The 1993 Jerzmanowice event in Poland and the 1908 Tunguska event

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Dedicated to the blessed memory of my grandmother (Tuzlukova Anna Ivanovna) and my mother (Ol'khovatova Olga Leonidovna)

Abstract. This paper is a continuation of a series of works, devoted to various aspects of the 1908 Tunguska event. In this paper its author would like to draw attention to the phenomenon that is sometimes called the Polish Tunguska in the Polish media, although it would probably be more correct to call it mini-Tunguska. In the evening of January 14, 1993, the village Jerzmanowice (about 20 km NW from the city of Krakow (Cracow) in Poland) was shaken by a powerful explosion. Some seconds later, stones of various sizes fell on the part of the village. Soon it was discovered that the source of the falling stones was a limestone crag. Fuses of electrical equipment in 30 houses also burned out. Some glowing flying objects in the sky were reported.

At first it was proposed a meteorite fall, but later it was discovered that the answer is not so simple. A review and some analysis of the event is presented in this paper, as well as some comparison with the 1908 Tunguska event.

1. Introduction

This paper is a continuation of a series of works in English, devoted to various aspects of the 1908 Tunguska event [Ol'khovatov, 2003; 2020a; 2020b; 2021; 2022; 2023a; 2023b; 2025a; 2025b; 2025c]. The works can help researchers to verify the consistency of the various Tunguska interpretations with actual data.

In this paper its author would like to draw attention to the phenomenon that is sometimes called Polish Tunguska in the Polish media and on the Internet, although it would probably be more correct to call it mini-Tunguska. The author of this paper (i.e. A.O.) for brevity will be named as “the Author”.

2. The 1993 Jerzmanowice event in Poland

In the evening of January 14, 1993, the village Jerzmanowice, which is about 20 km NW from the city of Krakow (Cracow) in Poland, was shaken by a powerful explosion. Some seconds later, stones of various sizes fell on the part of the village. Soon it was discovered that the source of the falling stones was a limestone crag 10 m high named Babia Skała (~50.2063° N, ~19.7546° E). About 2.5 m^3 of the limestone crag on its top was disintegrated into fragments a few cms in size, sometimes larger, thrown into the air and scattered within a distance of ~150 m.

Fuses of electrical equipment in 30 houses also burned out, some wires melted. It was reported of the appearance of a glow on metal objects like St. Elmo's fire. In the ground, numerous furrows were found after the explosion.

There was no strong wind before the explosion, but after the explosion, when Jerzmanowice's residents ran outside, it was a strong wind, and hail commenced.

The event was accompanied by luminous phenomena (including a flying ball of

fire). Some researchers interpreted the ball of fire as a meteoroidal bolide, and so the crag was hit by a meteorite. Other researchers proposed a meteorological interpretation (a lightning, and a ball-lightning).

A short note by Andrzej Manecki was published in the March 1993 issue of the Polish "Meteoryt" magazine about this phenomenon. The Polish astronomical magazine "Postępy Astronomii" in 1994 (issue 3) published an article in which it was suggested a kinship between "the Jerzmanowice meteorite" and the famous 1868 Pultusk meteorite. However its editors remarked that there is no certainty that this is really a meteorite, so the article was published to encourage polemics and discussion. Indeed in the same issue another article [Płeszka and Ścięžor, 1994] was published (these authors published a similar, less detailed article in 1993 [Ścięžor and Płeszka, 1993]), which stated that in the settlement of Zawoja (70 km from Jerzmanowice) a possible bolide was seen, but probably an hour earlier and in slightly different than the Jerzmanowice's azimuth. In the same article other important facts were presented. For example, that witnesses talk about the arrival of dense, black clouds before the event, and some other remarkable phenomena, which will be presented below in this paper.

In the next issue (number 4) of the same magazine a short note was published called (in translation): "Epitaph for the Jerzmanowice meteorite?" by the same authors [Ścięžor and Płeszka, 1994]. In the note the authors wrote that as a bolide was seen about an hour before the explosion on Babia Skala, so any direct relationship with the bolide should be finally rejected. The authors also contacted the US Department of Defense. Dr. Edward Tagliaferri checked satellite's data made that day. There was no trace of the bolide, but as he himself stated, it does not exclude the bolide, because their satellites are not intended for detecting meteors. The authors also wrote about their contact with a prominent Czech astronomer Dr. Zdenek (Zdeněk) Ceplecha (the head of the European fireball network) from the Ondřejov Observatory. Unfortunately, the network meteor-cameras were only turned on after the event. The authors also wrote that the coordinates of the radiant of another registered bolide at 22:42 UT, they are in good compliance with the coordinates of "our" bolide, taking into account a large error in the designation. At the end the authors came to conclusion regarding the Jerzmanowice event that the European fireball network data exclude the meteorite hypothesis.

In 1995 almost the whole issue of the Polish "Przegląd Geofizyczny" was devoted to the Jerzmanowice event. The articles in the issue have titles and abstracts in English, so let's consider them. Here is a fragment from the abstract to the introductory article [Morawska-Horawska and Manecki, 1995]:

> "In this issue of *Review of Geophysics* we present papers describing unusual atmospheric phenomenon in various scientific aspects. It is worth noting that there are two hypotheses on the nature of this phenomenon - meteorological and astronomical ones, both equally trustworthy. Also the

third explanation, involving the simultaneous flight of a bolid and the generation of a ball lightning can be tentatively accepted.

We present also reports of eye-witnesses of this unusual phenomenon collected by members of the Cracow section of the Polish Society of Astronomy Amateurs."

The next article was by Andrzej Kułak [Kułak,1995]. Here is its abstract:

"The analysis of the acoustic and electromagnetic phenomena accompanying the Jerzmanowice event should help to define its nature. A comparison of a typical scenario of the phenomena connected with the passage of some large meteoritic bodies through the atmosphere and the reports of the observers of the Jerzmanowice event showed a lot of analogies. We could accept the bolid hypothesis for the explanation of phenomena, but also the influence of a great atmospheric discharge should be taken under consideration."

The next article provides rather detailed data on the meteorological situation [Morawska-Horawska et al., 1995]. Here is its abstract:

"Poland was affected by the baric cyclone with the centre over the Baltic Sea on 14 January 1993. The atmospheric front system was moving through territory of the country. Advection of the unstable, polar-maritime origin air masses was observed. At the evening, secondary cold front was dividing the warmer air mass situated at its Southern side from the colder one laying at its northern side. Convergence of these two masses caused the larger atmospheric instability. This must have conduced to the creation of the very strong convection and vertically developed *Cumulonimbus* clouds and caused thunderstorms as the result. The atmospheric lightning flashes occurring during thunderstorms can assume different forms. Usually there are linear lightnings, but sometimes, though rarely, they can take forms of the pearl or ball lightning. The last phenomena are not well recognized. According to the literature they have the spherical shape with the most frequent diameter between 10 and tens cm or even morę. Ball lightnings give the strong light from the clearly yellow through orange to red colour, often with the blue aureole. The lightnings can move slowly vertically or horizontally and usually they look like falling down fireballs (like meteors). Touching the earth surface and the bad conductors (e.g. walls, rocks, timber etc.) they explode destroying these materials. In the mountains the ball lightnings can tear off even larger parts of rock. The meteorological situation on 14 January 1993, phenomena and damages observed as well

as descriptions in the scientific literature suggest that the considered phenomenon was the ball lightning."

In the article an important fact was mentioned (this fact was briefly mentioned earlier, already in 1993 [Ścięžor and Płeszka, 1993]). At 17:42 GMT (i.e. about 17 minutes before the Jerzmanowice event) from the control tower of an airport in Balice near Krakow, the light was seen in direction 355°, as if suspended, then the light began to fall, taking the shape of a ball. This phenomenon lasted from 15 to 30 seconds. The Author would like to add that the direction is close to the direction of the Jerzmanowice village.

The next article has self-speaking title: "On The Atmospheric Trajectory And Orbit Of The Jerzmanowice Object In The Case Of Meteoritic Nature Of The Event" [Mietelski and Włodarczyk. 1995]. Here is its abstract in English:

"On January 14,1993, at 17:57 GMT a huge fragment of the lone white limestone rock was destroyed by a strong explosion in village Jerzmanowice, 20 km to the NW of Cracow. Shortly before this event a bright fireball was observed by many eyewitnesses in Cracow, Jerzmanowice, Chrzanow and other near sites. The analysis of the observations is presented. The radiant and trajectory of the fireball are discussed. One of five variants of the heliocentric orbit closely resembles parameters of that of the Pultusk meteorite of 1868.

It was found that all acoustic, electrophonic, electric and mechanical effects as recorded in Jerzmanowice might be interpreted as a meteoritic fall of a small stone piece of preatmospheric mass 2500-8000 kg and velocity 12.4-13.5 km/sec. Because of the low initial velocity and highly inclined geocentric trajectory the final velocity was very high; 1.0 km/sec, and mass of 3-80 kg. In such a case the terminal explosion might be caused by a strong shock wave with a temperature of about 900 K. This scenario is strongly confirmed by a recorded Information on colour and brightness of the fireball."

It is not clear why did the authors write about 17:57 GMT, while the event took place almost 2 minutes later (i.e. 17:59 GMT) according to seismostation - see below.

The next article has a title: "The Analysis Of The Jerzmanowice Object Atmospheric Motion Assuming Its Meteoritic Nature" [Ścięžor and Płeszka, 1995]. Here is its abstract in English:

"In this paper the problem of the meteoritic body motion in the atmosphere is presented. The „Jerzmanowice Event” is taken as an example assuming, that it was associated to the falling of the meteorite

or indirectly to the bolide observed at the same time. The hypothesis has been developed, that the falling of the small meteorite with the cosmic speed (>2 km/s) has been responsible for the destruction of the rock.

The orbital elements of this body for some possible cases has been calculated. The Fesenkov's model has been used to describe the flight of the meteoritic body through the atmosphere. The standard model of atmosphere and two kinds of meteorites, stone and iron, have been used. The final state of the meteorite has been determined.

As the conclusions it must be said, that it is impossible to associate the destruction of the rock with the strike of the small meteorite. Nevertheless it is possible that the observed storm activity has been caused by the observed bolide flyby. In this case the meteorite initial mass would be equal to few tons. This could explain the great brightness of the sky and bolide, reported by the witnesses.

It has been possible to determine the coordinates of bolide radiant. It is interesting to note, that it almost coincides with the a-Lynxidy meteor shower radiant, with maximum about 17 January. This meteor shower is connected to the bright comet of 1833 year."

Unfortunately the Author can't understand the phrase: "Nevertheless it is possible that the observed storm activity has been caused by the observed bolide flyby". In the text of the article it is only written (at the end of the article) that it is therefore possible that the Earth on January 14, 1993 collided with a fragment of the nucleus of the Dunlop 1833 comet, and meteorological phenomena were observed as the effect of its flight through the atmosphere, and that it is of course one of many possibilities. And that is all what is written...

The next article presents data from seismic stations, which allows to pinpoint the time of the explosion [Mazur, 1995]. Here is its abstract in English:

"There are 4 seismological stations located in the region of the „event"' in distances 3-110 km. Only Seismological Observatory IGF PAN in Ojców (distance 3250 m) has recorded electromagnetic and seismic effects like generated there by local atmospheric discharge. All 9 electromagnetic seismographs recorded high „shock"' of the first lightning and 7 of them stopped at this moment. The registration was continued by 2 seismographs giving the typical seismic record like at other atmospheric storms. The second atmospheric discharge was registered after 83 sec; the record of it is almost identical but the amplitudes of the electric impulse and seismic waves were a bit smaller."

It is important to mention that there are several eyewitnesses who saw both flashes and then heard thundering sounds. Also it is noteworthy that when one of the eyewitnesses ran out of the house to the yard (the house was only 120 meters from Babia Skała) after the explosion, he saw two glowing objects moving towards Krakow.

The next article is called "Geomorphological And Geological Effects Of The Violent Event At Jerzmanowice" [Bąk et al., 1995]. Here is its abstract in English:

> "A violent natural explosion destroyed a part of a limestone crag at Jerzmanowice, 20 km northwest of Kraków, on 14 January 1993, a few minutes before 19.00 GMT.
>
> The explosion occurred about one meter below the top of the crag 10 m high. About 2.5 m^3 of limestone rock was disintegrated into fragments 1-5 cm in size, exceptionally larger, blown up and scattered within a distance of 140 m. The detachment surfaces on the crag are joint walls, partly weathered. Only about 10 percent of the detachment surface were freshly broken. We observed no traces of impact, push, abrasion or shearing on the detachment surfaces. A ground elevation was apparently punctured over a distance of 3 m. Sinuous or zigzagging furrows radiating away and bifurcating were carved in the grass-covered soil surface within 50 m from the detachment point on the crag.
>
> The observed effects are in agreement with an explosion caused by a violent electrical discharge from the atmosphere to the top part of the crag."

There is a mistake/mistype in the abstract - not "19.00 GMT", but 18.00 GMT.

The next article is called "Results Of Mineralogical And Geochemical Investigations Of The Minerals And Rocks Collected On The Spot Of The Explosion Related To The Atmospheric Phenomenon In Jerzmanowice On 14 January, 1993" [Manecki and Manecki, 1995]. Here is its abstract in English:

> "In Jerzmanowice near Cracow (Southern Poland) at 18:55 CET on 14 January, 1993 there was an explosion which resulted in the disintegration of the part of the limestone monadnock, called Skała Babia (Old Woman's Rock), with the weight of 2000 kg.
>
> The paper deals with the results of the investigations of the rock pieces collected on the spot of the explosion, the magnetic fraction of the dust separated from the snow and soil, solid particles remaining after melting of snow, and dark deposits on the surfaces of the fragmented rock. The investigations were carried out using optical and electron scanning microscopy, X-ray analyses, and chemical microanalyses by SEM/EDS.

Their results were compared with the results of the studies of meteorites, cosmic dust, and dusts of the natural and anthropogenic origin, recorded up to date by our laboratory. The major findings are listed below:

1. there are no meteorites among the collected rock material,
2. the atmospheric dusts are dominated by anthropogenic particles, i.e. emissions of big industrial plants and power plants,
3. among spherical particles the presence of single ones of the cosmic origin, with the composition close to that of the carbonaceous meteorites (Al, Si, Mg, Ca, Fe, K?, and others), cannot be excluded,
4. there are no thermal alterations in the shattered fragments of the limestone rock.

The question about the nature of the phenomenon requires further studies. It could be either a powerfull ball lightning or a bolide flying with a speed exceeding several times the acoustic velocity. Thus, the damage could be related to the explosion of the former or the sonic boom of the latter.

Jerzmanowice phenomenon may be compared to the Tunguska explosion, but on a micro-scale."

The Author doesn't understand how "the damage could be related... to the sonic boom of the latter" can be conformed with other manifestations of the event. But the Author agrees with the last phrase of the abstract.

There is also a compilation of eyewitness accounts in this issue. The accounts are in Polish.

The Author is not aware of subsequent fundamental publications on the 1993 Jerzmanowice event. In 2020 an article was published which briefly considered the event [Ciechowska et al., 2020]. According to its abstract in English: "In case of Jerzmanowice Event, observations indicate on one or two explosions of ball lightning".

Around the end of 1997 the Author got s-mail from Dr. Zdenek Ceplecha with info on the event. Ceplecha also presented in this s-mail his calculations of the "bolide's" trajectories. Unfortunately Ceplecha left our world in 2009...

The Author never saw these calculations published, and there is practically no hope that they will be published, so the Author decided to make them public. On Fig.1 there is a scan from the Ceplecha's s-mail regarding the first "bolide". The inscriptions in red are made by Ceplecha.

Jerzmanowice event Czechs, 1997

1st "bolide" trajectory

1993 January 14
First discharge: $17^{h}58^{m}53.9^{s}$ UT

Stations: 1, 10, 24, 25

$\epsilon = \pm 0.020°$ for one geographical position

$h_B = 2.05 \pm 0.65$ km

$\lambda_B = 19.693° \pm 0.014°$

$\phi_B = 50.183° \pm 0.004°$

$h_E = 0.48$ km

$\lambda_E = 19.756°$ Babia Skala (Witch Rock)

$\phi_E = 50.207°$

$a_R = 60° \pm 9°$

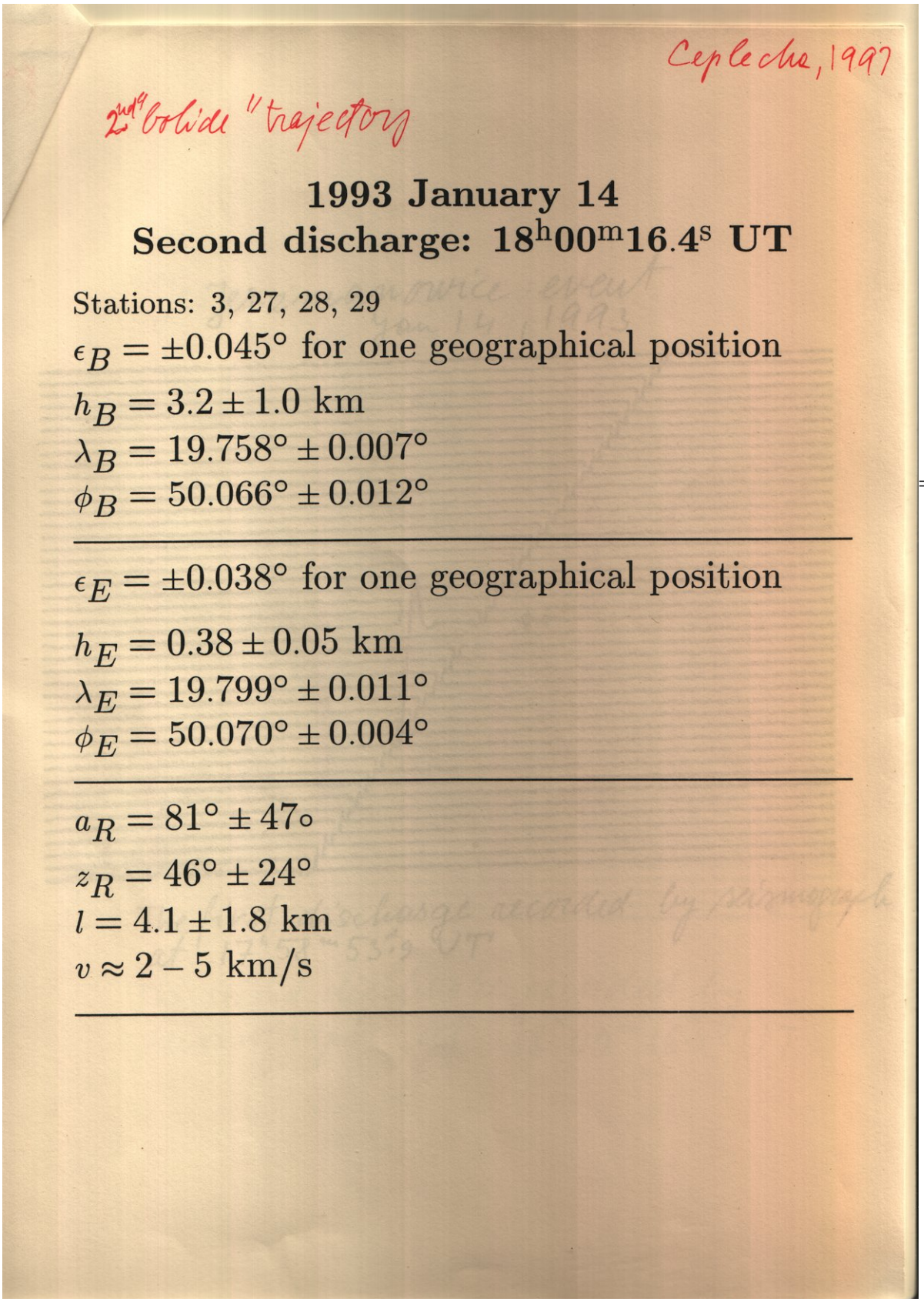
$z_R = 73° \pm 10°$

$l = 5.5 \pm 1.2$ km

$v \approx 3 - 5$ km/s

Fig.1

On Fig.2 there is a scan from the Ceplecha's s-mail regarding the second (weaker) "bolide". The inscriptions in red are made by Ceplecha.



Ceplecha, 1997

2nd bolide trajectory

1993 January 14
Second discharge: $18^h00^m16.4^s$ UT

Stations: 3, 27, 28, 29

$\epsilon_B = \pm 0.045°$ for one geographical position

$h_B = 3.2 \pm 1.0$ km

$\lambda_B = 19.758° \pm 0.007°$

$\phi_B = 50.066° \pm 0.012°$

$\epsilon_E = \pm 0.038°$ for one geographical position

$h_E = 0.38 \pm 0.05$ km

$\lambda_E = 19.799° \pm 0.011°$

$\phi_E = 50.070° \pm 0.004°$

$a_R = 81° \pm 47°$

$z_R = 46° \pm 24°$

$l = 4.1 \pm 1.8$ km

$v \approx 2 - 5$ km/s

Fig.2

It looks like Ceplecha admitted, but was not sure in existence of the third weak discharge. On Fig.3 here is what he wrote about it in the s-mail.

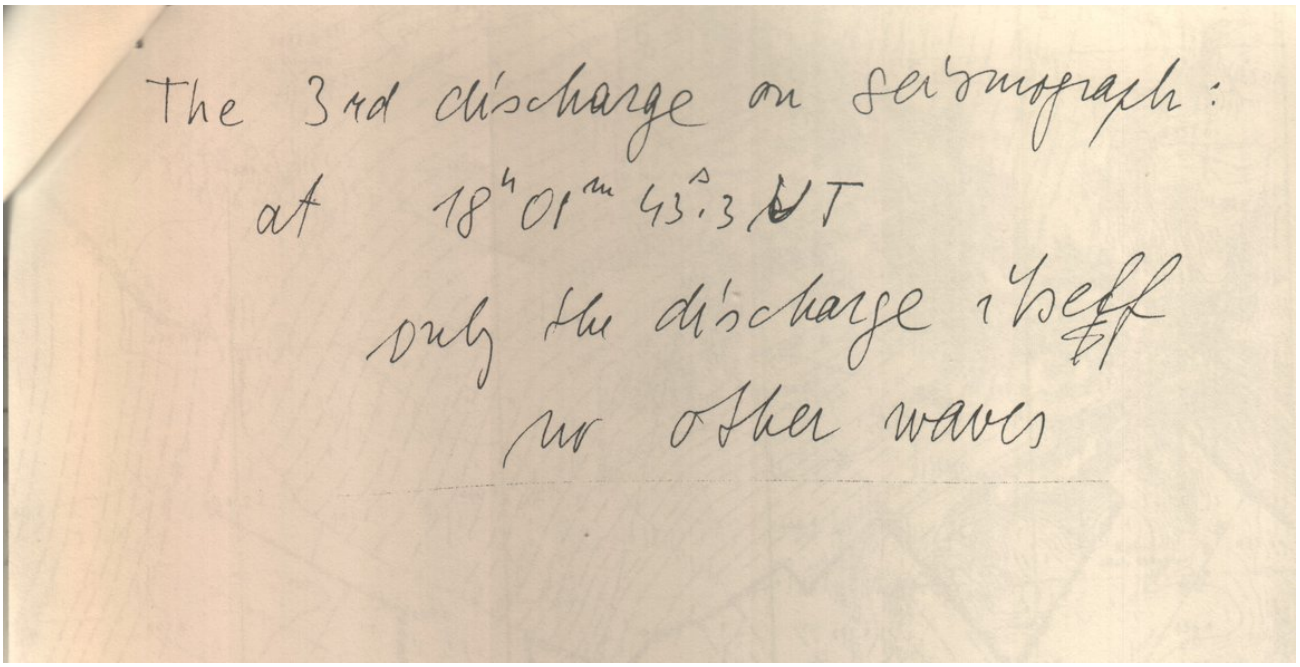


Fig.3

The Author hopes that these calculations by the prominent scientist will be useful for future researchers. In his s-mail Dr. Ceplecha also made some critical comments regarding articles with meteoritical interpretations in the 1995 issue of "Przegląd Geofizyczny" (which is considered early in this paper).

3. Discussion

The investigation of the Jerzmanowice event was carried out almost immediately in hot pursuit, thanks to which it was possible to collect a lot of factual information of very high reliability.

It follows from the data obtained that the meteoric and cometary versions of the event are currently of only historical interest.

It is noteworthy that even with regard to the history of research, this event resembles Tunguska - first a meteorite, then a comet, and then Tunguska...

Indeed, this event resembles Tunguska in miniature in many aspects. The similar variety of luminous phenomena and, in particular, at least two fireballs, precursors, the fireball(s) after the explosion, "redness" near the epicenter, strong wind and even rain. The furrows in the ground are also remarkable.

Of particular interest are the electromagnetic phenomena in the Jerzmanowice event, as there are signs of electrical discharges in Tunguska.

By the way, the duration of these discharges in the Jerzmanowice event makes it possible to verify the validity of the meteorite interpretation. Unfortunately, there is no information about the duration of the St. Elmo's fire in the published eyewitness accounts. However, it can be seen from the accounts that they were hardly observed for less than a few seconds. Thus, at the beginning of this observation, a hypothetical space body should have been located ~ten kilometers (if not more) from the place where the St. Elmo's fire were observed (they were observed only in the vicinity of the explosion site). Thus, the question arises - how could a hypothetical space body generate the St. Elmo's fire at the place of its impending impact (and only in it!), being at least ~ten kilometers away from it?

The question may arise - did endogenic processes play any role in the Jerzmanowice event? At first glance, their role is not clearly apparent. However, the fact that various luminous phenomena have been occurring in the same region for almost 6 hours hints at this possibility. Of course, this aspect requires special research. The same applies to the possible role of solar activity.

Before the time is completely over, it is advisable to carefully study this remarkable natural phenomenon once again. It seems that researching the 1993 Jerzmanowice event will help to better understand the nature of the 1908 Tunguska event.

4. Conclusion

The general conclusion is that the 1993 Jerzmanowice event was a very complex phenomenon lasting several hours at least. The explosion at Babia Skała was its culmination. There are many similarities between the 1993 Jerzmanowice event and the 1908 Tunguska event despite the difference in scale. It seems that researching the 1993 Jerzmanowice event will help to better understand the nature of the 1908 Tunguska event.

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