Séances du Service Géologique de Pologne), 29: 7–10. (in Polish).

DADLEZ R. & KOPIK J. 1963. Problem retyku w zachodniej Polsce na tle profilu w Książu Wielkopolskim. Kwart. Geol., 7: 131–158.

DESOJO J.B., HECKERT A.B., MARTZ J.W., PARKER W.G., SCHOCH R.R., SMALL B.J. & SULEJ T. 2013. Aetosauria: a clade of armoured pseudosuchians from the Upper Triassic continental beds. In: Nesbitt S. J., Desojo J. B. & Irmis R. B. (eds), Anatomy, Phylogeny and Palaeobiology of Early Archosaurs and their Kin. Geol. Soc., London, Spec. Publ., 379: 203–239.

DOBRUSKINA I.A. 1988. The history of land plants in the northern hemisphere during the Triassic with special reference to the floras of Eurasia. Geol. Paläont. Mitt., 15: 1–12.

DOBRUSKINA I.A. 1994. Triassic Floras of Eurasia. Springer Verlag, Wien, New York.

DYBOVA-JACHOWICZ S. & LASZKO D. 1980. Spektrum sporowo-pyłkowe utworów permu i triasu synkliny piekoszowskiej w Górach Świętokrzyskich (summary: Spore-pollen spectrum of Permian and Triassic rocks in the Piekoszów Syncline, Góry Świętokrzyskie Mts.). Geol. Quart., 24(3): 611–642.

DZIK J. 2001. A new *Paleorhinus* fauna in the early Late Triassic of Poland. J. Verteb. Paleontol., 21: 625–627.

DZIK J. 2003a. A beaked herbivorous archosaur with dinosaur affinities from the early Late Triassic of Poland. J. Verteb. Paleontol., 23: 556–574.

DZIK J. 2003b. Krasiejów – u zarania ery dinozaurów (wystawa w Muzeum Ewolucji). Ewolucja, 1: 2–13.

DZIK J. 2008. Gill structure and relationships of the Triassic cycloid crustaceans. J. Morphol., 269: 1501–1519.

DZIK J. & SULEJ T. 2004. Pierwszy polski dinozaur. Śląskie Wydawnictwo ADAN, Opole.

DZIK J. & SULEJ T. 2007. A review of the early late Triassic Krasiejów biota from Silesia, Poland. Paleont. Pol., 64: 1–27.

DZIK J., NIEDŹWIEDZKI G. & SULEJ T. 2008a. Zaskakujące uwieńczenie ery gadów ssakokształtnych. Ewolucja, 3: 2–21.

DZIK J., SULEJ T. & NIEDŹWIEDZKI G. 2008b. A dicynodont–theropod association in the latest Triassic of Poland. Acta Palaeont. Pol., 53(4): 733–738.

DZIK J., SULEJ T., KAIM A. & NIEDŹWIEDZKI R. 2000. Późnotriasowe cmentarzysko kręgowców lądowych w Krasiejowie na Śląsku Opolskim. Prz. Geol., 48(3): 226–235.

ECK H. 1865. Ueber die Formationen des bunten Sandsteins und des Muschelkalks in Oberschlesien und ihre Versteinerungen. Starcke, Berlin.

ENDLICHER S. 1847. Synopsis coniferarum. Schetlin and Zollikofer, Sangalli.

FIJAŁKOWSKA A. 1989. Nowe dane o palinostratygrafii osadów górnego triasu w północno-zachodniej części Gór Świętokrzyskich. Prz. Geol., 38(5): 252–256.

FIJAŁKOWSKA A. 1990. Palinostratygrafia osadów górnego permu i triasu w otworze wiertniczym Radwanów IG 1. Kwart. Geol., 34(4): 647–676.

FIJAŁKOWSKA A. 1992a. Palinostratygrafia osadów cechsztynu i dolnego pstrego piaskowca w północno-zachodniej części Gór Świętokrzyskich. Prz. Geol., 40(8): 468–473.

FIJAŁKOWSKA A. 1992b. Palynostratigraphy of the Keuper and Rhaetic in north-western margin of the Holy Cross Mts. Kwart. Geol., 36: 199–210.

FIJAŁKOWSKA A. 1994a. Palynological aspects of the Permo-Triassic succession in the Holy Cross Mountains, Poland. Docum. Nat., 87: 1–76.

FIJAŁKOWSKA A. 1994b. Palynostratigraphy of the Lower and Middle Buntsandstein in north-western part of the Holy Cross Mts. Kwart. Geol., 38(1): 59–96.

FIJAŁKOWSKA A. 1995. Palynostratigraphy and palynofacies of the Permian-Triassic transitional sequence in the Żary Pericline (SW Poland). Geol. Quart., 39(3): 307–332.

FIJAŁKOWSKA A. & UCHMAN A. 1993. Nowe dane do palinologii triasu Tatr Polskich. Prz. Geol., 41(5): 373–375.

FIJAŁKOWSKA-MADER A. 1999. Palynostratigraphy, palaeoecology and palaeoclimatology of the Triassic in South-Eastern Poland. Zbl. Geol. Paläont. Teil I, 1998(7–8): 601–627.

FIJAŁKOWSKA-MADER A. 2013. Palinostratygrafia, paleoekologia i paleoklimat późnego permu i triasu Niecki Nidy. Biul. Inst. Geol., 454: 15–70.

FOSTOWICZ-FRELIK Ł. & SULEJ T. 2010. Bone histology of *Silesaurus opolensis* Dzik 2003 from the Late Triassic of Poland. Lethaia, 43(2): 137–148.

FRANZ M. 2009. Litho- und Leitflächenstratigraphie, Chronostratigraphie, Zyklo- und Sequenzstratigraphie des Keupers im Östlichen Zentraleuropäischen Becken (Deutschland, Polen) und Dänischen Becken (Dänemark, Schweden). PhD Thesis, Martin-Luther-Universität, Halle-Wittenberg.

FRASER N. 2006. Dawn of the dinosaurs: Life in the Triasic. Indiana University Press, Bloomington and Indianapolis.

FUGLEWICZ R. 1973. Megaspores of Polish Buntersandstein and their statigraphical significance. Acta Palaeont. Pol., 18(4): 401–451.

FUGLEWICZ R. 1979a. Megaspores found in the earliest Triassic deposits of the Tatra Mountains. Ann. Soc. Geol. Pol., 49(3–4): 271–275.

FUGLEWICZ R. 1979b. Stratygraphy of Buntsandstein in the Borehole Otyń IG-1 (Fore-Sudetic Monocline, Poland). Ann. Soc. Geol. Pol., 49(3–4): 277–288.

FUGLEWICZ R. 1980a. Some new megaspore species of the Triassic of Poland. Acta Palaeont. Pol., 25(2): 233–241.

FUGLEWICZ R. 1980b. Stratigraphy and palaeogeography of Lower Triassic in Poland on the basis of megaspores. Acta Geol. Pol., 30(4): 417–470.

FUGLEWICZ R. & MARCINKIEWICZ T. 1986. Flora. Microflora. Megaspores: 155–177. In: Malinowska L. (ed.), Geology of Poland, vol. III. Atlas of guide and characteristic fossils, part 2a. Mesozoik. Triassic. Wydawnictwa Geologiczne, Warszawa.

FUGLEWICZ R. & ŚNIEŻEK P. 1980. Upper Triassic megaspores from Lipie Śląskie near Lubliniec. Prz. Geol., 28(8): 459–461.

FUGLEWICZ R., PTASZYŃSKI T. & RDZANEK K. 1981. Tropy gadów w utworach pstrego piaskowca w okolicy Ostrowca Świętokrzyskiego. Prz. Geol., 29: 608–609.

FUGLEWICZ R., PTASZYŃSKI T. & RDZANEK K. 1990. Lower Triassic footprints from the Świetokrzyskie (Holy Cross) Mountains, Poland. Acta Palaeont. Pol., 35: 109–164.

GAJEWSKA I. 1978. Stratygrafia i rozwój kajpru w północno-zachodniej Polsce (summary: The stratigraphy and development of the Keuper in northwest Poland). Pr. Inst. Geol., 87: 5–59.

GALLINEK E. 1894. Ueber fossile Fische aus dem oberschlesischen Keuper. Jahr. Schles. Ges. Vaterl. Cultur, 71: 32.

GOEPPERT H. 1836. Die fossilen Farnkräuter. Verhandl. Kaiserl. Leopold.-Caroli. Akad. Naturfor., Suppl., 17: 1–487.

GOEPPERT H. 1841–1846. Die Gattungen der fossilen Pflanzen. Les generes des plantes fossiles. Verlag von Henry und Cohen, Bonn.

GOEPPERT H. 1844. Über die fossilen Cycadeen überhaupt mit Rücksicht auf die in Schlesien vorkommenden Arten. Übersicht der Arbeiten und Veränderungen der Schlesischen Gesellschaft für Vaterländische Cultur im Jahre 1843: 114–144.

GOEPPERT H. 1845. Übersicht der fossilen Flora Schlesien: 157–225. In: Wimmer F. (ed.), Flora von Schlesien preussischen und österreichischen Antheils. Neue Beitrage zur Flora von Schlesien. Ferdinand Hirt's Verlag, Breslau.

GOEPPERT H. 1846a. Ueber die fossile Flora der mittleren Juraschichten in Obreschlesien. Uebersicht der Arbeiten und Veränderungen der Schlesischen Gesellschaft für vaterländische Cultur im Jahre 1845, 139–149.

GOEPPERT H. 1846b. Zur Flora des Muschelkalkes. Uebersicht der Arbeiten und Veränderungen der Schlesischen Gesellschaft für vaterländische Cultur im Jahre 1845: 149–150.

GORZELAK P., NIEDŹWIEDZKI G. & SKAWINA A. 2010. Pathologies of non-marine bivalve shells from the Late Triassic of Poland. Lethaia, 43(3): 285–289.

GOTHAN W. 1909a. *Lepidopteris Ottonis*. In: Potonié H. (ed.), Abbildungen und Beschreibungen fossiler Pflanzen-Reste, 6(110): 1–5.

GOTHAN W. 1909b. *Lepidopteris stuttgardiensis*. In: Potonié H. (ed.), Abbildungen und Beschreibungen fossiler Pflanzen-Reste, 6(111): 1–3.

GOTHAN W. 1909c. *Lepidopteris.* In: Potonié H. (ed.), Abbildungen und Beschreibungen fossiler Pflanzen-Reste, 6(109): 1–4.

GRADZIŃSKI R. & UCHMAN A. 1994. Trace fossils from interdune deposits – an example from the Lower Triassic aeolian Tumlin Sandstone, central Poland. Palaeogeogr., Palaeoclimat., Palaeoecol., 108: 121–138.

GRADZIŃSKI R., GĄGOL J. & ŚLĄCZKA A. 1979. The Tumlin Sandstone (Holy Cross Mts., Central Poland): Lower Triassic deposits of aeolian dunes and interdune areas. Acta Geol. Pol., 29(2): 151–175.

GRAUVOGEL-STAMM L. 1978. La flore du Grés a Voltzia (Buntsandstein Supérieur) des Voges du Nord (France) morphologie, anatomie, interprétations phylogénique et paléogéographique. Sci. Géol. Mém., 50: 1–225.

GRAUVOGEL-STAMM L. & ASH S.R. 2005. Recovery of the Triassic land flora from the end-Permian life crisis. C. R. Palevol, 4: 525–540.

GRODZICKA-SZYMANKO W. 1971. Cyclic-sedimentary subdivision of the Rhaetian of the Polish Lowlands. Bull. Acad. Polon. Sci., Ser. Sci. Terre, 19(3): 137–147.

GRODZICKA-SZYMANKO W. & ORŁOWSKA-ZWOLIŃSKA T. 1972. Stratygrafia górnego triasu NE części obrzeżenia Górnośląskiego Zagłębia Węglowego. Kwart. Geol., 16(1): 216–232.

GRUSZKA B. & ZIELIŃSKI T. 2008. Evidence for a very low-energy fluvial system: a case study from the dinosaur bearing Upper Triassic rocks of Southern Poland. Geol. Quart., 52: 239–252.

GÜRICH G. 1884. Über einige Saurier des Oberschlesischen Muschelkalkes. Zeitsch. Dtsch. Geol. Ges., 36: 125–144.

HARRIS T.M. 1926. The Rhaetic flora of Scoresby Sound East Greenland. Medd. Grønland, 68: 45–148.

HARRIS T.M. 1931. The Fossil Flora of Scoresby Sound East Greenland. Part 1: Cryptogams (Exclusive of Lycopodiales). Medd. Grønland, 85(2): 1–102.

HARRIS T.M. 1932. The Fossil Flora of Scoresby Sound East Greenland, Part 2: Description of seed plants *incertae sedis* together with a discussion of certain cycadophyte cuticules. Medd. Grønland, 85(3): 1–114.

HARRIS T.M. 1935. The fossil flora of Scoresby Sound East Greenland. Part 4: Ginkgoales, Coniferales, Lycopodiales and isolated fructifications. Medd. Grønland, 112 (1): 1–176.

HARRIS T.M. 1937. The fossil flora of Scoresby Sound, East Greenland. Part 5: Stratigraphic relations of the plant beds. Medd. Grønland, 112: 1–114.

HARRIS T. 1942. On two species of hepatics of the Yorkshire Jurassic flora. Ann. Magaz. Nat. Hist., Ser. 11, 9: 393–401.

HARRIS T.M. 1961. The Yorkshire Jurassic Flora I: Thallophyta – Pteridophyta. Trustees of the British Museum (Natural History), London.

HÖRICH O. 1910. *Knorripteris mariana*. In: Potonié H. (ed.), Abbildungen und Beschreibungen fossiler Pflanzen-Reste der palaeozoischen und mesozoischen Formationen, 7(134): 1–19.

HUNT A.P. & LUCAS S.G. 1991. The *Paleorhinus* biochron and the correlation of the non-marine Upper Triassic of Pangea. Palaeontology, 34: 478–501.

JÄGER G.F. 1827. Über die Pflanzenversteinerungen welche in dem Bausandstein von Stuttgart vorkommen. Verlag der J.B. Metzlerschen Buchhandlung, Stuttgart.

JAGT-YAZYKOVA E., JAGT J.W.M., BODZIOCH A. & KONIETZKO-MEJER D. (eds) 2012. Krasiejów – palaeontological inspiration. ZPW „Plik“, Bytom.

JARZYNKA A. & WAWRZYNIAK Z. 2012. Cuticle analysis of the Late Triassic and Middle Jurassic macroflora from Southern Poland as a basis of palaeoenvironmental reconstructions: 88–89. In: 3rd Students International Geological Conference. Abstracts. April 27–30, 2012. Ivan Franko National University of Lviv, Lviv.

JONGMANS W.J & DIJKSTRA S.J. 1973. Fossilium Catalogus II: Plantae. Pars 84 Gymnospermae (Ginkgophyta et Coniferae) VI: 559–686. W. Junk, Gravenhage.

KARASZEWSKI W. 1966. Tropy gadów i ślady wleczenia na powierzchni piaskowca retu z Jarug pod Ostrowcem Świętokrzyskim. Kwart. Geol., 10: 327–333.

KARASZEWSKI W. 1976. *Chirotherium łuniewskii* sp. nov. from Roethian sediments of the Holy Cross Mountains (Central Poland). Bull. Acad. Pol. Sc., Ser. Sc. Terre, 24: 23–25.

KELBER K.-P. 1998. Phytostratigraphische Aspekte der Makrofloren des süddeutschen Keupers. Docum. Nat., 117: 89–115.

KELBER K.-P. 2005. Makroflora (Die Keuperfloren). In: Beutler, G., Hauschke, N., Nitsch, E. & Vath, U. (eds), Deutsche Stratigraphische Kommission, Stratigraphie von Deutschland IV – Keuper. Cour. Forsch.-Inst. Senckenberg, 253: 32–41.

KELBER K.-P. & HANSCH W. 1996. Keuperpflanzen. Die Enträtselung einer über 200 Millionen Jahre alten Flora. Städttische Museen Heilbronn, Heilbronn.

KELBER K.-P. & van KONIJNENBURG-van CITTERT J.H.A. 1997. A new Rhaetian flora from the neighbourhood of Coburg (Germany) – preliminary results. In: Herngreen G.F.W. (ed.), Proceedings 4th European Palaeobotanical and Palynological Conference. Meded. Nederl. Inst. Toegep. Geowetens. TNO, 58: 105–113.

KELBER K.-P. & NITSCH E. 2005. Paläoflora und Ablagerungsräume im unterfränkischen Keuper (Exkursion H am 1. April 2005). Jber. Mitt. Oberrhein. Geol. Ver., N.F., 87: 217–253.

KING G. 1996. Reptiles and herbivory. Chapman & Hall, London.

KIRITCHKOVA A.I. 2006. O tipifikatsii vida *Lepidopteris ottonis* (Göppert) Schimper, 1869 (Pteridospermae, Cycadofilicales). Neftegazovaya Geologiya, 2006(1): 1–15.

KIRITCHKOVA A.I. 2008. The Upper Triassic *Lepidopteris ottonis* (Pteridospermae, Cycadofilicales) and its typification. Bot. Zhur., 93(6): 934–943. (in Russian with English summary).

KŁAPCIŃSKI J. 1993. Litostratygrafia profili głębokich otworów wiertniczych w regionie opolskim. Acta Univ. Wratisl., 8: 1–129.

KONIETZKO-MEIER D. & KLEIN N. 2013. Unique growth pattern of *Metoposaurus diagnosticus krasiejowensis* (Amphibia, Temnospondyli) from the Upper Triassic of Krasiejów, Poland. Palaeogeogr., Palaeoclimat., Palaeoecol., 370: 145–157.

KONIETZKO-MEIER D. & SANDER P.M. 2013. Long bone histology of *Metoposaurus diagnosticus* (Temnospondyli) from the Late Triassic of Krasiejów

(Poland) and its paleobiological implications. J. Verteb. Paleontol., 33(5): 1003–1018.

KONIETZKO-MEIER D. & WAWRO K. 2007. Variation in tooth rows distribution in *Metoposaurus diagnosticus krasiejowensis* (Temnospondyli) from Late Triassic of Krasiejów (Silesia, south-western Poland). Acta Palaeont. Pol., 52: 213–215.

KONIETZKO-MEIER D., BODZIOCH A. & SANDER P.M. 2013. Histological characteristics of the vertebral intercentra of *Metoposaurus diagnosticus* (Temnospondyli) from the Upper Triassic of Krasiejów (Upper Silesia, Poland). Earth Environ. Sci. Transac. Royal Soc. Edinb., 103: 237–250.

van KONIJNENBURG-van CITTERT J.H.A., KUSTATSCHER E. & WACHTLER M. 2006. Pteridophytes from the Anisian locality Kühwiesenkopf (Dolomites, Northern Italy). Palaeontology, 49(5): 943–968.

KOTLICKI S. 1974. Stratigraphic position of the Triassic sediments in the Upper Silesian region. Bull. Acad. Polon. Sci., Sér. Sci. Terre, 22(3/4): 161–166.

KOTLICKI S. & KUBICZ A. 1974. Trias Śląska Opolskiego: 18–26. In: J. Rutkowski (ed.), Przewodnik XLVI Zjazdu Polskiego Towarzystwa Geologicznego, Opole 12–14 września 1974. Wydawnictwa Geologiczne, Warszawa.

KOWAL-LINKA M. & BODZIOCH A. 2012. Warstwy kościonośne z *Dactylosaurus* (Reptilia, Sauropterygia) z retu (trias dolny, olenek) Opolszczyzny (summary: Bonebeds with *Dactylosaurus* (Reptilia, Sauropterygia) from the Röt (Lower Triassic, Olenekian) in the Opole Silesia region (S Poland). Prz. Geol., 60: 646–649.

KOZUR H.W. & BACHMANN G.H. 2008. Updated correlation of the Germanic Triassic with the Tethyan scale and assigned numeric ages. Ber. Geol. B.-A., 76: 53–58.

KOZUR H.W. & WEEMS R.E. 2010. The biostratigraphic importance of conchostracans in the continental Triassic of the northern hemisphere. In: Lucas S.G. (ed.), The Triassic Timescale. Geol. Soc., London, Spec. Publ., 334: 315–417.

KRÄUSEL R. 1952. *Pachylepis* nov. gen., eine neue Koniferen-Gattung aus dem süddeutschen Keuper. Senckenbergiana, 32: 343–350.

KRUPNIK J. & ZIAJA J. 2010. Analiza palinologiczna i palinofacjalna osadów mezozoicznych z rejonu Gór Świętokrzyskich: 109. In: Szczepkowski A. & Obidziński A. (eds), Streszczenia referatów i plakatów, 55 Zjazd Polskiego Towarzystwa Botanicznego „Planta in Vivo, in Vitro et in Silico", 6–12 września 2010, Warszawa.

KRUPNIK J., ZIAJA J. & FELDMAN-OLSZEWSKA A. 2011. Wstępne wyniki badań palinologicznych wiercenia Huta OP-1 (trias-jura) z północnego obrzeżenia Gór Świętokrzyskich: 110–111. In: Matyja B. A., Wierzbowski A. & Ziółkowski P. (eds), Jurassica IX, Materiały konferencyjne, Abstrakty, Małogoszcz, 06-08.09.2011. Polskie Towarzystwo Geologiczne, Polska Grupa Robocza Systemu Jurajskiego.

KULETA M., NIEDŹWIEDZKI G. & PTASZYŃSKI T. 2001. Tropy kręgowców z retu Baranowa, Góry Świętokrzyskie (summary: Vertebrate tracks from the Roetian of Baranów (Holy Cross Mts. Central Poland). Prz. Geol., 49(4): 325–327.

KULETA M., NIEDŹWIEDZKI G. & PTASZYŃSKI T. 2005. Nowe stanowisko z tropami kręgowców z górnego pstrego piaskowca Gór Świętokrzyskich (summary: New site with vertebrate footprints from the Upper Buntsandstein of the Holy Cross Mountains, Central Poland). Prz. Geol., 53(2): 151–155.

KULETA M., NIEDŹWIEDZKI G. & ZBROJA S. 2006. Stanowisko z tropami kręgowców z osadów najwyższego środkowego pstrego piaskowca Gór Świętokrzyskich (summary: Vertebrate track site in the uppermost Middle Buntsandstein of the Holy Cross Mountains, Poland). Prz. Geol., 54(12): 1081–1088.

KUNISCH H. 1886. *Voltzia Krappitzensis* nov. sp. aus dem Muschelkalke Oberschlesiens. Zeitsch. Dtsch. Geol. Ges., 38: 894–898.

KÜRSCHNER W.M. & HERNGREEN G.F.W. 2010. Triassic palynology of central and northwestern Europe: a review of palynofloral diversity patterns and biostratigraphic subdivisions. In: Lucas S.G. (ed.), The Triassic Timescale. Geol. Soc., London, Spec. Publ., 334: 263–283.

KUSTATSCHER E. & van KONIJNENBURG-van CITTERT J.H.A. 2005. The Ladinian Flora (Middle Triassic) of the Dolomites: palaeoenvironmental reconstructions and palaeoclimatic considerations. Geo. Alp., 2: 31–51.

KUSTATSCHER E. & van KONIJNENBURG-van CITTERT J.H.A. 2008. Lycophytes and horsetails from the Triassic Flora of Thale (Germany). Neues Jahrb. Geol. Paläont., 250(1): 65–77.

KUSTATSCHER E., HEUNISCH C. & van KONIJNENBURG-van CITTERT J.H.A. 2012. Taphonomical implications of the Ladinian megaflora and palynoflora of Thale (Germany). Palaios, 27(11): 753–764.

LILPOP J. & KOSTYNIUK M. 1957. Roślinność Polski w epokach minionych. Wydawnictwa Geologiczne, Warszawa.

LIMANOWSKI M. 1901. Fauna werfeńska w Tatrach. O wysepkach pratatrzańskich. Kosmos, 26: 15–17.

LINCK O. 1950. Koniferen-Fruchtschuppen (*Voltzia? quinquies* n. sp.) und Gymnospermen-Samen aus dem oberen Gipskeuper Nord-Württembergs (Mittl. Keuper 1). Jahresber. Mitt. Oberrh. Geol. Ver., 32: 41–46.

LINTNEROVÁ O., MICHALÍK J., UHLÍK P., SOTÁK J. & WEISSOVÁ Z. 2013. Latest Triassic climate humidification and kaolinite formation (Western Carpathians, Tatric Unit of the Tatra Mts.). Geol. Quart., 57(4): 701–728.

LIS J. & WÓJCIK Z. 1960. Triassic bone breccia and karst forms in Stare Gliny quarry near Olkusz (Cracow Upland). Kwart. Geol., 4: 55–75.

LOOY C.V., BRUGMAN W.A., DILCHER D.L. & VISSCHER H. 1999. The delayed resurgence of equatorial forests after the Permian-Triassic ecologic crisis. Proc. Nat. Acad. Sci., 96(24): 13857–13862.

LUCAS S.G. 1998. Global Triassic tetrapod biostratigraphy and biochronology. Paleogeogr., Paleoclimatol., Paleoecol., 143: 347–384.

LUCAS S.G. 2006. *Sanmiguelia* from the Upper Triassic Chinle Group, east-central New Mexico, and its biostratigraphic significance. In: Harris et al. (eds), The Triassic-Jurassic Terrestrial Transition. New Mex. Mus. Nat. Hist. Sci. Bull., 37: 407–409.

LUCAS S.G. 2007. Upper Triassic Chinle Group, western United States: a nonmarine standard for late Triassic time: 209–228. In: Dickins J.M., Zunyi Y., Hongfu Y., Lucas S.G. & Acharyya S.K. (eds), Late Palaeozoic and Early Mesozoic Circum-Pacific Events and their Global Correlation. Cambridge University Press, Cambridge.

LUCAS S.G., SPEILMANN J.A. & HUNT A.P. 2007a. Biochronological significance of Late Triassic tetrapods from Krasiejów, Poland. New Mex. Mus. Nat. Hist. Sci. Bull., 41: 248–258.

LUCAS S.G., HUNT A.P., HECKERT A.B. & SPIELMANN J.A. 2007b. Global Triassic tetrapod biostratigraphy and biochronology: 2007 status. New Mex. Mus. Nat. Hist. Sci. Bull., 41: 229–240.

MACHALSKI M. & MACHALSKA K. 1994. Arthropod tracks, *"Diplichnites" triassicus* (Linck, 1843), from the Lower Triassic (Buntsandstein) fluvial deposits of the Holy Cross Mts, Central Poland. Acta Geol. Pol., 44(3–4): 267–275.

MADER D. 1990. Palaeoecology of the Flora in Buntsandstein and Keuper in the Triassic of Middle Europe. Volume 2. Keuper and Index. Gustav Fischer Verlag, Stuttgart – New York.

MADER D. 1995. Taphonomy, sedimentology and genesis of plant fossil deposit types in Lettenkohle (Lower Keuper) and Schilfsandstein (Middle Keuper) in Lower Franconia (Germany). Peter Lang, Frankfurt am Main.

MADER D. 1997. Palaeoenvironmental evolution and bibliography of the Keuper (Upper Triassic) in Germany, Poland and other parts of Europe. Sven von Loga Verlag, Köln.

MADER D. & RDZANEK K. 1985. Sandy braidplain deposition with minor pedogenesis in the Labyrinthodontidae Beds (Middle Buntsandstein) of the northeastern Holy Cross Mountains, Poland. In: Mader D. (ed.), Aspects of Fluvial Sedimentation in the Lower Triassic Buntsandstein of Europe. Lect. Not. Earth Sci., 4: 287–317.

MÄGDEFRAU K. 1953. Neue Funde fossiler Coniferen im Mittleren Keuper von Haßfurt (Main). Geol. Bl. NO-Bayern, 3(2): 49–58.

MÄGDEFRAU K. 1956. Zur fossilen Flora des Mittleren Keupers von Haßfurt (Main). Geol. Bl. NO-Bayern, 6(3): 84–90.

MÄGDEFRAU K. 1963. Die Gattungen *Voltzia* und *Glyptolepis* im Mittleren Keuper von Haßfurt (Main). Geol. Bl. NO-Bayern, 13: 95–98.

MANDER L., COLLINSON M.E., CHALONER W.G., BRAIN A.P.R. & LONG D.G. 2012. The ultrastructure and botanical affinity of the problematic mid-Mesozoic palynomorph *Ricciisporites tuberculatus* Lundblad. Intern. J. Plant Sci., 173(4): 429–440.

MARCINKIEWICZ T. 1962. Megaspory retyku i liasu z wiercenia Mechowo koło Kamienia Pomorskiego i ich wartość stratygraficzna (summary: Rhaetian and Lias megaspores from the borehole Mechowo near Kamień Pomorski and their stratigraphical value). Pr. Inst. Geol., 30(3): 469–493.

MARCINKIEWICZ T. 1969. Granica miedzy retykiem i liasem w Polsce pozakarpackiej na podstawie badań florystycznych (summary: Boundary between Rhaetic and Lias in the Extra-Carpathian area of Poland, determined on floristic basis). Kwart. Geol., 13(1): 100–114.

MARCINKIEWICZ T. 1971. The stratigraphy of the Rhaetian and Lias in Poland based on megaspore investigations. Pr. Inst. Geol., 65: 1–58.

MARCINKIEWICZ T. 1976. Distribution of megaspore assemblages in Middle Bundsandstein of Poland. Acta Palaeont. Pol., 21(2): 191–200.

MARCINKIEWICZ T. 1978. Zespoły megasporowe w kajprze Polski (summary: Megaspore assemblages in the Keuper of Poland). Pr. Inst. Geol., 87: 61–84.

MARCINKIEWICZ T. 1981. W sprawie megaspor z Lipia Śląskiego koło Lublińca (On the question of megaspores from Lipie Śląskie). Prz. Geol., 39(8): 419–420. (in Polish).

MARCINKIEWICZ T. 1992a. The megaspore assemblage of *Capillisporites germanicus* from the Middle Triassic of Poland. Geol. Quart., 36(1): 33–74.

MARCINKIEWICZ T. 1992b. Remarks to the discussion on distribution of smooth spherules on Mesozoic megaspores with particular references to the species *Verrutriletes utilis* (Marcinkiewicz) Marcinkiewicz. Geol. Quart., 36(4): 421–434.

MARCINKIEWICZ T. 1992c. Megasporowy schemat stratygraficzny osadów pstrego piaskowca w Polsce (summary: Megaspore stratigraphical scheme of the Buntsandstein sediments in Poland). Biul. Inst. Geol., 368: 65–96.

MARCINKIEWICZ T. & ORŁOWSKA-ZWOLIŃSKA T. 1985. Współwystępowanie zespołu miospor *Corollina meyeriana*, z megasporą *Striatriletes ramosus* sp.n. w osadach najwyższego triasu Polski (summary: Cooccurence of the *Corollina meyerana* miospore assemblage: and megaspore *Striatriletes ramosus* sp. n. in the Uppermost Triassic of Poland). Geol. Quart., 29(3/4): 691–712.

MARCINKIEWICZ T. & ORŁOWSKA-ZWOLIŃSKA T. 1994. Miospores, megaspores and *Lepidopteris ottonis* (Goeppert) Schimper in the uppermost Triassic deposits from Poland Geol. Quart., 38(1): 91–116.

MAREK S. & PAJCHLOWA M. (eds) 1997. Epikontynentalny perm i mezozoik w Polsce (summary: The Epicontinental Permian and Mesozoic in Poland). Pr. Inst. Geol., 153: 1–452.

MARYNOWSKI L. & SIMONEIT B.R.T. 2009. Widespread Late Triassic to Early Jurassic wildfire records from Poland: evidence from charcoal and pyrolytic polycyclic aromatic hydrocarbons. Palaios, 24: 785–798.

MAZUREK D. & SŁOWIAK J. 2009. Silezaur dinozaurem? (Was *Silesaurus* a dinosaur?). Prz. Geol., 57(7): 569–571. (in Polish).

MERCKLIN C.E. 1852. Prospectus der Paläontologischen Pflanzenüberresten in Russland, so wie ihrer Erforschung. Bull. Cl. Phys.-Mathém. Acad. Imper. Sci. Saint-Petersbourg, 10(24): 373–384.

MERCKLIN C.E. 1855 (1856). Palaeodendrologikon Rossicum, vergleichende anatomisch-mikroskopische Untersuchungen fossile Holzer. Buchdruckerei der Kaiserlichen Akademie der Wissenschaften, St. Petresburg.

MEYEN S.V. 1987. Fundamentals of Palaeobotany. Chapman and Hall, London – New York.

MICHAEL R. 1893. Ueber eine neue Lepidosteiden-Gattung aus dem oberen Keuper Oberschlesiens. Zeit. Dtsch. Geol. Ges., 45: 710–729.

MICHAEL R. 1894. Ueber eine neue Lepidosteiden-Gattung aus dem oberen Keuper Oberschlesiens. Jahr. Schles. Ges. Vaterl. Cultur, 71: 71–74.

MICHAEL R. 1895a. Ueber fossile Fischer aus dem oberen Keuper Oberschlesiens. Jahr. Schles. Ges. Vaterl. Cultur, 72: 20.

MICHAEL R. 1895b. Ueber zwei neue Pflanzeresten aus dem oberschlesischen Muschelkalk. Naturwissen. Wochensch., 10(41): 491–492.

MICHALÍK J., PLENDEROVÁ E. & SÝKORA M. 1976. To the stratigraphic and paleogeographic position of the Tomanová Formation in the Uppermost Triassic of the West Carpathians. Geol. Zb., Geol. Carpath., 27(2): 299–318.

MICHALÍK J., KÁTLOVSKÝ V. & HLUŠTÍK A. 1988. Plant remains in the Tomanová Formation (Uppermost Triassic, West Carpathians): their origin, composition and diagenetic alteration. Geol. Zb., Geol. Carpath., 39(5): 523–537.

MILLER C.N. 1977. Mesozoic conifers. Bot. Rev., 43(2): 217–280.

NATHORST A.G. 1910. Lés depôts mésozoiques précrétacés de la Scanie. Geol. Förenin. Stockholm Förhandl., 32(3): 487–532.

NAWROCKI J. & SZULC J. 2000. The Middle Triassic magnetostratigraphy from the Peri-Tethys basin in Poland. Earth Planet. Sci. Lett., 182: 77–92.

NIEDŹWIEDZKI G. 2005. Nowe znalezisko śladów dinozaurów w górnym triasie Tatr (summary: A new find of dinosaur footprints in the Upper Triassic of the Tatra Mountains, southern Poland). Prz. Geol., 53(5): 410–413.

NIEDŹWIEDZKI G. 2008. Dinosaur tracks in the Late Triassic of the Tatra Mountains: 62–63. In: Pisera A., Bitner M.A. & Halamski A.T. (eds.), Abstracts, 9th Paleontological Conference, Warszawa, 10–11 October, 2008. Polish Academy of Sciences, Institute of Paleobiology, Warszawa.

NIEDŹWIEDZKI G. 2011. A Late Triassic dinosaur-dominated ichnofauna from the Tomanová Formation of the Tatra Mountains, Central Europe. Acta Palaeont. Pol., 56(2): 291–300.

NIEDŹWIEDZKI G. & PTASZYŃSKI T. 2007. Large Chirotheriidae tracks in the Early Triassic of Wióry, Holy Cross Mountains, Poland. Acta Geol. Pol., 57(3): 325–342.

NIEDŹWIEDZKI G. & SULEJ T. 2007. Tropy kręgowców w górnym triasie Polski: 93–94. In: Żylińska A. (ed.), Granice Paleontologii, XX Konferencja Naukowa Paleobiologów i Biostratygrafów PTG, Św. Katarzyna pod Łysicą, 10–13 września 2007. Polskie Towarzystwo Geologiczne, Kielce-Warszawa.

NIEDŹWIEDZKI G. & SULEJ T. 2008. Lipie Śląskie koło Lisowic – okno na późnotriasowy ekosystem lądowy (Lipie Śląskie off Lisowice – a window on the Late Triassic continental ecosystem). Prz. Geol., 56 (9): 821–822. (in Polish).

NIEDŹWIEDZKI G., BRUSATTE S.L. & BUTLER R.J. 2013. *Prorotodactylus* and *Rotodactylus* tracks: an ichnological record of dinosauromorphs from the Early-Middle Triassic of Poland. In: Nesbitt S.J., Desojo J.B. & Irmis R.B. (eds), Anatomy, phylogeny and palaeobiology of early archosaurs and their kin. Geol. Soc., London, Spec. Publ., 379: 319–351.

NIEDŹWIEDZKI G., GORZELAK P. & SULEJ T. 2011. Bite traces on dicynodont bones and the early evolution of large terrestrial predators. Lethaia, 44: 87–92.

NIEDŹWIEDZKI G., SULEJ T. & DZIK J. 2012. A large predatory archosaur from the Late Triassic of Poland. Acta Palaeont. Pol., 57(2): 267–276.

NIEDŹWIEDZKI G., KIN A., REMIN Z. & MAŁKIEWICZ M. 2007. Środkowotriasowa ichnofauna kręgowców z „warstw z Krynek" w Górach Świętokrzyskich – wstępny przegląd (summary: Middle Triassic vertebrate ichnofauna from the "Krynki Beds" in the Holy Cross Mountains – preliminary review). Prz. Geol., 55(10): 870–879.

OCIEPA A.M., STANECZKO K., FELDMAN-OLSZEWSKA A. & BARBACKA M. 2008. Nowe stanowiska *Lepidopteris ottonis* (Goeppert) Schimper w Polsce. In: Krobicki M. (ed.), Utwory przełomu jury i kredy w zachodnich Karpatach fliszowych polsko-czeskiego pogranicza, Jurassica VII, 27–29.09.2008, Żywiec/Štramberk, Abstrakty. Kwartalnik AGH Geologia, 34(3/1): 199–200.

OLEMPSKA E. 2004. Late Triassic spinicaudatan crustaceans from southwestern Poland. Acta Palaeont. Pol., 49: 429–442.

OLEMPSKA E. 2011. Fresh-water ostracods from the Late Triassic of Poland. Joann. Geol. Paläontol., 11: 154–155.

ORŁOWSKA-ZWOLIŃSKA T. 1967. Mikroflorystyczne kryteria oceny wieku warstw z pogranicza triasu i jury na terenie Polski Pozakarpackiej (summary: Microfloristic criteria for age dermination of the beds occuring At the Triassic-Jurassic boundary in the Extra-Carpathian areas of Poland). Biul. Inst. Geol., 203: 47–57.

ORŁOWSKA-ZWOLIŃSKA T. 1971. On several stratigraphically important species of sporomorphs occurring in the Keuper of Poland. Acta Soc. Botan. Pol., 40(4): 633–651.

ORŁOWSKA-ZWOLIŃSKA T. 1976. Palynological chracteristics of the reed sandstone in Polish Lowland area. Acta Geol. Pol., 26(4): 557–567.

ORŁOWSKA-ZWOLIŃSKA T. 1977. Palynological correlation of the Bunter and Muschelkalk in selected profiles from Western Poland. Acta Geol. Pol., 27: 417–430.

ORŁOWSKA-ZWOLIŃSKA T. 1983. Palinostratygrafia epikontynentalnych osadów wyższego triasu w Polsce (summary: Palynostratigraphy of the upper part of Triassic epicontinental sediments in Poland). Pr. Inst. Geol., 104: 1–89.

ORŁOWSKA-ZWOLIŃSKA T. 1984. Palynostratigraphy of the Buntsandstein in sections of western Poland. Acta Palaeont. Pol., 29(3–4): 161–194.

ORŁOWSKA-ZWOLIŃSKA, T. 1985. Palynological zones of the Polish epicontinental Triassic. Bull. Pol. Acad. Sci., Earth Sci., 33: 107–117.

ORŁOWSKA-ZWOLIŃSKA T. 1986. Flora. Microflora. Miospores: 126–155. In: Malinowska L. (ed.), Geology of Poland, vol. III. Atlas of guide and characteristic fossils, part 2a. Mesozoik. Triassic. Wydawnictwa Geologiczne, Warszawa.

ORŁOWSKA-ZWOLIŃSKA T. 1988. Palinostratygrafia utworów triasu w okolicach Brzegu – SE część monokliny przedsudeckiej (summary: Palynostratigraphy of Triassic deposits in the vicinity of Brzeg – SE part of the Fore-Sudetic Monocline. Geol. Quart., 32(2): 349–366.

ORŁOWSKA-ZWOLIŃSKA T. & SENKOWICZOWA H. 1970. Flora triasu: 17–19. In: Budowa Geologiczna Polski. Tom II. Katalog Skamieniałości. Część 2. Mezozoik. Wydawnictwa Geologiczne, Warszawa.

OOSTENDORP C. 1987. The Bryophytes of the Palaeozoic and the Mesozoic. Bryophytorum Bibliotheca, 34: 1–112.

PACYNA G. 2013. Critical review of research on the Lower Jurassic flora of Poland. Acta Palaeobot., 53(2): 141–163.

PACYNA G., ZDEBSKA D., BARBACKA M. & ZIAJA J. 2013a. Co jadły polskie dinozaury? Wszechświat, 114(7): 250–252.

PACYNA G., ZDEBSKA D., BARBACKA M. & ZIAJA J. 2013b. Ewolucja i sukcesja flor towarzyszących szczątkom kostnym i tropom dinozaurów w górnym triasie i dolnej jurze południowej Polski: 44–45. In: Kędzierski M. & Kołodziej B. (eds), „Aktualizm i antyaktualizm w paleontologii" 22 Konferencja Naukowa Sekcji Paleontologicznej Polskiego Towarzystwa Geologicznego, 27–30.09.2013, Tyniec. Materiały konferencyjne. Polskie Towarzystwo Geologiczne, Kraków.

PAWŁOWSKA K. 1979. Utwory triasowe w południowo-wschodniej części Gór Świętokrzyskich (summary: Triassic rocks of south-eastern Góry Świętokrzyskie Mts.). Kwart. Geol., 23(2): 337–362.

PAUTSCH M. 1958. Keuper sporomorphs from Świerczyna, Poland. Micropalaeontology, 4(3): 321–325.

PAUTSCH M. 1971. Sporomorphs of the Upper Triassic from the borehole at Trzciana near Mielec (S. Poland). Acta Palaeobot., 12(1): 1–59.

PAUTSCH M. 1973. Upper Triassic spores and pollen from the Polish Carphatian Foreland. Micropalaeontology, 19(2): 129–149.

PIECHOWSKI R. & DZIK J. 2010. The axial skeleton of *Silesaurus opolensis*. J. Verteb. Paleontol., 30: 1127–1141.

PIEŃKOWSKI G. 1988. Analiza facjalna najwyższego triasu i liasu Wyżyny Krakowsko-Wieluńskiej oraz perspektywy występowania surowców ilastych (summary: Facial analysis of the Uppermost Triassic and the Liassic of the Cracow-Wieluń Upland and prospectes for occurrence of clay deposits). Prz. Geol., 36(8): 449–456.

PIEŃKOWSKI G. 2004. The epicontinental Lower Jurassic of Poland. Pol. Geol. Inst. Special Papers, 12: 1–122.

PIEŃKOWSKI G., NIEDŹWIEDZKI G. & WAKSMUNDZKA M. 2012. Sedimentological, palynological and geochemical studies of the terrestrial Triassic–Jurassic boundary in northwestern Poland. Geol. Mag., 149(2): 308–332.

PIWOCKI M. 1970. *Lepidopteris ottonis* z retyku południowej części monokliny przedsudeckiej (summary: *Lepidopteris ottonis* from the Rhaetic deposits of the southern part of the Fore-Sudetic Monocline). Kwart. Geol., 14(1): 101–106.

POTONIÉ H. 1897. Lehrbuch der Pfanzenpalaeontologie. Ferd. Dümmlers Verlagsbuchhandlung, Berlin.

PRETO N., KUSTATSCHER E. & WIGNALL P.B. 2010. Triassic climates – state of the art and perspectives. Palaeogeogr., Palaeoclimat., Palaeoecol., 290: 1–10.

PTASZYŃSKI T. 1996. Ślady gadów w najniższym pstrym piaskowcu okolic Ostrowca Świętokrzyskiego (summary: Reptile tracks in the lowermost Buntsandstein near Ostrowiec Świętokrzyski – Central Poland). Prz. Geol., 44(10): 1042–1043.

PTASZYŃSKI T. 2000a. Lower Triassic vertebrate footprints from Wióry, Holy Cross Mountains, Poland. Acta Palaeont. Pol., 45: 151–194.

PTASZYŃSKI T. 2000b. Tropy kręgowców z piaskowca tumlińskiego Góry Grodowej – Góry Świętokrzyskie (summary: Vertebrate tracks from the Tumlin sandstone of Grodowa Hill, Holy Cross Mts. – Central Poland). Prz. Geol., 48(5): 418–421.

PTASZYŃSKI T. & NIEDŹWIEDZKI G. 2002. Nowe znaleziska tropów kręgowców z pstrego piaskowca Gór Świętokrzyskich (summary: New finds of vertebrate tacks from the Buntsandstein of the Holy Cross Mountains – Central Poland). Prz. Geol., 50(5): 441–446.

PTASZYŃSKI T. & NIEDŹWIEDZKI G. 2004. Late Permian vertebrate tracks from the Tumlin Sandstone, Holy Cross Mountains, Poland. Acta Palaeont. Pol., 49(2): 289–320.

PTASZYŃSKI T. & NIEDŹWIEDZKI G. 2006. Pstry piaskowiec w Górach Świętokrzyskich: chronostratygrafia i korelacja litostratygraficzna z basenem turyńskim (summary: Buntsandstein in the Holy Cross Mountains: chronostratigraphy and lithostratigraphical correlation with the Thuringian Basin). Prz. Geol., 54(6): 525–533.

RACIBORSKI M. 1890a. Flora retycka w Tatrach. Rozpr. Wydz. Mat.-Przyr. Pol. Akad. Umiej., 21: 243–260.

RACIBORSKI M. 1890b. Ueber eine fossile Flora in der hohen Tatra. Anz. Akad. Wiss. Krakau, October 1890: 230–232.

RACIBORSKI, M. 1890c. Ueber eine fossile Flora in der Tatra. Eine vorläufige Mittheilung. Verhandl. K.K. Geol. Reichsan., 1890(14): 263–265.

RACIBORSKI M. 1892. Zapiski paleobotaniczne 7. Ret tatrzański. 9. Obecność rodzaju *Ptilozamites* w recie górnego Szląska. 11. Najstarszy znany wątrobowiec. 12. Nowa *Gyroporella*. Kosmos, 17(11–12): 526–533.

RACIBORSKI M. 1893. Ueber ein neues fossils Lebermoos. Jahr-Ber. Schles. Ges. Vaterl. Cultur, 70: 26–27.

RACIBORSKI M. 1927. Paleobotanika: 206–240. In: Michalski S. (ed.), Poradnik dla samouków, T. VII, Botanika II. Wydawnictwo Kasy im. Mianowskiego Instytutu Popierania Polskiej Twórczości Naukowej, Warszawa.

RACKI G. 2010. Ewolucja środowisk lądowych kajpru Górnego Śląska jako biotopów kręgowców – nowy projekt badawczy (Evolution of Late Triassic terrestrial environments in the Upper Silesia as vertebrate habitats – a new research project). Prz. Geol., 58(2): 124–126. (in Polish).

RAYFIELD E.J., BARRETT P.M., MCDONNEL R.A. & WILLIS K.J. 2005. A Geographical Information System (GIS) study of Triassic vertebrate biochronology. Geol. Mag., 142(4): 327–354.

RDZANEK K. 1982. Stratigraphy of the Bunter of the Bukowie brachyantycline (NE margin of the Holy Cross Mts. Poland) on the basis of megaspores. Ann. Soc. Geol. Pol., 52(1–4): 211–230.

REYMANÓWNA M. 1984. Flora retycka z Czerwonych Żlebków: 12–13. In: Paleontologia mezozoiku Tatr. Materiały VIII Konferencji Paleontologów, Zakopane, 8–10 czerwca 1984. Sekcja Paleontologiczna Polskiego Towarzystwa Geologicznego, Instytut Nauk Geologicznych UJ, Komisja Paleontologii przy Komitecie Nauk Geologicznych PAN. Wydawnictwo AGH, Kraków.

REYMANÓWNA M. 1986. Macroflora. Classes Pteridophyta and Spermatophyta: 184–186. In: Malinowska L. (ed.), Geology of Poland. Volume III. Atlas of guide and characteristic fossils. Part 2a. Mesozoic. Triassic. Wydawnictwa Geologiczne, Warszawa.

REYMANÓWNA M. & BARBACKA M. 1981. *Lepidopteris ottonis* (Goeppert) Schimper z Wyżyny Śląsko-Krakowskiej i obrzeżenia Gór Świętokrzyskich (*Lepidopteris ottonis* (Goepp.) Schimp. from Śląsko-Krakowska Highland and Holy Cross Mountains): 79–84. In: Fauna i flora triasu obrzeżenia Gór Świętokrzyskich i Wyżyny Śląsko-Krakowskiej. Materiały V Krajowej Konferencji Paleontologicznej, Kielce-Sosnowiec 1981. (in Polish).

RIEPPEL O. 2000. Handbuch der Paläoherpetologie. Teil 12A. Sauropterygia I. Placodontia, Pachypleurosauria, Nothosauria, Pistosauria. Verlag Dr. Friedrich Pfeil, München.

RIEPPEL M.O. & HAGDORN H. 1997. Paleobiogeography of Middle Triassic Sauropterygia in Central and Western Europe: 121–144. In: Callaway J.M. & Nicholls E.L. (eds), Ancient Marine Reptiles. Academic Press, San Diego.

ROEMER F. 1862. Die Nachweisung des Keupers in Oberschlesien und Polen. Zeitsch. Dtsch. Geol. Ges., 14: 638–654.

ROEMER F. 1863. Weitere Beobachtungen über die Verbreitung und die Gliederung des Keupers in Oberschleschien. Zeitsch. Dtsch. Geol. Ges., 15: 694–707.

ROEMER F. 1866. Geognostische Beobachtungen im Polnischen Mittelgebirge. Zeitsch. Dtsch. Geol. Ges., 18: 667–690.

ROEMER F. 1867. Neuere Beobachtungen über die Gliederung des Keupers und ihn zunächst überlagernden Abteilung der Juraformation in Oberschleschien und ihn den angrenzenden Theilen von Polen. Zeitsch. Dtsch. Geol. Ges., 19: 255–269.

ROEMER F. 1870. Geologie von Oberschlesien. Nischkowsky, Breslau.

ROGHI G., KUSTATSCHER E. & van KONIJNENBURG-van CITTERT J.H.A. 2006. Late Triassic plant from Julian Alps (Italy). Boll. Soc. Paleont. It., 45(1): 133–140.

ROSPOND S. 1951. Słownik nazw geograficznych Polski Zachodniej i Północnej według uchwał Komisji Ustalania Nazw Miejscowości pod przewodnictwem Stanisława Srokowskiego. Część II Niemiecko-Polska. Polskie Towarzystwo Geograficzne, Wrocław, Warszawa.

ROTHWELL G.W., MAPES G., STOCKEY R.A. & HILTON J. 2012. The seed cone *Eathiestrobus* gen. nov.: fossil evidence for a Jurassic origin of Pinaceae. Amer. J. Bot., 99: 708–720.

RÓŻYCKI S.Z. 1930. Sprawozdanie z badań geologicznych, wykonanych w r. 1930 nad utworami górnego kajpru, retyku, liasu i doggeru w południowo-zachodniej części arkusza „Żarki" mapy 1:100.000 (Compte-rendu des recherches géologiques effectuées en 1930). Posiedzenia naukowe Państwowego Instytutu Geologicznego (Comptes-Rendus des Séances du Service Géologique de Pologne), 28: 24–27. (in Polish).

SADLOK G. & WAWRZYNIAK Z. 2013. Upper Triassic vertebrate tracks from Kraków-Częstochowa Upland, southern Poland. Ann. Soc. Geol. Pol., 83(2): 105–111.

SAMPSON S.D. 2012. Dinosaurs of the Lost Continent. Scientific American, 306(3): 40–47.

SAMSONOWICZ J. 1924. Sprawozdanie z badań geologicznych między Wierzbnikiem a Ostrowcem nad Kamienną (Compte rendu des rechereches géologiques entre Wierzbnik et Ostrowiec sur la Kamienna). Posiedzenia naukowe Państwowego Instytutu Geologicznego (Comptes-Rendus des Séances du Service Géologique de Pologne), 8: 24–27. (in Polish).

SAMSONOWICZ J. 1929. Cechsztyn, trias i lias na północnym zboczu Łysogór (summary: Les Zechstein, le Trias et le Liasique sur le versant nord du Massif de S-te Croix). Spraw. Pol. Inst. Geol., 5(1–2): 1–281.

SCHENK A. 1867. Die fossile Flora der Grenzschichten des Keupers und Lias Frankens. Kreidel's Verlang, Wiesbaden.

SCHIMPER W.P. 1869. Traité de paléontologie végétale ou la flore du monde primitif dan ses rapports avec les formations géologiques et la flore du monde actuel, Tome premier. J.B. Bailliére et Fils, Paris.

SCHIMPER W.P. 1870–1872. Traité de paléontologie végétale ou la flore du monde primitif dan ses rapports avec les formations géologiques et la flore du monde actuel, Tome second. J.B. Bailliére et Fils, Paris.

SENKOWICZOWA H. 1966. Subdivision and facial development of Rhaethian in the Holy Cross Mts. Kwart. Geol., 10(3): 769–785.

SENKOWICZOWA H. 1970. Trias. (summary: Triassic). In: Stratygrafia mezozoiku obrzeżenia Gór Świętokrzyskich. Pr. Inst. Geol., 56: 7–48.

SENKOWICZOWA H. 1982. Struktury biogeniczne w osadach retu i dolnego wapienia muszlowego Gór Świętokrzyskich (summary: Biogenic structures in Rhöt and Muschelkalk rocks tn the Góry Świętokrzyskie Mts.). Geol. Quart., 26(3/4): 559–583.

SKAWINA A. 2010. Experimental decay of gills in freshwater bivalves as a key to understanding their preservation in Late Triassic lacustrine deposits. Palaios, 25: 215–220.

SKAWINA A. 2013. Population dynamics and taphonomy of the Late Triassic (Carnian) freshwater bivalves from Krasiejów (Poland). Palaeogeogr., Palaeoclimatol., Palaeoecol., 379: 68–80.

SKAWINA A. & DZIK J. 2011. Umbonal musculature and relationships of the Late Triassic filibranch unionoid bivalves. Zool. J. Linn. Soc., 163: 863–883.

SUES H.-D. 2000. Evolution of herbivory in terrestrial vertebrates. Perspectives from the fossil record. Cambridge University Press, Cambridge.

SUES H.-D. & FRASER N.C. 2010. Triassic life on land. The great transition. Columbia University Press, New York.

SULEJ T. 2002. Species discrimination in the Late Triassic labyrinthodont *Metoposaurus*. Acta Palaeont. Pol., 47: 535–546.

SULEJ T. 2003. Krasiejów. Sensacyjne odkrycia triasowych pra-dinozaurów. Przygoda Studio, Opole.

SULEJ T. 2004. Krasiejów – okno na świat późnego triasu. Otoczak, 31: 2–22.

SULEJ T. 2005. A new rauisuchian reptile (Diapsida: Archosauria) from the Late Triassic of Poland. J. Verteb. Paleontol., 25: 78–86.

SULEJ T. 2007. Osteology, variability, and evolution of *Metoposaurus*, a temnospondyl from the Late Triassic of Poland. Palaeont. Pol., 64: 29–139.

SULEJ T. 2010. The skull of an early Late Triassic aetosaur and the evolution of the stagonolepidid archosaurian reptiles. Zool. J. Linn. Soc., 158: 860–881.

SULEJ T. & MAJER D. 2005. The temnospondyl amphibian *Cyclotosaurus* from the Late Triassic of Poland. Palaeontology, 48: 157–170.

SULEJ T. & NIEDŹWIEDZKI G. 2013. A new large capitosaurid temnospondyl amphibian from the Early Triassic of Poland. Acta Palaeont. Pol., 58(1): 65–75.

SULEJ T., NIEDŹWIEDZKI G. & BRONOWICZ R. 2012. A new Late Triassic vertebrate fauna from Poland with turtles, aetosaurs, and coelophysoid dinosaurs. J. Verteb. Paleontol., 32(5): 1033–1041.

SULEJ T., BRONOWICZ R., TAŁANDA M. & NIEDŹWIEDZKI G. 2011a. A new dicynodont-archosaur assemblage from the Late Triassic (Carnian) of Poland. Earth Environ. Sci. Transact. Royal Soc. Edinburgh, 101: 261–269.

SULEJ T., NIEDŹWIEDZKI G., NIEDŹWIEDZKI R., SURMIK D. & STACHACZ M. 2011b. Nowy zespół kręgowców z marginalno-morskich i lądowych osadów dolnego kajpru –ladyn, środkowy trias– z Miedar na Śląsku (summary: New vertebrate assemblage from marginal-marine and land Lower Keuper strata – Ladinian, Middle Triassic – of Miedary, Silesia, SW Poland). Prz. Geol., 59: 426–430.

STANECZKO K. 2007. Nowe dane paleobotaniczne na temat górnego triasu z Lipia Śląskiego koło Lublińca –południowa Polska: 155–168. Geo-Sympozjum Młodych Badaczy Silesia 2007. Uniwersytet Śląski, Sosnowiec.

SZULC J. 2005. Sedimentary environments of the vertebrate-bearing Norian deposits from Krasiejów, Upper Silesia (Poland). Halles. Jahr. Geowiss. Reihe, B, 19: 161–170.

SZULC J. & BECKER A. (eds) 2007. International Workshop on the Triassic of Southern Poland. September 3–8, 2007. Fieldtrip Guide. Polish Geological Society, Polish Geological Institute and

Institute of Geological Sciences, Jagiellonian University, Cracow.

SZULC J., GRADZIŃSKI M., LEWANDOWSKA A. & HEUNISCH C. 2006. The Upper Triassic crenogenic limestones in Upper Silesia (southern Poland) and their paleoenvironmental context. In: Alonso-Zarza A.M. & Tanner L.H. (eds), Paleoenvironmental Record and Applications of Calcretes and Palustrine Carbonates. Geol. Soc. Amer. Spec. Paper, 416: 133–151.

SZYPERKO-ŚLIWCZYŃSKA A. 1960. O stratygrafii i rozwoju kajpru w Polsce (summary: On Stratigraphy and development of the Keuper in Poland). Kwart. Geol., 4(3): 701–712.

ŚWIŁO M. 2010. Znaleziska szczątków rekinów z Lipia Śląskiego. In: Zatoń M. et al. (eds.) Materiały 21 Konferencji Naukowej Sekcji Paleontologicznej PTG „Kopalne biocenozy w czasie i przestrzeni". Żarki-Letnisko. Pr. Wydz. Nauk o Ziemi UŚ 64: 84.

ŚWIŁO M., NIEDŹWIEDZKI G. & SULEJ T. 2014. Mammal-like tooth from the Upper Triassic of Poland. Acta Palaeont. Pol. http://dx.doi.org/10.4202/app.00016.2013 (accepted for publication).

TAŁANDA M., DZIĘCIOŁ S., SULEJ T. & NIEDŹWIEDZKI G. 2011. Vertebrate burrow system from the Upper Triassic of Poland. Palaios, 26(2): 99–105.

TARLO L.B. 1959. A new Middle Triassic reptile fauna from fissures in the Middle Devonian limestones of Poland. Proc. Geol. Soc. London, 1538: 63–64.

TAYLOR T.N., TAYLOR E.L. & KRINGS M. 2009. Paleobotany: The biology and evolution of fossil plants, Second Edition. Academic Press, Burlington.

WAWRZYNIAK Z. 2010a. Tafonomia późnotriasowej flory z Lipia Śląskiego: 42. In: Dubicka Z., Gorzelak P. & Rakowicz Ł. (eds), II Konferencja Naukowa Młodzi w Paleontologii, Materiały konferencyjne, Środowiskowe Studium Doktoranckie Geobios przy Instytucie Paleobiologii Polskiej Akademii Nauk, 13.03.2010, Warszawa.

WAWRZYNIAK Z. 2010b. Późnotriasowe kutykule z Lipia Śląskiego k. Lublińca. In: Zatoń M. et al. (eds.) Materiały 21 Konferencji Naukowej Sekcji Paleontologicznej PTG „Kopalne biocenozy w czasie i przestrzeni". Żarki-Letnisko. Pr. Wydz. Nauk o Ziemi UŚ 64: 85.

WAWRZYNIAK Z. 2010c. Późnotriasowe kutiule z Lipia Śląskiego: 110. In: Szczepkowski A. & Obidziński A. (eds), Streszczenia referatów i plakatów, 55 Zjazd Polskiego Towarzystwa Botanicznego „Planta in Vivo, in Vitro et in Silico", 6–12 września 2010, Warszawa.

WAWRZYNIAK Z. 2010d. (unpubl.) Późnotriasowa flora z Lipia Śląskiego. MSc Thesis, Archives of the University of Silesia.

WAWRZYNIAK Z. 2010e. What could eat dicynodonts (Dicynodontia, Therapsida) from Lipie Śląskie? (Upper Silesia, Poland) – preliminary results of research of the Late Triassic macroflora. In: Nowakowski D. (ed.), Morphology and Systematics of Fossil Vertebrates. DN Publisher, Wrocław.

WAWRZYNIAK Z. 2011. Kutykule z górnotriasowych osadów Lipia Śląskiego – wskaźniki paleoklimatu. In: Opała M. et al. (eds.) Geo-Sympozjum Młodych Badaczy Silesia 2011 „Współczesne trendy w naukach o Ziemi" Cieszyn 2011. Prace Wydziału Nauk o Ziemi Uniwersytetu Śląskiego, 70: 86.

WAWRZYNIAK Z. & ZIAJA J. 2009. Wstępne wyniki badań górnotriasowej makroflory Lipia Śląskiego, Polska. Preliminary results of research of the Upper Triassic macroflora from Lipie Śląskie, Poland. In: Krobicki M. (ed.), Jurassica VIII, Vršatec 09–11.10.2009. Kwartalnik AGH Geologia, 35(3/1): 105–106.

WAWRZYNIAK Z. & ZIAJA J. 2010. The Upper Triassic Coniferales from Lipie Ślaskie (Poland): 252. In: 8th European Palaeobotany-Palynology Conference, 6–10 July, Budapest, Hungary, Program and Abstracts.

WCISŁO-LURANIEC E. 1984. *Palaeohepatica roemeri* Raciborski, mało znany wątrobowiec kopalny (*Palaeohepatica roemeri* Raciborski a little known fossil liverwort). Wiad. Bot., 28(4): 267–269. (in Polish).

WEBER R. 1968. Die fossile Flora der Rhät-lias-Übergangsschichten von Bayreuth (Oberfranken) unter besonderer Berücksichtigung der Coenologie. Erlan. Geol. Abhandl., 72: 1–73.

ZATOŃ M. & PIECHOTA A. 2003. Carnian (Late Triassic) charophyte flora of the *Paleorhinus* biochron at Krasiejów (SW Poland). Freib. Forschungsh. C, 499: 43–53.

ZATOŃ M., PIECHOTA A. & SIENKIEWICZ E. 2005. Late Triassic charophytes around the bone-bearing bed at Krasiejów (SW Poland) – palaeoecological and environmental remarks. Acta Geol. Pol., 55: 283–293.

ZNOSKO J. 1955. Retyk i lias między Krakowem a Wieluniem (summary: Rhaetic and Lias between Cracow and Wieluń (South-west Poland). Pr. Inst. Geol., 14: 1–146.

ŻYŁA D., WEGIEREK P., OWOCKI K. & NIEDŹWIEDZKI G. 2013. Insects and crustaceans from the latest Early–early Middle Triassic of Poland. Palaeogeogr., Palaeoclimatol., Palaeoecol., 371: 136–144.