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An overlooked contribution to Devonian studies in the Holy Cross Mts: rediscovering Alexei Doronin's 1893 article on the Kadzielnia Limestone

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ABSTRACT:

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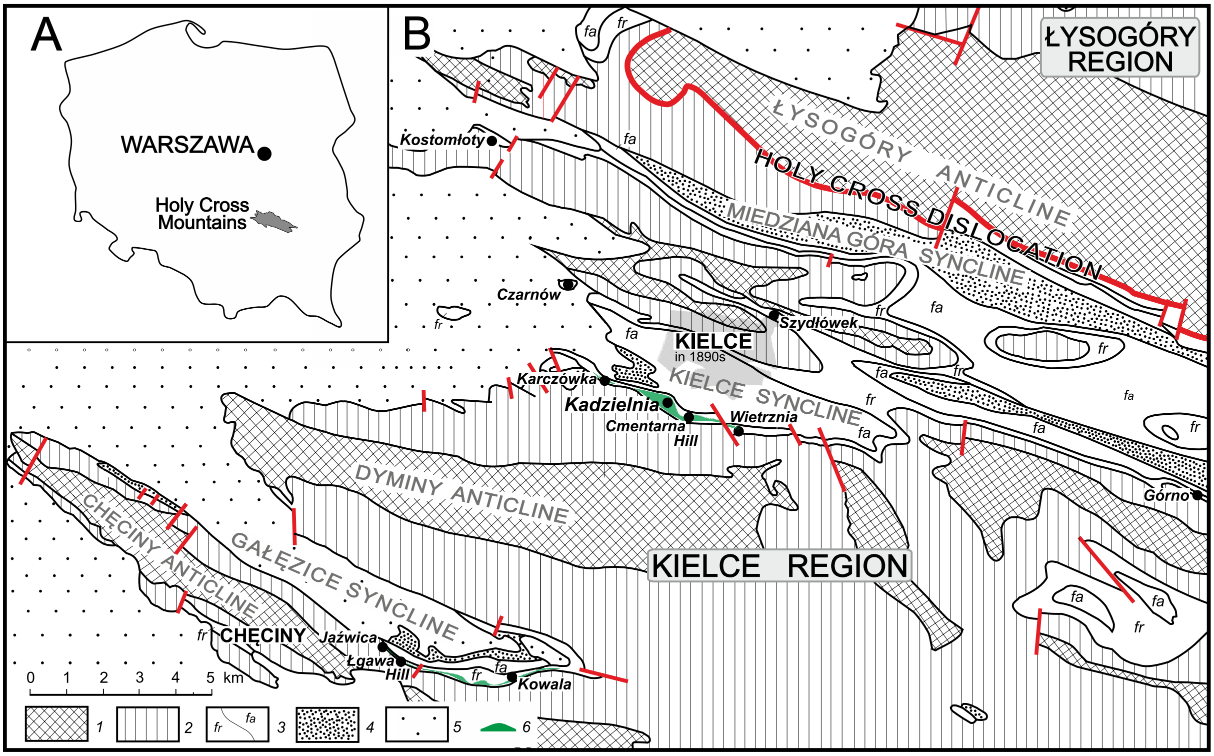
The unused Kadzielnia quarry in Kielce is the most publicly known geological site in the Holy Cross Mts and its geotouristic landmark (now the Kadzielnia Park and Reserve). The 'rocky' (coral) Kadzielnia Limestone, corresponding to a stromatoporoid-microbial mud mound, now treated as the Kadzielnia Massive Limestone Member of the Kowala Formation, has been studied for almost 200 years. This large bioherm is famous for its exceptionally diverse fossil inventory. The history of its geological exploration is insufficiently known, as exemplified by the overlooked contribution of Alexei Doronin, a master's student at the Imperial University of Warsaw (IUW). In 1893, under the guidance of Professor Vladimir Amalitsky, he published a note on the age of the Kadzielnia Limestone. The paleontological basis for this discussion was the IUW student's fossil collection, in which Doronin identified 28 taxa, mainly brachiopods (19 species). He was the first to recognize the occurrence of gastropods (e.g., *Loxonema*) and crinoids, and at least four species of brachiopods (e.g., *Dielasma sacculus*). In a comprehensive brachiopod-based stratigraphic discussion, Doronin emphasized the great similarity of the Kadzielnia assemblage to the Middle Devonian fauna of Western Europe, but also including the typical Upper Devonian species *Rhynchonella cuboides*. Ultimately, he advocated assigning a terminal Middle Devonian age to the Kadzielnia Limestone. Despite this erroneous dating, Doronin's noteworthy but unnoticed contribution holds significant implications not only for further study of Kadzielnia but also for understanding the development of geosciences in the late 19th century in the Congress Poland (then part of partitioned Poland within the Russian Empire), including the academic role of the IUW. Unfortunately, for reasons unknown, the scientific career of Amalitsky's talented pupil never truly began.

Key words: Holy Cross Mts; Upper Devonian; Kadzielnia Limestone Member; Brachiopods; Imperial University of Warsaw; History of geology.

INTRODUCTION

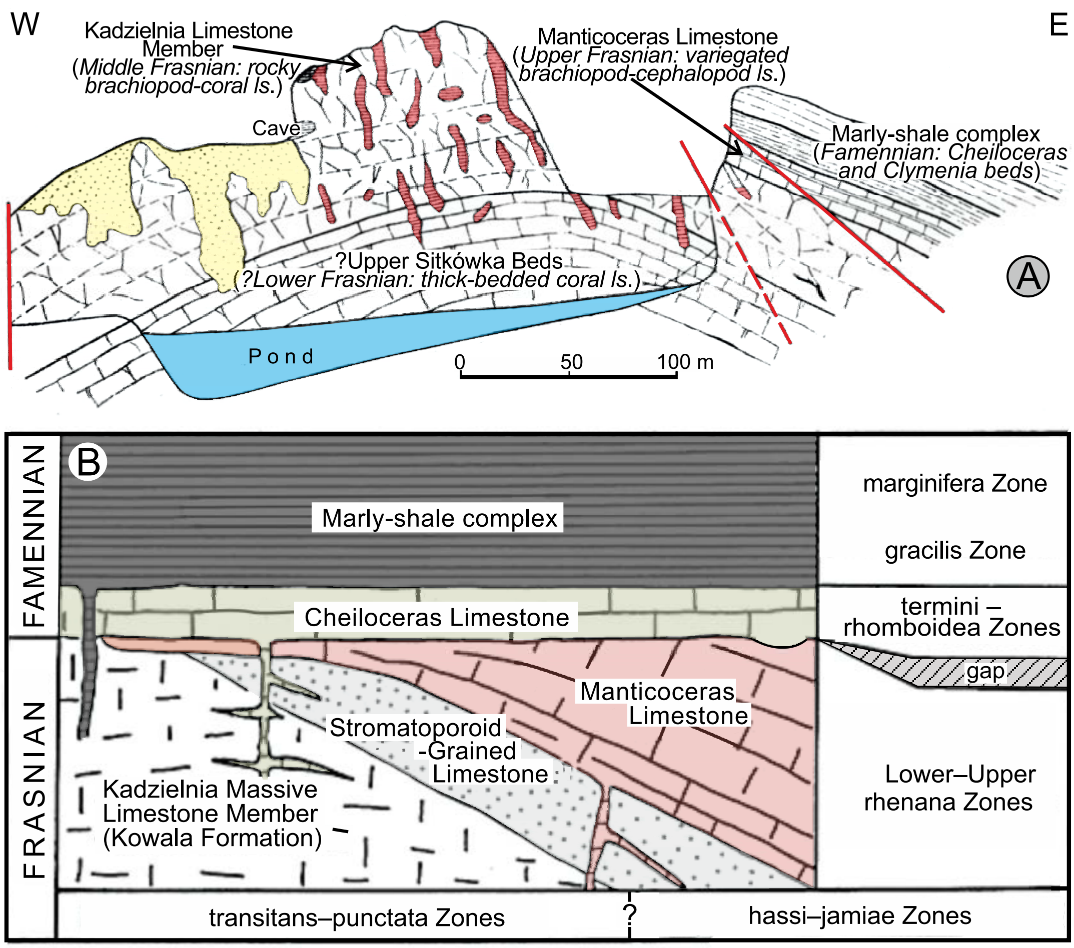
Spectacular natural exposures of Devonian sedimentary rocks in the Holy Cross Mts, central Poland (Text-fig. 1), attracted the attention of naturalists already in the early 19th century (Staszic 1815). In the first truly 'geognostic' exploration in the style of the Werner school, Pusch (1830, pp. 16–17) emphasized the abundance of fossils (41 taxa) especially in the Transition Limestone ("Übergangskalk") near Kielce and Chęciny (= "Sandomirer Übergangs-Kalkformation"; Pusch 1837, p. 172). However, progress in the study of this fossiliferous series, assigned to the Devonian System by Murchison *et al.* (1845, I, p. 39; see Narkiewicz *et al.* 2012), was rather slow in the following decades until the first systematic study



Text-fig. 1. Location of Kadzielnia quarry in Kielce and other localities of the Kadzielnia Limestone Mbr. in Poland (A), showing the geological structure of the western part of the Holy Cross Mts (B; Szulczewski and Racki 1981); after Szulczewski (1971, fig. 1, modified). Contour of Kielce city in the 1890s (during the period of Doronin's studies) approximated from a map of Sobolew (1911). 1 – Cambrian, Ordovician and Silurian, 2 – Lower and Middle Devonian, 3 – Upper Devonian (*fr* – Frasnian; *fa* – Famennian), 4 – Lower Carboniferous, 5 – post-Variscan cover; 6 – known extent of the Kadzielnia-type bioherms; tectonic contacts shown in red.

on a regional scale by Gürich (1896). A stimulus was the rapid development in the production of lime and building stone ('Kielce marbles') after the opening of the Ivangorod-Dąbrowa (Dęblin-Dąbrowa Górnicza) railroad line in 1883–1885 (Pająk and Szczepański 2013; Główka and Szczepański 2020). This was a major infrastructural investment in the Congress Kingdom of Poland, then a part of the dismembered Poland that was incorporated into the Russian Empire (officially called "Tsarstvo Pol'skoye"). As a result, the progressive exploitation of the rock resources of many hills for the building industry greatly facilitated geological research at the end of the 19th century. This article aims to recall an unknown episode in the Devonian research of Holy Cross Mts in the interlude between the regionally groundbreaking studies of Pusch and Gürich.

The former Kadzielnia quarry (now the Kadzielnia Park and Reserve) is certainly the most publicly known geological locality in the region and its geotourist iconic landmark (see below – Text-fig. 4E). In a scientific perspective, Szulczewski (1981, p. 110) stressed that "The Kadzielnia hill plays a special role in the study of the Devonian of the Holy Cross Mts. From here hundreds of species of fossils have been described, including many previously unknown to science, from here the concept of the Kadzielnia Limestone was derived, here the idea of the tripartite nature of the Holy Cross Frasnian was rooted, and here, finally, the disputes about the reef character of the Frasnian succession are played out." Remarkably, the site has been extensively studied for almost 200 years (Szulczewski 1971; Wróblewski 2008), and it is best known for its very diverse fossil inventory. About 100 taxa had already been listed by Sobolew (1909, pp. 365–369; see also Gürich 1896; Różkowska 1969; Biernat 1970, 1971; Racki 1993; for others see Table 1). However, the history of its geological survey is not well known, as exemplified by the overlooked contribution of Alexei Doronin, a graduate student at the Imperial Warsaw University. In 1893, under the supervision of Professor Vladimir Amalitsky, he published a note on the age of the Kadzielnia succession. Regrettably, the work was virtually unno-



Text-fig. 2. Geology and stratigraphy of the Kadzielnia site. A – Geological cross-section (exaggerated) showing a gentle anticline with a steeper and more faulted eastern limb (compare Łuczyński 2009, fig. 9), and two generations of karst cauldrons (red – Permian–Triassic, yellow – Cenozoic; Wróblewski 2008, Pawlik 2023) in the Geologists' Rock (see Text-fig. 4E; modified from Czarnocki (1942, published posthumously 1958, fig. 2). Compiled Czarnocki's (1947, 1958) stratigraphic units (*italicized; ls. – limestones*) refer to the present stratigraphic scheme. B – Generalized stratigraphic section showing the temporal-spatial relationship of lithostratigraphic units (modified fig. 10 from Szulczewski 1995, based on Szulczewski 1981, text-fig. 8). Terminology has been partially updated (see Narkiewicz *et al.* 1990 for lithostratigraphy and Becker *et al.* 2016, fig. 1 for the zonation of conodonts), in particular the Stromatoporoid-Grained Limestone (= Detrital Limestone *sensu* Szulczewski 1971, 1981) is introduced (modified from Racki 1993). Note the progradation of the Middle–Late Frasnian wedge-shaped units, the extensive hiatus in the eventful Frasnian–Famennian transition, the condensed nature of the Cheiloceras Limestone (covering four conodont zones), and the three generations of neptunian dikes recording the stepwise disintegration of the Kielce carbonate platform (Łuczyński 2023).

ticed by subsequent researchers; its sole mention is in Gürich (1900, p. 382), noting its unavailability to him, and received some criticism from Sobolew (1909, p. 365). This contribution is rediscovered here within the broader context of the development of geological science in the Congress Poland at the end of the 19th century, and the eventful history of the Kadzielnia hill. Both these geological and historical topics were repeatedly addressed by JubilarianProfessor Michał Szulczewski (e.g., Szulczewski 1971, 1981, 1995, 2016; Szulczewski and Racki 1981).

GEOLOGIC SETTING

Multi-level excavation of a former quarry, with an anthropogenic rock outlier in the central part (Text-fig. 4E), is located in the southern part of Kielce, on the left bank of the Silnica river, between Krakowska and Pakosz streets and Legionów Avenue. The quarried hill is part of the Kadzielnia Range. It is built of Frasnian limestones and borders the Famennian-filled Kielce Syncline, on which the city centre is situated (Text-fig. 1B). According to Sobolev (1909, p. 178), this chain of hills reflects former 'coral lenses' (i.e. a tract of bioherms), but in general the Dyminy Reef passed northeastwards into downslope and basin facies (Czarnocki 1947; Szulczewski, 1971; Racki 1993).

The exposed Upper Devonian succession at Kadzielnia forms a gentle anticline and consists of five lithostratigraphic units (Text-fig. 2B). The lower three belong to the Frasnian and form a progradational sequence (Szulczewski 1971, text-figs 3, 4). An initial slope morphology was created by a large, ca. 50 m thick bioherm of the Kadzielnia Limestone (Kaźmierczak 1971). The term was introduced as "Korallenkalk des Kanzelberge [Kadzielnia]" by F. Roemer (1866; also as "Kadzielnia-Hauptkalk" in Gürich 1896), but included also an overlying thick-bedded 'non reef' unit. The talus-like Stromatoporoid-Grained Limestone, first distinguished by Szulczewski (1971; pl. 24, fig. 1, pl. 29, fig. 2; pl. 30, figs 3, 4) as detrital limestones, is developed as a clinoform which flanks the gently inclined slope of this buildup and wedges out towards its top. In the model of Bednarczyk *et al.* (1997, text-fig. 34) this differentiated unit consists of a coarse-grained 'debris reef' with microbial patch reefs succeeded by thick-bedded graded limestones (apron facies). The pelagic Manticoceras Limestone (micrites, intraformational breccias – Szulczewski 1971, pl. 23, fig. 2) finally compensates a relief shaped by the two lower units. The Lower and Middle Famennian succession consists of the condensed, thin (1–3 m) Cheiloceras Limestone, covering Frasnian units, and a series of rhythmically alternating thin-bedded limestones and marly shales.

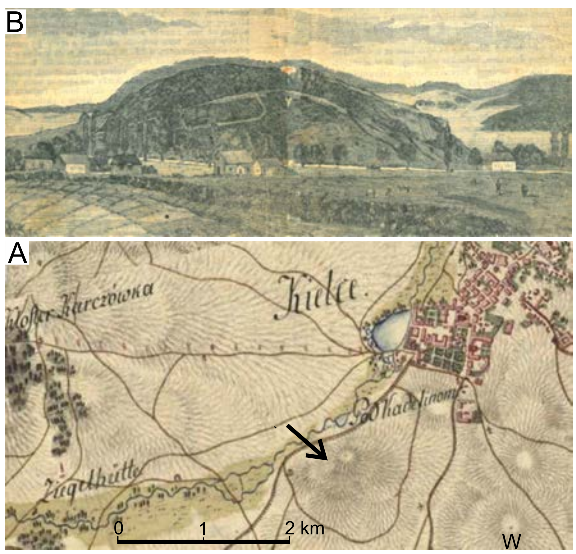
Since the time of Sobolew (1909, pp. 178, 364) and Siemiradzki (1922, p. 154), the focal point of research interest has been the Kadzielnia 'reef' built by light poorly stratified and massive stromatoporoid-coral biolithites ('boundstones'; see Szulczewski 1971; text-fig. 8, pl. 22, pl. 23, fig. 1), formalized as the Kadzielnia Limestone Mbr. by Narkiewicz *et al.* (1990). This specific lithofacies is characterised by fibrous calcite-filled cavities (mainly shelter voids) and, in places, bioclastic streaks and brachiopod coquinas (see Kaźmierczak 1971; Szulczewski 1971; Szulczewski and Racki 1981; Wolniewicz 2021). It was thought to be a large mud-supported buildup without a firm wave-resistant organic framework, developed in quiet waters (Kaźmierczak 1971; Szulczewski 1971, 1981; Szulczewski and Racki 1981). Particularly in the south-western part of the outcrop (the Monument Rock in Łuczyński 2009, fig. 9), the buildup passed laterally into stratified darker stromatoporoidal-coral limestones (compare the "interbiohermal limestones" of Pajchlowa and Stasińska 1965, text-figs 2, 3). According to Czarnocki (1958), the bioherm is also underlain by thickly or indistinctly bedded coral limestones (= ?reefal Lower Frasnian *sensu* Czarnocki 1947, with large gastropods *Loxonema* and *Pleurotomaria*; Text-fig. 2A). The strata probably belong to the mostly biostromal Upper Sitkówka Beds (see Narkiewicz *et al.* 1990), as demonstrated in the Kowala area by Szulczewski (1971) and Szulczewski and Racki (1981).

This distinctive 'reef mound' facies is limited to the north and south peripheries of the Kielce carbonate platform (Sobolew 1909, pp. 363–364; Szulczewski and Racki 1981; Narkiewicz e*t al.* 1990; Racki 1993; Text-fig. 1B). In light of current data, the bioherm is considered to be a rapidly lithified mud-mound with a predominantly microbial framework that developed on gentle ramp slopes in intermittently agitated (subturbulent) waters (see Szulczewski and Racki 1981; Racki *et al.* 1993; Bednarczyk *et al.* 1997; Łuczyński 1998, 2009, 2023; Racki 2007; Wolniewicz 2020). Its metazoan-dominated parts grew at an estimated depth of 10–20 meters (according to the bathymetric zonation model of Klovan and Embry 1972 – Racki 1993). The microbial activity, inferred from the presence of clotted and sponge fenestral fabrics in a stromatactoid micrite matrix, probably resulted in early mud cementation and at least the development of a localized framework. Bednarczyk *et al.* (1997) interpreted the mound as a cryptomicrobial-algal-stromatoporoid buildup, but in fact, the role of microbial processes in the mound accretion has yet to be thoroughly studied. In the context, Wolniewicz (2021) notably linked the Kadzielnia bioconstruction with the metazoan-microbial reef fabric category, distinguished by the *Stictostroma*-tabulate corals association as a low-profile sediment-binding community. It should be noted that this author's stromatoporoid-microbialite association is partly (?mainly) of the 'reefal' variety of Stromatoporoid-Grained Limestone (Bednarczyk *et al.* 1997). Measuring the orientation of stromatoporoid growth, Łuczyński (2009) showed that the inclined contact between the Kadzielnia Mbr. and overlying Frasnian units corresponds to the original depositional surface sloping at an angle of 15–20° to the south (i.e. opposite to the main topographic gradient of the Dyminy Reef flank).

A relatively complex issue remains the age of the Kadzielnia Mbr., since the guide conodonts in this facies are poor (Szulczewski 1971). Small bioconstructions in the Gałęzice Syncline are probably restricted to the Early Frasnian transitans Zone (fig. 11 in Pisarzowska et al 2006). Thus, they could be slightly older than the large buildup at Kielce (not older than punctata Zone; Szulczewski 1971, 1981, 1995). Significantly, Kadzielnia-like structures developed locally even earlier, as exemplified by the terminal Givetian alveolitid-stromatactoid mudmound in the Kostomłoty succession (section L-V in Racki *et al.* 1985). On the other hand, it is now also well established that the Early–Middle Frasnian transition was distinguished by a global perturbation of the carbon cycle recorded in a large-scale positive $\delta^{13}C$ highstand (= punctata Isotopic Event; Yans *et al*. 2007; Pisarzowska and Racki 2012). However, $\delta^{13}C$ values in brachiopod calcites from the lower Kadzielnia Mbr. are close to Frasnian background levels (Pisarzowska *et al.* 2006), contrary to its time and facies equivalent from the Ardenne type area (Arche Mbr.; Godefroid and Racki 1990, p. 63; see Yans *et al.* 2007). Moreover, this Frasnian interval was also marked by the Middlesex (IIc) anoxic-deepening-anoxic pulse, progressive climatic cooling and tectonic activation, but without drastic ecosystem changes (Pisarzowska *et al.* 2006; Yans *et al.* 2007; Baliński *et al.* 2016; Becker *et al.* 2016). Although regional reef suppression has been suggested (Yans *et al.* 2007; Pisarzowska and Racki 2012), at the scale of the Kielce Region, the most pronounced biotic crisis has so far been demonstrated in the bottom-level, off-mound brachiopod faunas (Górno site; Baliński *et al.* 2016). In particular, in the nearby Wietrznia reef-slope succession in Kielce, the early Middle Frasnian stagnation/depletion phase contrasts with the benthic diversity and abundance of the Early Frasnian transitans Zone (Baliński 2006). Thus, the relatively cool-water, extremely rich 'reef' biota, if restricted to the punctata Zone, would be a distinct ecosystem specificity confined to the local refuges. Rather, the main development of the Kadzielnia mounds took place in the Early Frasnian, but continued during the IIc eustatic rise, at least in the Kielce vicinity. An allied doubt also applies to the huge, 100-m-plus Middle Frasnian Arche mounds in the Ardennes (compare Da Silva *et al.* 2011, fig. 1B, and Mottequin *et al.* 2015, fig. 3), because a high-resolution graphic correlation also points to their Early Frasnian onset (Gouwy and Bultynck 2000, fig. 17).

KADZIELNIA IN NATURAL, HISTORICAL AND INDUSTRIAL CONTEXTS

The name Kadzielnia probably comes from the junipers that grew abundantly on this limestone hill in the past and were used for incense ("kadzidło" in Polish) in the local church (Siarkowski 1874). The early explorers (Pusch 1833, 1837; F. Roemer 1866) also mentioned it as "Kanzelberg" (Mount Pulpit). The first major exploitation of its rocks to make lime began in 1770, when the area still belonged to the Bishops of Kraków, and continued until the end of the 18th century (Majcher 2005; Cichocka 2022). Despite this, the dome-shaped rocky landmark at the outlet to Kraków, rising 42.5 meters above the level of the nearby Silnica River (Czarnocki 1958; Text-fig. 3A), remained in an almost primary state until the last decades of the 19th century (Text-fig. 3B). Already in the 1820s, "a place for public strolls was arranged" in Kadzielnia (Anonymous 1829, p. 61), and the first project to create a city park and botanical garden there was proposed in 1824 (Majcher 2005). The name of Spacerowa Street ("Walking Street"), which runs north-east from Kadzielnia towards the city centre, is therefore no coincidence. Siarkowski (1874, p. 77) gorgeously described the cave-bearing hill as "a marble mountain, not very high, covered with juniper, which in the winter season is the only food for countless flocks of fieldfares (...) The top of this mountain is decorated with a row of vertically protruding rocks which, at sunset, gilded with its rays, shine in the shape of a crown (...). This is a charming place with a beautiful view of the neighboring mount Karczówka, Kielce and the surround-



Text-fig. 3. The natural terrain of Kadzielnia before the beginning of industrial lime production in 1884. A – Primary geomorphology of the Kadzielnia Range, with mount Kadzielnia (indicated by arrow) exhibiting a distinct karst relief (including at least two rocky crests and a small cave; Siarkowski 1874, Gürich 1896), in contrast to the more uniform hill of Wietrznia (W), as shown on 1804 Austrian map of Western Galicia (Heldensfeld and Benedicti 1808). B – Kadzielnia as an attractive place for sub-urban walks and rest in 1870s, in the view from the north (from Siarkowski, 1874, pp. 78–79; drawing by H. Baranowski, woodcut by W. Zawadzki).

ing villages that seem to be resting at the foot of this mountain. This place is pleasant and useful for the people of Kielce for many reasons, so it is often the destination of walks for them." In geological context, Gürich (1896, p. 80) characterized the karstified hilltop as two short, almost parallel ridges (see Text-fig. 3A), connected from the east by a transverse branch, with the southern crest distinguished by the massiveness of the rock.

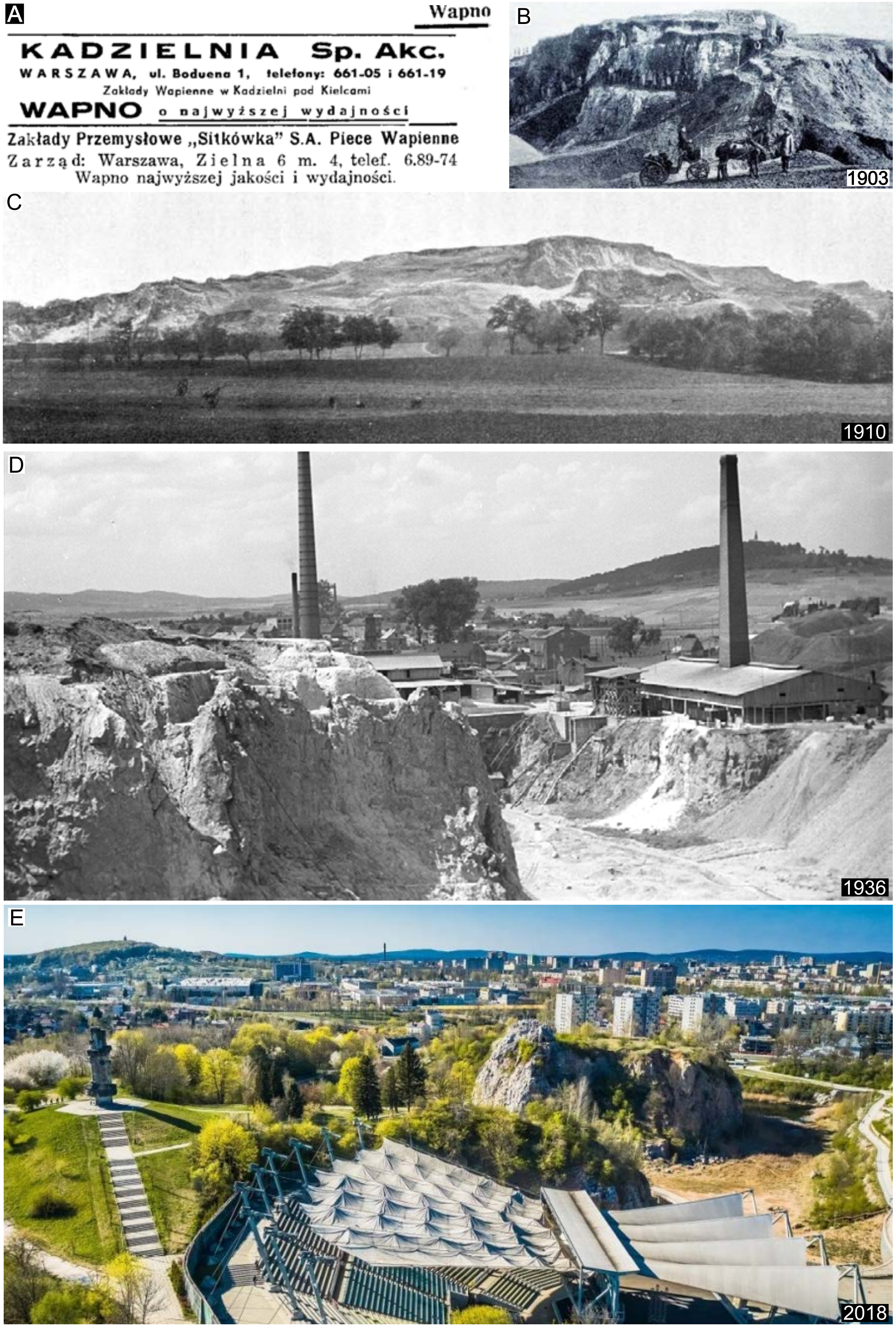
The 'marble mount' was notable for its compact limestone, which had been exploited for building purposes since the early 18th century (Majcher 2005). Święcicki (1874) noticed three varieties of Kadzielnia marbles: white calcite, spotty light-grey, and grey with spots and veins (see also appendix 1 in Główka and Szczepański 2020). Limestone was also mined in several small quarries as a raw material for occasionally reactivated lime kilning, as mentioned by F. Roemer (1866) and Majcher (2005). However, continuous production likely did not begin until 1884, when local producers, probably encouraged by the building of the railway, set up again a small furnace (Pająk and Szczepański 2013). Dynamic development was indeed possible thanks to the addition of a railway siding to the mine in 1891 (Pająk and Szczepański 2013). In 1896, the entire business was bought by a Warsaw banker of Jewish nationality, Juda Ehrlich (Majcher 2005; Pająk and Szczepański 2013; Król 2022). He built modern Hoffman-type kilns and quickly increased the production of lime tenfold (to 120 tons per day) and the number of employees to 100 (Majcher 2005). This increasing mining, noted by Siemiradzki (1888), Gürich (1896) and Sobolew (1909, 1911), led to the mount degradation even before the First World War (Text-fig. 4B–C). It was incorporated into the city in 1919 (Majcher 2005).

The relict top of the northeastern rocky ridge (see Text-fig. 3A), rising to 295 m a.s.l., has been protected since 1962 as an inanimate nature reserve – the Geologist's Rock (Text-fig. 4E). Kadzielnia is also one of the most famous cave systems in Poland, and three connected caves are now open to visitors (https://geopark.pl/kadzielnia/; Pawlik 2023). Today, after 70 years of intensive mining to almost 50 m below its original surface (Czarnocki 1958), a disused quarry and the small remains of the hill form the key fragments of the Kadzielnia Park and Reserve. It is the educational part of the Świętokrzyskie Geopark, which was included in the UNESCO World Geopark Network in 2021. In the post-industrial area, its recreational-geotourist part was created in the form of a municipal park and a festival amphitheater, considered by some to be the most beautiful in Poland (Text-fig. 4E). The visionary Enlightenment plans of 200 years ago have more than come true – the history of Kadzielnia has come full circle.

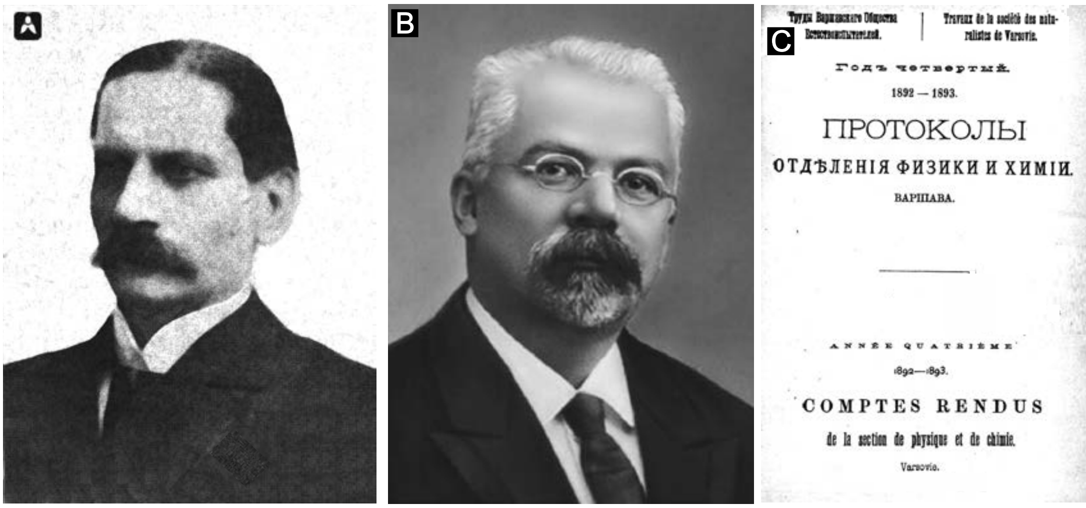
GEOLOGY AT THE IMPERIAL UNIVERSITY OF WARSAW IN 1890S

In Doronin's time, Poland was not an independent state, and Warsaw was located in the Congress Kingdom of the Russian Empire. The period after the January Uprising of 1863–1864 was a new stage in the history of partitioned Poland, aimed at reducing Kingdom of Poland to an ordinary province of Russia (so semi-officially called the Vistula Land). The Imperial University of Warsaw (IUW) was established in 1869 as one of the harsh repressions resulting from the consistent Russification policy (Schiller-Walicka 2016). At this university, geological sciences were incorporated into the Faculty of Natural Sciences, Faculty of Mathematics and Physics. From 1874, there were two chairs: mineralogy with crystallography and geology with paleontology (Thugutt 1956; Szulczewski 2016). The second unit was headed by Jan Trejdosiewicz (Text-fig. 5A), with the title of professor from 1881, until retirement in 1890. He was a well-educated geologist in Russian and German high schools of Polish nationality (born and died in Warsaw). Trejdosiewicz received his doctorate in Heidelberg and (under the Russian degree system) at Kharkov University. The scientific value of his works was highly regarded during his lifetime (Demby 1901), but his not very abundant output was quickly overshadowed by the results of the next generation of researchers. It is worth stressing that Trejdosiewicz also studied the Paleozoic succession of the Holy Cross Mts. His doctoral dissertation, published in Russian (1872) and Polish (1875), was the most comprehensive regional summary before Gürich's monograph (1896). It contains a list and detailed synonymy of 11 Silurian and 104 Devonian fossil taxa, often with commentaries. Interestingly, although he portrayed himself as an enthusiastic supporter of Lyell's and Darwin's ideas (Trejdosiewicz 1868), in his dissertation he used the obsolete stratigraphic term of the Werner doctrine – Transition Formations – instead of the Paleozoic Strata or Series (Phillips 1860).

Geology at IUW received a new impetus, thanks to the young and dynamic successor of Trejdosiewicz. Vladimir Amalitsky (Text-fig. 5B), who came to this provincial university from the capital St. Petersburg, was already a scientist of international repute, soon confirmed in 1895 by his membership of



Text-fig. 4. Kadzielnia hill as a building material production center (A), its progressive degradation (B–D), and the current landscape after its transformation into a recreational/educational area (E). A – An announcement for two leading lime factories from the Kielce region, including Kadzielnia JSC, in the trade magazine *Przegląd Budowlany* in 1937. B – The earliest photograph of the first stage of exploitation around 1900, showing the emerging escarpment of Geologists' Rock (from Gloger *et al.* 1904, p. 54). C – The heavily quarried western slope 10 years later (from Sobolew 1911, fig. 11). D – The peak of the mining in the 1930s view on the northern foot of the hill from the east with a fragment of the karstified Geologists' Rock and furnaces of the lime plant visible in the foreground, and the Karczówka hill in the upper right corner (photo by H. Poddębski; https://mnki.pl/palac/pl/edukacja/cykl:_muzealne_fotoatelier/kadzielnia). E. – Kadzielnia Park and Reserve in view from the south-east, with an attractively located amphitheater and the Geologists' Rock, a post-mining outlier of 'rocky' limestone (Text-fig. 2A; https://rajdladzieci.kihttps://rajdladzieci.kielce.eu/uploads/gals/galeria__0_40834500_1527078672/big_image_0_36152800_1617912375.jpg).



Text-fig. 5. A – Jan Nepomucen Trejdosiewicz (1834–1900), Polish geologist, graduate of St. Petersburg University and Freiburg Mining Academy, associate professor and professor at IUW from 1869 to 1890 (from Demby 1901, modified). B – Vladimir Prokhorovich Amalitsky (1860’1917), renowned Russian paleontologist and geologist, professor at IUW from 1890 to 1915 (from Petukhov 2010). C – Title page of the Warsaw Naturalist Society periodical in which Doronin published his article in 1893.

the Geological Society in London (Petukhov 2010; Szulczewski 2016). His scientific career developed considerably during academic work in Warsaw. To this day, Amalitsky’s research on the Permian vertebrate fauna of northern Russia is admired, the lasting result of which is an exceptionally rich collection of complete skeletons (Petukhov 2010; Jagt-Yazykova and Racki 2017). Morever, he also recognized for the first time the existence of a single paleobiogeographic province during the Permian, which was later identified by Wegener as the supercontinent of Pangaea (Szulczewski 2016). Unnoticed is the fact that Amalitsky comprehensively discussed the close relationship between the evolution of flora and fauna and the causal links between the evolving biosphere and geological processes (Jagt-Yazykova and Racki 2017). In 1896, he gave a lecture at a special meeting of the IUW, in which he outlined the groundbreaking (‘punctualistic’) conception, i.e., there have been long periods of gradual change in the Earth’s topography and biosphere, interrupted by orogenic activity triggering biotic crises (Amalitsky 1896).

Wójcik (2016) points out that Amalitsky saw the great geological attractiveness of the Vistula Land, and the Holy Cross region was one of the privileged survey directions for his talented students. His ambition was to establish his own school, which would focus on the modern study of the Congress Kingdom. Amalitsky’s plan was at least partly realised, even if his personal participation in it was minimal (a note on the Pleistocene series in Warsaw). As summarised by Wójcik (2016, p. 41): “Together with the crystallographer Georg Wulff, they created a leading research centre on a European scale, and several of their students became professors at Russian and Polish universities in later years.“ The author lists nine eminent Polish and Russian pupils of Amalitsky who were involved in the study of the Polish lands: Stanisław Karczewski, Piotr Koroniewicz, Jan Lewiński, Borys Reihbinder, Feliks Rutkowski, Aleksandr Skrinnikow, Józef Sioma, Dmitrij Sobolew, and Konstanty Wołłosowicz (see also Thugutt 1956). Of these promising young men, Dmitry Sobolev, who graduated in 1899, had the greatest scientific career. He is known in Poland only as a distinguished researcher of the Devonian system and its ammonoid fauna (Ozonkowa 1972; Szulczewski 2016; Racki *et al.* 2022). In fact, however, as a professor at Kharkiv University, he was also very outstanding in the recognition of the geology and mineral resources of the East European Platform and an implicit pioneer of mass extinction science (Jagt-Yazykowa and Racki 2017).

On the other hand, Amalitsky – despite his Polish roots – was a loyal citizen and official of the Russian Empire, usually considered a supporter of forced Russification (Thugutt 1956; Szulczewski 2016). Among the students, however, were many future Polish geologists who would soon play a crucial role in the development of the free homeland after 1918 (Wójcik 2016).

ALEXEI DORONIN AND HIS 1893 ARTICLE

The author of the forgotten article on the geology of Kadzielnia from 1893, Alexei I. Doronin, is an entirely unknown person. After searching Internet sources, only scant information about him was found. The IUW student registers (Anonymous 1892, p. 35; 1893, p. 35) show that he was a graduate of the Theological Seminary in Riga and a student of the last two years (III and IV courses) of natural sciences at the Faculty of Mathematics and Physics. He should therefore have finished his studies in Warsaw in 1893. There is no further information about the fate of such a trained Russian priest and geologist. For example, is Alexei Ivanovich Doronin, who died in 1896, an assistant professor at the Main Physical Observatory of the Russian Academy of Sciences in St. Petersburg (http://db.ranar.spb.ru/ru/person/id/24119/), the same person? It should be added that this combination of education was not uncommon – it also applied to Sobolew (Ozonkowa 1972). For the purposes of Russification, the best candidates for the tsarist authorities among native Russians were graduates of theological seminaries, for whom access to studies in Russia was much more difficult at that time (Schiller-Walicka 2016). Doronin, if he was a distinguished Latvian or Estonian graduate of the Riga Seminary, could receive a scholarship for university study (Aleksandr 2006).

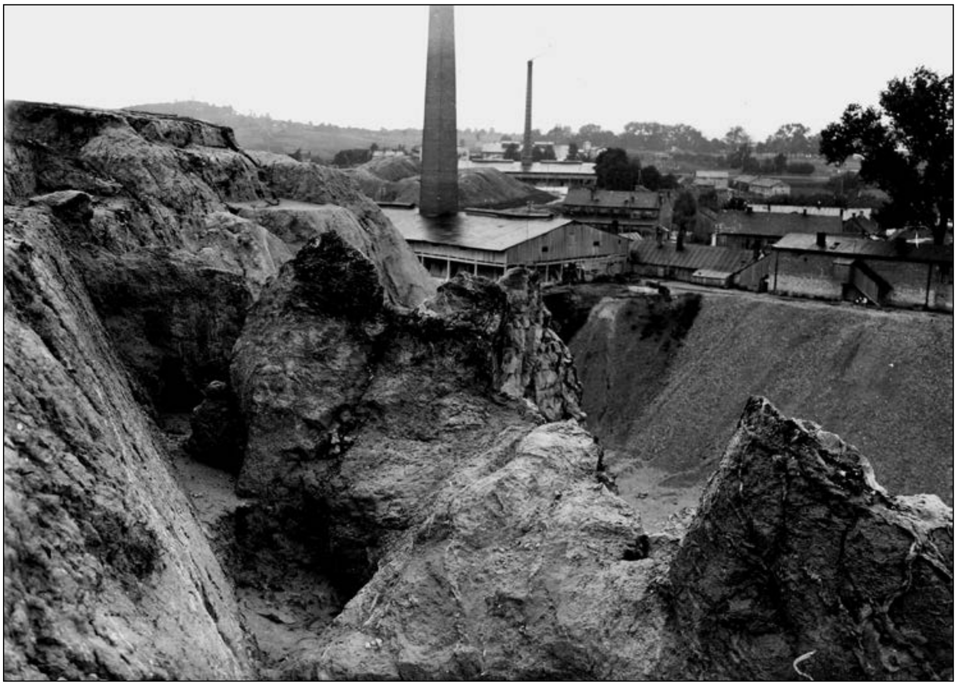
As mentioned above, the beginning of the 1890s was the time of a change of head of the IUW geology chair, hence Doronin was probably educated exclusively by Amalitsky. In fact, in the note under discussion, which was actually an extended summary of his talk for the elite Warsaw Society of Naturalists (Petukhov 2010; Wójcik 2016), Doronin emphasized that Professor Amalitsky gave him the task of conducting this elaboration. This disposition confirms both Amalitsky's interest in the Holy Cross region and his particular emphasis on the development of the IUW museum, which at the time was limited to the Pusch collection (Jagt-Yazykova and Racki 2017; see also F. Roemer 1866, p. 671). Doronin's research on the fossils from Kadzielnia, carried out under Amalitsky's supervision and possibly Trejdosiewicz's, culminated in a significant list of identified fossil taxa. The research material was collected mainly during a summer field trip of third- and fourth-course students of natural science, perhaps in 1892 (footnote in Doronin 1893, p. 6). Thus, a total of 24 students could be participants in this excursion (Anonymous 1892). As a result of russification, Doronin's classmates included only seven Poles (Catholics) who graduated not only from Warsaw secondary schools (also from e.g., Płock, Radom, Lublin, Częstochowa and Siedlce).

Doronin's 1893 article, covering just under 4.5 pages, does not include footnotes for the sources cited, but they are fairly easy to identify. In the introduction Doronin presented the previous views on the age of the coral Kadzielnia Limestone. He quoted the works of Pusch (erroneously dated 1883 instead of 1833), Murchison *et al.* (1845) and Zeuschner (1866). Doronin focused on the more detailed work of F. Roemer (1866), but also recalled the conclusions of Trejdosiewicz (1872), Michalski (1883) and Gürich (1887).

REGISTER OF THE KADZIELNIA FOSSILS

The fossil set studied by Doronin probably consisted of several hundred specimens collected in expanding outcrops as a result of the exploitation of the limestones for lime production (Siemiradzki 1888; Gürich 1896). Fossils were then easily found on the southern slope (Gürich 1896). Heavily weathered, loose limestone blocks from even partially decalcified karstified massif (Czarnocki 1958; Pawlik 2023; Text-figs 2A, 4D, 6) certainly provided the best preserved specimens. As observed by Sobolew (1911, p. 20): "On the walls of fissures, limestone often shows a peculiar weathering, turning into a white powdery mass in which it is still possible to distinguish fossils of Kadzielnia limestone." [By the way, the fossils first excavated by the present author in the late 1960s came from softened pieces of heated Kadzielnia Limestone, which were left as waste from the lime used for construction by my relatives.]

Compared to older lists from Kadzielnia, the register of 28 fossil taxa (Table 1) was considerably richer (e.g., only 12 taxa listed by Trejdosiewicz 1872, 1875). The most recent report at the time, overlooked by Doronin, was by Siemiradzki (1888), but he compiled data from all Upper Devonian sites in the area; his material included 19 species that might be found at Kadzielnia (Table 1). Only one brachiopod species, *Spirifer punctatus*, was previously described as new from this site by Zeuschner (1870; Text-fig. 7D). In the Kadzielnia section (Text-fig. 2B), the fossils were commonly collected from the Lower–Middle Frasnian biohermal variety, but an addition from higher Frasnian units (e.g., massive rugosan colonies; strophomenid brachiopods) is very probable. The highlighted Famennian cephalopods, described by Pusch (1837, pp. 139–152; see also Murchison *et al.*



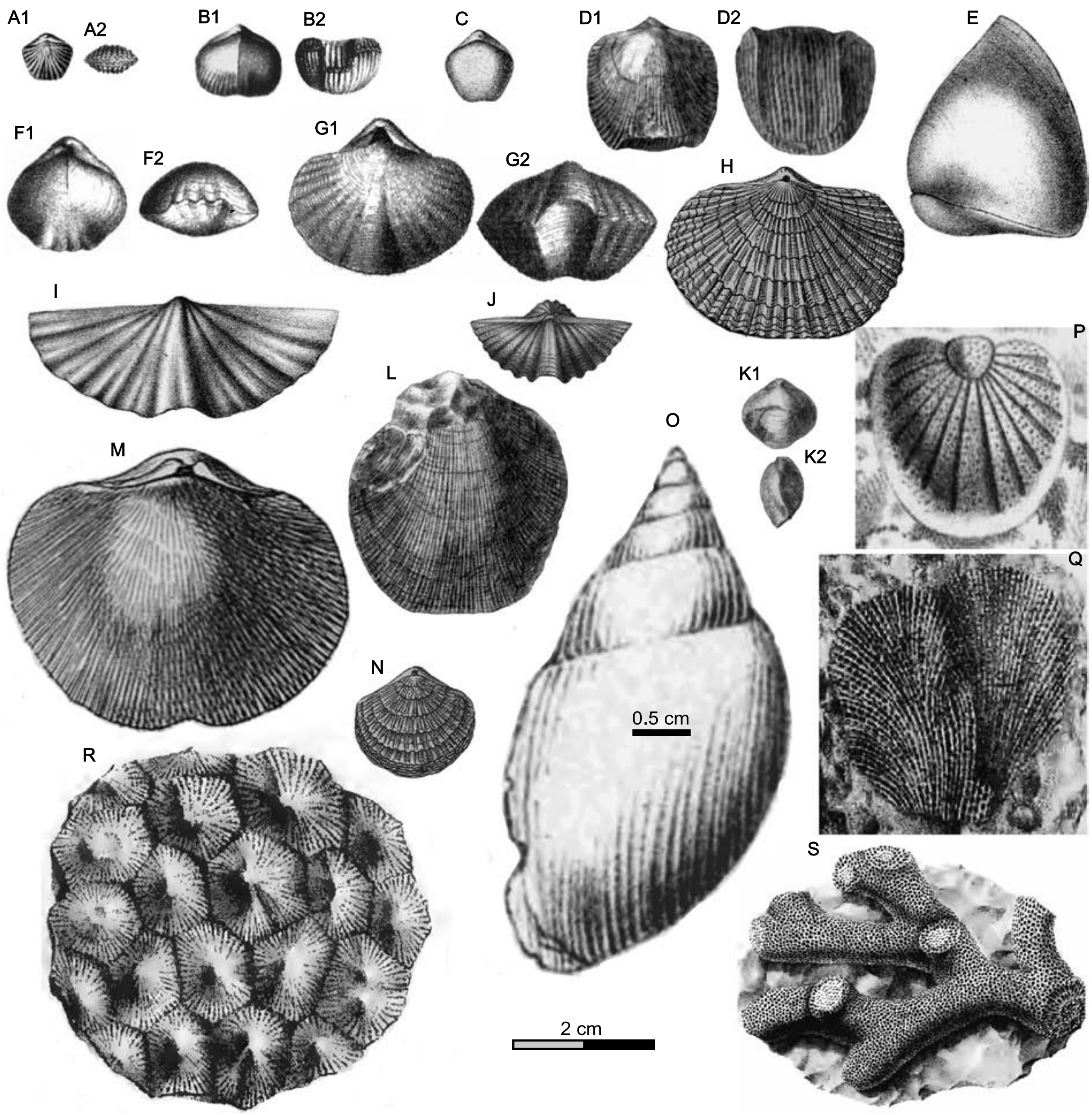
Text-fig. 6. Weathered blocks of karstified Kadzielnia Limestone, a source of complete fossils, mined in the Kadzielnia quarry in 1936 (photo by J. Czarnocki; courtesy of P. Król, National Museum in Kielce, cat. no. MNKi/Ph/59).

1845, p. XXVI; Trejdosiewicz 1872, 1875), were not found then.

Of the 28 taxa listed by Doronin, 19 are brachiopods, but representatives of corals (Tabulata, Rugosa), bryozoans, gastropods, trilobites and crinoids have also been identified (Table 1; Text-fig. 7). Doronin was the first to record the occurrence of supposedly large-sized gastropods (*Loxonema*, *Euomphalus*; see Krawczyński *et al.* 2003) and crinoids, as well as at least four species of brachiopods (e.g., *Dielasma sacculus*, two species of athyridides and *Spirifer undiferus*). Additional four species (including guide species *Rhynchonella cuboides*) were earlier collectively quoted by Siemiradzki (1888) from Kielce localities. Furthermore, some brachiopod identifications are unclear due to inconsequent understanding by particular researchers (e.g., *Rhynchonella parallelpipeda* vs. *R. wahlenbergi*; see comments in Appendix 1A).

Due to the advanced techniques used today in systematic works (e.g. for corals - Wrzołek 1993), it is not surprising that within the current taxonomy only the shelly fossils (brachiopods and gastropods) can be discussed rather easily (see Appendix 1A). Importantly, the brachiopod species of Kadzielnia from Doronin's register soon found confirmation in 13 cases in the monographic study by Georg Gürich of the University of Breslau (Gürich 1896, pp. 83–84; 1900, p. 382; see also Siemiradzki 1903, p. 138). Gürich reported a total of 27 brachiopod taxa from this locality, of which 3 species (including *Camarophoria elegans* from the Manticoceras limestones) and 8 varieties were described as new. In turn, Sobolew (1909, p. 365), when compiling paleontological data sixteen years later, noticed that "Doronin's determinations in some cases required correction". However, this justified criticism from the perspective of a scientific successor was also directed at much more experienced paleontologists such as F. Roemer and Gürich. Unfortunately, Sobolew did not revise this Kadzielnia collection, which was al-

Text-fig. 7. Fossil species identified by Doronin (1893) from Kadzielnia, as illustrated in 19th century German and English works which he probably used (see Appendix 1A). The historical designations are preceded by inferred current systematic data from Table 1 (see Text-fig. 8 for real specimens from this site). A – *Fitzroyella alata* Biernat, 1969, possibly identified by Doronin as *Rhynchonella parallelepipeda* Bronn (copied from F.A. Roemer 1843, pl. 5, fig. 10a, b). B – *Hypothyridina ascendoides* Nalivkin, 1951, compared with question with *Rhynchonella wahlenbergi* Goldfuss (from Steininger 1853, pl. 5, fig. 4a, c). C – *Dielasma* cf. *sacculus* (Martin, 1809), identified by Doronin correctly as *Dielasma sacculus* Murchison (from Kayser 1871, pl. 9, fig. 1b). D – *Hypothyridina* cf. *coronula* (Drevermann, 1901), registered as *Rhynchonella cuboides* Sowerby (from Sowerby 1840, pl. 56, fig. 24). E – *Parapugnax brecciae* (Schmidt, 1941), listed as *Rhynchonella* →



pugnus Martin, illustrated with a large specimen from Kadzielnia by F. Roemer (1866, pl. 5, fig. 8) as *Rh. acumitata*. F – *Gypidula* cf. *greindli* (Maillieux, 1909), given as *Pentamerus galeatus* Dalman (from Davidson 11864–1865, pl. 15, fig. 6, 6a). G – *Undispirifer* sp., quoted as *Spirifer·undiferus* F.A. Roemer (from F.A. Roemer 1844, pl. 4, fig. 6a, c). H – *Spinatrypina (Exatrypa) planata* Biernat 1971, identified as *Atrypa reticularis* var. *explanata* Schlotheim (from Schlotheim 1822, pl. 18, fig. 2b). I – *Adolfia punctata* (Zeuschner, 1870), described from Kadzielnia by Zeuschner (1870, p. 264; extra-large dorsal valve figured in pl. 5, fig. 1). J – A species of *Adolfia* registered as *Sprifer* cf. *elegans* Steininger (from Kayser 1871, pl. 11, fig. 2e). K –An athyridide reported as *Merista plebeja* Sowerby (from Sowerby 1840, pl. 56, figs 12, 13). L – *Desquamatia* (*Seratrypa*) *pectinata* (Schröter, 1777), designated as *Atrypa reticularis* var. *desquamata* Sowerby (from Sowerby1840, pl. 56, fig. 20). M – *Schizophoria* cf. *prohibita* (Halamski, 2012), identified as *Orthis striatula* Schlotheim (from Schlotheim 1822, pl. 15, fig. 4b). N – S*pinatrypina* cf. *plicata* Rzhonsnitskaya, 1964, recorded by Doronin as *Atrypa aspera* Schlotheim (from Schlotheim 1822, pl. 18, fig. 3b). O – *Westerna subcostata* (Schlotheim, 1822), quoted as *Loxonema* sp. (from Phillips 1841, pl. 39, fig. 194). P – Trilobite *Scutellum costatum costatum* Pusch, 1833, reported as *Bronteus granulatus* Goldfuss (from Pusch 1837, pl. 14, fig. 5). Q – Fenestellid bryozoan, listed as *Fenestella* sp. (from Goldfuss 1826–1833, pl. 36, fig. 2b). R – Rugose coral *Hexagonaria hexagona kowalae* Wrzołek, 1993, presumably determined as *Cyatophyllum hexagonum* Goldfuss (from Goldfuss 1826–1833, pl. 19, fig. 5). S – Thamnoporid tabulate coral quoted as *Favosites cervicornis* Milne-Edwards et Haime (from Goldfuss 1826–1833, pl. 27, fig. 2b). The brachiopod shells are shown in dorsal (1) and posterior (2) views, except E and K2 (lateral view). The sizes are partly adjusted to species known from Kadzielnia (Text-fig. 8); note different scale for the giant gastropod, *W. subcostata* (O) up to 20 cm long (Krawczyński *et al.* 2003).

Table 1. Register of 28 fossil taxa from Kadzielnia in the order given by Doronin (1893), compared with five older lists from this site (frequently under different names or with other species creators) and their presumed recent status. Exactly the same determinations in older papers are signed by +; otherwise, the taxa are quoted literally as written by particular workers; uncertain locality (especially in Siemiradzki 1888) is marked by (?+); uncertainly being conspecific, by ?+. *Unless otherwise specified, the current taxonomy of brachiopods is based on Biernat (1971). ** Many taxa mentioned by Siemiradzki (1888) but not listed by Doronin were omitted because Siemiradzki included fossils from all Upper Devonian localities in Kielce. ***The occurrence of species at Kadzielnia recorded by Schlotheim (1822, p. 68).

	Fossil taxon listed by Doronin (1893)	Previous taxonomic data					Implied present identification [main literature source*]
		Pusch (1833, 1837)	F. Roemer (1866)	Zeuschner / Zejszner (1866, 1867, 1870)	Trejdosiewicz (1872, 1875)	Siemiradzki (1888)	
TABULATA							
1	*Alveolites suborbicularis* Lamarck		+				*Alveolites suborbicularis* Lamarck, 1801 [Zapalski (2012)]
2	*Favosites cervicornis* Milne-Edwards et Haime		*Calamopora cervicornis* (= *F. cervicornis*)	+	*Calamopora cervicornis*		Likely *Thamnopora* ex gr. *boloniensis* (Gosselet, 1877) [Zapalski (2012)]
RUGOSA							
3	*Cyatophyllum caepitosum* Goldfuss		*C. caespitosum* Goldfuss(?)	+		+	*Disphyllum* and/or *Thamnophyllum*
4	*Cyatophyllum hexagonum* Goldfuss				+	+	Possibly *Hexagonaria hexagona kowalae* Wrzołek, 1993
BRYOZOA							
5	*Fenestella* sp.				*Fenenestella Lonsdale* sp.?	(?+) *Fen. subrectangularis* Sandberger	*Rectifenestella* in Morozova *et al.* (2002, p. 316)
BRACHIOPODA							
6	*Spirifer urii* Flemming					*Sp. inflatus* Schnur	*Crurithyris globosa* (Gürich, 1896)
7	*Spirifer· undiferus* Roemer						*Undispirifer* sp.
8	*Sprifer* cf. *elegans* Steininger					?+ *Sp. bifidus* A. Roemer	Probably a species of *Adolfia*
9	*Spirifer punctatus* Zeuschner			+ (pl. 5, figs 1–3)	+	+	*Adolfia punctata* (Zeuschner, 1870)
10	*Merista plebeja* Sowerby						An athyridide
11	*Athyris concentrica* v. Buch						*Athyris* sp.
12	*Atrypa reticularis* Linne	*A. reticularis* Dalman	*A. reticularis* Dalman	*A reticularis* Dalman	*A. reticularis* Dalman	*A. desquamata* Sowerby	*Desquamatia* (*Seratrypa*) *pectinata* (Schroter, 1777), other variatrypiniids and pseudogrunewaldtiniids [Racki and Baliński 1998]
13	*Atrypa reticularis* var. *desquamata* Sowerby	*Terebratula prisca* Schlotheim					
14	*Atrypa reticularis* var. *explanata* Schlotheim	*Terebratula explanata* Schlotheim			*A. reticularis* var. *explanata* Dalman	*A. explanata* Schlotheim	*Spinatrypina* (*Exatrypa*) *planata* Biernat, 1971
15	*Atrypa aspera* Schlotheim	*Terebratula aspera* Schlotheim					*Spinatrypina* cf. *plicata* Rzhonsnitskaya, 1964
16	*Dielasma sacculus* Murchison						*Dielasma* cf. *sacculus* (Martin, 1809)
17	*Pentamerus galeatus* Dalman		*P. galeatus* Dalman var.	+	+ *Pentamerus brevirostris* Geinitz	+ *Pentamerus brevirostris* Geinitz	*Gypidula* cf. *greindli* (Maillieux, 1909) [Godefroid and Racki 1990]

18	*Pentamerus globus*(?) Bronn					*P. globus* Bronn	?*Novozemelia* sp. [Godefroid and Racki 1990]
19	*Rhynchonella pugnus* Martin	*Terebratula curvata* Schlotheim***	*R. acuminata* Morris (pl. 5, fig. 8.)	*R. acuminata* Martin	*R. acuminata* Morris	+ *R. acuminata* Morris	*Parapugnax brecciae* (Schmidt, 1941); *Yunanella* (?) *globifrons* (Gürich, 1896)
20	*Rhynchonella parallelepipeda* Bronn		*R. primipilaris*	*R. Wilsoni* Sowerby	*R. primipilaris* F.A. Romer	*R. primipilaris* F.A. Romer	Possibly *Fitzroyella alata* Biernat, 1969
21	*Rhynchonella Wahlenbergi* Goldfuss						Possibly *Hypothyridina ascendoides* Nalivkin, 1951
22	*Rhynchonella cuboides* Sowerby					(?+)	*Hypothyridina* cf. *coronula* (Drevermann, 1901)
23	*Strophomena interstrialis* Phillips	?+ (?) *Leptaena euglypha* Dalman			?+ (?) *Leptaena euglypha* Dalman (Pusch coll.)	+ *Strophomene euglypha* Dalman	A douviliniid or another strophomenid
24	*Orthis striatula* Schlotheim		*O. striatula* de Koninck		*O. striatula* de Koninck	*O. striatula* de Koninck	*Schizophoria* cf. *prohibita* (Halamski, 2012)
GASTROPODA								
25	*Loxonema* [Phillips] sp.						*Westerna subcostata* (Schlotheim, 1820) [Krawczyński *et al.* (2003)]
26	*Euomphalus* [Goldfuss] sp						Likely *Orecopia kadzielniae* (Gürich, 1896) [Krawczyński *et al.* (2003)]
TRILOBITA								
27	*Bronteus granulatus* Goldfuss	?*Asaphus* pl. 14, fig. 5 (in 1833, p. 119, described as *Scutellum costatum*)	+		*B. fiabellifer* Goldfuss	*B. fiabellifer*	*Scutellum costatum costatum* Pusch,1833 and/or *Scutellum mariae* Chlupač, 1993 [Chlupač 1993]
CRINOIDEA								
28	Disarticulated stem ossicles (*Cupressocrinites* and nine parataxa of columnals from the Kadzielnia Frasnian were reported by Głuchowski (1993]							
Species reported from Kadzielnia limestone in earlier publications, but not confirmed by Doronin**								
29	*Stromatopora polymorpha* Goldfuss		+	+	+	+	*Actinostroma* or other massive stromatoporoids [Kaźmierczak 1971]
30	*Cyathophyllum turbinatum* Goldfuss		*Hippurites turbinatus* Schlotheim		+	+	A phillipsastreid or another massive rugosans

most certainly kept at the IUW until 1915. In the last systematic study by Biernat (1971), many of the taxa from the 1893 register, often under catch-all names (atrypids, gypidulids, pugnacids), are identifiable, at least at the family level (see Table 1 and Text-figs 7, 8). The brachiopod collection (with a contribution from M. Szulczewski; ca. 180 specimens, 21 taxa) was gathered after mining ceased mainly from the lower part of the Kadzielnia bioherm.

Doronin strictly adhered to the brachiopod systematics in Kayser's (1871) work on the Middle and Upper Devonian fauna of the Eifel Mts, which included a thorough revision of the older taxonomic data. Only two species were added to those from Kayser's review: the *Spirifer punctatus* and *Atrypa explanata*. In addition, *Atrypa aspera* was classified as a separate species instead of being a variety of *Atrypa reticularis*. On the other hand, Kayser

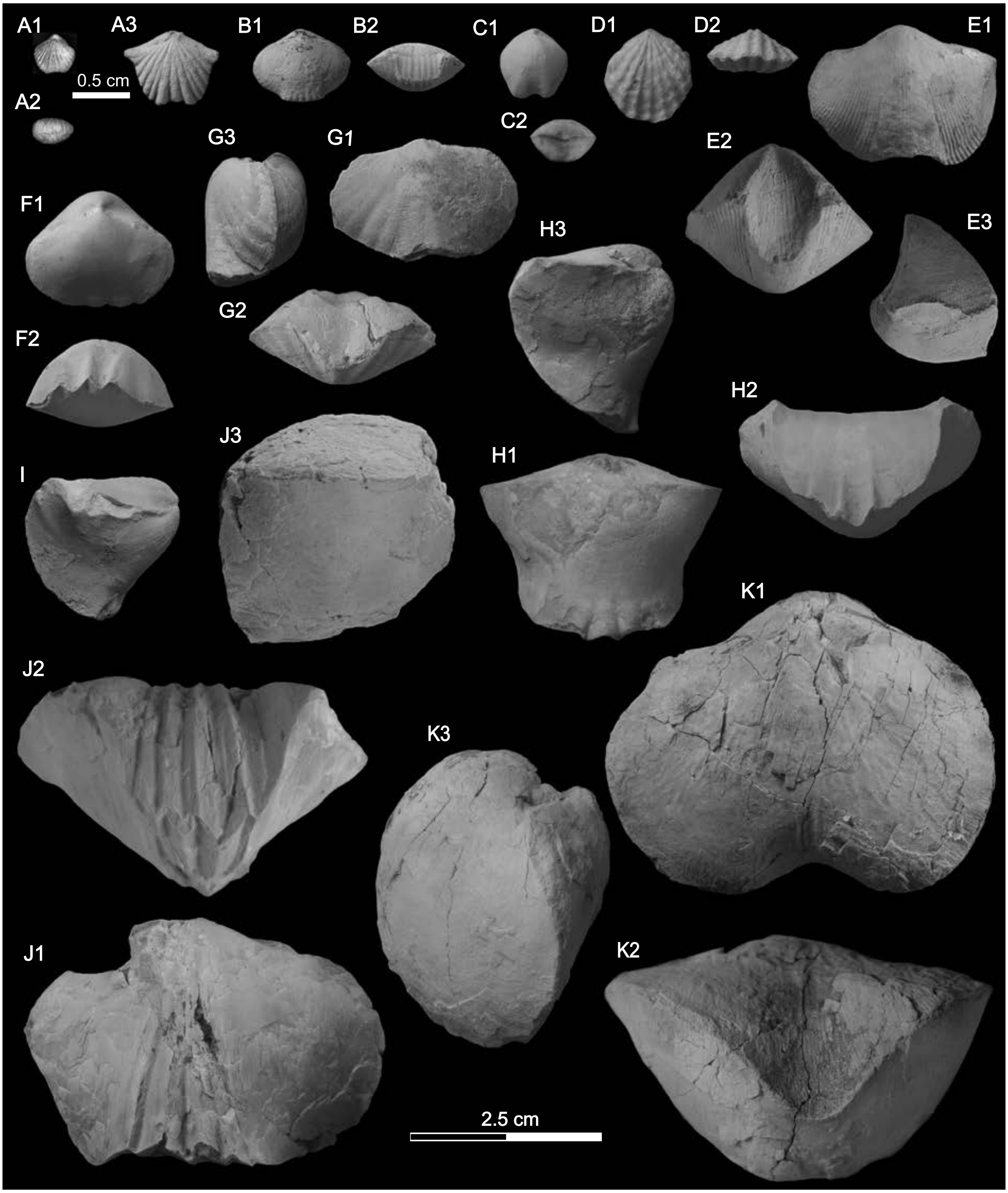
(1871) illustrated only two of the species reported by Doronin (Text-fig. 7C, J). Therefore, Doronin undoubtedly studied the literature sources from Kayser's extensive synonymics. He definitely became familiar with several of the German and English classics of Devonian paleontology available to Trejdosiewicz (1872, 1875), such as Goldfuss (1826–1833), Sowerby (1840), Phillips (1841) and Murchison *et al.* (1845). However, most of Doronin's species designations are rather based on the later monographs by F.A. Roemer (1850–1852), Schnur (1853), Davidson (1864–1865) and Clarke (1885). Thus, several publications – not quoted by Doronin – are given as possible bases for his species identification in the explanatory text to Text-fig. 7. In an interesting case, he allocated the amboceliid spiriferid from Kadzielnia to the English species *Spirifer urii* Fleming, 1822, and not the German *Spirifer inflatus* Schnur, 1853 (as done by Siemiradzki 1888 and Gürich 1896). The Eifel species has been synonymized with *S. urii* by Davidson, Kayser and Clarke. Doronin's taxonomic nomenclature differs positively from that of previous researchers of this fauna, as it is more in line with the taxonomic principle of priority (Table 1). The only exception is the terebratulid *Dielasma sacculus* Murchison, 1845; Text-fig. 7C), described by Kayser (1871) as *Terebratula sacculus* Martin, 1809. Such a correctly updated generic name (see Biernat 1971) suggests an extensive literature search.

DATING OF THE KADZIELNIA LIMESTONE

Doronin accepted F. Roemer's (1866) viewpoint that the reference point for the Holy Cross Devonian is the better known German succession ('Rhenish Province'), especially in the Harz Mts. F. Roemer emphasized the close resemblance of the coral limestone lithology and the rich fauna of Kadzielnia to the well-studied Grund locality (= Iberg Reef in Bad Grund; https:///www.hoehlen-erlebnis-zentrum.de/iberg_a_reef_goes_traveling). Doronin recalled the biostratigraphic arguments of previous researchers which pointed to the Late Devonian age of the Kadzielnia succession, i.e. the occurrence of 'guide species' (according to F. Roemer 1866: *Rhynchonella acuminata*; according to Michalski 1883: *Rhynchonella cuboides* and *Spirifer verneuili*). However, he stressed the weakness of these claims, since the rhynchonellid species were also reported from older strata. Doronin, on the other hand, presented the following arguments in favor of the Middle Devonian (Stringocephalus stage) dating of the Kadzielnia Limestone:

– *Quantitative biostratigraphic affinities*. In the Middle Devonian and Upper Devonian of Western Europe, 92% and 72%, respectively, of the Kadzielnia brachiopod species (Table 1; Text-figs 7, 8) occurred. Unfortunately, Doronin did not reveal the factual basis for these estimates.
– *'Guide fossils'*. The occurrence of definitely Middle Devonian species such as *Spirifer undiferus*, *Rhynchonella wahlenbergii* and *Rhynchonella parallelepipeda*. The acme of other species was believed to be restricted to the Middle Devonian, best exemplified by *Merista plebeja*, which forms coquinas at Kadzielnia. This Middle Devonian range is mostly confirmed nowadays (e.g., Halamski 2004, see Appendix 1A), but the species in fact do not occur at Kadzielnia (Table 1).
– *Absence of goniatites*. The lack of Upper Devonian goniatites at Kadzielnia contrasted with their numerous occurrence in the key Grund area (Roemer 1850–1852; Clarke 1885). Paradoxically, the finding of Frasnian *Manticoceras* at Kadzielnia had just been announced by Gürich (1894).
– *Regional stratigraphic succession*. By analogy with the Upper Devonian of Western Europe, Doronin (1893) assumed that the thick marl-limestone sequence developed north of Kielce (sites: Czarnów, Szydłówek, Kostomłoty, see Text-fig. 1B) represented the lower Upper Devonian (cuboides horizon). This correlation was thought to be supported by the occurrence of the Upper Devonian rhynchonellid *Camarophoria formosa* Schnur. Following Kayser (1871, p. 534), he regarded *C. polonica* F. Roemer, 1866 (wrongly spelled as *C. ?podolica* by Kayser) merely as "a variety ["eine Localart"] of *formosa*."

Doronin (1893, p. 7) finally posed a dilemma: "Shall we consider the Kadzielnia Limestone as the highest Stringocephalus stage or include it in the basal cuboides horizon." He favored the view that the cuboides horizon in the Kielce region corresponds to a thick marly-nodular series and not the coral Kadzielnia Limestone. This claim was in agreement with the preliminary proposal of Gürich (1887), who suggested a Middle Devonian age for the "coral limestones with brachiopod accumulations" from Kielce. However, this contradicted the dating concept of F. Roemer (1866), Michalski (1883) and Siemiradzki (1888), which was soon comprehensively proven by Gürich (1896). Today we know that the dark marly sequence (= Szydłówek Beds of Gürich 1896) actually represents the Middle to Late Devonian transition (Racki *et al.*1985; Pisarzowska *et al.* 2006; Baliński *et al.* 2016). The hemipelagic basin deposits were replaced



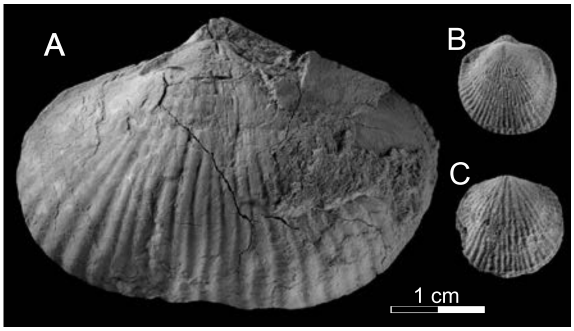
Text-fig. 8. Frasnian brachiopods from the Kadzielnia Limestone Member (A–I, K) and the Stromatoporoid-Grained Limestone (J) of the University of Silesia collection (Appendices 1B and 2; determinations after Biernat 1971, modified; for references to species from the Doronin's 1893 register see Table 1 and Text-fig. 7). Note the great diversity of shell size, shape and morphology (see also Szulczewski and Racki 1981, plate 2). A – *Fitzroyella alata* Biernat, 1969 (1–2 – non-alate variety; 3 – magnified alate variety). B – *Hypothyridina ascendoides* Nalivkin, 1951. C – *Dielasma* cf. *sacculus* (Martin, 1809); D – *Spinatrypina* cf. *plicata* Rzhonsnitskaya, 1964. E – *Cyrtospirifer cuspidatus* (Archiac and Verneuil, 1842). F – *Gypidula* cf. *greindli* (Maillieux, 1909). G – *Undispirifer* sp. H–I – *Parapugnax brecciae* (Schmidt, 1941). J – *Lateralatirostrum cf. athabascensis* (Kindle, 1924). K – *Schizophoria* cf. *prohibita* (Halamski, 2012). All from Kadzielnia except F–G (Jaźwica quarry), H (Kowala raiload cut; Szulczewski and Racki 1981, pl. 2, fig. 1) and I (Łgawa Hill). The specimens are shown in dorsal (1), anterior (2, except for C, posterior), and also lateral (3; E, G, H, J K) views. Photos by Z. Wawrzyniak.

southwards by the ramp-style flanking facies of the emerging Dyminy Reef, where the Early Frasnian mud mounds grew (Szulczewski 1971; Racki 1993). On the other hand, the distinctive *Phlogoiderhynchus polonicus* (F. Roemer, 1866) indeed commonly occurs in the Early to Middle Frasnian off-reef strata in the Holy Cross Mts (Biernat and Szulczewski 1975; Baliński *et al.* 2016).

FINAL REMARKS

The paleontological aspect of Doronin's note should be highly valued by the standards of the 1890s, and is still informative nowadays. On the other hand, despite the many data considered, Doronin misinterpreted the age of the Kadzielnia Limestone. This obsolescence reflects the weakness of the paleontological basis for time correlation at the time, as many supposedly key species turned out to be poorly defined taxa each without a precisely recognized stratigraphic range. Doronin, however, was aware of the preliminary nature of his hypothesis. In summary, what emerges from the 1893 note is a picture of someone very capable and adept at science, familiar with the literature, open-minded and independent in his thinking. Good research skills are evident in Doronin's observations and discussion. Partly because of the Warsaw periodical's limited availability (Gürich 1900, p. 382), later researchers failed to notice his article. It is a pity that the academic career of this pupil of Amalitsky's, which might have matched Sobolew's progress, never fully began.

This rediscovery of Doronin's contribution emphasizes the attractiveness of the Kadzielnia fossils, especially the brachiopods, which are still insufficiently known. The tasks are not limited to the diverse Frasnian inventory (Text-fig. 8), as the Famennian fauna presents two great puzzles. The single nest occurrence of the giant rhynchonellid (up to 9 cm wide; Biernat 1967, p. 148), costate and bisulcate *Dzieduszyckia kielcensis* (Text-fig. 9A), explored in 1825 by Pusch (1833, 1837), is still unresolved at the crucial locality (see also Trejdosiewicz 1872, 1875). This type species of the dimerelloid genus has a long-standing history of research (Pusch 1833, 1837; Buch, 1834; F. Roemer 1866; Gürich 1896; Siemiradzki 1909a, 1909b; Biernat 1967; Baliński and Biernat 2003). *Dzieduszyckia* almost certainly comes from the Cheiloceras limestone (after dating of the *D. kielcensis* coquina occurrence in the Ruda Strawczyńska borehole, ca. 20 km NW of Kielce; Malec 2014). The widespread Famennian genus (comprising 12 species) remains of great interest,



Text-fig. 9. Famennian brachiopods from Kadzielnia from the collection University of Silesia. A – *Dzieduszyckia kielcensis* (F. Roemer, 1866) in dorsal view, probably from the Cheiloceras Limestone, from the former collection of J. Czarnocki. B–C – "*Atrypa*" sp. sensu Biernat (1970, pl. 3, fig. 4), two specimens collected in last 1990s from the shaly-limestone unit in dorsal (B) and ventral (C) views. Photos by A. Baliński.

as some of its populations have adapted to the peculiar hydrocarbon-seep niche (Shapiro 2024). Even more mysterious is the atrypide record occurring after the Frasnian–Famennian mass extinction in the Middle Famennian coral-bearing marly strata (Różkowska 1969), established by Biernat (1970) and confirmed by the present author (Text-fig. 9B).

On the occasion of Szulczewski's jubilee, it is apparent that the Kadzielnia site, despite its reserve status, still offers several other attractive scientific challenges. In particular, more work is needed to explain the age and growth processes of the metazoan-microbial mud-mound, and the later role of syndepositional tectonics and the genesis of neptunian dykes (Text-fig. 2B; Łuczyński 2023). The mosaic richness of the benthic niches would also be an essential area for paleoecological studies, as outlined for the brachiopod *Fitzroyella alata–Parapugnax brecciae* Asociation in Szulczewski and Racki (1981) and Racki *et al.* (1993), and for ostracod microfauna by Malec and Racki (1993). The benthic specificity of mud-mounds, which is not limited to Devonian brachiopod-rich metazoan-microbial buildups (see the Carboniferous mud-mound case in Carniti *et al.* 2023), has made them a hotspot of speciation and endemism (Szulczewski and Racki 1981). Last but not least: collections of the Kadzielnia fossils, scattered not only in Poland [Warsaw, Sosnowiec (see Table-app. 2), Wrocław (Gürich's collection), Lviv (Zejszner; Czarnocki), possibly also Kharkiv (Sobolew) and St. Petersburg (Michalski); see Siemiradzki 1909a, 1909b; Ozonkowa 1972], are waiting for an up-to-date systematic revision. That is why the Kadzielnia site is a constant invitation to further research!

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Appendix 1

Notes on some taxa included in Table 1 and Text-figs 7, 8.

A. The numbering below refers to the order in Doronin's list in Table 1.

2. The selection of the species of Golduss (11826–1833), *Calamopora polymorpha* var. *ramoso-divaricata*, shown in Text-fig. 7S, follows the synonymy of *Favosites cervicornis* in F. Roemer (1866, p. 670).

4. The *Cyathophyllum hexagonum* group was placed by Gürich (1896, p. 171) in the genus *Hexagonaria*, and at Kadzielnia he noticed *Hexagonaria basaltiformis* F.A. Romer, 1843. The cited species of Wrzołek (1993) occurs in the Lower Frasnian biostromal set on the southern periphery of the Dyminy Reef.

5. The distinctive fan-shaped bryozoan species *Fenestella subrectangularis* Sandberger were reported by Gürich (1896, pp. 211–212) as rare at Kadzielnia, in contrast to nearby Cmentarna Hill (see Morozova *et al.* 2002, p. 316).

8. *Spirifer elegans* was created by Martin (1809), but attributed to Steininger (1853) by Kayser (1871, p. 569; Text-fig. 7J). *S. elegans* sensu Doronin may actually represent *Adolfia zickzack* F.A. Roemer, 1843, found in Kadzielnia by Gürich (1896, pp. 252–253), but not reported by Biernat (1971). Siemiradzki (1922, p. 154) even highlighted a nest-like accumulations of two species of *Adolfia (S. deflexus* F.A. Roemer, 1843 and *S. zickzack*).

10. The common occurrence of *Merista plebeja* in the Kadzielnia site, recorded by Doronin, was soon confirmed by Gürich (1896, p. 269) as a single athyridide species in this site. It was not found by Biernat (1971), who identified only *Athyris* sp. The species has been registered in the Givetian strata of the Łysogóry Region (Biernat 1966; Baliński and Halamski 2023), but genus continued in the Kielce Region into the Late Frasnian (*M. rhenanensis*; Grunt and Racki 1998).

12–13. Diverse atrypids from all Kadzielnia Frasnian units may include several variatrypiniid [e.g., *Desquamatia.* (*D.*) *alticoliformis* Rzhonsnitskaya, 1975; *"Atrypa" kadzielniae* Gürich, 1896; see Gürich 1900, p. 359] and pseudogrunewaldtiniid species (Racki and Baliński 1998, pp. 290, 292). In fact, Gürich (1900, p. 382) mentioned a species similar to *Atrypa* (= *Grunewaldtia*) *latilinguis* Schnur, 1853 [= *A.* sp. aff. *latilinguis* in Siemiradzki, 1903, p. 138]. *"A." kadzielniae* is likely close to *Desquamatia macroumbonata*, described by Racki (1985) from the Givetian–Frasnian transition of the Chęciny region.

20–21. Doronin recorded two small-sized rhychonellid species from the *R. parallelepipeda* group (= *R. Wilsoni* 'Formenreihe' of Kayser 1871), identified earlier as *R. primipilaris* and *R. Wilsoni* Sowerby, respectively, by F. Roemer (1866) and Zejszner (1867). Gürich (1896) and Biernat (1971) also reported frequent minute uncinuloids from Kadzielnia, but their systematic position remains unresolved till now.

R. wahlenbergi Goldfuss, listed by Doronin, was poorly known species (Kayser 1871, pp. 510–511), and *R. parallelepipeda* was similarly insufficiently defined by Bronn (1837, p. 71), without illustration of the holotype. Thus, the species of the group have been differently understood (see e.g., Goldfuss 1826–1833; F.A. Roemer 1843, 1850–1852; Schnur 1853; Davidson 1864–1865; Kayser 1871), and, as noted by Trejdosiewicz (1872, 1875), often misidentified. Currently, all the species are restricted to the Middle Devonian and assigned to different genera (Halamski *et al.* 2020; Höflinger and Jung 2020).

It is therefore impossible to decide which of the two species Doronin considered to be more similar to the very characteristic species now known as the almost non-sulcate *Fitzroyella alata* (Text-fig. 8A) than to the variable *Hypotyridina nana* sensu Biernat, 1971; pl. 2, figs 2, 3), with distinct, approximately rectangular sulcus (Text-fig. 8B). The re-figured *Fitzroyella*-like specimen (non-alate morphotype – Text-fig. 7A; see Baliński *et al.* 2016, pl. 12, figs 1–10) was identified by F.A. Roemer (1843) as *R. primipilaris*, but by Kayser (1871, pp. 508–509, pl. 9, fig. 4) thought it as close to *R. parallelepipeda* var. *pentagona* Goldfuss. On the other hand, Gürich (1896) did not seem to have *F. alata* in his fossil set (see also Biernat 1971). Three small (mostly under 1.5 cm) uncinuloid species were identified by him (*R.* aff. *semilaevis* F.A. Roemer, *R. reniformis* Sowerby and *R. cuboides* Sowerby var. *minor*), but Gürich himself pointed out that they may even belong to the same species, likely the variable *H. nana*. This species has been transferred to *H. ascendoides* Nalivkin by Baliński (1979), and according to Biernat (1971), it is represented at this site by different ontogenetic stages. Czarnocki (1947) characterized the Kadzielnia Middle Frasnian (Text-fig. 2A) by the occurrence of *H. coronula* (Drevermann).

Significantly, Gürich (1896, p. 287) remarked that in his variety *minor* "the saddle acquires a unique appearance due to the fact that the outermost ribs converge more strongly than the inner ones, thus fanning out towards them." The fan-like costation pattern is visible also in the shell of *H. nana* figured by Biernat (1971, pl. 2, fig. 3), and it is diagnostic for the genus *Flabellulirostrum* Sartenaer, 1971, richly occurring in the Lower Frasnian of nearby Wietrznia site (Racki *et al.* 1993; Baliński 2006).

23. The occurrence of strophomenids is not established by Biernat (1971); however, they were also reported by Gürich (1896, p. 228) and Sobolew (1909, p. 366), and finally found in the Stromatoporoid-Grained Limestone in the newly collected material (Appendix 2).

25. This gastropod genus was confirmed at Kadzielnia by Gürich (1896, pp. 311–312; pl. 11, figs 1, 2), who described new species *Loxonema polonicum*, considered by Czarnocki (1947) as a 'guide fossil' of the lower part of the Kadzielnia Limestone (Lower Frasnian).

B. The letter order below refers to the specimens illustrated in Text-fig. 8.

E. Pyramidal-shelled cyrtospiriferids from Kadzielnia, described by by Gürich (1896, pp. 249–250, pl. 9, fig. 1) as *Spirifer canaliferus* Valenciennes var. *cuspidata* Verneuil, were unfortunately not included in the extensive revision of *Tenticosprifer* and related genera by Ma and Day (2000). Thus, following the recent revision by Wang *et al.* (2022), this species is designated as *Cyrtospirifer cuspidatus* (Archiac and Verneuil, 1842). Gürich (1896) considered the German and Polish cyrtospiriferids to be conspecific on the basis of description in Archiac and Verneuil (1842, p. 369, pl. 35, figs 7, 7a).

J. Large-sized transversely ovate and weakly costate leiorhynchids with a very high tongue from Stromatoporoid-Grained Limestones are comparable with *Calvinaria variabilis athabascensis* (Kindle, 1924) from correlative Frasnian strata at Dębnik (see Baliński 1979, pl. 6, fig. 2). The Canadian species was considered to be the type species of the genus *Lateralatirostrum* proposed by Sartenaer (1979).

L. In the light of the study by Pocock (1966), the large (up to 45 mm wide) schizophoriids from Kadzielnia (see also Biernat 1971, p. 140, pl. 1, fig. 8) can only be identified as *Schizophoria striatula* (Schlotheim, 1822). In the Lower Frasnian of Górno, however, Baliński *et al.* (2016) found *Schizophora schnuri prohibita*, the subspecies described by Halamski (2012) from the uppermost Givetian strata of this locality. The sporadic shells from Kadzielnia, significantly larger and with a high sulcus, probably represent new species (Biernat 1971), but are similar to those from Górno in their rounded-subrectangular (subquadrate according to Biernat 1971) shell outline (see e.g., Halamski 2012, text-figs 7P–T and EE–II). The shell outline of the Polish species also distinguishes it from the Givetian species *S. schnuri schnuri* from the Eifel Mts, which is marked by subelliptical shells. It is therefore tentatively interpreted here as a separate Givetian–Frasnian species, *S. prohibita*, restricted to the Holy Cross region, richly occurring in the eastern Kadzielnia Chain (Wietrznia, section W-Ia; Cmentarna Hill; Racki *et al.* 1993).

Appendix 2

Brachiopod collection from the Kadzielnia site, kept at the University of Silesia in Sosnowiec (Text-figs 8, 9).

Unlike older collections, the unstudied fossil sets housed at the University of Silesia are assigned to the current lithostratigraphic units (Table-app. 2; see Text-fig. 2B). These specimens were collected by the present author between 1980 and 2000 using three methods: (1) hand-picked loose specimens from weathered or crushed rocky waste, (2) mechanically hammered from fresh rock, primarily from quarry walls, and (3) sieved from powdered weathered limestone crusts (also referenced in Galińska's 1984 master's thesis). The third method enabled the retrieval of unique early ontogenetic stages of shell growth (Fig.-app. 2; see also Biernat 1971, p. 159). The primary collection originates from the biohermal Kadzielnia

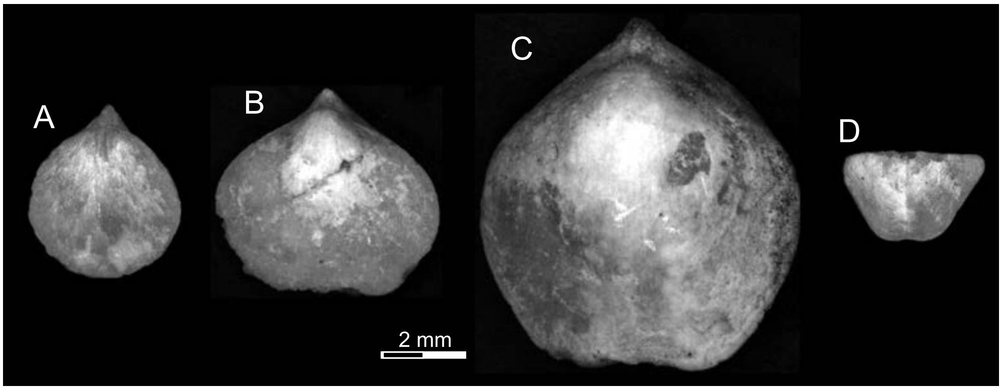

Fig.-app. 2. Different growth stages of terebratulid *Dielasma* cf. *sacculus* (Martin, 1809; A–C; see Text-fig. 8C) and immature specimen of spiriferid *Verneuilia kadzielniae* (Gürich, 1896; D) in dorsal view. Photos by Z. Wawrzyniak.

Table-app. 2. Characteristics of brachiopod collection from the Kadzielnia site kept in the University of Silesia. * The contribution of each gathering method is shown semi-quantitatively by the number of crosses.

		Kadzielnia Limestone Mbr.	Stromatoporoid-Grained Limestone	Manticoceras Limestone	Marly-Shale Complex
		Lower–?Middle Frasnian	Middle Frasnian	Upper Frasnian	Middle Famennian
Cat. no. GIUS 4-		258	267	271	3760
Collection method*	hand-picked loose specimens	+++			+++
	hammered from fresh rock	+	+++	+++	
	sieved from weathered crust	++			
Preservation of the shelly material		variably preserved, highly shell-dominated	poorly preserved, highly valve-dominated	poorly preserved, shells and valves	well preserved, almost exclusively shells
Approx. number of subcomplete specimens		260	200	50	190
Minimal number of taxa		22	18	10	7

Limestone Member, mainly from its lower (Lower Frasnian) section exposed in the Geologist's Rock. Notably, a similarly well-preserved fauna from the Kadzielnia Member bioherms (approximately 160 nearly complete shells) was obtained from three localities in the Gałęzice Syncline (Szulczewski and Racki 1981, pl. 2; Text-fig. 1B).

Two higher Frasnian units provided poorly preserved brachiopod material from the southeastern quarry wall, dominated by disarticulated and exfoliated atrypid valves (see Racki and Baliński 1998). Of the five samples from the Stromatoporoid-Grained Limestone, only one contains a significant number of nearly complete shells (e.g., *Lateralatirostrum* cf. *athabascensis*, Text-fig. 8J), particularly pugnacid rhynchonellids. This assemblage is quite distinct from the biohermal association, with part of it related to the coeval fauna from the Kraków region (Calvinaria cracoviensis Assemblage Zone of Baliński 1979).

Only two brachiopod samples were taken from the coquinoid-encrinite intercalations in the Manticoceras Limestone, but these yielded some specific species (*"Camarotoechia" elegans* – Gürich 1896; large-sized *Hypothyridina cuboides* – Czarnocki 1947). Well-preserved material from the Middle Famennian marly strata represents a deep-water assemblage dominated by the small-sized rhynchonellid *Tenuisinurostrum subcrenulatum* Biernat, 1970. An important addition is ten well-preserved shells (including a unique *Dzieduszycka* specimen; Text-fig. 9A; also Text-fig. 8E and K), remnants of Jan Czarnocki's collection (GIUS 4-834 JCz), originally held in the State Geological Institute in Warsaw but destroyed during World War II.

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