Meteorite search campaigns of the Polish Fireball Network

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Video registrations of bright fireballs capable of producing meteorite falls over Poland have been observed since the Polish Fireball Network was established. The bolides selected as being worthy of further investigation have been those for which the PyFN software analysis indicated that the meteorite fall would have a total mass in the range of about 300 g – 10 kg. This article describes the main meteorite search campaigns of PFN carried out following detailed analyses of such events. Some expeditions originally organized for meteorite search training but which produced positive results are also described.

1 Introduction

The Comets and Meteors Workshop held by amateur astronomers has existed since 1987. During the years 1987–1990 some searches for meteoritic material (cosmic dust) were conducted, mainly around the Frombork crater-like structure that is suspected of having a cosmic origin[1]. The first meteorite strewnfield inspection took place near the town Oświęcim in autumn 2003 following the EN290903 meteorite dropping fireball (Spurný, 2003). This activity was made possible by the European Fireball Network, assisted by the Recovery Group of the Polish Meteoritical Society (from which the Meteoritical Section of PFN was created).

2 History

Polish Fireball Network

The Polish Fireball Network (PFN, associated with the Comets and Meteors Workshop, has been monitoring the sky over Poland regularly for over 10 years, registering the bright fireballs over the whole country (Olech, 2006; Wiśniewski, 2012). Each year we identify a few likely meteorite falls but poor weather conditions sometimes mean that there is insufficient data for reliable strewnfield calculations. In collaboration with the European Fireball Network the whole territory of Poland is monitored almost regardless of the weather.

Meteoritical Section of PFN

The Meteoritical Section (MS) of the Polish Fireball Network was created in 2010. The MS is the only group in Poland that specializes in searching for meteorites using tested and validated methods of exploration. The main task of the Section is to find the meteorites dropped from bolides registered by the Polish Fireball Network and to donate them as the research material to the scientific institutions. International cooperation also provides information about phenomena observed by friendly organizations (i.e. European Fireball Network) increasing the chances of finding meteorites spread out across Polish territory and abroad. Meteorites thus found are valuable because they provide a unique opportunity for a comprehensive analysis of the phenomenon, including the determination of:

- an orbit for the body
- the chemical composition of the meteorite
- an isotopic record of the meteorite
- pre-atmospheric size of the meteoroid

all which can reveal the origin of the body and the cosmic history of the meteoroid.

3 Main searching campaigns of PFN

Since being created, the Meteorite Section of PFN has regularly organized meteorite search campaigns. The PFN is developing its own PyFN software for multipurpose meteor analysis, including dark flight calculations. This offers the possibility that the most spectacular bolides can be examined to identify meteorite dropping candidates. Field trips that have been carried out for such events are described below. Locations of meteorite falls are marked on the map (*Figure 1*).

Sołtmany

On the morning on April 30th 2011 a meteorite hammer crashed through the roof of the Kruklanki magistrate (Mazury region). The meteorite was broken by the impact into two large and many smaller pieces. The MS conducted the search for a possible second fragment one

[1] J. W. Kosiński, private communication

week after the fall but without a positive outcome – we only found small meteorite pieces scattered around the impact point.

Oslo

Fragments of an asteroid that had fallen over Norway were found in a few locations in Oslo at the beginning of March 2012. Subsequently, some pieces of the meteorite from the most Southern area were collected by M. Burski and the Meteoritical Section members of the Comet and Meteor Workshop with the help of the local meteoritical authorities. The Oslo meteorite fall event was not observed (Tymiński, 2013, 2015).

PF131010 Ciechanów

A fireball was registered by 4 video stations belonging to the PFN. The observing data are listed in *Table 1*. The final velocity and height were obtained for the last visible point of flight and these indicated the possibility of a meteorite fall of about 2 kg near Grabowo, south of Ostrołęka (Olech, 2015). Two meteorite search expeditions were prepared but, due to accessibility issues, the strewnfield was only partially searched (*Figure.2*).

Table 1 – Data obtained for PF131010 fireball.

Fireball name :	Ciechanów
Terminal velocity	4.9 km/s
Terminal height	29.3 km
Impact point	52.961(5)° N 21.62(3) ° E

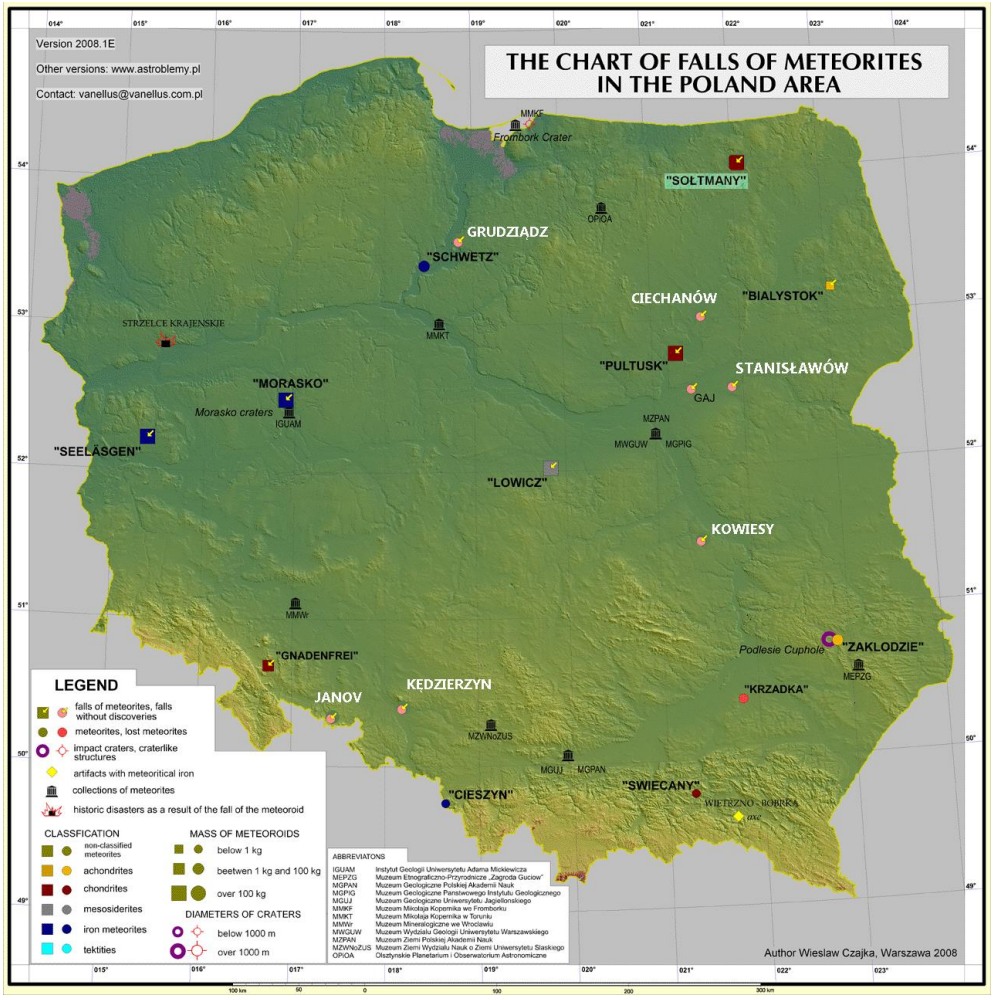

Figure 1 – Map of the selected locations of old and new meteorite falls and finds in Poland; map based on (Czajka, 2008).

PF310713 Kowiesy

A bright fireball -12m with entrance velocity ~20 km/s was observed at $21^h23^m55^s$ UT from central Poland and was registered by four PFN stations which also recorded evidence for atmospheric fragmentation of the meteoroid into at least two main fragments. After ~2-3 minutes one loud detonation was heard by many people (including the author). Calculations indicated that a fall of meteorites occurred, with the main fragment having a mass of about 250 g. Field trips in recent years haven't yielded any positive results.

PF/EN020313 Grudziądz

Due to stormy weather, a fireball was only partially registered by PFN stations. The strewnfield was calculated with the help of the European Fireball Network data and the search expeditions were carried out during 2013–2015. Further searching is already planned.

PF/EN070914 Kędzierzyn-Koźle

A fireball was observed by 3 video stations in Poland and also by the European Fireball Network. The calculations of the impact area were conducted by EN. Several

expeditions to the strewnfiled have already been organized and more are scheduled.

PF310515 Stanisławów
The fragmentation of -8m bright fireball into 5 pieces was observed by 5 PFN cameras. Further calculations indicated that at least 4 pieces survived the atmospheric flight as meteorites. One field expedition has already taken place and another one is planned.

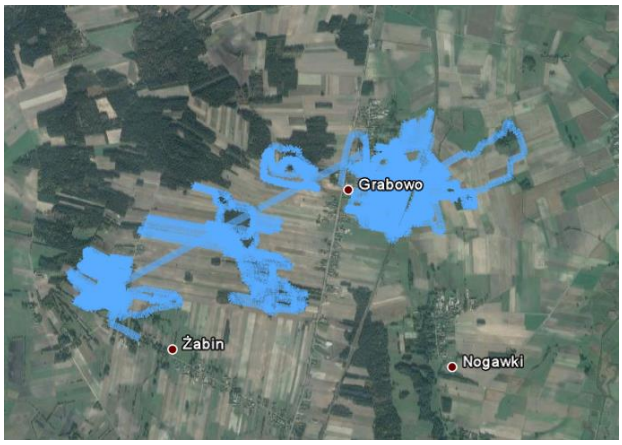

Figure 2 – Map of the meteorite impact area after the Ciechanów fireball; GPS-tracks of the Meteoritical Section members are plotted.

4 Training activities and finds

Training activities in the old Polish strewnfields
For relatively easily accessible fields, such as Pułtusk, Morasko, Łowicz and Białystok, we are to collect the full the meteorite mass distribution. Searches in such places also provide real training for the people and the equipment and greatly helps with the development and maintenance of good meteorite hunting techniques. As a result, several specimens in the Pułtusk strewnfield and many chunks of iron meteorite in Morasko have been discovered by MS in the recent years.

Finds
Most spectacular finds other than those from fields listed above (mainly old Polish places) have been those in the deserts of Africa and Asia (Stolarz, 2014). The latest and most interesting meteorite hunting was carried out in the Benguerir strewfield in Morocco. The MS members didn't find any significant meteorites but an important outcome was the rediscovery of the true strewnfield of this famous Moroccan meteorite fall.

5 Conclusion and outlook

Since the creation of the Meteoritical Section (MS), several dozen meteorite search campaigns have taken place in Poland and abroad. The members of MS have found different kinds of meteorites during expeditions planned for meteorite search training. The Section is still lacking a PFN-registered meteorite find. Due to a lack of man-power the future objective is to recruit more volunteers that are interested in hunting for extraordinary material especially dedicated for science.

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The Polish team of PKIM when just arrived at Mistelbach, from left to right *Mariusz Wiśniewski*, *Przemysław Żołądek*, *Marcin Stolarz* and *Zbigniew Tymiński* (Photo by *Axel Haas*).