Meteoritics & Planetary Science 39, Nr 8, Supplement, A151–A156 (2004)
Abstract available online at http://meteoritics.org

Artifacts in Polish collections made of meteoritic iron

Andrzej KOTOWIECKI

District Prosecutor's Office, ul. Michejdy 17/4, 43-400 Cieszyn, Poland
E-mail: tektites_andrew@poczta.onet.pl

(Received 21 July 2003; revision accepted 21 August 2003)

Abstract–Only several artifacts made of meteoritic iron have been found throughout the world. The number of these artifacts is still overstated and has never been verified because museums do not allow specialists to test these objects. Until now, a few objects made of meteoritic iron were discovered in Poland. An axe from Wietrzno-Bobrka and bracelets from Częstochowa-Raków are listed as Polish meteorites—the latter ones as Częstochowa-Raków I and Częstochowa-Raków II. In my opinion, a special meteoritic category should be created for artifacts made of meteorites: meteoritic antiques or manmade artifacts of meteorites and tektite glass. Within such a category, further categorization could be made, based on the material a given meteorite is made of.

INTRODUCTION

A list of Polish meteorites should be expanded because more artifacts made of meteorites, including those made of meteoritic iron, have been found on the territory of Poland.

It has to be emphasized that iron, after stone and bronze, was the last material after which an important epoch in the world's history was named. Chronologically, this period began in the mid second millenium BCE and lasted till the early middle Ages in Europe. During that time, the Hittites and the Babylonians spread the technology of processing and smelting iron throughout the Middle East and Egypt. Gradually, iron came into use in various areas of the world coexisting with bronze for some time. However, its earliest appearance was in Egypt and the West Asia at the turn of the 4th and 3rd century in the form of products made of cold-wrought iron mainly of meteoritic origin. In Babylon, this metal was already in use from the times of Hammurabi, i.e., from the first half of the 18th century BCE. Nevertheless, it is the Hittites who are regarded the first metallurgists of iron. When the Middle East was already in the full Iron Age, Europe was still in the Bronze Age. First tools and weapons made of iron appeared on the territory of Poland in the Lusatian period and were mainly imported.

It is beyond any doubt that the only form of iron a prehistoric man could have come across was meteoritic iron (apart from, for example, indigenous iron from the Island of Disco situated off the west coast of Greenland, and containing up to 4% nickel).

Meteoritic iron was also known to the Hittites who called it "black iron," sometimes adding "from the skies." The weapons made of were of great advantage in their conquests. For example, according to some scientists, an invasion of the aggressive Doric tribes armed with, until then unknown, iron weapons put an end to the Cretan culture around 1100 BCE.

The oldest Egyptian hieroglyphs used the sign "min" to describe iron in general because initially Egyptians were unaware of the origin of the meteoritic fragments they would find. However, when they learned the truth, the name was changed into "bia-en-pet," meaning "metal or something hard from the skies" or, in other words, "metal from the skies," (literally "copper from the skies"). The oldest mention of this kind comes from around 2500 BCE. Assyrian and Babylonian words "anbar" or "parzillu" have the same meaning: "metal from the skies," as well as Sumerian and Chaldean "barsa" and "barzel," and, finally, Hebrew "barzel." It is assumed that the oldest objects made of meteoritic iron found so far are two groups of tiny beads (in one case 7 and in the other 2) forming a necklace or a chaplet. They were found by G. A. Wainwright in Gerzeh (Lower Egypt) and date from the predynastic period (5000–3400 BCE). When discovered, they were much oxidized and after a chemical analysis it was established that they contained 92.5% Fe and 7.5% Ni.

METEORITIC ARTIFACTS

Only several arifacts made of meteoritic iron have been found throughout the world, and the number is still overstated and has never been verified because museums will not allow these objects to be tested by specialists.

Until now, a few objects made of meteoritic iron have been discovered in Poland. During my search for any

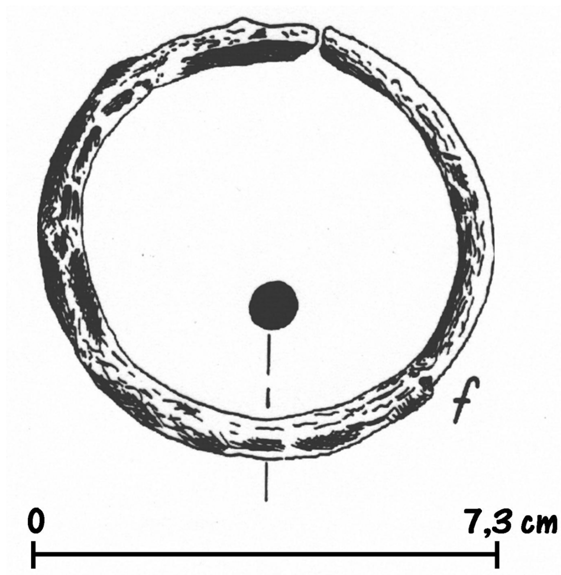

Fig. 1. Bracelet Częstochowa-Raków I.

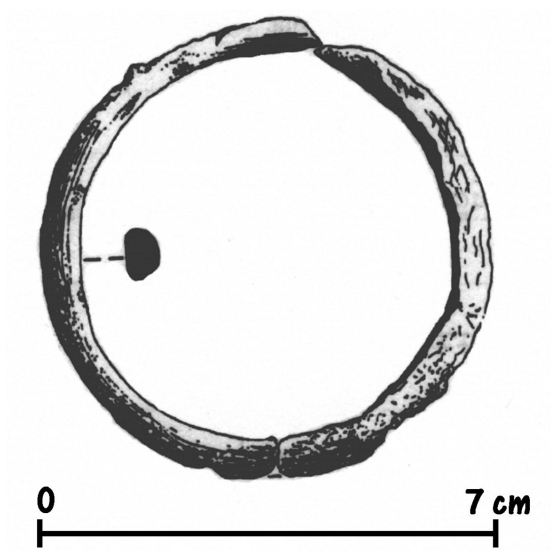

Fig. 2. Bracelet Częstochowa-Raków II.

literature dealing with such objects, I came across an article by J. Zimny describing Hallstatt iron products from Częstochowa-Raków.

During the archeological research in Częstochowa-Raków, a number of iron bracelets was discovered in holocaustal and skeletal graves. When tested, two of the bracelets (#3 and #4) turned out to be made of meteoritic iron.

Bracelet #3

This bracelet (Fig. 1) comes from a skeletal grave and, after conservation, has the following dimensions: outside 71.5 × 75.3 mm, inside 59.1 × 62.8 mm; the diameter of the rod's cross-section is 6.3 mm. Chemical and spectrographic examination indicated the content of 18.25% Ni, about 0.05% C, 0.052% P, and 0.05% Cu (all numbers are approximate), which means that this object was made of a meteorite called an ataxite. It is a group of meteorites containing high amount of nickel. This means that this is most probably the only Polish ataxite. The artifact is a smooth-surfaced bracelet with meeting ends, made of a smooth-surfaced rod of a round cross-section. It is well-preserved and only slightly corroded. In his study, J. Zimny suggests that the bracelet was made by forging, and the deformations caused by it as well as their direction revealed by a long-lasting process of etching with nitric acid, show a medium degree of reforging of the metal.

Moreover, according to the author, in the cross-section of the sample appeared a homogeneous acicular structure characteristic for nickel alloys and consisting of acicular martensite (bainite) and austenite (i.e., solution of solid carbon in gamma iron with the maximum content of carbon at the level of 2%). It has also been established that the average hardness of this structure is 285–295 HV and the tests conducted confirmed its homogeneous structure. What is more, the rim of the object was forged with a significant non-metal insertion in the brand.

Bracelet #4

This bracelet (Fig. 2) comes from a holocaustal grave and, after conservation, has the following dimensions: the outer diameter of 70 mm, the inner diameter of 50 mm, the diameter of the rod's cross-section is 8 × 4.5 mm. Chemical and spectrographic examination indicated the content of 12.47% Ni, 0.052% P, 0.05% C, and 0.05% Cu. The object is a smooth-surfaced bracelet with meeting ends. Is is in very good condition despite being broken in half.

In the bracelet's cross-section different structures were found: nickelic ferrite, martensitie, and austenite. The author of the study stresses that the measurements done with the help of Vickers's hardness tester varied from 239 to 345 HV and from 145 to 351 HV (microtester). Also, it was established that there were just few small non-metallic insertions in the cross-section of the sample, while near the surface, during the microscopic tests, two large laps were found, one of which was surrounded by crushing streaks. This bracelet was made by means of forging as well, and the location of structures and traces of welding indicate that it was made of four layers of nickelic iron. The range of the temperature of forging is, according to J. Zimny, hard to determine because the bracelet was partly annealed in the holocaustal pyre and also because the cross-section in question did not show any traces of intensive forging. The chemical composition of the material proves that it was made of octahedrite. Both bracelets are beautifully forged and undoubtedly belonged to very wealthy women (perhaps princesses?)

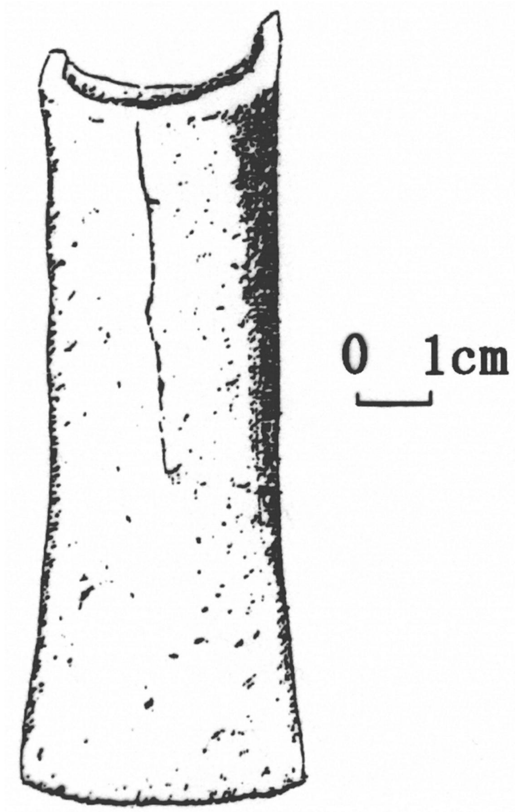

Fig. 3. The axe Wietrzno-Bobrka.

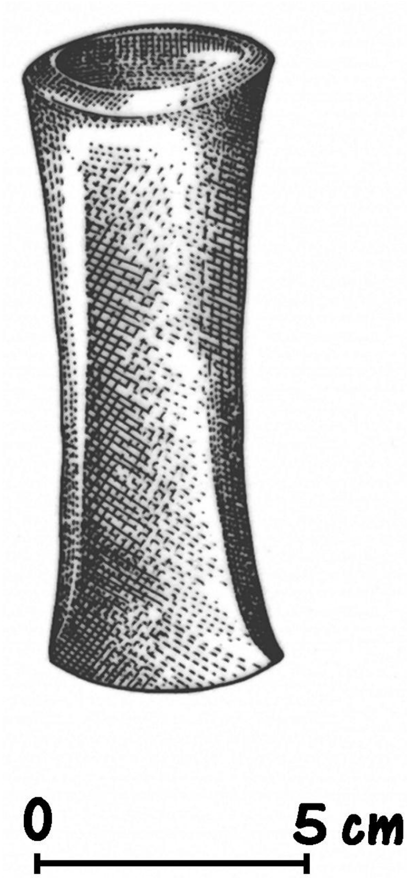

Fig. 4. The axe Jezierzyce Małe.

Axe from Wietrzno-Bobrka

Another object made of meteoritic iron is an axe from Wietrzno-Bobrka (Fig. 3) described by J. Piaskowski and A. Zaki (1961). It is an axe with a sleeve dating from the Hallstatt period (700–550 BCE). It was discovered in 1957 in the castle of the village of Wietrzno-Bobrka, not far from the Dukla Pass. The object is well-preserved, with little corrosion. It has the shape of a short round sleeve with the so-called raised or double-indent rim ending with a relatively thick blade. The axe's dimensions are: length 11.3 cm, sleeve's diameter 4.1 cm, slot's diameter 3.1 cm, width 4.2 cm, weight 376 g.

According to J. Piaskowski, the axe's structure is difficult to explain: the object was forged from one piece of metal, which has been confirmed by an X-ray test using gamma beams of the isotope of cobalt-60, but it seems that the metal was welded from several layers. A sample extracted from the blade showed a structure with five easily distinguishable layers. Further research proved that the layers one, three, and five are made of soft steel or common iron smelted in a blast furnace, while the layers two and four are made of iron with a significant amount of nickel (8 to 10%). One could argue this conclusion and claim that the axe was made of one piece of an octahedrite meteorite. J. Piaskowski, however, takes into consideration two possible explanations for the structure of the axe: it was forged from five layers including a layer containing nickel, or the layers were created spontaneously as a result of the segregation of nickel and carbon.

These hypotheses are presented by J. Piaskowski in his work (Piaskowski 1960). However, a year later, the author tends to think that welding the axe from pieces of soft steel and nickelic iron (meteoritic) is more probable (Piaskowski and Zaki 1961). Therefore, the layers two and four are part of a medium or fine-grained meteorite, octaedrite or ataxite.

Research suggests that the axe was imported, but the place of its origin or its creator are unknown.

It is worth emphasizing that such a technique of processing meteoritic iron was developed by the Malayans. F. L. Boschke. In his book *From cosmos to Earth*, he writes on page 166: "Two-sided blades of their daggers, very often bent serpentine-like, were made like this: two thin bars of meteoritic iron were placed between three layers of regular iron or soft steel. Then, this five-layer 'cake' was forged into a whole. This method was used to produce especially valuable pieces of weaponry." What is interesting, is the way the method traveled covering such a huge distance, probably via India to Europe. It is also striking that it survived millennia.

The axe from Wietrzno-Bobrka as well as the bracelets from Częstochowa-Raków are included on the Natural

History Museum's world list of meteorites as Polish meteorites, the latter ones as Częstochowa-Raków I and Częstochowa-Raków II.

POLISH 19TH METEORITE?

Preparing my lecture for the 2nd Meteoritical Seminar and the Congress of the Polish Meteoritical Society (established in April 2002), which was held in late April 2003 at the Astronomical Observatory and Planetarium in Olsztyn, I had never suspected that a great adventure with the flavor of a private investigation awaited me.

Having analyzed the available literature on the subject, I arrived at a conclusion that there are actually only three artifacts falling into this category: two bracelets from the Hallstatt period found in Częstochowa-Raków and an axe from the same period discovered in the area of Dukielska Pass in the village of Wietrzno-Bobrka. Quite unexpectedly, I found out that the objects had disappeared years ago. I must admit that I was upset by the lack of any control over the objects of such significance (only several comparable monuments exist in the world).

I made a decision of conducting a private investigation before taking official legal measures. I was aware of the situation of the Polish museum management in the times of the Polish Peoples Republic, the times when corrupted "big wigs" would simply point at exhibits to be placed in the trunks of their limousines and to be taken to various exhibitions and museums. Often these items would never return to their original place of exhibition, leaving no traces of their whereabouts.

I knew it was going to be difficult, however, after just a few weeks my investigation produced surprising results. I found out who might have had those objects last and who had been researching them. As a result, the Częstochowa-Raków I bracelet, or more precisely a big fragment of it (it had been cut up for research), was found in a desk drawer of a professor in Kraków. He had received the bracelet over twenty-five years earlier and, unfortunately, had to give it back to the Częstochowa Museum through me. The other bracelet cut up for testing over thirty years ago was found in the very museum as well. The axe from Wietrzno-Bobrka was found, too. It was supposed to be stored at the Wawel Royal Palace Museum or possibly at the Archeological Museum in Kraków, but I found it at a museum in Krosno. The director of the museum had no idea what a wonderful artifact he had in his collection.

So far, eighteen Polish meteorites have been registered. During my search for the three missing ones, I made an unexpected discovery—I found the 19th Polish meteorite.

The newly discovered one is an axe from Jezierzyce Małe near Strzelin (Fig. 4). Using records from the Wrocław Museum, I established that it had been found in the second half of the 19th century in the village of Klein Jeseritz, Kres Strehlen-Jezierzyce Małe near Strzelin.

It is a loose find dated from the Hallstatt period D. The find was researched and described by Professor Jerzy Piaskowski.

According to him, gammagraphic test showed that the axe was made entirely from one piece of metal. However, a sample taken from the blade revealed a layered structure. Later research of the chemical composition of the axe showed that it contained, among others, 1.6% to 3.0% Ni, 0.2% to 0.5% Co, 0.177% Si, and 0.56% P. After examining the composition and the structure of the object, we can safely say that the axe was made from one piece of a meteorite, type octahedrite, and is yet another Polish meteorite that should be included in the world list of meteorites kept at the Natural History Museum in London (which was, of course, seen to by the author of this study who had compiled proper documentation and filled in an appropriate form).

ENCOLPION FROM TREPCZA

Another very interesting object, actually not made of meteoritic iron but of a meteorite, is the 13th century Encolpion from Trepcza near Sanok (Fig. 5).

The discovery was thoroughly described by Jerzy Ginalski-the finder of this artifact and the director of the Museum of Folk Building and the Ethnographic Park in Sanok.

Encolpion with a relic is a unique reliquary, one of several encolpions found during salvage excavations in the Horodyszcze Castle in the years 1996–1997. As described by J. Ginalski, the encolpion is perfectly preserved, with straight bars in the shape of a cross, somewhat between a Latin and a Greek one, on its obverse there is a convex relief of the Crucifixion, while the reverse presents a concave relief of a cross. The tetragonally finished bars not widening at their ends differentiate the encolpion from the typical Kiev ones, which were very often finished with medallions embraced by two spherical knobs. As the author further points out, the difference is also in the layout of the composition: the scene of the Crucifixion is not matched by an image of the Virgin Mary on the other side. Also, it lacks any additional figures, symbols, or inscriptions. The reliquary is somewhat similar to some Palestinian encolpions (also known as Syrian-Palestinian) spread around the Mediterranean. Inside the bipartite reliquary from Trepcza was a tiny relic in the shape of a triangular wedge. It was placed along the vertical bar of the cross, tightly matched to one of the edges—it was the only place to make it possible for the pectoral to close. Reliquaries usually adapted the form of the worshipped relic, therefore, the relic in question was interpreted to be a fragment of Christ's Cross. This hypothesis was also supported by the shape of the relic resembling a splinter as well as its texture

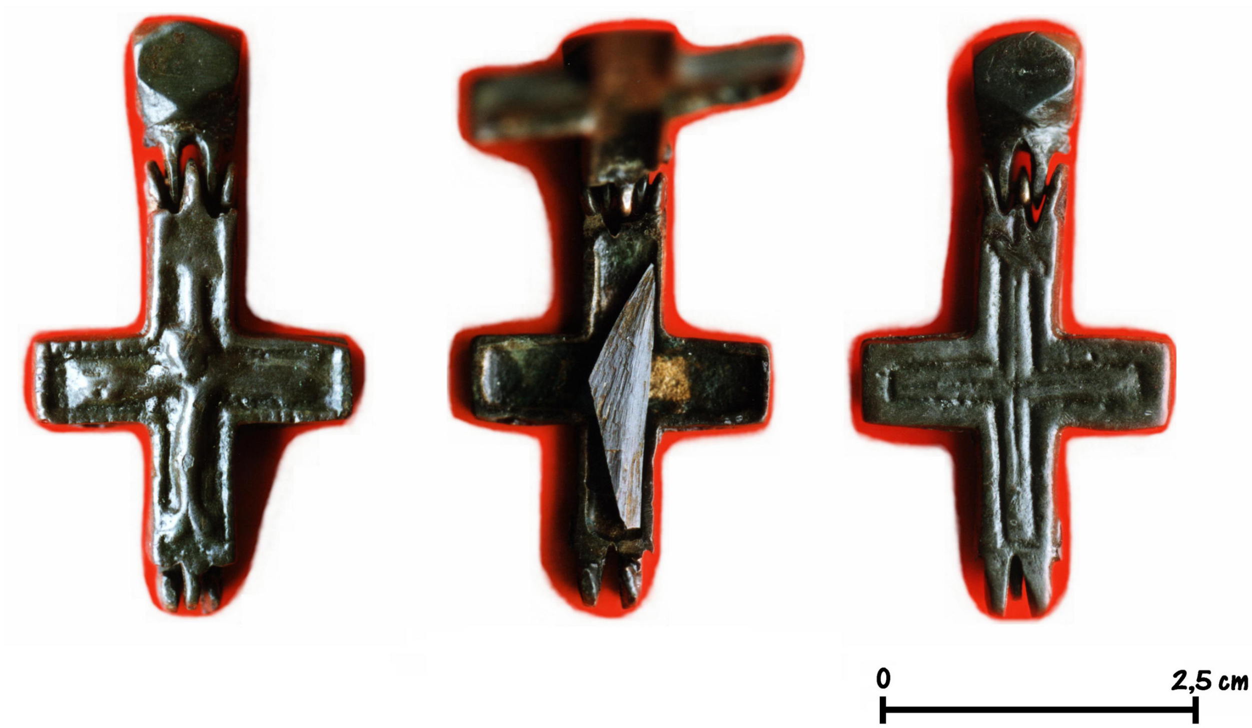

Fig. 5. Encolpion from Trepcza near Sanok.

similar to this of wood. However, other features of the object, such as dark graphite color, metallic gloss, perfect smoothness of some parts, and most of all the weight too heavy for wood contradicted this theory. Dr. Marek Krapiec and Dr. Elżbieta Bielańska from Akademia Górniczo-Hutnicza (AGH) in Kraków performed a detailed laboratory research of the preserved fragment using a scanning microscope at the Institute of Metallurgy of the Polish Academy of Sciences in Kraków. The analysis showed that the main element of the relic is iron (90%), and chlorine, lead, arsenic, copper, calcium, aluminum, and silicon are its other components. Such high proportion of iron, together with absolutely no carbon, denies the possibility that the object was manufactured in the early Middle Ages using the techniques known at that time. The presence of chlorine and arsenic suggested the possibility of dealing with the meteoritic or possibly indigenous iron. Therefore, further research was done with special emphasis on the presence of individual elements on the surface of the relic. It turned out that the ions of the admixtures are relatively regularly placed in the crystal structure of the iron. Taking into consideration the overall results of the analyses, Dr. Marek Krapiec suggested that the only plausible explanation for the origins of the analyzed fragment is attributing an extraterrestrial provenance to it. In his opinion, the relic placed in the encolpion from Trepcza is an extremely rare (as free from any traces of nickel) variation of iron meteorite! The author of the study J. Ginalski remarks that this is the only known case of using a piece of a meteorite as a relic and probably the encolpion was “tailored” for it only after its acquirement. This theory seems to be supported by the fact that the relic fits perfectly its casing and by the unique form of the Trepcza pectoral.

In my opinion, this object is very intriguing and worth spending more time studying it, especially, that the author of the study formulated a very bold theory concerning the lack of nickel in the specimen. Nevertheless, the problem is very exciting.

Recently, one of the members of the Polish Meteoritical Society told me about yet another interesting object. Since the beginning of the 17th century, every Good Friday, the Way of the Cross service has been held at the Franciscans church with the participation of the so-called Archfraternity of Good Death. The whole ceremony is very picturesque because the members of the Archfraternity (12 members and a leader) are wearing habits made of sackcloth and hoods with holes for the eyes. During the service, they repeatedly say *memento mori*, lie down on the churche’s floor to pray, etc. Incredible experience! But what does it have to do with meteorites? Every friar holds a tall cane the end of which are decorated with various items. The first two have human skulls on their canes, while the others bear ornaments resembling reliquaries. The last friar has a quite heavy (you can tell that by watching the way he carries it) black stone in the shape of a chopper with beautiful regmaglypts (a characteristic element of the appearance of a meteorite) on his cane. The stone’s dimensions are: 15 × 8× 8 cm. What is this stone and why is it joining other reliquaries? Can it be a fragment of a forgotten and unregistered fall of meteorites in Poland? If it is, it could be re-discovered if the stone is made available to scientists. Or maybe it comes from some other place, for example, was brought from the Holy Land by a pilgrim? In any case, the problem is extremely interesting and worth further investigation.

SUMMARY AND CONCLUSIONS

To sum up my study of artifacts made of iron meteorites:

1. Meteorites need not be searched for outside in the fields, but also in places that seem to have been already searched, for example, in museums;
2. Some objects or scientific research should be verified and compared with the latest discoveries;
3. There can be many other meteoritic artifacts in various museums all over the world, but to make sure that they actually are there, some preliminary examination is needed followed by more complex tests not only of the chosen iron objects but others as well. Therefore, a closer co-operation between archeologist and historians should be developed to work out methods of research of manmade meteoritic artifacts;
4. Meteoritic artifacts should not be neglected by meteoriticisits because, despite being reworked, forged, or smelted, they are still of extraterrestrial origin and should be registered as meteorites;
5. Artifacts made of meteorites are protected all over the world by special laws addressing goods of cultural importance (or by archeological laws or those concerning monuments in general). Therefore, a special attention should be paid to how they are traded, and a detailed catalog for collectors and dealers ought to be prepared to make the protection of meteoritic objects easier in case of theft or wartime unrests (as it has been observed in Iraq) and to make them easier to find;
6. In my opinion, a special meteoritic category should be created for manmade meteoritic artifacts: meteoritic antiques or manmade artifacts of meteorites and tektite glass. Within this category, further sub-categorization could be made, based on the material given meteorites are made of.

REFERENCES

Ginalski J. 1999. Ekolpiony z grodziska Horodyszcze w Trepczy koło Sanoka. *Acta Archeologica Carpathica* 35:211–262. In Polish.

Grady M. M. 2000. *Catalogue of meteorites*. Fifth edition. Cambridge: Cambridge University Press. 690 p.

Piaskowski J. 1960. An interesting example of early technology. *Journal of the Iron and Steel Institute* 194:336–340.

Piaskowski J. 1960. Metaloznawcze badania wyrobów żelaznych z okresu halsztackiego i lateńskiego z Małopolski. *Materiały Archeologiczne* 2:197–224. In Polish.

Piaskowski J. 1988. The earliest iron in the world, Pact 21-II.3. pp. 37–46.

Piaskowski J. 1992. Technical studies on high nickel irons with special reference to the Indonesian Kris. *Archeomaterials* 6:35–52.

Piaskowski J. and Zaki A. 1961. Żelazna siekierka halsztacka z grodziska Wietrzno-Bobrka koło przełęczy Dukielskiej. *Acta Archeologica Carpathica* 3:177–184. In Polish.

Pokrzywicki J. 1970. O starożytnych wyrobach z żelaza meteorytowego. *Wiadomości Archeologiczne* 35:295–302.

Zimmer G. F. 1906. The use of meteoric iron by primitive man. *Journal of the Iron and Steel Institute* 94:306–349. In Polish.

Zimny J. 1965. Metaloznawcze badania halsztackich wyrobów żelaznych z Częstochowy-Rakowa. *Rocznik Muzeum w Częstochowie* 1:329–400. In Polish.