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Inventory of Polish meteorites

Andrzej S. PILSKI

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Meteorites which fell on or were found in Poland are arranged in chronological order. Each meteorite is described, and specimens preserved in Polish collections are listed.

Andrzej S. Pilski, Nicolaus Copernicus Museum in Frombork, Katedralna 8, PL-14-530 Frombork, Poland, e-mail: frombork@softel.elblag.pl (received: September: 11, 2000; accepted: October 19, 2000).

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INTRODUCTION

This inventory deals with meteorites which fell on or were found in Poland (present-day borders) and are listed in catalogues as Polish meteorites. The meteorites are arranged in chronological order in accordance with the classification and naming system used in the *Catalogue of Meteorites* (Graham *et al*., 1985; Grady, 2000) and, for subsequent falls/finds, in the meteoritical bulletins. Synonyms used in some collections are shown in parentheses. Only those meteorites for which at least one specimen was found or reported are taken into account.

Each meteorite is described, and specimens preserved in Polish collections, both institutional and private, are listed. The list is not complete, as some institutions and many private collectors refused to give any data about specimens they possess. This refers especially to the Morasko octahedrite: in the last few years many sizeable specimens were found, but the meteorite hunters are not willing to give any data about their finds.

METEORITES

Sagan (Dąbrowa Łużycka) — fell March 6, 1636; 06:00; coordinates: 51°32’N, 14°53’E; stone.

One stone, grey with a black crust, fell onto the village of Dubrov but nothing is now preserved. “Dubrov” cannot be identified with certainty but is probably Dubraucke (= Dubrawka); 51°47’N, 14°31’E; 27 km NW of Priebus (= Przewóz) (Pokrzywnicki, 1964; Graham *et al*., 1985).

Schellin (Skalin) — fell April 11, 1715; 16:00; coordinates: 53°21’N, 15°3’E; stone, olivine-hypersthene chondrite L, veined; olivine Fa 25.

In a clear sky three detonations were heard like gunshots followed by a rumble as if a heavy loaded wagon ran rapidly along paving-stones. Then herdsmen saw a stone hit the ground causing a burst of soil, and extracted the stone from the ground. The stone weighed about 7 kg and was the size and shape of a skull. Another man found a second stone some 3 km away, as large as a goose egg. Little is preserved, and no piece of the meteorite exists in Polish collections (Pokrzywnicki, 1964).

Białystok — fell October 5, 1827; 9:30; coordinates: 53°6’N, 23°12’E; stone, achondrite, Ca-rich, howardite.

At a meeting of the scientific section of the Towarzystwo Królewskie Przyjaciół Nauk (Royal Society of Friends of the Sciences) in Warszawa (then in the Kingdom of Poland) which was held on October 24, 1827, count W. Krasiński presented the society with an aerolite which had fallen on his estate near the town of Knyszyn. According to his words it fell “...on October 6 between 11 and 12 a.m. during a violent storm lasting a quarter of an hour...”. Reportedly, a substantial number of stones, similar to the one presented, had fallen; some of them were the size of “a hen’s egg” (Pokrzywnicki, 1956, 1964).

J. Wolski, teacher of physics in the Grammar School at Białystok, in his report for the director of schools for the district, wrote as follows: “On the 23rd day of September 1827

(on Friday), between 9 and 10 o'clock in the morning, when most of the residents of the village of Fasty were occupied in digging up vegetables in gardens, there was suddenly heard a powerful explosion in the air, quite clearly, and at once many other ones repeated like gun fire, which called attention to the people working in the gardens and in the fields, followed by a loud whistle accompanied by sounds of rapidly falling bodies and strong impacts into the ground in some places. The phenomenon alarmed all the people for some time, but the fear passed off when one man ventured to the place of the fall and picked up a black stone and showed it to the gathered people and they, emboldened, ran to other places where dust was rising and found other similar stones.

In accordance with the testimony of nearly all the residents of the village, there fell many other stones, mostly into the swampy area along the Supraśl River running by the village, as well as into the river itself, but it is hard to get them, and maybe next year by ploughing and scything somebody will accidentally find a few. Therefore, there is no room for doubt that this meteoritic phenomenon in the village of Fasty and in the nearby localities actually happened; it is very unfortunate only that villagers had all the stones broken up and given to various people, and, after realising that these stones are of great worth, they did not want to give up the ones they had found".

Despite some inconsistencies, both reports refer to one event, which took place on October 5, 1827. In the report by J. Wolski, the date was given according to the J. Calendar, which was used in Russia (at that time the Kingdom of Poland belonged to Russia). Count W. Krasiński could have been misinformed by the villagers who had found the stone. In Fasty the sky was clear except for a dense black cloud at the zenith from which the stones fell. So one may suppose that the "storm" count Krasiński described came from the sonic booms and clouds of vaporised meteoroid material. However, Fasty was not owned by count Krasiński and was situated some 20 km south-east from his estate. This suggests that the dispersion ellipse of the Białystok meteorite shower, which was never determined, was at least 20 km long.

In J. Wolski's account one can also find a description of the fallen stones as well as his explanation of the event.

"The shape at the stones is more or less spherical, their surface is ragged, covered by shining lava, the matrix inside is ash-grey, fragile, like a compact pumice, with embedded olivine and chlorite crystals, the fracture is fine-grained, rough, the density moderate.

Muriatic acid extracts much sulphuretted hydrogen gas from the stone, and even by rubbing one can obtain a smell of sulphur; a magnet attracts crumbled fragments very faintly.

There is no doubts that they are igneous and that it fell as a large lump from a very high altitude — maybe from the Moon, and after it fell into the dense atmosphere, it heated because of its speed and friction and cracked: this gave the first loud explosion, which was heard some miles around, followed next by cracks like gun fire. Because it must have been much heated, the surface of the resulting fragments was melted and bathed in lava."

Remember this was written nearly 200 years ago. Here is a contemporary description written by H. Schulze of the Museum für Naturkunde of Humboldt University in Berlin, Germany.

"The Białystok meteorite is composed mostly of a grey-white matrix (it looks like concrete) in which are embedded single grains of olivine (greenish, brown and black) and of feldspar (white). Their size reaches 1–2 mm. Furthermore, there occur rare, coarse-grained black fragments up to 1 cm, which constitute 10% of the meteorite. These fragments consist mainly of olivine but contain some feldspar too, and as a curiosity, metallic nickel iron, which is very rare in this type of meteorite. The specimen is covered with a beautiful black crust. Its density is 3.17 g/cm^3."

The Białystok meteorite is a stone, achondrite, which belongs to the group of HED achondrites. There has been some controversy as to whether it is a howardite or eucrite. It is now counted among the former. Meteorites of this type are probably fragments of sediment from the surface of the 4 Vesta asteroid. They are breccias composed of crumbled eucrites and diogenites cemented together, sometimes with some of the fragments of the impactor that hit the surface. Because eucrites are also often breccias, the only difference between eucrites and howardites is that the latter include fragments of diogenites. The question was, did Białystok have enough diogenitic matter for it to be counted as a howardite? (Pilski, 1995).

Only a few specimens totalling 4 kg were collected soon after the fall, and most of these were lost as the years went by. Today, according to the *Catalogue of Meteorites* (1985), the largest specimens are in: Kiev — 120 g, Budapest — 101 g, Moscow — 91 g, Berlin — 73 g and Vienna — 59 g. In Poland there are about 4 g of fragments in Warszawa (Hanczke, 1995). Most of the fragments are still embedded in the swamps near the Supraśl River and in the Knyszyn Forest, most by now are probably weathered. No find of Białystok is known since 1827.

S p e c i m e n : MZPAN: 3.7 f.

Grüneberg (Wilkanówko) — fell March 22, 1841; 15:30; coordinates: 51°56'N, 15°30'E; stone, olivine-bronzite chondrite H4, veined; olivine Fa 17.

Residents of the village of Heinrichau (now Wilkanówko) who were working in the fields, heard three loud booms similar to gunshots. The sky was quite clear except for one small cloud at the zenith. Just after these booms a loud whistle was heard which seemed to come from the west and got stronger, and stronger, and finally a thud was heard as if a heavy body hit the ground. The workers came to the source of the sound and found a stone in a pit half a foot deep. The shape of the pit suggested that the stone fell perpendicular to the ground. The workers feared to touch the stone thinking it was hot but it turned out to be completely cold. The meteorite found its way to the Royal Mineralogical Collection in Berlin (Pokrzywnicki, 1964).

S p e c i m e n : MMWr: 46.4 ep.

Seeläsgen (Przełazy) — found 1847 (known in this year); coordinates: 52°16'N, 15°33'E; iron, octahedrite coarse (3.1 mm) IIICD; 6.23% Ni, 6.47% Ni, 96.8 ppm Ga, 493 ppm Ge, 1.1 ppm Ir.

A villager from Seeläsgen, when digging a drainage ditch on his meadow, found a mass of iron of about 102 kg, which he then sold to a blacksmith named Jähnsch from Züllichau (now

Sulechów). Several years afterwards in November 1847 a machinist named Hartig took a fragment for examination. When it was recognised as a meteorite, the main body was moved to Wrocław and then fragments were distributed to many collections over the world (Pokrzywnicki, 1964). V. Buchwald (1975) later found evidence that the mass had been mildly shocked and cosmically annealed, then artificially heated to 600şC. Analysis of trace elements (Ga, Ge and Ir) proved that the meteorite is paired with Morasko (Kracher *et al*., 1980). Previously IA was reclassified in 1995 as IIICD (Choi *et al*., 1995). A meteorite hunter found a mass of iron of about 5 kg in Przełazy in 2000.

S p e c i m e n s : IGUAM: 580 sc; MMWr: 277.64 sc, 276.8 sc, 28.0 f, 1.2 fp; MGUJ: 238.7 sc; OPiOA: 134.9 sc; KMaG: 52.6 sc; MZPAN: 12.8 s; KSoK: 3.4 f.

Schwetz (Świecie) — found 1850; coordinates: 53°24'N, 18°27'E; iron, octahedrite medium (1.0 mm) IIIA; 7.44% Ni, 18.3 ppm Ga, 33.5 ppm Ge, 11 ppm Ir.

In Spring 1850, during the removal of a sandy hill for a railroad on the left bank of the Wda River near the town of Świecie, a mass of iron was found about 4 feet below the surface, at the boundary between layer of sand above and a layer of clay below. It weighed about 21.5 kg and had many cracks along kamacite plates resulting from weathering. It found its way to the Royal Mineralogical Collection in Berlin (Pokrzywnicki, 1964).

S p e c i m e n s : MZPAN: 516.5 s; OPiOA: 6.4 s.

Swindnica Gorna (Świdnica Górna) — found 1857, possibly fell October 12, 1856; 17:00; coordinates: 53°21'N, 15°3'E; stone, doubtful.

In the magazine *Przyroda i Przemysł* no. 5, p. 39, 1858 one can read: "Dr. J. Szafarkiewicz reported on an aerolite found in autumn 1857 near the village of Górna Świdnica by Wschowa and sent to the Poznańskie Towarzystwo Przyjaciół Nauk (Poznań Society of Friends of the Sciences) by count K. Kwilecki. It is one of fragments into which a fire-ball came apart, when falling down at 5 p.m. in 1856. Count K. Kwilecki wanted villagers to look for fragments; till now only one fragment has been found. which sent to the Towarzystwo has been examined." Reportedly its specific weight was 3.018. The specimen was lost prior to 1913, as it is not mentioned in a catalogue of the collection of the Poznań Society of Friends of the Sciences published in that year (Pokrzywnicki, 1955, 1964).

Pułtusk — fell January 30, 1868; 19:00; coordinates: 52°46'N, 21°16'E; stone, olivine-bronzite chondrite H5, veined, brecciated; olivine Fa 18.5, 27.19% total iron.

On January 30, 1868 at 7 p.m. a bright bolide was observed from many parts of Poland. Seen from Warszawa first, it was observed as a 1st magnitude meteor in the constellation of Andromeda. Its brightness increased rapidly until it rivalled the first-quarter Moon. The bolide passed through Cassiopeia, Cepheus and Draco to the Great Bear. Its colour changed from white to bluish-green and finally to red.

The villagers of Rowy, Nowy Sielec and Gostkowo watched the fire-ball swell until it became too bright to look at. As it fizzled out the peasants heard loud detonations and the whistle of falling stones followed by the sound of meteorites striking the ground, roofs, trees and the ice-covered Narew River. When daylight broke, the villagers were able to recover numerous black stones that were scattered over the snow and ice (Pilski, 1991).

The Pułtusk meteorite shower is one of the greatest in the world. Estimates of how many stones fell near Pułtusk range from a few thousand to 180 000 (Lang and Kowalski, 1971). One of the most accurate estimates was that of the Polish geologist J. Samsonowicz who, after detailed field work between 1922 and 1929, and having interviewed the few remaining witnesses, concluded that 68 870 meteorites had fallen (Samsonowicz, 1952). Samsonowicz also managed to determine the extent of the dispersion ellipse which he put at 18 x 9 km.

The best of the early morphological descriptions of the Pułtusk meteorites can be found in "Notice sur la météorite tombée le 30 Janvier 1868 aux environs de la ville de Pułtusk" published "par la Haute École de Varsovie" in May 1868. This booklet, in French, was distributed with specimens of the meteorites to many universities in Europe, as well as to famous professors and scientific organizations (Pokrzywnicki, 1964). The booklet notes:

"The specimens supplied to the Main School (la Haute École) were covered with a glassy layer coloured brown-black, having a thickness of 0.5 mm on average. This layer also covered the small specimens supplied later, so each was a small individual specimen. Examples were found of other forms, which seemed to have been broken up. The surface of some meteorites was in places wrinkled with furrows running out radially from one point".

This seems to be evidence that the Pułtusk meteoroid was not a single body but a swarm of meteoroids prior to entry into the Earth's atmosphere. However, it is also possible that the meteoroid fragmented high in the air, long before reaching its retardation point, and consequently each fragment underwent ablation and developed a fusion crust.

The booklet continues:

"The main mass of the meteorites is composed of grainy fragments coloured ashen-grey with a yellowish hue. In some specimens there are two shades of grey: light and dark. Sometimes both hues are mixed together in such a way that the surface looks like marble. Sometimes the dark grey embraces the lighter hue and the surface looks like a breccia. On one specimen the light hue is prevalent, on the other specimen it is the darker hue.

In the main mass are perceptible globules of two kinds: the ones that are relatively fragile are scarce, the others — dark grey — are sometimes ellipsoidal in shape with diameters up to 3 mm.

The nickel-iron is disseminated in the meteorite as steely-grey coloured grains of various shape and size. Some are small-imperceptible to the naked eye — others are much greater, up to several millimetres in diameter".

The investigations of A. Manecki (1972) of the University of Mining and Metallurgy in Kraków concluded that the Pułtusk meteorite is a brecciated olivine-bronzite chondrite of H5 type. Dominant minerals are olivine and pyroxene with minor amounts of kamacite, troilite and chromite. Chalcopyrrhotite, plagioclase and copper occur as accessory minerals.

The Pułtusk meteorites need more detailed petrographic examination. Macroscopic examination quickly reveals that the parent body of the meteorite was not homogeneous. Many specimens are homogeneous with shock veins scarce or absent. In the others a brecciated texture prevails, with abundant shock veins. Recently one small specimen was recovered which is composed of a completely shock-melted rock. In many specimens the matrix has a yellowish tint, in others it is gray. Meteorites composed of both types of matrix testify that this is not an effect of weathering.

S p e c i m e n s : MZPAN: 8100 cs, 3130 cs, 2343 cs, 1400 cs, 986.35 cs, 938.0 cs, 304.5 cs, 236.25 cs, 226.31 cs, 183.35 cs, 140.0 cs, 77.23 cs, 69.91 cs, 68.97 cs, 67.1 cs, 39.9 cs, 34.8 cs, 32.5 cs, 29.58 cs, 20.35 cs, 18.78 cs, 15.3 cs, 11.2 cs, 10.93 cs, 8.4 cs, 5.92 cs; MGPAN: 2970.0 cs, 1800.0 cs, 1210.0 cs, 1000.0 cs, 875.0 cs, 703.0 cs, 693.39 cs, 652.0 cs, 641.0 cs, 628.93 cs, 496.0 cs, 436.0 cs, 422.32 cs, 368.75 cs, 350.25 cs, 314.12 cs, 311.4 cs, 296.32 cs, 296,0 cs, 294.0 cs, 280.7 cs, 275.66 cs, 258.36 cs, 243.8 cs, 210.36 cs, 180.4 cs, 178.24 cs, 167.5 cs, 157.0 cs, 145.7 cs, 143.65 cs, 138.41 cs, 134.5 cs, 122.44 cs, 121.8 cs, 118.13 cs, 112.68 cs, 108.67 cs, 106.52 cs, 97.83 cs, 94.60 cs, 89.44 cs, 78.15 cs, 76.0 cs, 75.66 cs, 65.0 cs, 64.95 cs, 36.69 cs, 36.1 cs, 34.1 cs, 32.75 cs, 31.3 cs, 29.7 cs, 29.5 cs, 29 cs, 28.5 cs, 27.6 cs, 25.2 cs, 24.7 cs, 24.5 cs, 24.1 cs, 23.8 cs, 23.1 cs, 22.2 cs, 21.7 cs, 21 cs, 20.2 cs, 20.1 cs, 19.5 cs, 18.4 cs, 17.4 cs, 17.3 cs, 16.9 cs, 16.7 cs, 16.7 cs, 16.3 cs, 15.3 cs, 14.6 cs, 13.1 cs, 12.2 cs, 4.4 cs, 3.7 cs, 156 specimens from 5.0 to 1.0, total 412.42; MGUJ: 2860 cs, 1360 cs, 431.5 cs, 169.0 cs, 138.1 cs, 137.5 cs, 131.8 cs, 106.6 cs, 72.3 cs, 64.9 cs, 62.5 cs, 60.9 hs, 46.3 cs, 41.6 cs, 35.4 cs, 35.0 cs, 33.4 cs, 26.4 cs, 20.9 cs, 20.5 cs, 17.3 cs, 16.0 cs, 15.6 cs, 14.9 cs, 14.3 cs, 14.3 cs, 14.2 cs, 13.4 cs, 13.2 cs, 12.8 cs, 12.5 cs, 12.4 cs, 10.9 cs, 10.2 cs, 8.7 cs, 8.3 cs, 8.2 cs, 7.2 cs, 6.1 cs, 6.1 cs, 5.9 cs, 5.7 cs, 5.0 cs, 2.3 cs, 1.9 cs; OAUW: 1235 cs; MGPIG: 675.4 cs; MMWr: 205.0 cs, 37.81 cs, 15.0 ep, 21.67 cs, 18.83 cs, 20.05 cs, 17.15 cs, 19.02 cs, 8.59 cs, 11.66 cs, 12.62 cs, 10.23 cs, 8.71 cs, 6.95 cs, 8.10 cs, 12.25 cs, 17.36 cs, 18.33 ep, 11.57 cs 2.86 cs, 7.52 cs, 6.71 cs, 6.67 cs, 6.49 cs, 6.06 cs, 6.09 cs, 5.93 cs, 4.98 cs, 4.97 cs, 4.93 cs, 4.50 cs, 4.51 cs, 4.36 cs, 3.97 cs, 3.81 cs, 3.84 cs, 3.27 cs, 3.75 cs, 4.41 sc, 3.56 cs, 3.10 cs, 2.65 cs, 2.51 cs, 2.34 cs, 4.99 cs, 3.70 cs, 3.60 cs, 4.78 cs, 4.01 cs, 4.18 cs, 2.65 cs, 3.55 cs, 3.18 cs; OPiOA: 110.5 wcs, 22.54 hs, 1.9 cs, 1.0 cs; MRP: 75.5 cs, 63.4 fc, 15.6 hs, 10.4 cs, 6.2 cs, 5.7 hs, 5.6 cs, 4.5 fc, 4.4 cs, 3.9 cs, 2.1 cs; OAUJ: 46.0 wcs; MGZPŚ: 43.0 cs, 10.9 cs, 8.3 cs; PWDT: 29.1 hs; MMKF: 27.5 sc; KMaG: 26.7 cs, 21.5 cs, 13.9 cs, 3.2 f; MWGUW: 18.80 cs, 5.0 hs; KSoK: 18.6 cs; MEPZG: 13.2 hs; MKGW: 12.2 hs, 6.9 hs, 6.0 cs, 5.0 hs; LGL: 10.1 cs; MZWNoZUŚ: 10 s; MCiD: 9.3 hs, 7.5 cs, 5.5 hs; WWoG: 6.9 cs; RBoW: 5.7 cs, 3.7 ep; JWKW: 4.65 cs, 3.59 cs; PŻoW: 4.1 cs, 3.15 fc; JAB: 3.3 cs, 2.9 cs, 2.1 sc; JBaZ: 3.0 cs; PiOAG: 2.7 ep; BDąT: 2.2 sc, 0.8 cs; JJDL: 1.5 ep; SKoZ: 1.5 cs; TZwW: 1.5 hs; AKKC: 1.2 f; MPPF: 1.2 cs; GMGS: 0.95 sc; TP!W: 0.85 fc; MKoL: 0.07 f.

Gnadenfrei (Piława Górna) — fell May 17, 1879; 16:00; coordinates: 50°40'N, 16°46'E; stone, olivine-bronzite chondrite H5, brecciated; olivine Fa 18.

Loud booms gunshots were heard like, then something like a whizz, and a woman working in a field saw that something hit the ground, making a burst of soil. A meteorite weighing 1 kg was found in a pit one foot deep. The second piece, about 0.75 kg, was found at a depth of 6–8 inches. As some heard three booms, one thought three meteorites could have fallen, but no further piece was found (Pokrzywnicki, 1964).

S p e c i m e n s : MMWr: 665.0 cs, 16.03 ep, 18.2 fp, 10.65 fp.

Ratyn — fell August 24, 1880; between 14:00 and 15:00; coordinates: 52°12'N, 17°59'E; stone.

A stone of about 1 kg fell in the village of Ratyń, about 13 km from the town of Konin, made a hole a foot deep. The fall was accompanied by a loud noise. The stone fell between mowers who felt a very hot wind. The meteorite was extracted and found its way to a chief officer of the Golin commune. It has since been lost (Pokrzywnicki, 1955, 1964).

Grzempach (Grzempy) — fell September 3, 1910; 15:00; coordinates: 52°52'N, 16°38'E; stone, olivine-bronzite chondrite H5; olivine Fa 20.

A Mr. Bydołek, a resident of the village of Grzępy (= Grzempy) ituated some 7 km from the town of Czarnków, was working in his farmyard, when suddenly a sound like thunder was heard and a fire-ball fell. The ball broke a few tree branches and lodged in the ground next to him. Bydołek scraped in the ground and found a meteorite, still so hot that he could not to catch hold it. There was a smell of sulphur. The meteorite was round and fist-sized. Apparently two fragments were dislodged; one during its fall, as the broken surface was heated, and the second one when the meteorite hit the ground, as the broken surface looked fresh (Pokrzywnicki, 1955, 1964).

The meteorite was donated to a Museum in Poznań, and finally found its way to the collection of the Polish Academy of Sciences, now in the Geological Museum in Kraków (Łaptaś and Ćwiżewicz, 1998). A few fragments were cut for examination. A slice was traded with the Polish Geological Institute for the Baszkówka chondrite.

S p e c i m e n s : MGPAN: 535.2 cs; 11.36 sc; 1.82 f; MGPIG: 5.65 sc.

Morasko — found 1914; coordinates: 52°28'N, 16°54'E; iron, octahedrite coarse (2.5 mm) IIICD; 6.65% Ni, 6.56% Ni, 98.9 ppm Ga, 496 ppm Ge, 1.0 ppm Ir.

On November 12, 1914, during the digging of trenches near the village of Morasko, only a few kilometres north of Poznań city, a sergeant, Dr. Cobliner, found a nodule of metal weighing about 75 kg. We know this from a letter to the director of a museum in Poznań in which Cobliner wrote: "...Bei Schanzarbeiten fand ich heute im gewachsenen Boden (Kies) ungefähr einen halben Meter unter der Erdoberfläche einen Metallklumpen von 75 kg gewicht...". A fragment of this iron was sent to the Geologische Landesanstalt in Berlin, Germany, where it was recognised as meteoritic. After World War I the mass found its way to the Wielkopolska Museum in Poznań (Pokrzywnicki, 1955, 1964).

In 1954 J. Pokrzywnicki found, in the Muzeum Przyrodnicze (Natural History Museum) in Poznań the main mass of the Morasko meteorite plus three more small (3–4 kg) individuals. Thinking that it could be a meteorite shower, J. Pokrzywnicki began to inquire of the residents of Morasko about possible finds of lumps of iron. Soon he found, in a farmyard, an iron of 78 kg, which the farmer had ploughed up in the fall of 1947 and brought to his yard. Another farmer told him that before World War II a lump of 80 kg and eight other masses of 1.5 to 8 kg had been ploughed up. Most of them had been lost, but some could be the individuals which J. Pokrzywnicki found in the Museum.

J. Pokrzywnicki noticed too, in a small forest south of the places where the meteorites had been found, that there are depressions resembling small craters. As this area is a post-glacial one, it was thought that the depressions had been formed by glaciers. However, since meteoritic fragments had been found near these craters, it was then suggested that they could be of meteoritic origin. The largest crater is about 60 m in diameter and is filled with water and rimmed by a ridge up to 8 m high on the south side.

In 1970, scientists from the Astronomical Observatory in Poznań analysed the distribution of the meteorite dust content in soil around the craters and found that this is greatly enhanced, the area containing the largest amount of dust being elongated to the north, suggesting a possible direction of flight. This suggested direction was confirmed by information concerning possible iron meteorite finds near the town of Oborniki, some 30 km north of Poznań. Unfortunately the specimens were lost during World War II.

In 1990 meteorite hunters began to search the area north of the craters with metal detectors. An earlier search in 1960 with army mine detectors was unsuccessful and it was presumed that no more meteorites were to be found. Better detectors quickly demonstrated that this opinion was wrong. In 1995 two large specimens of 28 and 40 kg were found as well as many smaller fragments, from a few kilograms to few dozen grams. One of these small individuals, now in the possession of the Museum of the Earth in Warszawa, was found embedded in a cart-track mixed together with terrestrial stones that had been used to fill a pot-hole (Pilski and Walton, 1999).

In 1998 an offer appeared on an Internet site where a lump of some 80 kg was offered for sale plus a few smaller pieces. The owner refused to give any data about his finds, so it is not clear if it is a new find or if he had found the 80 kg mass lost during World War II. In any case the total amount of Morasko finds greatly exceeds 300 kg including a 50 kg individual found in 2000 by a German meteorite hunter.

The Morasko meteorite, previously IA, reclassified in 1995 as IIICD (Choi *et al*., 1995), is a typical coarse octahedrite which can show quite different macrostructures even in the same fragment. The width of the kamacite bands can vary from 1.5 to 3.0 mm while the length is ranges from 2.0 to 15.0 mm. In some kamacite grains there are aggregates of plessite measuring around 3.0 mm. Neuman lines have been observed in most of the samples that have been studied. Taenite forms parallel lamellae, but they are generally not homogeneous and they often have a plessitic core.

The inclusions that have been observed in Morasko include troilite, graphite, schreibersite, rhabdite and cohenite with minor sphalerite and whitlockite. The distribution of the inclusions is irregular. Graphite composes an average of 1 vol. % where it occurs as aggregates of various types and as fine intergrowths. Schreibersite occurs as elongated veiny concretions, oriented parallel with the kamacite growth planes. Schreibersite forms approximately 1.5 vol. %. Rhabdite forms grains which are rhomboidal, parallelopipedal, square, rectangular or needle-like in shape. Rhabdite forms approximately 1 vol. %. Cohenite is elusive in Morasko as it is abundant in certain individuals and almost absent in others. Even where abundant, it still only amounts to approximately 1 vol. %. The cohenite found in Morasko is strongly graphitised along fissure cracks and where it has been exposed to atmospheric oxidation (Dominik, 1976; Donten, 2001).

Sphalerite occurs in polymineral nodules and as isolated grains within kamacite. Several of the larger masses have been crushed into sharp-edged fragments. Boundaries between the sphalerite and troilite are not sharp and are surrounded by zones of fine intergrowths up to 20 μm wide. Whitlockite has only been observed as rims on graphite-troilite masses and can also be associated with cliftonite and schreibersite.

Morasko shows various deformation events which have produced fissures, cataclastic phenomena, brecciation and mechanical twins. The impact pressures of Morasko are thought to be of medium magnitude (130–750 kb). A few smaller specimens of Morasko exhibit strong effects of reheating during impact (Buchwald, 1975). A nice example is in the collection of the Olsztyn Planetarium and Astronomical Observatory. The cut surface of a small individual shows that it is composed of three fragments cemented together during impact. Near the surface of contact the Widmanstätten pattern is fully destroyed and only flow lines in metal are visible. The pattern appears a dozen or so millimetres from the contact surface. Near the surface of a 28 kg individual is a layer about 2 mm thick composed of metal that was reheated and kamacite was turned into a granular structure.

S p e c i m e n s : IGUAM: 78000 cs (on loan in MMWr), 61000 cs, 4000 hs, 2850 hs, 2000 cs; MGPAN: 71800 cs, 6350 cs, 4175 cs, 2645 cs, 74.3 s, 7.6 ep; PŚ: 15600 cs; SPSL: 4300 cs, OAUJ: 1250 sc; MWGUW: 760 sc, 82.5 s, 39.5 sc, 20.7 cs, 10.6 cs, 4.2 ep; MMWr: 640 sc; KSoK: 560.2 wcs, 96.5 ep, 51.1 ep, 47.0 s; KMaG: 490.0 sc, 232.5 ep, 87.8 cs; MMKF: 511.5 wcs; MZPAN: 226.7 cs; JAB: 154.1 cs, 86.3 sc, 45.0 cs, 31.3 sc; RBoW: 151.0 cs, 61.8 s, 57.5 s, 23.6 ep; MKGW**:** 145.0 s, 94.8 s, 75.0 cs; MCiD: 137 cs, 105 cs; OPiOA: 126.0 hs; LChG: 106.0 cs, 90.4 ep, 82.0 ep, 77.0 ep, 53.0 cs, 26.1 ep, 22.0 cs; MSzŁ: 59.7 ep, 12.7 s, 3.1 s; MEPZG: 58.1 s; ITSN: 41.5 cs; JWKW: 39.76 hs; TZwW: 37.0 s; PiOAG: 35.3 ep; JP: 26.6 hs; JBaZ: 25.6 s, 7.1 ep; PTuK: 23.98 s; JJDL: 22.6 ep; JStM: 20.6 hs; JPłK: 19.3 ep; WWoG: 17.0 hs; JRaT: 14.6 ep; MLPS: 12.6 hs; ŁODG: 11.3 ep, 8.09 f; MPPF: 11.2 sc; TP!W: 11.0 s; BDąT: 6.6 cs; PŻoW: 6.40 s; NAWPI: 6.2 s; KZT: 5.0 wcs; KMoW: 4.9 ep, 3.3 f; TŚcK: 4.08 s, 0.8 f; HGwL: 3.9 ep.

Krzadka — found July, 1929; coordinates: 50°22’N, 21°44’E; iron, octahedrite.

In July 1929 a geologist, J. Gołąb was on military training near the village of Krządka. The soldiers were gathering stones scattered over the fields in order to throw them later as hand grenades. Looking over these stones J. Gołąb found a piece of a

petrified tree. Encouraged by this find, he dug around in local gravel pits in the hope of finding more fossils. In the wall of an excavation about 2–2.5 m deep he noticed a dull, dark, roundish lump of iron. Upon digging it out he saw that the lump was shaped like a short cone, melted smooth on all sides except for the base which was rough. The sample was covered by a black crust that was shiny in places. The meteorite had lain with its sharp end probably pointing west. It measured no less than 8 x 7 cm and it weighed 2–3 kg. The strata where it was found consisted of mixed glacier gravel. The find was made about 1.5 km south of the village of Krządka, which is 7.5 km north-west of Majdan and about 18 km from Kolbuszowa.

The sample was taken to Poznań for examination. A peculiar feature was two shallow parallel lines, some centimetres long, on one of its sides. After being polished a small part of the metallic surface, roughly 2.5 cm^2, displayed a coarse structure even without etching. J. Gołąb considered that it was a Widmanstätten structure with kamacite crystals more or less 2.5–3 mm. In this case it would be a coarse octahedrite.

The Krządka specimen was kept in the collection of the Poznań University Geological and Paleontogical Institute on Grunwald Street, until the World War II when the building was destroyed by English bombs in 1944, when the specimen was lost (Pokrzywnicki, 1958, 1964).

Pomorze — found 1931; iron, ataxite Ni-rich, doubtful.

A few pieces of iron, of total weight 2 to 5 kg, were found by a man working a quarry for road-stone. The iron was approx 50/50 Fe/Ni. Two pieces were sent to Technical University of Gdańsk; after the war neither they nor the original locality could be found (Pokrzywnicki, 1964).

Oborniki — found 1933–1936; coordinates: 52°37'N, 16°45'E; iron, doubtful.

Two pieces of iron found near Oborniki Wielkopolskie 30 km NNW of Poznań were brought to K. Smulikowski at Poznań University. Both were relatively flat and elongated. One of them was examined by A. Polański but no result was published. Its cut surface displayed bright metal with a distinctive pattern. Both specimens were lost during the World War II; they perhaps belonged to the same shower as Morasko (Pokrzywnicki, 1964).

Łowicz — fell March 12, 1935; 00:52; coordinates: 52°00'N, 19°55'E; stony-iron, mesosiderite; 7.69% Ni, 15.3 ppm Ga, 54 ppm Ge, 3.8 ppm Ir.

On the night of March 11/12, 1935 a bright bolide was seen from many parts of Poland. There were many suggestions, where meteorites were fallen but nothing was found until the Director of the Astronomical Observatory of Warsaw University, M. Kamieński, got a call from the principal of a school for teachers in Łowicz. He was told that a number of children in a nearby village had presented their teacher with fragments of the meteorite, which had apparently fallen a few days previously.

M. Kamieński asked J. Gadomski and M. Bielicki to go there and investigate reports of the fall. They arrived in the village of Krępa near Łowicz. The villagers told them they had seen a brilliant light on the night of March 11/12 and had heard loud thunderclaps and saw stones falling from the sky. Next morning a villager found a black stone "rooted into the ground" as he said, and he was adamant that it had not been there previously. The villagers managed to get the stone out of the ground and realised it was relatively heavy. Believing the stone may contain gold they decided to break it open. Instead of gold they found bright metal which at first they took to be silver but it soon dawned on them that the metal was, in fact, only iron.

J. Gadomski and M. Bielicki got three fragments of the broken stone — about 2 kg in all — and also two other meteorites, weighing 4 and 1 kg, which were found in the fields near Krępa. They brought it back to the Observatory and one fragment was later presented by M. Kamieński to the Polish President (Różycki and Kobyłecki, 1936).

The Towarzystwo Muzeum Ziemi (The Society of the Muzeum of the Earth) on learning about the meteorite fall, despatched S. Z. Różycki and M. Kobyłecki to investigate further. They successfully recovered more specimens and were able to document eyewitness accounts. It is largely through their efforts that we know more about the Łowicz fall. Within a few days, scientists from the Jagiellonian University in Kraków arrived at the scene and started to buy meteorites from the villagers. As a result of all the activity more than 60 specimens were found with a total weight slightly in excess of 60 kg. They were eventually consigned to the collections of the Museum of the Earth in Warszawa and to the Geological Museum and Astronomical Observatory of Jagiellonian University in Kraków.

The total area over which the meteorites were found is about 9.2 km^2, elongated in an east-west direction from Krępa village to Seligów. The area consists mostly of cultivated fields which were combed thoroughly by researchers. In one area of about 1 km^2 near Wrzeczko in the centre of the dispersion ellipse some 28 specimens were found with a total weight of about 6.5 kg. The dispersion ellipse is very flattened and resembles more a teardrop than a regular ellipse. It is one of the few dispersion ellipses throughout the world which has been reversed, where the largest specimens, instead of being to the fore of the ellipse, lie towards the rear. Those eyewitnesses who were within about a dozen kilometres of the fall maintain that the bolide flew from west to east or from winter sunset to summer sunrise as they recalled — but strangely, those observers who were at greater distances claim it travelled from east to west.

The cause of the grouping of meteorites within the dispersion ellipse is a matter of debate. It could be the result of selective collecting but, more likely, it is because the meteorite disintegrated fairly low in the atmosphere and the fragments thus lost some of their kinetic energy, making them fall to the ground sooner. A number of specimens display secondary fusion crusts, which would tend to support this idea, and villagers did report three detonations. Two fragments in the Museum of the Earth in Warszawa, weighing 442 and 54 g fit together perfectly even though they were found 2 km apart at Wrzeczko (Pilski, 1992; Hanczke, 1995).

The richest collection of Łowicz meteorites is at the Museum of the Earth in Warszawa with two specimens of 2858 and 2810 kg and many smaller ones. The largest specimens are in Kraków: the one weighing 5.67 kg in the collection of the Astronomical Observatory (now on loan in the Geological Museum of the Polish Academy of Sciences) (Łaptaś and Ćwiżewicz, 1998), and the second one weighing 5.65 kg in the

Geological Museum of the Jagiellonian University. The third largest specimen, weighing 3.8 kg, brought back to the Astronomical Observatory in Warsaw by M. Bielicki and J. Gadomski, and found in debris of the Observatory after the World War II by M. Gadomski, is still preserved at the Astronomical Observatory (Pilski, 1995).

The Łowicz specimens are very heterogeneous. Some small specimens look like silicated iron, while others are mostly silicate with only small amount of metal. The cross section of a large specimen reveals balls of metal with silicates and clasts of plagioclase in the well mixed silicate-iron matrix. Łowicz looks very similar to the Estherville mesosiderite.

S p e c i m e n s : OAUJ: 5670 cs (on loan in MGPAN), 1442 cs, 835 cs, 526 hs, 103 cs, 51.8 cs, 51.5 hs, 47.3 hs, 42.5 cs, 29.8 cs, 29.2 cs, 24.8 cs, 12.3 cs; MGUJ: 5650 cs, 2950 cs, 2380 cs, 703.5 cs, 378.7 cs, 246.9 cs, 193.5 cs, 176.0 cs, 166 cs, 146.3 cs, 118.8 cs, 111.3 cs, 57.6 cs, 47.1 cs, 30.5 cs, 29.8 cs, 29.1 ep, 27.5 cs, 20.5 cs, 14.6 cs, 12.5 cs, 11.2 cs, 6.2 cs, 3.3 f; OAUW: 3750 cs; MZPAN: 2858 cs, 2810 cs, 2159 cs, 1520 hs, 1386.25 cs, 1023 cs, 724.94 cs, 480.00 cs, 442.23 cs, 442.17 cs, 441.1 cs, 406.0 cs, 166.5 f + f, 158.65 cs, 145.11 cs, 144.31 cs, 129.47 cs, 110.72 cs, 108.58 cs, 100.1 f, 88.64 cs, 69.0 cs, 58.57 cs, 42.0 cs, 56.6 cs, 53.0 cs, 47.23 cs, 41.86 cs, 35.45 cs, 34.05 f, 26.24 cs, 20.45 f, 19,07 f, 19.0 cs, 15.29 hs, 12.37 cs, 2.8 f, 2.67 f, 2.32 f, 1.8 fc, 1.5 s, 1.05 f, 0.76 f, 0.65 fp; LOŁow: 243.2 f; OPiOA: 181.3 wcs, 110.91 ep, 21.74 hs, 16.80 sc, 13.50 hs; MGPIG: 159.0 ep; MGPAN: 26.86 cs, 14.24 cs; MEPZG: 26.6 wcs; MMWr: 18.0 s; MWGUW: 16.5 ep; LChG: 13.6 f; KMaG: 7.9 sc; JAB: 6.9 ep; MKGW: 2.64 sc, 1.93 sc; AKKC: 2.0 f; MPPF: 1.1 f; KRdK: 1.0 ep; JBaZ: 0.95 ep; JStM: 0.2 f; SKoZ: 0.15 f; MKoL: 0.12 f; KSoK: 0.05 f.

Czestochowa Rakow I — found 1960; coordinates: 50°48’N, 19°7’E; iron, octahedrite finest to nickel-rich ataxite; 18.25% Ni, 0.05% C, 0.05% Cu, 0.052% P.

A bracelet found in a grave dated at 700–500 B.C. is composed of meteoritic iron. It is oval, measures about 73 x 61 mm and is 6.3 mm thick (Pokrzywnicki, 1971).

S p e c i m e n : MRCz: a bracelet no. Cz.I-9:60.

Czestochowa Rakow II — found 1961; coordinates: 50°48’N, 19°7’E; iron, octahedrite finest to nickel-rich ataxite; 12.47% Ni, 0.05% C, 0.05% Cu, 0.052% P.

A bracelet found in a grave dated at 700–500 BC is composed of meteoritic iron. It is oval, measures about 70 x 50 mm and is 4.5 mm thick (Pokrzywnicki, 1971).

S p e c i m e n : MRCz: a bracelet no. Cz.I-294:61.

Wietrzno-Bobrka — coordinates: 49°25’N, 21°42’E; iron, octahedrite (or ataxite?); 8–10% Ni.

An hatched iron of weight 376 g was found in a hill fort dated at 700–500 BC The fort is situated near the Dukla Pass in the Carpathians (Pokrzywnicki, 1971).

S p e c i m e n : The place of preservation unknown.

Baszkówka — fell August 25, 1994; 15:50; coordinates: 52°02’00’’N, 20°56’15’’E; stone, olivine-hypersthene chondrite L5; olivine Fa 24.

On August 25, 1994, just before 4 p.m. in the small village of Baszkówka near Warszawa a few of the residents heard a loud noise. It was “...like air being cut by a propeller blade...” as one of the villagers said. H. Grodzki working in the field looked over her shoulder and saw a burst of soil about 200 m from her. She told her brother-in-law K. Grodzki where this event had occurred. On inspecting the area he soon found on the plowed field a 2 m circle inside of which the soil was freshly loosened. There was a small pit in the centre of the circle and at a depth of 25 cm he found something hard and warm. He dug out the stone and brought it to his farmhouse.

Only after six months or so did he inquire of the scientists at the Polish Geological Institute in Warsaw if they wished to purchase a meteorite. M. Stępniewski from the Institute visited the man at his farm and saw the most beautiful oriented stone ever seen in Poland. Its frontal surface was covered by elongated pits and grooves up to 1 cm deep, running radially from its centre. The fusion crust was dark gray to paler gray in some places. On its rear surface the fusion crust was black and looked in some areas like a clinker of slag. Only a few patches were chipped off revealing the gray interior. The stone was about 30 cm in diameter and weighed some 15.6 kg.

At first sight it was easy to see that it was a chondrite as there were chondrules clearly visible on the broken surfaces. In most of the chondrites, however, the chondrules have relatively smooth surfaces. In this stone many of their surfaces were very rough and uneven. The most unusual sight was the kamacite and troilite crystals in the pore spaces.

The cut surface of the meteorite looks like one of a typical L chondrite with large chondrules associated with abundant grains of troilite and metallic iron. Some metallic grains are quite large and the grains show intergrowths of troilite and metal. There are many void spaces between the chondrules and the other grains. Empty spaces exist inside the chondrules also. Some of chondrules resemble tiny “geodes” that are crystal-lined (Pilski and Walton, 1998).

The chondrite is so porous that it looks as if it is devoid of matrix. Most chondrules and grains touch another chondrule or grain only at two to three places. The rest of the area is next to a void space. The rock is clearly loosely compacted with many open spaces, revealing why the density of Baszkówka is only 2.9 g/cm^3 (Stępniewski *et al*., 1996). The meteorite is well described in other papers in this issue.

S p e c i m e n s : MGPIG: 15000 wcs; MZPAN: 100 ep; OAUJ: 54.3 sc; KMaG: 19.4 ep; MGPAN: 13.0 fc; MMKF: 11.6 sc; JAB: 6.23 fc; PWDT: 5.8 s; MKGW: 4.0 sc; TZwW: 2.1 fc; JJDL: 1.39 fc; JP: 0.70 f; KZT: 0.7 fc; BDąT: 0.5 f; WWoG: 0.4 fc; JBaZ: 0.2 fc.

Zakłodzie — found September, 1998, possibly fell April 21, 1897; coordinates: 50°45’46”N, 22°51’58”E; stone, enstatite-rich, ungrouped.

Granoblastic texture of mainly ortho-enstatite and Si-rich (1.6%) metal, Cr-Mn-Ti-rich troilite, feldspars, accessory schreibersite, SiO_2, oldhamite, alabandite, amphibole.

Key classificational information: Fs < 0.1–1.6, En97.7 Fs1.6 Wo0.7 // Ab64-89 An36-0 Or0.5-11 (*Meteoritical Bulletin*, 84, 2000).

One day in September 1998, S. Jachymek went down a dirt loess road to a relative who lived in a nearby village. His attention was caught by a rusty stone, which probably rolled down from a nearby field (the road was in a shallow ravine). Stones were scarce in that area. “Could it be a meteorite?” he thought. Walking back home he looked at the stone once again and decided to take it along with him.

The finder was a minerals and fossils collector but knew little about meteorites. He remembered most of them contain metal. So when came home he cut off a small corner. He got excited on seeing abundant metal grains. To be sure it was a meteorite rather than a piece of a slag. He began to inquire of scientists in nearby universities. They had doubts though. A test for nickel was positive, but the stone did not resemble a chondrite nor an achondrite. So opinions were that it was probably a meteorite, but being a fragment of a blast-furnace could not be excluded either.

A definitive opinion was obtained from Ł. Karwowski, professor of geology at the Silesian University: “From examination it is clear that it is a meteorite of a rare class. Undoubtedly it is enstatite meteorite. It resembles an enstatite chondrite, but a lack of chondrules and the composition of the kamacite suggest it could be an anomalous aubrite. However, it contains too much kamacite and troilite to classify it as an aubrite. It needs a more detailed examination”.

The finder was not satisfied, however, and decided to send some fragments to the Gifhorn Meteorite Fair. In the February 2000 issue of *Meteorite!* one could read: “Many fair visitors inspected the «meteorite suspected» material… one of the samples showed a crystalline structure with intergrown metal specks comparable to olivine-free primitive achondrites. It is currently under investigation and hopefully will appear in the next *Meteoritical Bulletin* as a unique primitive achondrite intermediate between E chondrites and aubrites.”

The opinion of R. Bartoschewitz was confirmed by analyses made by F. Wlotzka from the Max-Planck-Institut für Chemie in Mainz, Germany and M. Stępniewski from the Polish Geological Institute in Warszawa, Poland. The finder finally revealed the true location. After the nearby village, the meteorite was given the name of Zakłodzie.

In the newspaper *Gazeta Lubelska* of April 24, 1897, a report was published about a very bright bolide on the night of April 21, 1897 followed by a long noise so loud that ground and window-panes trembled. It was just in the area where this new meteorite was found. It seems that the meteorite could be a part of that fall. It is not very weathered and contains fresh fragments deep inside (Pilski, 2000).

S p e c i m e n s : MEPZG: 5020 wcs, 650 sc; KMaG: 79.6 sc, 49.4 sc, 6.1 ep; OPiOA: 56.5 sc; MGPIG: 30 ep; OAUJ: 17.3 sc; MMWr: 11 sc; MZWNoZUŚ: 10.1 s; MKGW: 8.0 sc; MCiD: 7.5 sc, 3.9 sc; AKKC: 3.0 fc; JStM: 3.0 s, 1.0 f; KZT: 1.4 fc; JBaZ: 1.0 f, 0.4 f; JWKW: 1.0 s; PiOAG: 0.1 s.

Collections:

AKKC — private collection of A. Kotowiecki.
BDąT — private collection of B. Dąbrowski.
GMGS — private collection of G. M. Gnysiński.
HGwL — private collection of H. Gwarda.
IGUAM — collection of the Geological Institute of the Adam Mickiewicz University (Instytut Geologii UAM, ul. Maków Polnych 16, Poznań).
ITSN — private collection of I. T. Sławiński.
JAB — private collection of J. Burchard.
JBaZ — private collection of J. Bandurowski.
JJDL — private collection of J. and J. Drążkowski.
JP — private collection of J. Puszcz.
JPłK — private collection of J. Płeszka.
JRaT — private collection of J. Rafalski.
JStM — private collection of J. Strzeja.
JWKW — private collection of J. W. Kosinski.
KMaG — private collection of K. Mazurek.
KMoW — private collection of K. Morawski.
KRdK — private collection of K. Rudnicki.
KSoK — private collection of K. Socha.
KZT — private collection of K. and Z. Tymiński.
LChG — private collection of L. Chróst.
LGL — private collection of L. Gładyszewski.
LOŁow — collection of High School in Łowicz (Liceum Ogólnokształcące w Łowiczu).
ŁODG — private collection of Ł. Obroślak.
MCiD — private collection of M. Cimała.
MEPZG — collection of the Ethnology and Natural History Museum in Guciów (Muzeum Etnograficzno-Przyrodnicze “Zagroda Guciów”, Guciów 19).
MGPAN — collection of the Geological Museum of the Polish Academy of Sciences (Muzeum Geologiczne Polskiej Akademii Nauk, ul. Senacka 1, Kraków).
MGPIG — collection of the Geological Museum of the Polish Geological Institute (Muzeum Geologiczne Państwowego Instytutu Geologicznego, ul. Rakowiecka 4, Warszawa).
MGUJ — collection of the Geological Museum of the Jagiellonian University (Muzeum Geologiczne Uniwersytetu Jagiellońskiego, ul. Oleandry 2a, Kraków).
MGZPŚ — collection of the Museum of Geology of Deposits of the Silesian Technical University (Muzeum Geologii Złóż Politechniki Śląskiej, ul. W. Pstrowskiego 2, Gliwice).
MKoL — private collection of M. Kosmulski.
MKGW — private collection of M. Gregorczyk.
MLPS — private collection of M. Ledwoń.
MMKF — collection of the Nicolaus Copernicus Museum in Frombork (Muzeum Mikołaja Kopernika, ul. Katedralna 8, Frombork).
MMWr — collection of the Mineralogical Museum of Wrocław University (Muzeum Mineralogiczne Uniwersytetu Wrocławskiego, ul. Kuźnicza 22, Wrocław).
MPPF — private collection of M. Pilska-Piotrowska.
MRCz — collection of the Regional Museum in Częstochowa (Muzeum Regionalne w Częstochowie).
MRP — collection of the Regional Museum in Pułtusk (Muzeum Regionalne w Pułtusku, Wieża Ratuszowa, Pułtusk).
MSzŁ — private collection of M. Szurgot.
MWGUW — collection of the Museum of the Geology Department of Warsaw University (Muzeum Wydziału Geologii Uniwersytetu Warszawskiego, al. Żwirki i Wigury 93, Warszawa).

MZPAN — collection of the Museum of the Earth of the Polish Academy of Sciences (Muzeum Ziemi PAN, al. Na Skarpie 27, Warszawa).

MZWNoZUŚ — collection of the Museum of the Earth of the Earth Sciences Department of the Silesian University (Muzeum Ziemi Wydziału Nauk o Ziemi Uniwersytetu Śląskiego, ul. Będzińska 60, Sosnowiec).

NAWPI — private collection of P. Nawalkowski.

OAUJ — collection of the Astronomical Observatory of the Jagiellonian University (Obserwatorium Astronomiczne Uniwersytetu Jagiellońskiego, ul. Orla 171, Kraków).

OAUW — collection of the Astronomical Observatory of Warsaw University (Obserwatorium Astronomiczne Uniwersytetu Warszawskiego, al. Ujazdowskie 4, Warszawa).

OPiOA — collection of the Olsztyn Planetarium and Astronomical Observatory (Olsztyńskie Planetarium i Obserwatorium Astronomiczne, al. Piłsudskiego 38, Olsztyn).

PiOAG — collection of the Grudziądz Planetarium and Astronomical Observatory (Planetarium i Obserwatorium Astronomiczne, Grudziądz).

PŚ — collection of the Silesian Planetarium (Planetarium Śląskie, Chorzów).

PTuK — private collection of P. Turek.

PWDT — collection of the Władysław Dziewulski Planetarium (Planetarium im. Władysława Dziewulskiego, ul. Franciszkańska 15-21, Toruń).

PŻoW — private collection of P. Żochowski.

RBoW — private collection of R. Borzęcki.

SKoZ — private collection of S. Kozłowski.

SPSL — collection of the Grammar School in Suchy Las near Morasko (Szkoła Podstawowa, Suchy Las).

TP!W — private collection of T. Przylibski.

TŚcK — private collection of T. Ścieżor.

TZwW — private collection of T. Zwoliński.

WWoG — private collection of W. Wojnowski.

Abbreviations: cs — complete specimen; wcs — windowed complete specimen; hs — half specimen; ep — end piece; s — slice; sc — slice with crust; f — fragment; fc — fragment with crust; tp — fragments in test-tube.

REFERENCES

BUCHWALD V. (1975) — Handbook of iron meteorites. Berkeley Univ. California Press.

CHOI B. -G., OUYANG X. and WASSON J. T. (1995) — Classification and origin of IAB and IIICD iron meteorites. Geochim. Cosmochim. Acta, **59**: 593–612.

DOMINIK B. (1976) — Mineralogical and chemical study of a coarse octahedrite Morasko (Poland). Pr. Miner. Komis. Nauk Miner. PAN Kraków, **47**.

DONTEN M. L. (2001) — Meteoryt Morasko widziany pod skanningowym mikroskopem elektronowym. Meteoryt, **10** (2): 22–24.

GRADY M. M. (2000) — Catalogue of Meteorites. 5th ed. Cambridge.

GRAHAM A. L., BEVAN A. W. R. and HUTCHISON R. (1985) — Catalogue of meteorites. 4th ed. London, Tucson.

HANCZKE T. ed (1995) — Meteoryty i tektyty w zbiorach Muzeum Ziemi. Katalog. Muz. Ziemi PAN. Warszawa.

KRACHER A., WILLIS J. and WASSON J. T. (1980) — Chemical classification of iron meteorites; IX, A new group (IIF), revision of IAB and IIICD, and data on 57 additional irons. Geochim. Cosmochim. Acta, **44**: 773–787.

LANG B. and KOWALSKI M. (1971) — On the possible number and mass of fragments from Pułtusk meteorite shower, 1868. Meteoritics, **6**: 149–158.

ŁAPTAŚ A. and ĆWIŻEWICZ M. ed. (1998) — Meteoryty w zbiorach Muzeum Geologicznego w Krakowie. ING PAN. Kraków.

MANECKI A. (1972) — Mineralogical and petrographical study of the Pułtusk meteorite (in Polish with English summary). Pr. Miner. Komis. Nauk Miner. PAN Kraków, **27**: 53–68.

PILSKI A. S. (1991) — The Pultusk meteorite shower. Impact, **2**: 16–19.

PILSKI A. S. (1992) — Łowicz: my meteorite story. Impact, **5**: 11–15.

PILSKI A. S. (1995) — The Białystok meteorite shower. Meteorite!, **1** (2): 22–23.

PILSKI A. S. (1995) — Meteoryty w zbiorach polskich. Lidzbark Warmiński.

PILSKI A. S. and WALTON W. (1998) — Baszkówka, Mt. Tazerzait and Tjerebon — chips off the same block? Meteorite!, **4** (1): 12–15.

PILSKI A. S. and WALTON W. (1999) — Morasko — the largest European iron meteorite shower. Meteorite!, **5** (4): 27– 28.

PILSKI A. S. (2000) — A new Polish meteorite. Meteorite!, **6** (3).

PILSKI A. S. (2001) — Meteoryty w zbiorach polskich. Olsztyn.

POKRZYWNICKI J. (1955) — O niektórych mało znanych polskich meteorytach. Acta Geol. Pol., **5**: 427–438.

POKRZYWNICKI J. (1956) — O meteorycie białostockim. Kosmos, **2** (4[8]): 351–358.

POKRZYWNICKI J. (1958) — The Krządka meteorite. Acta Geophys. Pol., **6** (1): 84–85.

POKRZYWNICKI J. (1964) — Meteorites of Poland. Catalogue of meteorites in Polish collections. Stud. Geol. Pol., **15**.

POKRZYWNICKI J. (1971) — New Polish meteorites (in Polish with English summary). Acta Geophys. Pol., **19** (2): 235–238.

RÓŻYCKI S. Z. and KOBYŁECKI M. (1936) — Les météorites de Łowicz. Informations recueillies sur le terrain de la chute et caractéres généraux des spécimen (in Polish with French summary). Zabyt. Przyr. Nieożyw., **3**.

SAMSONOWICZ J. (1952) — La météorite de Pułtusk (in Polish with French summary). Wiad. Muz. Ziemi, **6** (1): 57–68.

SIEMIĄTKOWSKI J. (1998) — Petrografia chondrytu Baszkówka. Pol. Tow. Miner., Pr. Spec., **11**: 160–161.

STĘPNIEWSKI M., BORUCKI J. and SIEMIĄTKOWSKI J. (1998) — New data on the L5(S1) chondrite Baszkówka (Poland). 61th Meteoritical Society Meeting, July 27–31,1998, Trinity College, Dublin. Meteor. Planet. Sc., suppl., **33**: A150–A151.

STĘPNIEWSKI M., RADLICZ K., SIEMIĄTKOWSKI J. and BORUCKI J. (1996) — Preliminary study of the L chondrite Baszkówka (Poland). 59th Annual Meteoritical Society Meeting, July 22–26, 1996, Humbolt-University. Meteor. Planet. Sc., suppl., **31**: A134–A135.