Zał. 3b

SUMMARY OF PROFESSIONAL ACCOMPLISHMENTS

1. Name

Piotr Daniel Szrek

2. Diplomas, degrees conferred in specific areas of science or arts, including the name of the institution which conferred the degree, year of degree conferment, title of the PhD dissertation.

2010 – PhD in Earth science in the field of paleontology, Faculty of Geology of Warsaw University; title of the dissertation: *Placodermi of the Devonian Period of the Holy Cross Mountains*; supervisor: Professor Michał Ginter; reviewers: Professor Magdalena Borsuk-Białynicka and Professor Michał Szulczewski.

2004 – MSc in geology in the field of paleontology, Faculty of Geology of Warsaw University (diploma with honours);

2002 – BSc in geology in the field of paleontology, Faculty of Geology of Warsaw University.

3. Information on employment in research institutes or faculties/departments or schools of arts.

2009 – till present – Polish Geological Institute – National Research Institute (2009 – 2010 – specialist; 2010 – 2013 – senior specialist; 2010 – 2016 – director of the Geological Museum; since 2013 – adjunct professor; since 2020 – unpaid leave from the position of an adjunct professor due to taking the position of the Deputy Director for research and development of Polish Geological Institute – National Research Institute.

2007 – 2008 – Institute of Paleontology of the Polish Academy of Sciences; assistant professor.

2005 – 2007 – Museum of Earth of the Polish Academy of Sciences, museum assistant.

4. Description of the achievements, set out in article 219 paragraph 1 point 2 of the Act of July 20, 2018 on Higher Education and Science (Journal of Laws 2020, item 85 as amended). The description should concern the substantive view of the achievements in question as well as precisely define the individual contribution to their development if the achievement is a co-authored work, taking into account the possibility of indicating the achievements of the entire professional career.

The presented series of works discussing the issue of ***Reflection of the evolution of Devonian environments of the Holy Cross Mountains in the fauna of vertebrates with particular emphasis on placoderms*** includes the following articles published in journals indexed in the *Journal of Citation Reports* database:

[A1] **SZREK, P.**, NIEDŹWIEDZKI, G. & DEC, M., 2014. Storm origin of bone-bearing beds in the Lower Devonian placoderm sandstone from Podłazie Hill (Holy Cross Mountains, central Poland). *Geological Quarterly*, 58: 795-806, doi: 10.7306/gq.1191.

I planned and supervised the excavations at the site described in the article. I conducted observations and developed photographic documentation of sedimentary structures and obtained material for analyses. I also developed a research concept. While writing the manuscript I created the first version of the article: I described and illustrated the profile as well as distinguished the basic groups of vertebrates, which was later used in the quantitative and qualitative analysis of vertebrate remains. I authored all the figures as well as the discussion and conclusions of the article. At the review stage, I made some fundamental changes as suggested by the reviewers.

[A2] **SZREK, P.**, DEC, M. & NIEDŹWIEDZKI, G. 2015. The first placoderm fish from the Lower Devonian of Poland. *Journal of Vertebrate Paleontology,* 35(3): e930471 (5 pages). DOI: 10.1080/02724634.2014.930471.

I acquired and cataloged the specimen, made a silicone cast and marked the described fossil. I developed the concept of the article, conducted the main process of comparison with the material from other sites in the world and prepared all the figures, including a comparative one, with a palaeogeographic map and similar representatives of the homosteid group in the world. I took the article through the review process.

[A3] **SZREK, P.**, SALWA, S., NIEDŹWIEDZKI, G., DEC, M., AHLBERG, P.E. & UCHMAN, A. 2016. A glimpse of a fish face - an exceptional fish feeding trace fossil from the Lower Devonian of the Holy Cross Mountains, Poland. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 454: 113-124. DOI: 10.1016/j.palaeo.2016.04.019

I made the discovery within the outcrop as well as identified and labeled the vertebrate trace fossils. I made silicone casts of the traces, which I then scanned with a 3D optical scanner and pre-processed the files. I labeled fish trace fossils, wrote the manuscript of the article, which was later consulted with the other co-authors. I conducted discussions at the review stage and led to the final approval of the final draft of the article.

[A4] **SZREK, P.** & DUPRET, V. 2017. Placoderms from the Early Devonian "placoderm sandstone" of the Holy Cross Mountains, Poland with biostratigraphical and palaeobiogeographical implications. *Acta Palaeontologica Polonica* 62: 789-800. doi.org/10.4202/app.00395.2017.

I collected the specimens, made silicone casts and marked the paleontological material. I wrote the first version of the manuscript, took photos and developed figures and next drew

selected specimens using the drawing apparatus. I participated in discussions with reviewers and made fundamental changes at the stage of editing the article.

[A5] **SZREK P.** 2020. Comments on distribution and taphonomy of Devonian placoderms in the Holy Cross Mountains, Poland. *Bulletin of Geosciences* 95: 23-39. DOI: 10.3140/bull.geosci.1761

[A6] **SZREK P.** & SALWA S. 2020. High-energy events in the Frasnian-Famennian boundary interval of the Płucki section in the Holy Cross Mountains, Poland. *Facies*, 66:9. DOI: 10.1007/s10347-020-0593-0

I organized excavation works, carried out the work uncovering the profile, collected, marked and cataloged fossils, interpreted landslide structures. I prepared the concept and the text of the article. I made figures 1-2, 4-9 and worked with the co-author on the description of the structures. Finally, I wrote the discussion and conclusions.

Introduction

A series of six articles entitled **Reflection of the evolution of Devonian environments of the Holy Cross Mountains in the fauna of vertebrates with particular emphasis on placoderms** includes the outcome of 10-year research focused on palaentological studies from environmental and palaeogeographic perspectives. The research was possible thanks to the implementation of several projects, the most important of which was a grant financed by the Ministry of Science and Higher Education, implemented between 2011-2012 and entitled *Palaeoecology and the evolution of vertebrates in the early Devonian period of the Holy Cross Mountains* (no. IP2010 041470) of which I was the head and under which I developed, as the main author, all the previous publications on the Lower Devonian period, including those indicated as my habilitation scientific accomplishments ([A1], [A2], [A3], [A4]). It was a key project that led to the collection of a wealth of material that is still being used today as a starting point for subsequent projects. It was also the basis for writing two master's theses, which I co-supervised, and to some extent an ongoing doctoral dissertation (financed by a currently implemented grant of the National Centre of Science) of which I am an auxiliary supervisor. The project that made it possible to organize and significantly expand the knowledge about vertebrates from carbonate formations was the grant of the National Centre of Science entitled: *Evolution and paleoecology of vertebrates from carbonate formations of southern Poland* (no. 2016/23/B/ST10/03262) awarded to Professor Michał Ginter, where I was the main executor and which resulted in two publications included in the above-mentioned series ([A5], [A6]) as well as most of post-doctoral achievements regarding Upper Devonian fish.

Research methodology

The research and publications were based on numerous structural and trace fossils obtained in the course of numerous works in bassets as well as those found in museum collections. Field observations regarding the conducted works in numerous bassets consisted both in the acquisition of fossils and in the precise understanding of the context in which they occur in terms of stratigraphy and sedimentology. Depending on the type of rocks, fossils were obtained by making their silicone casts or by processing them mechanically or chemically. Due to the diversity of the conditions and occurrence of fossils in the Devonian period in the Holy Cross Mountains, various methods of preparing them for analyses were used in the course of the research. Lower Devonian fossils, preserved as bone voids, were filled with silicone (GumoSil WW with a catalyst and a pigment reducing the whiteness level of pure silicone), which faithfully reflected the morphology of the analysed specimens. Such specimens were then thoroughly studied and photographed and the selected ones were mapped using a binocular with a drawing adapter.

The fossilized bone remains of the Late Devonian Placodermi are found in the Holy Cross Mountains exclusively in carbonate rocks of various types. Their remains were prepared using two methods: mechanical and chemical ones. The mechanical method consisted in splitting the rocks with a hammer and then removing smaller fragments with the use of preparation tools (chisels, drills, needles). The chemical method, i.e. acid etching, was carried out according to the procedure described in Toombs and Rixon (1959). Basically, it involves removing the limestone in which the bone is stuck by dissolving it in acetic acid or formic acid. Acetic acid is better for the material from the Holy Cross Mountains due to the highly aggressive interaction of formic acid with the spongy interior of the placoderms' discs. The bones are made mostly of calcium phosphate, which may be additionally saturated with bitumen. As a result, acetic acid is corrosive only as regards the limestone, leaving the bone matter intact, provided that it is secured early enough. The limestone specimen with the bone stuck in it was immersed in a 10% aqueous acetic acid solution for approximately 48 hours, heating the solution three to four times to a temperature of approximately 90°C. After the solution had cooled down, the specimen was taken out and rinsed by heating it in clean water to remove acid residues and then dried in a laboratory drying oven. The acid-exposed bone elements were then impregnated with cyanoacrylate glue, sometimes diluted with pure ethanol. After the glue solidified, the acid bath procedure was repeated until the subjectively expected effect was achieved. The complete dissolution of the specimen from the rock depended on the pure calcium carbonate content, the thickness of the rock covering the bone, and the size of the specimen as a whole. The extraction time varied, depending on the volume of the surrounding rock, taking up from two or three dissolution cycles (approximately 6 days) to twenty or more cycles, which was approximately 1.5 to 2 months.

The method currently implemented in the study of the Holy Cross material, and widely used for several years across the world, is the use of images obtained by means of high-energy computer tomography. Currently, I am carrying out such tests in cooperation with researchers from the Military University of Technology in Warsaw. By x-raying the rock,

a series of several dozen to several thousand sections is obtained, showing the interior of the examined specimen with entire heterogeneity, including bone remains. By isolating all cross-sections of a given bone, using appropriate software (MIMICS), they can be compiled into virtual three-dimensional models which include all the details of the anatomical structure of the bone surface morphology as well as internal architecture. This method is very useful in for finding a high contrast of the fossil against the surrounding rock. In the case of the Upper Devonian material, this contrast is weak, as demonstrated by numerous tests - only one still undescribed specimen of the skull roof was isolated. This method gave the best results in the case of placoderm sandstones, in which an interesting high density contrast occurs between the quartzite sandstone and the bone voids filled with air or, sometimes, with clay minerals.

Studies of trace fossils are based on the analysis and photographing of casts of traces fixed with plaster or silicone (GumoSil WW with a catalyst). In the case of tests conducted on the material from Ujazd near Iwaniska, the castings were additionally scanned with an optical scanner to obtain virtual objects and model the appearance of those who left the traces.

In one case, the study of the rocks went beyond the standard analysis of micro-sections and polished fossils as well as thin plates on a petrographic microscope and included observations using cathodoluminescence, which gave excellent results in the diagnosis of lithological diversity of rocks from Płucki near Łagów (Szrek & Salwa 2020 [A6]).

The dating of the studied deposits was performed each time only in the case of Upper Devonian specimens, which, as a rule, being preserved in carbonate rocks yielded enough surrounding rock to extract conodonts from them. In the case of the Lower Devonian rocks, the lithostratigraphic premises and the correlation proposed by Tarnowska (1976)as well as Fijałkowska-Mader and Malec (2011; attempts to date deposits with zircons using the SHRIMP ion micro probe, were much pre-Devonian - Nawrocki et al. 2020) were referred to.

Detailed description

The Devonian was characterized by a remarkable diversity of aquatic vertebrates - fish and the Agnatha (jawless fish) - and for this reason this period was called "the age of fish." This term is currently becoming untenable as recent paleontological research results, mainly from China (e.g. Zhu et al. 2016) show that the key diversification of the main vertebrate evolutionary lines took place in the Silurian. The last of the great transformations of aquatic vertebrates took place in the Devonian - the formation of a group of the Osteichthyes that left the waters and gave rise to tetrapods. It is a separate area of my research interests and is reflected in my general achies. Thus, 4 well-developed fish groups lived in the Devonian: extinct Acanthodii and placodermi, as well as the Chondrichthyes and the Osteichthyes that are still alive today. Representatives of all these groups are represented in the Devonian fossil material of the Holy Cross Mountains, which is reflected in numerous publications about them written with varying intensity since 1933 (Gorizdro-

Kulczycka). Among the fossils of all these groups, the remains of the Placodermi have the highest fossilization potential, so their remains, especially in the Upper Devonian, where the largest representatives of these animals are present (e.g. the emblematic species of *Dunkleosteus*),constitute the vast majority.

Research on Devonian formations and fossils of vertebrates of this era has been conducted since the second half of the 19th century. The reason for this coexistence in the interest of researchers was the usefulness of such fossils for dating rocks and determining the environment of their formation. In the case of Lower Devonian formations, the correlations related to attempts at dating were of key importance. The fauna of vertebrates, mainly placoderms, became a stratigraphic tool that was formally used from 1882 (Kontkiewicz) until the times of Czarnocki (1919 and later - see Szrek 2020 **[A5]**). Thanks to the analysis of the presence of "placoderm fossils" in various clastic formations of the Holy Cross Paleozoic, Czarnocki (1919) was able to make one of the most important corrections as to the age of the sandstones that build the Łysogórskie Range, previously considered Lower Devonian and finally dated to the Cambrian. The so-called remains of placodermi were also the basis for giving the adjectival name to sandstones containing these fossils (Gürich 1896) - placoderm sandstones. However, until the last decade (**[A1]** Szrek et al. 2014, **[A2]** Szrek et al. 2015 and **[A4]** Szrek and Dupret 2017), no representative of the Lower Devonian of the Holy Cross Mountains and (paradoxically) of the placoderm sandstone was described. Probable reasons for this were discussed in the work of Szrek (2020; **[A5]**) and most likely include the generalizing approach of former geologists (Georg Gürich, Jan Czarnocki) to bone remains in the Lower Devonian sandstones, included in the group of placoderms due to the apparent common occurrence of representatives of this group in the Devonian. I attempted to establish the presence of placoderms in placoderm sandstones for the first time in 2003 and 2006 (in the pre-doctoral achievements), however, these interpretations turned out to be premature and unconfirmed (Szrek 2020 **[A5]**). Regardless of these speculations, the first certain (illustrated and verified) remains of placoderms were presented in the work of Szrek et al. (2014 **[A1]**) in figure 5A. Silicone casts of this specimen were described along with others, in a detailed paleontological study on placoderms from placoderm sandstone (Szrek and Dupret 2017 **[A4]**). The first Lower Devonian placoderm from the Holy Cross Mountains is a large representative of the homosteids from Bukowa Góra, from the so-called spiriferous sandstones (Szulczewski and Porębski 2008) described in 2015 (Szrek et al. **[A2]**.Providing paleontological characterization of the placoderms from Bukowa Góra (Szrek et al. 2015 **[A2]**) and the group of placoderms from placoderm sandstone from the Podłazie site near Daleszyce (Szrek et al. 2014 **[A1]**, Szrek and Dupret 2017 **[A4]**), one of the hitherto unknown issues of the genesis of bone accumulations of breccia nature, recorded in many places in the Holy Cross Mountains, was resolved. The similarity of storm accumulations of brachiopods from Bukowa Góra (Szulczewski and Porębski 2008) and such accumulations consisting of broken skeletons of fish and jawless fish were rightly linked on the basis of extensive excavations at the Podłazie site. The Podłazie site is currently the most important place in terms of the amount of obtained fossil material and sedimentological observations.

The profile, belonging to the Emsian formation from Winna, was discovered in an old, completely overgrown and partially buried sandstone quarry, which during mining activities was the only source of placoderm sandstone for scientific purposes (Kulczycki 1960) and for academic collections. Unfortunately, the profile and sedimentological details were not documented by anyone in any form known to me, therefore, when starting the excavation work, I conducted basic research with particular emphasis on obtaining fossils. As a result, material consisting of several hundred specimens still being developed was collected (Burrow and Szrek 2018, Dec 2019, Wilk et al. 2020, Szrek et al. - in press - publications not included in the list of habilitation accomplishents), which is the largest material collected so far. According to documentation reports (Czarnocki 1919, 1936, Filonowicz 1968), there is an outcrop on Mount Barania in Dębska Wola near Zbrza in the south-west of the Holy Cross Mountains that consist of rich material of this kind, but despite numerous attempts it was only at the end of 2020 that it was possible to select a place that would fit data from the aforementioned literature, which will be of interest in the near future. At the Podłazie site, for the first time the contact of breccia with the lower and higher layers was detected, which allowed for the observation of sharp, erosive contact of the accumulation in the bottom and the disappearance of breccia towards the ceiling, combined with the reduction of grain and the appearance of hummocky cross stratification. The one-off nature of individual accumulations is also evidenced by the breaking of all the debris, the edges being sharp, the surfaces without any traces of abrasion, and therefore not subject to multiple rolling processes. From the quantitative and qualitative analysis of breccia from Podłazie (Szrek et al. 2014 **[A1]**), a full spectrum was obtained, giving a picture of a mixed group of vertebrates inhabiting various environmental niches and whose remains were finally mixed and deposited *en masse* during a storm. Moreover, it was established that the placoderms are not a dominant component in placoderm sandstones, such as the remains of armored jawless fish, mainly the Psammosteids (Szrek et al. 2014, Fig. 8 **[A1]**). The nature of the environment in which the profile of the Podłazie site was formed was described for the first time and based on sedimentological premises and the analysis of invertebrate fossils (described for the first time), Czarnocki's (1936) assumptions about a shallow, coastal sedimentation environment were confirmed, defining them as open-shelf and marginal sea ones. The analysis of the rich collection of trace fossils also indicated the presence of the *Cruziana* ichnofacies. So far, such detailed studies of the Lower Devonian profile have been carried out only at the Podłazie site, however, the presence of bone breccia of various thickness was found in several other sites of the Holy Cross Mountains from the western to the eastern regions of the Paleozoic core, both in the Łysa Góra and Kielce zones. Obviously, it is impossible to directly extrapolate the conclusions concerning the genesis of the bone accumulations from Podłazie to the remaining bassets, therefore the research potential of the formations of this age still remains large. Information about the shallow ("continental") sedimentation environment in the early Devonian of the Holy Cross Mountains has appeared in the literature since the times of Czarnocki (1919, 1936, Filonowicz 1968, Kowalczewski 1971, Tarnowska 1976, Szulczewski 1995). However, the first direct evidence of non-short-

term emersion was provided by studies from the western part of the Holy Cross Mountains, from Mount Trójeczna (Szrek et al. 2015 - not included in the list of the habilitation achievements). The traces of developed root systems found in this place are direct evidence of the presence of a terrestrial environment of as yet unknown nature, including possible (after Kowalczewski 1971) lake and marsh environments.

The detailed research of the Ujazd site near Iwaniska in the central part of the Holy Cross Mountains testifies to the great scientific importance of the trace fossils I investigated, the diversity of which was found in almost all sites. The profile belongs to the lower part of the Emsian formation from Winna. In 2016 (Szrek et al. [A3]) we described a group of trace fossils representing invertebrates and lungfish. The ichnogroup which was unique due to the state of preservation and importance for understanding the behavior of lungfish was found in the profile documenting the episode of the shallow tidal coast. On the surfaces of two horizons, we documented numerous traces of fish feeding, which were attributed to representatives of the lungfish referred to as a new ichnospecies *Osculichnus tarnowskae* Szrek et al 2016. Traces preserved as pits formed during the fish feeding at the bottom of the sea and eating invertebrates (clams, arthropods) buried there. During such an attack, the fish left a detailed imprint of the front of the mouth in the sediment. Thanks to the quick covering of the entire surface with a layer of tuft of several centimeters, the entire complex has been preserved with all the details. On the basis of several, exceptionally well-preserved traces, from which silicone casts were made and then scanned with a 3D scanner, it was possible to reconstruct the appearance of the animals that left the traces. Most likely it was a representative of the species of *Dipnorhynchus* or *'Chirodipterus' australis*. These traces turned out to be the oldest fossils left by the lungfish. They are also the first direct evidence of the feeding behavior of Early Devonian lungfish and the oldest documented record of vertebrate predation in general. This material also introduced an important group of lungfish as durophages into the Early Devonian ecosystem of the Holy Cross Mountains, the presence of which should now be taken into account when analyzing the conservation status of organic remains: vertebrates and invertebrates. The knowledge of lungfish so far has included understanding their feeding/preying under the general term of durophages. The documented traces show, however, that they did not limit themselves only to catching prey from the midwater or from the bottom but were able to recognize the ground. Low-angle imprints of a closed mouth suggest that the places of attack were selected by sensing the victim hidden in the sediment through the senses of smell or side line. Traces documenting the attack with the retrieval of the prey from the sediment were left by the fish advancing to the bottom at an almost right angle, while those which aimed at locating the prey were advancing at a very low angle in relation to the bottom surface. Such precise behavioral details have so far been observable only on living representatives of this conservative group. Due to the presence of a large number of traces (around 150 at the time of the research), it was possible to measure the directions of the fish attack, which made it possible to establish that the fish hunted almost only from one direction, obliquely to the longitudinal channel filled with sediment, in which the traces were preserved. The accuracy of the identification

of the fish leaving the traces was also confirmed by the bone record from the Podłazie site, from which the remains of lungfish belonging to the species of *Dipnorhynchus* were described (Szrek et al. - in press - publication not included in the list of habilitation accomplishments). Taking into account the equivalence or at least high age proximity of both profiles, it can be concluded with high probability that a rare situation of linking the trace with a specific perpetrator has been observed. After the finding was made public for the first time during a lecture at the International Symposium on Early and Lower Vertebrates in Australia (Melbourne) in 2015 (Szrek et al. 2015) and the publication of a paper included in the list of habilitation accomplishments (Szrek et al. 2016 **[A3]**), similar traces from the Upper Devonian of China (Fan et al. 2019) have been described and widely discussed in relation to those from Poland, which proves the universal importance of the achievement.

The marginal-sea shallow environments that dominated the early Devonian were not favored by the large placoderms, which developed large forms penetrating the deeper sea at that time. The situation changed during the middle, but above all, the late Devonian, when large species appeared on a global scale, occupying the top of the marine food chain. The Late Devonian in the Holy Cross Mountains was a favorable time for the presence of such animals: the Middle Devonian carbonate platform was gradually disintegrating and the regional extensive tectonics led to a very large environmental diversification and the creation of locally elevated areas, which could, in extreme cases, undergo periodic emersion, as well as deep areas, characterized by pelagic sedimentation. The environmental differentiation is evidenced by the age-old works of extremely different lithology, documented, among others, by Szulczewski 1971, 1989 and Racki 1993. The analysis of the occurrence of vertebrates, especially placoderms, shows the relationship between their variability over time and the evolution of the environment, which was discussed in my work (Szrek 2020 **[A5]).**

The characteristics of the Lower Devonian placoderms from the Holy Cross Mountains in the palaeobiogeographic context became the first contribution to the palaeobiogeographic definition of the Holy Cross Mountains as a transition area between Western Europe and the East European Platform. Such conclusions were drawn from the discussion of the specimen from Bukowa Góra (Szrek et al. 2015 **[A2]**) and the group of placoderms from Podłazie (Szrek and Dupret 2017 **[A4]**). Additionally, in the latter case, the presence of the youngest representatives of the *Kujdanowiaspis* placoderms in the world was found, similar to those found in large numbers in Podolia. Taking into account the most western (today's geography) and southern (in early Devonian palaeogeography) range of the occurrence of this fauna, we concluded that during the environmental changes in the Early Devonian, unanalyzed environmental factors resulted in the migration of the placoderm fauna that developed in great numbers during the Lochkovian and the Pragian stages (*Kujdanowiaspis* - assemblage) to the area of the Holy Cross Mountains in the Emsian stage. Recently, I have been participating in the research of the Early Devonian placoderm from the Acanthothoraci group from Podolia (Dupret et al. - in press), which, while further developing

the research on the analogous fauna of the Holy Cross region, will allow me to refine the image of regional relations changing during the Early Devonian.

Research on fish from the Middle Devonian is the least documented research area I am dealing with. This does not mean that there are no fossils of these animals in the thick profile of rocks of this age in the study area. However, they are a small number of contributing microfossils. Their analyzes were part of the National Science Centre's research project led by prof. dr. hab. Marek Narkiewicz (no. N N307 323439) entitled *Palaeonvironments of the Eifelian dolomites with earliest tetrapod trackways* (Holy Cross Mountains, Poland), in which I was a co-executor. The results of my work in the project with include 4 publications on trace fossils of the sedimentation environment in Zachełmie as the site of the first tetrapods (Niedźwiedzki et al. 2014, Narkiewicz et al. 2015, Qvarnstrom et al. 2018, Niedźwiedzki and Szrek 2020 – not included in the list of habilitation accomplishments). In the course of the work the environmental diversity in Zachełmie, greater than assumed in the study by Niedźwiedzki et al. (2010 – not included in the list of habilitation accomplishments) was discovered, covering lakes close to the sea coast, which during storms received marine sediments and fossils such as conodonts and fish.

Studies of Upper Devonian vertebrates have a long history and date back to the first study from 1934 (Gorizdro-Kulczycka). Since then, several palaeontological studies have been published, the most important of which - Kulczycki (1957) - is so far the only monographic presentation of Upper Devonian fish in general, to which all subsequent works, also those of a revision character, refer (Ivanov and Ginter 1997, Szrek 2020 **[A5]**). The works initiated during the implementation of the doctorate resulted in publications of the last decade, which constituted a description of selected aspects of the dissertation (Rakociński et al. 2016, Dworczak and Szrek 2016, Szrek and Wilk 2018 – not included in the list of habilitation accomplishments).

The topic that I took up after completing my doctorate was the genesis of the profile from the site in Płucki near Łagów. This site is widely known among researchers of the upper Devonian of the Holy Cross Mountains. The exposed layer of dark limestone with numerous fossils was considered to be the equivalent of the famous upper Kellwasser limestone horizon (Upper Kellwasserkalk), dating from the turn of the Frasnian and the Famennian stages and documenting the end of the second faunal crisis which occurred in the late Devonian (after the Kellwasser event). My interest in Płucki resulted from the large amount of fossils that this layer of relatively small thickness (up to approx. 0.5 m) contains. The abundance of fossil material in Płucki includes both invertebrates and vertebrates, which palaeontologically made up most of the fossils described in my doctoral dissertation. Thanks to numerous observations during many years of excavation work in Płucki, the publication of Szrek and Salwa (2020 **[A6]**) included a description and interpretation of the entire profile exposed at the site as a fossil underwater landslide, which was composed of mixed sediments from different environments. This explains the significant differences in the composition of the profiles of this basset, presented by different authors who probably had a different profiling site exposed in a narrow vertical range (see Szrek and Salwa 2020 **[A6]**,

Fig. 1). Based on the observation of the profile in a wide, 6-meter horizontal dimension, the presence of structures characteristic of the formation of mass movements was discovered, such as breaking the continuity of layers, sudden changes in thickness, folding and overlapping of layers, the presence of suspended silt sediments between the torn limestone horizons, the presence of silt deposits of limestone fragments with the so-called shadow or tail. The re-deposition of limestone fragments was confirmed by the presence of rotated geopetal structures. As for the horizon itself, considered to be Kellwasser limestone, its assumed homogeneity with any discontinuous surfaces visible in the cuts has been questioned. In fact, it is an accumulation of redeposited sediments composed of black, fossilized bituminous limestone, whose crushed fragments of various sizes, along with gray, palaeontologically silent limestone, are embedded in the dolomitic silt sediment. Despite numerous studies of this site, carried out by many authors, these lithological differences were invisible or hardly visible, and only the use of cathodoluminescence observations revealed the mentioned types of sediments. According to the scenario adopted in the publication of Szrek and Salwa (2020 **[A6]**), the history of the turbulent deposition of the entire profile begins with the deposition of the horizon, previously considered to be the upper Kellwasser limestone, in the form of a landslide containing broken, eroded fragments of lithified limestone sediments, one of which includes fossils. This is evidenced by the state of preservation of some of the armored fish fossils, which were excavated in the form of clusters from brown mudstone dolomitic sediment. Such bones are partially embedded in bituminous limestone, the surface of which, together with the bone, shows traces of earlier abrasion, most likely from the place from which a high-energy event led to the commencement of the transport of sediment, its mixing with pieces of gray limestone and with the loose sediment of dolomite mud, the final deposition. The landslide initiation could have been tectonic or stormy. An additional observation, which I drew attention to in one publication (Szrek 2020 **[A5]**), is the nature of the abraded surface, suggesting subaerial environmental conditions to which the diagnosed sediment was subjected in the Devonian. This means that the habitats of animals whose fossils are found in the so-called Kellwasser limestone in Płucki differed from the assumed deep shelf of the Łysogórski Basin. They had to be located higher and the direction from which they were transported can be determined based on the directional arrangement of the orthocone nautiloids. After the episode that led to the deposition of the so-called upper Kellwasser limestone, a steady sedimentation of several alternating layers of limestone and limestone mudstone with a total thickness of approx. 30 cm took place, which was disturbed by a supposed seismic shock. It led to the rupture of the still poorly lithified limestone layers, forming bulky limestone bodies and the penetration of loose silt between them. The so-called pinch-and-swell structures, characteristic of the deposits subject to seismic activity, were formed. Moreover, there are plastically deformed alternating limestone and silt sediments with numerous folds, continuity breaks and thickenings typical of submarine landslides, especially from the Devonian of the Holy Cross region (Szulczewski 1968, Kaźmierczak and Goldring 1978). The initiation of a landslide in this part of the profile may be tectonic or stormy, but in the

context of the unequivocally seismic genesis of pinch-and-swell structures, I am inclined to conclude that it was due to seismic tremors. From the stratigraphic perspective, the landslide character of the profile did not change the views on its age: the documented episodes took place in a short time, not exceeding previous dating, at the turn of the conodont Zone of *Palmatolepis linguiformis* and *P. triangularis*, and thus remains at the turn of the Frasnian and the Famennian stages. However, due to the allochthonous environmental nature of sediments and fossils, the Płucki profile lost its importance in the context of tracking the causes and effects of the great extinction at that time. The observed phenomena document the greater influence of tectonic processes, characteristic of the region, rather than of global eustatic changes on the formation of sedimentary succession during the Late Devonian.

Aspects of the taphonomy of vertebrate remains, mainly the Płucki placoderms, used to establish the origin of the submissive bone fragments together with the surrounding lithification sediment eroded as early as in the Devonian, have become the starting point for similar observations of material from other sites in the Holy Cross Mountains: from the Famennian of Kowala and Wietrznia (Szrek 2020 **[A5]**). Due to the rare character of such phenomena, a comprehensive comparative analysis and extensive palaeoecological conclusions on their basis were not possible, however, their presence was not observed in the Late Devonian environment of the Holy Cross Mountains before. The presence of feeding traces of other organisms on the bones is a prerequisite for choosing such a substrate in order to use the bio-mineral resources contained in such debris. Such traces have been observed on specimens of placoderm bones and bone skeletons. In one of the cases, I also documented an interesting phenomenon, confirming the great importance of the remains of dead fish for the local invertebrate fauna (Szrek 2020 **[A5]**). One of the bone specimens of a large placoderm from Arthrodira group is covered on one side with sediment filled with trilobite exudates. This is probably an example of the use of the few hard elements on the bottom as an aid of biological process and shows the lack of other convenient places for the development of this type of arthropod behavior.

The last taxonomic achievement is the significant revision of one of Kulczycki's (1957) determinations relating to shark bone material. In his work, the author described and illustrated (pl. 13) several longitudinal bone elements derived from the Famennian of Ostrówka, as spines of sharks of *Alienacanthus malkowskii*. The same elements in the bottom of the Famennian condensed limestone were illustrated by Szulczewski et al (1996; fig. 8f) as "fragments of large fish bones". During the fieldwork, I collected more complete material, which significantly changed the view on such elements being the fragments of the lower jaw of the placoderm. Due to the presence of a long edge with serially arranged conical denticles with vertices pointing posteriorly, the specimen represents a hitherto unknown group of specialized placoderms. Unfortunately, apart from the fragments of the jaws, no other elements of it have survived. Taking into account the precedence of the generic name given to these remains by Kulczycki (1957), I decided to leave the name *Alienacanthus* as the one referring to a representative of Placodermi and not to

Chondrichthyes. I clarified the age definition given by Kulczycki as Famennian recognizing the dating of the remains that I discovered, and probably those discovered by Kulczycki, as the Famennian stage of *Palmatolepis trachtera*.

Summary

As part of the discussed series of publications, I presented the previously unknown aspects of the storm genesis of Lower Devonian bone accumulations - placoderm sandstones. For the first time, I described the placoderms originated from such sandstone and from which their name was derived. I also showed the connection of the Holy Cross placoderm group with the older groups of placoderms from Podolia, pointing to the possible place of their migration from there to the area of today's Holy Cross Mountains. I have documented the world's oldest Early Devonian record of vertebrate predation in the form of feeding traces of lungfish, whose feeding behavior has been extended to extract the prey hidden in the sediment. In addition, I identified marginal-sea shallow sedimentary environments from invertebrate trace fossils. In the field of Upper Devonian research, I found that one of the most famous palaeontological sites in Poland - Płucki near Łagów, considered to be the site of the turn of the Frasnian-Famennian stages in the classic Kellwasser facies, is represented by an underwater landslide with mixed sediments from different environments and cannot be taken into account in the analysis of the fauna crisis at the turn of the Frasnian-Famennian stages, and thus confirmed the greater influence of tectonic processes rather than of global eustatic on the formation of late Devonian sedimentary succession in the Holy Cross Mountains. For the first time, I have documented the traces of epibionts and the use of the remains of dead fish by other organisms. In addition, in terms of taxonomy, I have redefined the spines of *Alienacanthus* fin sharks as placoderm jaws.

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5. Presentation of significant scientific or artistic activity carried out at more than one university, scientific or cultural institution, especially at foreign institutions

I started researching Devonian vertebrates during my studies at the Faculty of Geology of the University of Warsaw, representing the Polish Academy of Sciences from 2005 to the end of 2008 (in 2005-2007 - the Earth Museum and in 2008 - the Institute of Paleobiology). The range of research interests included the study of armored fish scheduled for my doctorate research (e.g. Szrek 2004), however, the publications output also included the research of the Osteichthyes (Szrek 2007) and the works on the ichnological record of the evolution of vertebrates from water to land and issues accompanying this event (Szrek & Niedźwiedzki 2008a, b, Niedźwiedzki et al. 2010, 2013, Narkiewicz et al. 2015, Qvarnstrom et al. 2018, Niedźwiedzki and Szrek 2020).

Before my employment at the Polish Geological Institute – National Research Institute, at the invitation of researchers from foreign centers, I studied palaeontological collections in Latvia (Riga, University of Latvia, Prof. Ervin Luksevics, 2001), Iran (Isfahan, Islamic Azad University, Dr. Vachik Hairapetian, 2008) and in Great Britain (London, Natural History Museum, Dr. Kim Dennis-Bryan, 2008), which provided the basis for a better understanding of the fragmentary material from the Holy Cross region, thanks to complete, classic materials from around the world). In 2003 I participated in my first international symposium (Gross Symposium, Riga) with the paper presentation on the first representative of the Antiarch placoderm from Poland, which was published a year later and where a new scientific name of the species - *Bothriolepis jazwicensis* – was used (Szrek, 2003). In 2007 I took part in International Symposium on Early / Lower Vertebrates in Sweden (Uppsala) with a paper presentation on the results of palaeontological research on fossils from Płucki in the Holy Cross Mountains. These fossils became the basis of my doctoral dissertation (Szrek 2009). During my employment at Polish Geological Institute – National Research Institute and during the implementation of the ongoing research projects, I had the opportunity to conduct comparative research on Devonian vertebrate collections in Australia (2011 and

2012; Melbourne, Canberra, Sydney and Perth), USA (2016; Cleveland, Ohio), Germany (2018; Berlin) and Belgium (2020; Brussels).

In 2019, at the invitation of researchers from the University of Uppsala, I took part in a research expedition to the island of Valentia (Ireland), the purpose of which was to study sediments nearly the same age as those in Zachełmie, containing ichnological and bone records of tetrapods and other vertebrates and invertebrates. The project - in which I still participate - is ongoing. Currently, I am also carrying out three research projects at the invitation of Dr. Sebastien Olive from the Natural History Museum in Brussels, including one related to the description of Belgium's Upper Devonian vertebrate fauna. One of the works developed as part of this cooperation is currently under review.

As part of the National Science Centre grant 2019/35/B/ST10 / 01505, Reconstruction of the Lower Devonian fauna of the Holy Cross Mountains awarded to prof. dr. hab. Michał Ginter from the Faculty of Geology of the University of Warsaw (2020-2022), in which I am an executor, we conduct research whose main goal is to reconstruct a large predator from placoderm sandstones based on bone and ichnological records.

In general, in my entire publication output (published or accepted for publication) includes 24 publications indexed in the JCR database (20 published after obtaining the doctoral degree, 6 of which were included in the list of habilitation accomplishments), 13 in journals scored by the Ministry of Science and Education, 4 popular science ones (including one co-authored book), 3 chapters in a palaeontology textbook on vertebrates and 37 conference papers and abstracts. I participated in 19 scientific conferences (of which 12 took place after my obtaining the PhD degree), including 12 foreign or international conferences organized in Poland (8 after my obtaining the PhD degree).

6. Presentation of teaching and organizational achievements as well as achievements in popularization of science or art

In 2006, I participated in the organization of a scientific conference and conference trips during the 77th Scientific Congress of the Polish Geological Society.

In 2008, I co-organized an international meeting entitled *Evolution and diversity of chondrichthyans* at the Faculty of Geology of the University of Warsaw, including the organization of field sessions.

As part of my post-doctoral activities, the most important conference, the organization of which in Poland I personally negotiated, winning he competition with Great Britain and China, was the 14th International Symposium on Early and Lower Vertebrates organized in 2017 jointly by the Faculty of Geology at the University of Warsaw and the Polish Geological Institute-National Research Institute together with the local Delta Association from Ostrowiec Świętokrzyski. In addition to organizational issues, I actively participated in the conference by presenting a paper, posters and conducting field sessions.

Between 2009-2015, I was a member of the steering committee of Scientific Collections International (now Global Registry of the Scientific Collections International) - an

international organization aimed at facilitating the exchange of data on the world's scientific collections.

In 2009-2017, as an employee of the Geological Museum of the Polish Geological Institute-National Research Institute (including in 2010-2016 as the head), I actively participated in the organization of numerous exhibitions and events popularizing Earth science. Exact number and list of the conducted classes and lectures is not provided here. There were certainly about 50-60 events of this type throughout my employment at the Polish Geological Institute-National Research Institute.

In 2012 and 2013, I took part in film productions made by the famous BBC (David Attenborough series) and Japanese NHK channels. The photos were taken mainly in the Zachełmie quarry and concerned the issue of the evolution of the vertebrate from water to land and the geology of the Holy Cross Mountains. Since 2011, I have been regularly cooperating with the Kielce regional television as part of the documentary series entitled *Śladami dinozaurów, Szept Ziemi, Koło się kręci* and ad hoc reports on palaeontology and new palaeontological findings from Poland. As part of this cooperation, over a dozen productions were broadcast on regional and national channels.

Between 2008-2011 I was employed as a lecturer in the program the Postgraduate Studies in Geo-tourism at the Faculty of Geology of the University of Warsaw.

Between 2011-2018, I delivered annual lectures for students at the Faculty of Geology of the University of Warsaw on palaeontology at the invitation of Dr. Ewa Głowniak.

I was a co-supervisor of 4 completed master's theses (2010, 2013, 2014, 2016) at the Faculty of Geology of the University of Warsaw and the Adam Mickiewicz University in Poznań, and currently I am an auxiliary supervisor of 1 doctorate at the Faculty of Geology at the University of Warsaw.

7. Apart from information set out in 1-6 above, the applicant may include other information about his/her professional career, which he/she deems important.

During my post-doctoral research activity, my achievements have been awarded several times at various levels.

As the second co-author of publications on the traces of the oldest tetrapods, Niedźwiedzki et al. (2010) I was awarded the Special Prize of the Prime Minister in 2010 and by the director of the Polish Geological Institute-National Research Institute.

In 2010, I was awarded the Krzysztof Beres grant by the Polish Geological Society for lifetime achievements.

In 2011 together with Grzegorz Niedźwiedzki we awarded the Traveller price granted by National Geographic Poland for earliest tetrapods studies.

Two other publications were also awarded with the special prize of the Polish Geological Institute-National Research Institute director: Szrek et al. (2014 [A2]) in 2015 and as a co-author of the work by Narkiewicz et al. (2015) in 2016.

In 2010 my organizational activity was awarded with the prize of the director of the Polish Geological Institute-National Research Institute for my contribution to the acquisition of European Union funds for the expansion of laboratory facilities in the form of a fossil preparation laboratory at the Holy Cross Branch in Kielce.

As a researcher, periodic assessments made by the Committee of the Scientific Council of the Polish Geological Institute-National Research Institute to which I report, regarded my achievements as very good and (recently) distinguishing.

As a candidate for the head of the Geological Museum at Polish Geological Institute-National Research Institute, I obtained a positive recommendation twice by the organizational and economic committee of the Polish Geological Institute-National Research Institute Scientific Council and finally by the Scientific Council in 2010 and 2015, and I held this position in 2010-2016).

Since October 2019, I have been the deputy director of Polish Geological Institute-National Research Institute responsible for research and development, appointed by the Minister of the Environment.

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