Physics – Uspekhi **39** (11) 1189 – 1190 (1996)

METHODOLOGICAL NOTES PACS number: **92.90.+x**

Ball lightning in the Novosibirsk Akademgorodok

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According to published evidence, ball lightnings are most often formed and destroyed in mountainous regions. I was fortunate to see fantastic scenery in the Altai which was a link chain of mountains with near-round flat valley 5 km in diameter. For several hours the slopes of the mountains were bombarded by numerous lightnings, while over the valley it did not storm. Some forked lightnings rolled themselves into balls and lived for about two seconds. Something prevented them from evolving into ball lightnings.

The ball lightning described in this paper was observed in the center of a residential district of Novosibirsk research center (Tsvetnoĭ passage, 1) on June 28 at 6 p.m. The phenomenon was momentary. At most 8 – 9 s passed since the point of its emersion on mid-trunk of a pine-tree approximately 12 m above the ground and disappearance in a water pot hole in a concrete road. The whole visible cycle of the ball lightning occurrence included immediate contact in the mid-trunk of the pine-tree, vertical motion down the tree and 90 degrees change in the trajectory near the ground. The change in the trajectory led to partial failure of the ball lightning, which nearly halved in size from 20 cm to 10 cm in diameter. Then the rest of the lightning moved over the ground and covered 12 m of grassy surface, 10 m of earthen footpath and about 40 m of concrete road. Finally, it disappeared on the concrete road in a water pot hole.

The phenomenon was preceded by the following meteo-conditions. For two days the weather was cloudy, short-term rains fell several times at 20 °C. Two hours before the lightning occurrence it drizzled and there were puddles on the roads. As the ball lightning emerged there was a storm far away on the south, as judged from peals of thunder.

Impulse decomposition of the ball lightning took place near the ground, where its trajectory changed 90 degrees (pine-tree – ground) with attending powerful explosion and momentary light flash. The luminous intensity was so high that the light front concealed trees, clouds and even window-frames. The first idea occurred was that it was the explosion of a powerful bomb.

About the trajectory of the ball lightning motion. The track of its motion was evident as a groove of stripped off bark on the pine-tree. The groove started at an altitude of 12 m (which is the height of a four-story building), ran vertically down the trunk and widened itself near the ground. At the foot of the pine-tree the trajectory swung through 90 degrees, α_1 (Fig. 1). There the ball lightning started destroying and produced the radiation of light and explosive acoustic perturbation. Then the ball of reduced size traveled over the grassy surface (10 – 12 meters) to the earthen footpath where it swung through $\alpha_2 = 120°$. Next it moved along the footpath and after that — along a concrete ground and the road parallel to a residence 62 m long. In passing from the concrete ground to the road the trajectory swum again through $\alpha_3 = 120°$ (see Fig. 1). On the last part of the path the lightning moved linearly along the center line of the road to the water pot hole on the interval between the first and the second entrances of the residence. Such a trajectory of the ball lightning motion has some interesting peculiarities. It traveled along the pine-tree nearly vertically downwards to the ground, which is evidenced by the groove on the bark. Having changed the trajectory the lightning chose seemingly reasonable variant of minimal distance to the footpath (over the grass). True, this area falls by approximately 30 cm, but there is another much greater fall towards the concrete ground, however, overgrown with grass and bushes.

Having found itself on the footpath, the ball lightning traveled along it towards the concrete road of lower level (for

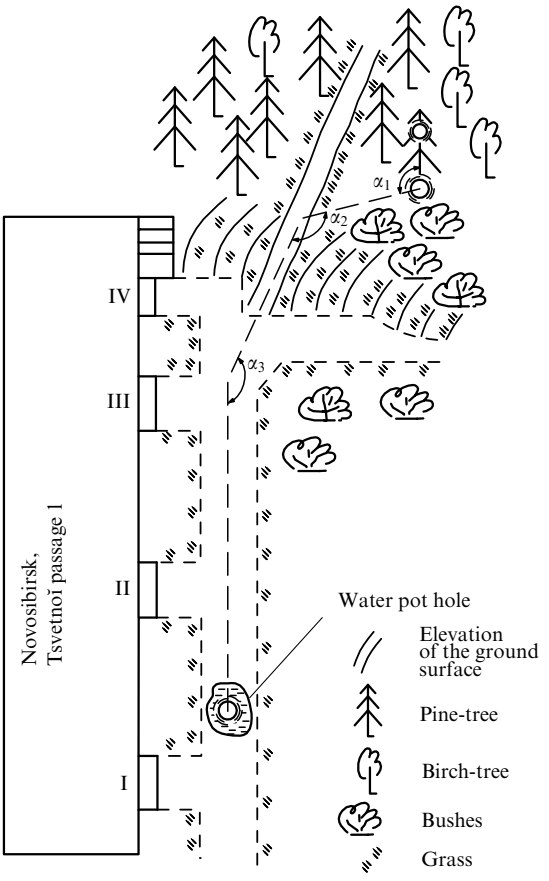

Figure 1. Scheme of motion of ball lightning.

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Received 15 April 1996
Uspekhi Fizicheskikh Nauk **166** (11) 1253 – 1254 (1996)
Translated by G N Chuev; edited by M S Aksent'eva

20 m the drop was 1.5 m). On coming to the road with minimal drop 40 cm for 40 m, the ball took advantage of it. The regular motion downwards was, probably, caused by gravity. As regards the configuration of the motion along the footpath and the road, for some reason, smooth and unimpeded surface was required. On the sides of the road there was grass, flowers, bushes.

The only visible mark of the ball lightning motion was left on the pine-tree as the groove of bark and phloem stripped off the trunk up to the cambium. At the place where the ball lightning settled on the tree the groove's width was 5 mm, broadening itself up to 50 mm at the foot of the tree. No impurities or heat effects on the groove (walls, fibers) were seen. The surface was clean. Widening of the groove towards the foot of the tree is, most likely, associated with relevant thickening of the trunk. This is supported by the fact that on the segment concerned there are several distinct swellings in the form of ribs. Therefore, starting with line *d* (Fig. 2a) the groove widens itself proportionally ($dm = 60$ cm).

Some more about the peculiarities of the lightning track. For example, in the upper part of the pine-tree where the lightning passed, there is a branch, one side of which coincided with the center of the groove (region B). The ball lightning bypassed the branch from the left and the groove width did not change. Vertical coaxiality of the groove retained below the branch. It seems that the obstacle had no effect on the lightning trajectory.

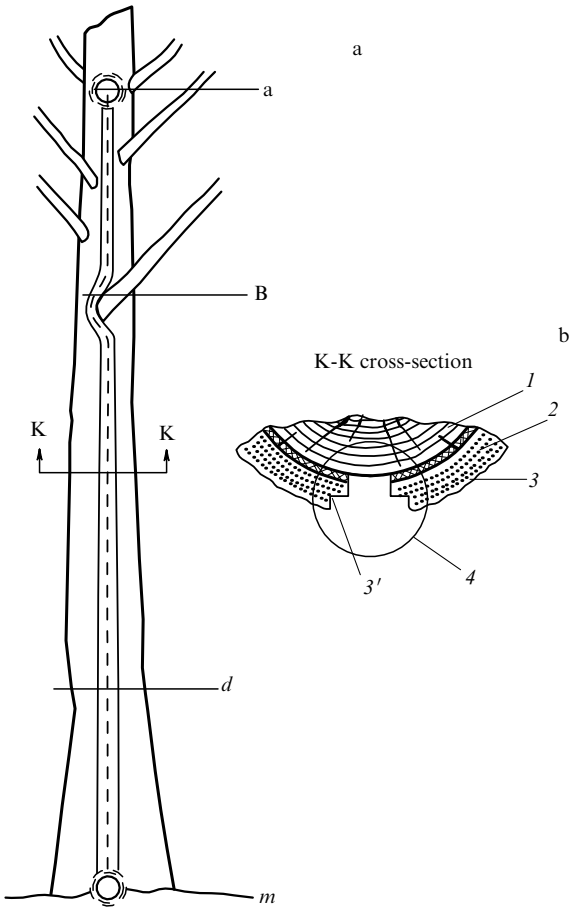

Figure 2. Motion of the ball lightning along the tree (details are given in the text)

Another peculiarity. On the side walls of the groove there is a dent *3′* practically all along the length of the strobe. The groove section is shown in Fig. 2b, where *1* is the cambium, *2* is the phloem, *3* is the bark and *4* is the groove region.

According to eyewitness evidence the ball lightning passed down the pine-tree with the ejection of saw-dust and powder from the groove for a distance of several meters.

While traveling along the road the ball lightning had the form of a rounded cylinder with acute protuberance ahead. Its disappearance in a small water pot hole was accompanied with a soft clap, the volume of water in the hole not exceeding 3 – 4 liters.

The character of the ball lightning behavior allows some projective conclusions. In the forcing period the lightning is known to possess the properties of an aerostatic object. The physical model suggests the fact of internal gaseous heat release during certain time intervals. As long as the balance of gravity-to-mass is lower than the lifting force, the ball lightning soars [1].

The ball lightning being discussed accomplished earlier the phase of formation and was observed in our yard in the phase of destruction. The most characteristic energy loss took place on the contacting site with the pine-tree. The groove on the tree testifies that the motion down the trunk was kept vertical. Besides, the groove has smooth walls. These phenomena could likely be associated with the high-speed rotation of the whole of the ball lightning or the rotation of its shell or core. The rotation is supported by the gyroscopic effect, manifested in the characteristic configuration of the strobe.

Rectilinear motion could have been retained due to gyroscopic effect, i.e. high-speed rotation (several thousand turns per sec). In the path of the ball lightning (rectilinear vertical track) there was a knot. Having looped, the lightning bypassed it and continued motion coaxially to the strobe below the knot. Thus, if an axis had been drawn along the groove, it should have passed through the center of the knot. Therefore, the track of the groove (and, accordingly, the ball lightning) was kept unchanged, most likely, due to the gyroscopic effect, caused by the rotation of the shell and the ball lightning as a whole. The latter is supported by the way of the groove 'production' which was attended with the ejection of finely divided bark for a distance of several meters.

The groove could have been produced as a result of wave processes on the surface of the ball lightning or micropulse thready generation of electrodynamic energy in the dendritic form, or similarly fine-toothed milling center. As regards the bypassing of the knot, this could happen as a result of mechanical deformation of the ball, which subsequently restored its form.

Of interest is the final step of the ball lightning destruction — it dived in a pool with accompanying faint clap 12 m away. Of all that seen reliable is the fact, that, at least the surface of the ball lightning is cold. The analysis of the finest fibers of the bark did not reveal any burnt sites. Everything was clean and natural colors of the bark, phloem and cambium remind unchanged.

This observation is of interest for understanding of the ball lightning nature.

References

1. Smirnov B M *Zagadka Sharovoĭ Molnii* (Enigma of the Ball Lightning) (Moscow: Znanie, 1987) p. 47