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Polarization effect - a key to solution of the Tunguska-1908 problem

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Introduction

In the early morning of June 30th, 1908 a powerful explosion occurred in the Tunguska river region of Siberia. Scientists examining the area calculated that the explosion was equivalent to 5÷40 megatons of TNT. As was estimated, the blast felled 80 million trees over 2,150 km^2. The air waves and ground tremors generated by the explosion were detected world-wide. Although most observers generally accept that some kind of a celestial body, either a comet or an asteroid, no one has yet found fragments of the object or any impact craters in the affected region. And now, more 100 years later, the debate about the Tunguska event continues.

Polarization effects of the Tunguska event

Under clear conditions of the atmosphere, there are singularities in the sky where the intensity of polarization is zero (the skylight is unpolarized). These peculiar points (two near the Sun and two near the anti-Sun) located in the plane of the Sun's vertical and called the neutral points Arago, Babinet, Bruwster, and point IV. Their positions are sensitive indicators of atmospheric conditions. It was assumed [1] that characteristics of the polarization for neutral points have correlations alternatively: (a) with a Sun's spots number, (b) with changes of the Earth's magnetic dipole, (c) with a turbidity of the atmosphere after volcanic explosions. For the first few nights after the Tunguska explosion, skies over Eurasia were exceptionally bright and then the effect abruptly disappeared [2]. To explain such effect by the atmospheric turbidity is impossible, because small dust particles of the cometar or volcanic origin would fall from big altitudes to the Earth surface for years. Moreover, optical anomalies of the Tunguska event have a long prehistory. The effect of the inversion of speeds for neutral points was noted for the first time approximately on 10 May, 1907 when the growth rate of a point Arago exceeded the growth rate of a point Babine. During the same time, in the beginning of May, 1907, A. Stensel observed magnetic rotational structures of the Sun (earlierly, similar structures were registered in 1857) [3]. Increase of the angular distance of neutral points of Arago and Babine, having begun in May, 1907, proceeded till the end of June, 1908. Exactly after the Tunguska explosion the maximum relative increase in polarisation for all period from 1905 till 1910 was recorded [1]. The position of a point of Arago (i.e., an area of negative polarization) depending on the angular elevation of the Sun, as a rule, quickly falls when the Sun approaches to horizon. When the Sun is under horizon on – 2° ÷ – 4,5° that corresponds to atmosphere illumination by the Sun's rays at altitudes of 10–20 km, the position of a point of Arago passes through a minimum, and then grows again. According to the hypothesis of R. Suring [4], the first minimum of neutral points is connected with turbidity at altitudes of 3–4 km – for a point Babine, and for a point of Arago – at altitudes 5–20 km, above which an atmosphere is pure and consequently a polarisation again increases. The second minimum of a point of Arago, when Sun is under horizon on – 6° ÷ – 10° (corresponds to atmosphere illumination by the Sun at altitudes of ~ 80 km), can arise because a polarisation again correlates with multiply scattering light. This polarisation is great, but less than a polarisation of simply scattering light [5]. Usually "classical" minimum for a point of Arago was observed when the Sun under horizon at angular position of the between – 0,5^o and – 1,5^o.

For one day before the Tunguska event (Fig.1) the Arago point's curves registered by prof. F. Bush in Arnsberg [6] clearly indicate the occurrence of anomalies. The minimum for the Arago point was displaced in a branch of positive elevation of the Sun (ξo = + 0,5^o [2]). For all 34 years of measurements for a point of Arago by prof. F. Bush [6] similar anomalies had not been marked. Given the

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identity of this minimum both on June 29th, and on July 1st, its shift has no relation to effects of the Tunguska explosion on June, 30th. Obviously, drift of minimum of a Arago point allows us to assert that the effect of violations of the polarisation was already on 29 June, continued to July 1st, and occurred only when the angular elevation of the Sun was ± 1,5^o, affecting mostly the lower atmospheric layers. In this article we show that the curve for a Arago point on 29th of June already corresponded to the average curve of the second half of 1908 (Fig. 1) and it is one of confirmations of the version about the occurrence of polarisation anomalies well before the Tunguska explosion. So, for Sun positions above horizon, for a point of Arago it was expressed in the reduction of distances concerning an average distance in the first half of 1908 and, on the contrary, for the Sun position under horizon, for a Arago point it was expressed in increase of distances concerning an average distance in the first half of 1908. However, on 1 July, 1908 a typical increase which was observed for the Arago point before, on 29 June, has disappeared.

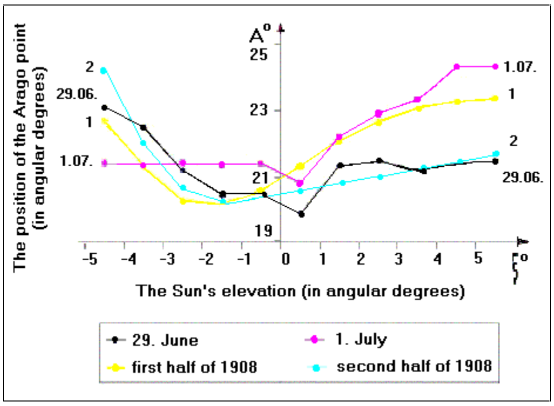

Figure 1: Change of the position of a Arago point during the first and second half of the 1908

Instead of the increase an oscillating plateau was observed. This anomaly was observed when the Sun was moving under horizon from – 1.5^o to – 7.5^o (corresponds to atmosphere illumination by the Sun up to E– and F–layers of the ionosphere) [6]. We see that from June 29 till July 1, 1908 effect of polarization anomalies occured in a direction from the lower layers to the upper layers of the atmosphere, rather than vice versa, as would be expected if the comet's substance penetrated from the space into the atmosphere. This conclusion has a support from the fact of an observation of optical anomalies in the low atmosphere sector (15–35 km) since April, 1908 [7]. Therefore we assert that the polarization effect of the Tunguska event could not correlate with a substance of comets or asteroids, but probably had correlations with fluctuations of a Earth's magnetic field and as consequence with a tectonic activity.

The situation for the inversion of the velocities for neutral points repeated later in 1919 [6]. In fact, 11-year cycle between 1908 and 1919 allows to say about correlations between the polarization effect and a solar activity. The tilt of the geomagnetic dipole to the interplanetary magnetic field determines the point of summer solstice. Indeed, before Tunguska phenomenon, on 22 June, 1908, the optical anomalies in Europe sharply increased [2].

Conclusion

No previous explanations for the optical mystery of the Tunguska event are wholly satisfactory. The polarization effect was not explained in context of the Earth's encounter with comets or asteroids, but clearly is in favor for the hypothesis of a tectonic Tunguska explosion as a consequence of the fluctuations of the magnetic Earth's field. In this report, we show that the polarization effect is one of the keys to the solution of the Tunguska problem.

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