TUNGUSKA-1908 EXPLOSION AND GLOBAL WARMING

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ABSTRACT

Although already 100 years had passed after the Tunguska event, the scientific community is still far from clear understanding of what happened in Siberia on 30 June, 1908.
For three nights following the explosion in the Tunguska area, skies over Eurasia were exceptionally bright; glows diminished rapidly thereafter.
Recently, the Tunguska explosion was offered as an alternative reason for global warming which is observed today. However, we remind that a loss of synchronism of a trend of temperatures in both Hemispheres of the Earth was recorded only in the first decade after the Tunguska phenomenon. Similar changes in the trend of temperatures was not noted during all the following 10-year periods. We prove that silvery clouds were not major luminescences during the Tunguska event. Therefore, we assert that changes in water balance in the atmosphere after the Tunguska catastrophe could not be the crucial factor affecting global warming.

1. ALTERNATIVE EXPLANATIONS FOR CLIMATE WARMING

Already there were attempts to explain the climate change on the Earth by its periodic collisions with the swarm of comets generated by the proto-Encke comet [1]. Russian scientist Schaidurov V. (a director of the Krasnoyarsk Center for computer modelling of the Academy of Sciences) recently presented a hypothesis about the changes in water balance in the mesosphere as a result of the Tunguska explosion [2]. He proposes this process as an alternative variant instead of the greenhouse effect theory for an explanation of global warming which is observed today. As confirmation Shaidurov points to an increase in the number of observations of silvery (noctilucent) clouds or night-luminous clouds (abbreviation: NLC) and the change in thermoprotective properties of the atmosphere after the Tunguska event.
In our report we should remind that several papers already discussed the problem of long-term geophysical effect of the Tunguska event, including its influence on the entire climate [3, 4]. But their conclusion was negative: large atmospheric disturbances did not trigger major climatic alterations after the Tunguska explosion. For the first time Volz [5] (and later a Kondratyev's group from S. Petersburg [4]) claimed that the large absorption event of July/August 1908, apparent in the data of the Smithsonian Astrophysical Observatory (abbreviation: APO) [6], may have been due to the high water vapor content of the atmosphere over Mount Wilson at that time and hence a high humidity enhanced the opacity. Nevertheless distinct positive correlation has been found later between precipitable water vapor and the extinction coefficient at each wavelength of the APO data [7]. According to these results, water vapor variations would have had only a secondary role in the anomaly of July/August 1908. Therefore, Turko's group suggested that the water deposited in the upper atmosphere by the Tunguska event caused no particular long-lasting or widespread photochemical effects worth mentioning [3]. Accordingly, except for a possible role in the formation of noctilucent clouds, the water injections were ignored.

2. ABOUT THE PROPAGATION OF DUST AND SILVERY CLOUDS DURING THE TUNGUSKA PHENOMENON

Only the twilight emissions with a broad diffuse spectrum - like the extended twilights which usually follow volcanic eruptions - without flickers or scintillations have been detected during the Tunguska event [8].
Recently there were several scientific works according to which the anomalous bright skies after the Tunguska explosion have been connected with the formation of a field of silvery clouds [9, 10, 11]. It has been assumed that these NLC were a direct result of the increase in water vapors and meteoric nuclei in the atmosphere because of intrusion of a cosmic substance of the Tunguska comet. However, it has been revealed that during of the peaks of meteor showers Arietids (on June, 8th), ζ-Perseids (on June, 9th), Aquarids (on July, 28th), and Perseids (on August, 12th) a significant increase in the activity of silvery clouds does not occur [12]. Moreover, the peak of NLC activity falls around July 10 when no major meteor shower exists. These and other [13, 14] results indicate that the formation of NLC is not dependent on cometary meteor showers.
For the Tunguska epoch, if the encounter with the comet in 1908 took place, the nitrogen oxides must be widely scattering [15] (as it was, for example, after the atomic test [16]). But an attempt by Rasmussen to find excess nitrate precipitates in Greenland in 1908, guiding by

prognostic calculations by Park [15] gave a negative result just like the search of the iridium anomaly referring to 1908 there [17]. According to the conclusion of group Turko, the chemiluminescent emissions of nitrogen oxides did not control the Tunguska optical phenomena [9].

Additional evidence for a dust intrusion is found both in the observations of solar halos over England and of nacreous clouds over Christiania (Oslo) before noon on June 30, 1908. However, this explanation meets complications as well, because the whole of West Europe fell into the region of so-called the dust shadow, i.e., the hemisphere opposite to the incoming direction of the dust masses accompanying of the supposed Tunguska body [18]. Geometrical limits of optical anomalies over Eurasia during the Tunguska event were the following: river Yenisey - in the east, the Atlantic coast - in the West, and in the south - along the Tashkent-Bordeaux line. If optical anomalies were caused by a dust from Tunguska explosion epicentre, we can suppose a transport of cosmic aerosols from Siberia to Europa by mesospheric winds. But no winds could transfer the dust particles from the boundary of the dust shadow to the British Isles in 12 hours. For example, F. Whipple asserts that "if dust from Siberia had reached Christiania in 12 h it would have travelled at about 400 km/h. Such a velocity is improbable and the difficulty in understanding why the dust did not reach America is accentuated" [19]. Furthermore, the data on the upper atmosphere dynamics point at the presence of westerly winds at middle latitudes in June-July. Hence dust particles should have moved within one day to the Far East and Kamchatka where nevertheless no optical anomalies were observed [20].

W. Kundt points out that mesospheric dust cannot scatter light to the 42°N latitude (i.e., latitude for Tashkent) and, in addition, would traverse the exobase unbraked within half a minute (rather than during three days) [21]. Therefore, Kundt disagrees that a dust from the envelope of a cosmic body (a comet or an asteroid) is responsible for glows during the Tunguska event.

It was already pointed out by Turko's group that the typical fall velocities of 0.1-μm-radius particles above 100 km are about 5 m/sec, or about 500 km/day. Moreover, the dust could not have been stopped by viscous forces above 100 km, and so would probably be approaching the Earth at meteoric velocities. It is therefore difficult to explain how any optically active cometary dust particles remained above 100 km for a period of several days.

On the other hand, the so-called "new" physics for NLC has been put forward. According to this physics, there can be new mechanisms for the formation and transport of silvery clouds: there is possibly capture of a water vapor in counterrotating eddies with extreme energy, and in this case the water in the atmosphere will move very quickly. So, observers detected the NLC formations some days after the space shuttle launched in 1997, 2003, and 2007 [11]. Space shuttle flights injected water vapor into the atmosphere and this exhaust plume was proposed as similar to the comet's water action in 1908. However, we remind that during previous experiments with a water injection into the atmosphere (Arcas rockets), by contrast, silvery clouds did not appear [12]. Probably the failure of artifical NLC to form may be due to factors in the atmosphere such as temperature, pressure etc.

Despite the accumulating evidence pointing to the NLC meteoric explanation for the Tunguska phenomenon luminescence, other reasonable theories are also available. We assume that the water vapor deposited at high altitude by the explosion not of a comet, but of the Tunguska paleovolcano might have contributed to enhanced NLC. The presence of volcanic dust intermixed with injected water vapor from 2 June, 1908 [22], (i.e., long before the explosion in Siberia) should have guaranteed the generation of silvery clouds.

It was reported that by the electron microprobe evidence, sulfur was found associated with many of the particles collected in the NLC [23]. As an explanation it was suggested that both the water and sulfates have been diffused into the mesosphere. This conclusion is confirmed by recent observations of the consequences of sulfates injections in the mesosphere after the eruption of the Russian volcano Sarychev Peak (Kuril Islands) on June, 12th, 2009. The first time after the Tunguska event silvery clouds, beautiful sunsets, and twilight glows have accompanied many volcanic dust veils and appeared over wide regions of the Earth inclusive at southern latitudes of Ukraine (Odessa) and of Spain. There is indeed a remarkable similarity between the observations on 30 June, 1908 and in June-July, 2009.

It had been investigated that the opacity spectrum of the dust layers produced by both the 1908 Tunguska explosion and by the 1912 eruption of the Katmai volcano accords with an inverse wavelength dependence [24]. On 30 June, 1908 F. Bush has defined a height of the orange clouds over North Germany equal 52 km (it is interesting that the dust cloud after the eruption of Agung volcano on the island of Bali on 17 March 1963 had a primary glow stratum at a height of 22 km and some indication of a secondary one at 53 km [25]). Therefore, with a high level of probability the dust layer over Eurasia in 1908 was caused by the eruption of the Tunguska paleovolcano in Siberia, not a comet.

In addition, we do not exclude an idea by Kundt, that volcanic ejections of methane in 1908 could cause an anomalous field of NLC in the summer of 1908. Hydrogen from methane reacts with atmospheric oxygen to form the water vapor required by NLC [21]. But the geological data testifies about low quantities of methane deposits in the Tunguska area where carbon dioxide dominates [26].

However, we stress that, there are significant unsolvable problems for all theories, which accept of the NLC as major luminescences during the Tunguska phenomenon.
Firstly, the NLC may be visible from the ground only when the atmosphere at altitude of 82 km is sunlit. These conditions are fulfilled when the sun is not more than 16^o below the observer's horizon [12]. But at night on 30 June, 1908 in such cities as Tashkent the solar depression was more than 26^o, that is, the atmosphere was directly lit by the rays of the Sun at an altitude of 700 km. It is clear that in this case silvery clouds could not be observed. Nevertheless in Tashkent the sky was of such brightness that photographic exposures with a normal astrograph were not possible at all [27].
Secondly, we argue that after the explosion in Siberia a special activity of silvery clouds was not observed because the reports, concerning observations of "bright clouds" at characteristic heights NLC ~ 80÷85 km from 30 June to 2 July, 1908, are not noted. So, F. Bush has defined a height of the orange clouds over Arnsberg, as equal to 52 km [28]. V. Backhause categorically denied a causal connection of luminescences with NLC and noted that the height of a bright atmospheric layers equaled 92 km [29]. Furthermore, on June, 30th, 1908 in 12 points (London, Prague, Hamburg, Bordeaux, Dublin, Hirshberg, Uindermir, Hempsted, Kherson, Krakow, Tiraspol, and Miass) where strong luminescences were observed, silvery clouds were absent all together [30].
Thirdly, during the Tunguska event the observed brightness of the sky was estimated ranging from 10^{-7} to 10^{-6} stilb [8]. Usually, however, the brightness of NLC was lower.
In addition, NLC are so tenuous that stars shine through them almost undimmed. But on 30 June, 1908 the luminescence in several regions did not allow stars to be seen [22].
It is known well that the summer months are the best time for the appearance of noctilucent clouds and hence NLC probably were not unusual in the Northern Hemisphere from 30 June to 2 July, 1908 [31].
Consequently, the concept of a dominating role of NLC in the mechanism of "bright nights" can no longer serve in favour of the cometary hypothesis for the Tunguska event. As a result, in the summer of 1908 opacity could be caused by a dust and a water vapor because of the volcanic eruption in Siberia. However, major optical anomalies could not be generated by the propagation of dust and NLC. Nevertheless it is possible to offer more adequate hypotheses for an explanation of "bright nights" during the Tunguska phenomenon.

3. IONOSPHERIC SPREAD EFFECTS AS THE BEST EXPLANATION FOR OPTICAL ANOMALIES OF THE TUNGUSKA PHENOMENON

We can best explain all optical anomalies from 30 June to 2 July, 1908 if we accept a tectonic (seismo-volcanic) hypothesis for the Tunguska phenomenon. It has been found that so-called spread effects exist, which mainly due to plasma instabilities produce irregularities in the E- and F layers of the terrestrial ionosphere. Spread-effect phenomena usually last about one week. It was shown that days before earthquakes, even before rather weak ones, the turbulization of the plasma of ionospheric layers changes [32]. There are images that clearly showed patches of turbulence associated with spread ionospheric bubbles drifting across the sky [33]. During spread effects both the produced structures, and the altitude covered with them can reach more than 1000 km [34]. For example, enhancements of light ion density have been observed by satellites in the inner plasmasphere at altitudes of 2000-2500 km above the seismically active zone prior to the Iranian earthquake on 20 June, 1990 [35], and ionospheric variations during the Wenchuan earthquake which occurred in China on 12 May, 2008 extended more, than 1500 km in a latitude and 4000 km in a longitude [36]. The above parametres are satisfactory to all optical observations during the Tunguska event.
It was shown that ionospheric spread phenomena before earthquakes are caused by an enhanced activity of acoustic waves with periods up to a few minutes, which propagate from the region of earthquake preparation up into the ionosphere [32]. During the Tunguska event L. Weber, of Kiel University, reported regular magnetic oscillations with a period of 3 min on 27-30 June, 1908. These strange disturbances occurred [37]: June 27/28 - from 6:00 p.m. to 1:30 a.m., June 28/29 - the same, June 29/30 - from 8:30 p.m. to 1:30 a.m. There are several intriguing aspects of registrations in Kiel: pulsations were detected in the evening/night time only and ended on June 30, 1908 at 0:30 UT, i.e., 15 min after the explosion in Siberia. Therefore, the source of pulsations in Kiel is one of the key factors for the solution of the Tunguska 1908 enigma.
According to the typical classification scheme of pulsations, oscillations with a period of about 3 min are continuous compressional Pc5 pulsations in the ULF range from 2 mHz to 8 mHz. Our previous studies showed that Pc5 pulsations observed by L. Weber in Kiel on 27-30 June, 1908 were caused by infrasound waves propagating from the epicenter of volcano-earthquake preparation in the Kulik caldera in Siberia during a night radon emission [38]. The velocity of infrasound waves about 300÷330 m/sec well explains the difference in 15 min between the explosion in the Kulik kaldera and ending of the pulsations in Kiel on 30 June, 1908.

In other words, we have the indirect confirmation of appearance of the ionospheric spread effect during the Tunguska event.

The gamma ray flux and ionization from radon decay products propagate to long distances and cause an increase in electrical conductivity of the atmosphere [39]. We found that an ionisation increase has been already recorded on 15 May, 1908 in the Atlantic Ocean, and stronger at the coast of England on 2 July, 1908, i.e., immediately after the Tunguska explosion [40].

Transient luminous events (sprites, elves, jets, etc.) perturb the upper atmosphere by changing its electrical properties [36]. Spread phenomena probably results from a vertical coupling process ‘involving upward propagation of atmospheric waves (in the form of tides, gravity- and planetary waves) from the lower atmospheric regions of their origin to the dynamo region in the ionosphere’ [41]. It was shown that the anomalous frequency changes before the earthquake onset can be caused by unknown supervolt seismic discharges [42]. ULF electromagnetic waves radiated by hypocentral zones during pre- and seismic periods may cause charged particle flux precipitation from the plasmasphere [43]. This mechanism possibly explains why eyewitnesses saw an object shaped like a pipe moving vertically down for about ten minutes in the epicentre of Tunguska area on 30 June, 1908.

Ionospheric effects of earthquakes are often superposed with solar and geomagnetic disturbances. Probably, it not casual coincidence. Scientists from the Ulysses mission have proven that the interplanetary magnetic field (IMF) interacts with the Earth’s magnetic field and causes it to oscillate in resonance with the characteristic of the solar gravity waves of g-modes. As the Earth moves to the rhythm of the Sun the changes in the geomagnetic field (in the solid Earth etc.) produce small detectable pulsations [44]. Although the period of oscillation of the solar corona (solar p-modes) is equal to 5 min, the period of fluctuations of solar photosphere and layers of deeper, than photosphere, is equal to 3 min (as a period of pulsations in Kiel). It is known that the tangential component of IMF has no compensation, as IMF possesses daily variations with a local peak of intensity at around 18 h local time. This time coincides with the beginning of registrations of pulsations in Kiel on 27-30 June, 1908 and it points out the Sun’s fields.

Summarizing, we claim that ionospheric spread effects are responsible for so-called "lights of earthquakes” which were observed as “bright nights” during the Tunguska phenomenon.

4. POLARIZATION EFFECT OF THE TUNGUSKA EVENT

During the Tunguska event a change of sky polarization was detected by F. Bush at Arnsberg, Germany [45]. Usually a "classical" minimum for a neutral Arago point was observed when the Sun was under horizon at angular position between $\xi^o = -0.5^o$ and $\xi^o = -1.5^o$. However, daytime polarization measurements by Busch at Arnsberg indicated that for one day before the Tunguska explosion this minimum was displaced in a branch when the solar angular elevation was positive ($\xi^o = +0.5^o$) (Fig.1) [46]. Given the identity of the position of this minimum both on June 29th, and on July 1st, its shift has no direct relation to effects of the Tunguska explosion on June, 30th. Obviously, a drift of minimum of the Arago point allows us to assert that the effect of violations of the polarization was already present on 29 June and continued on July 1st.

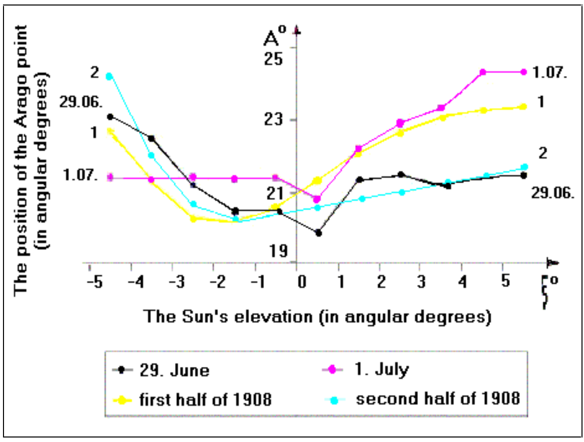

Figure 1. Change in the position of the Arago point during the first and second half of the year 1908

The curve for the Arago point on 29th of June already corresponded to the average curve of the second half of 1908 and it is one of the confirmations of the version about the occurrence of polarization anomalies well before the Tunguska explosion. We found that from June 29 to July 1, 1908 the effect of polarization anomalies extended in a direction from the lower layers to the upper layers of the atmosphere (Fig.1), but not vice versa, as would be expected in case the comet's substance had penetrated from the space into the terrestrial atmosphere. Therefore, we assert that the data for the polarization effect of the Tunguska event also disagree with the hypothesis of encounter of the Earth with a fragment of an asteroid or a comet.

Some papers discuss the problem of the Tunguska event’s influence on the Earth’s ozone layer [3, 4]. The general blue colouring of NLC is caused by absorption of incident sunlight by ozone in the Chappuis bands. According to Turko [3], archival atmospheric transmission of the APO data from the period of 1908 to 1911 have been analysed for Chappuis band absorption; the data imply an ozone reduction of 30 ± 15 %. The ozone perturbations can be explained by large stratospheric injections of nitrogen oxides, which may be produced, for example, by solar proton events. However, the characteristic auroral lines (red 6300 Å and green 5577 Å) or other characteristic emission lines or bands were not detected in the anomalous glows during the Tunguska event.

On the other hand, if we accept the hypothesis of explosion of paleovolcano in Siberia on 30 June, 1908, then the ozone layer could be violated by dynamic effects of volcano during its activization and explosion.

The ozone reduction can cause various physical effects. During the Tunguska event, observers reported about phenomenal transparency of the atmosphere. Possibly, that was caused by a falling of the finest dust in the stratosphere. But it is known in atmosphere physics, that when the thickness of ozone layer is less, than the thickness of the sub-ozone layer (that is, when the Buger's law is violated), then the transparency is also increasing. Therefore, as one of versions of an explanation of the polarization effect of the Tunguska phenomenon we can offer a violation of ozone layer and the changes of atmospheric scattering connected with it.

On the other hand, when the Sun under horizon is at an angular position of $\xi o = -12^o$ and then $\xi o = -18^o$, polarisation minima are also registered. They are explained by the change (by increase) in critical frequencies of ionospheric layers E and F, respectively [47]. In turn, change of frequencies is caused by the following: at twilight an intensity of pulsations of an electric vector of the geofield directed parallel to a plane of scattering of light, reaches a night maximum earlier, than the stronger perpendicular vector. That is, the nature of depolarization is not always caused by dust, and can depend on changes in intensity of a geoelectric field. Thereby, the polarization effect during the Tunguska phenomenon is evidence of the ionospheric spread effects mentioned above.

Magnetic friction between the Earth's magnetosphere and the solar wind decelerates the Earth's core while lunar tidal forces decelerate the mantle [48]; and a difference in speeds of rotation of the mantle and the core is a generator for the terrestrial magnetic field. Therefore, the anomalous gravitational tide (outflow) which occurred during the Tunguska event [49] could lead to fluctuation of a terrestrial magnetic dipole and, consequently, to a tectonic phenomenon. We remind that the epicentre of the Tunguska explosion is the 248 Myr-old volcanic crater that associates with the mantle plume, i.e., with a hotspot. Eastern Siberia is the field of protokimberlite pipes. They are spread out over a few hundred kilometres. One can suppose that as a result of the displacement of the Siberian platform (i.e., of the old craton) relative to the hotspot - of the Tunguska paleovolcano - a huge number of explosions and eruptions occurred as in the epicentre (i.e., in the Kulik caldera), as well and on the periphery of the platform on 30 June, 1908. Therefore, on 30 June, 1908 witnesses reported not only about the object shaped like a pipe, which moved vertically down for about ten minutes, but also about the several objects which were quickly moving in the direction of the epicentre.

5. REASONS FOR CLIMATE CHANGE

One of reasons for the recent spread of noctilucent clouds might be global warming, but not vice versa as this follows according to the hypothesis by Shaidurov. It is considered that NLC have appeared for the first time in connection with rising greenhouse gases emissions in beginning of the Industrial Revolution. The years of maximum NLC activity reports were 1887, 1899, 1908, 1926, 1937, 1959, etc. Evidently, close to the year 1908 special activity of silvery clouds was not registered [50] (Fig. 2). In the above mentioned sequence of maximums of NLC activity we can note two periods: the first is an 11-year cycle of activity of solar spots and, the second is the Saros-cycle (18,6-years) from 1908 to 1926. In other words, NLC probably have a causal connection with activity of the Sun (temperatures?) and of the Moon (tides?).

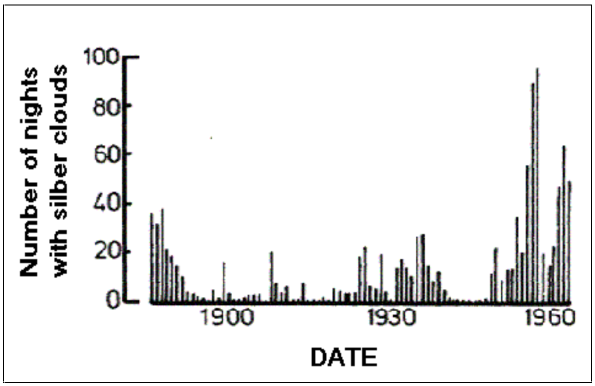

Figure 2. The number of nights with observed silvery clouds (1885-1965) [50].

Also, Shaidurov believes that the Tunguska event coincided with the period when a global warming began rising steadily during the twentieth century. However, it is easy to prove that after 1908, and for almost a decade, the annual average surface temperature in the Northern Hemisphere decreased [51]. We remind that stratospheric temperature decreases associated with the Tunguska explosion were estimated in the range of 1°-2° K. Temperature records indicate that during the Tunguska epoch, that is, in the decade after 1908, the Northern Hemisphere has been cooled by -0.3°K more relative to the Southern Hemisphere. Moreover, a loss of synchronism of temperature trends in both Hemispheres of the Earth was recorded during the first decade after the Tunguska-1908 phenomenon only. The similar changes in temperature trends was not detected during all other 10-year periods after the Tunguska explosion [6]. It means that there is no evidence to confirm Shaidurov's hypothesis of the alternative variant of explanation for global warming. It is likely that current and past climate change can not be attributed to unique isolated events.

On the other hand, the calculated changes in temperature for the Tunguska event are comparable with temperature changes caused by dust from volcanic eruptions. Correlations between a volcanic/seismic activity and the cooling are well-known. For example, the period of highest average summer temperatures and most sunshine in central Europe was from 1942 until 1953 (that is, having ended some years after the beginning of atomic tests; that also contradicts the hypothesis of Shaidurov because he finds correlations between the cooling and atomic tests from 1945). This period correlates with the minimum of volcanic dust (zero of previous 30-40 years) [52]. It was found that finest volcanic dust or some small increase in the solar constant were causes of the increased vigour of the general wind circulation from the 19th to the early 20th century. It underlines a role of a volcanic dust in climate change [53].

Finnish geologist V. Auer revealed a sequence of layers of volcanic tephra in the southern Andes during post-glacial time and determined the periods of the waves of volcanic activity which took place on Earth [54]. Later this dating of volcanic waves by Auer has been confirmed for other areas of the Earth. The period of cold climate, i.e., the Little Ice Age, between about 1430 and 1850 also overlapped with the last wave of volcanic activity. The year 1908 in which the Tunguska explosion occured belongs to the last wave of volcanic activity that according to Auer ended in 1915 [55].

It is known that eruptions of submarine volcanoes and submarine earthquakes produce more greenhouse gases (CO_2, etc.) than antropogenous activity. According to Auer, word-wide waves of the increasing volcanic activity were brought about by stresses in the Earth's crust. Possibly, this phenomenon associates with post-glacial isostatic movements and changes in world sea level. We may remind: total arctic sea ice was rapidly increasing between 1908 and 1911 as well [6]. But it is doubtful that only the volcanic dust was the unique factor responsible for climate change.

What additional factors can play an essential role? The Earth's geomagnetic poles are migrating. We suppose that most likely, global warming which is observed today is correlated with the changes in geomagnetic field. The Moon and the Earth orbit around a common gravitational midpoint, called a barycenter, which is inside the Earth, about three fourths of the way out from the centre. The discrepancy in the secular evolution of the Moon longitude (the big bump) was observed in the beginning of the 20th century (1900-1920). It is a historically old problem [56]. Remarkably, the period of time of the discrepancy in the Moon longitude also includes the year of the Tunguska event. The effect of a mass transfer from the Southern to the Northern Hemisphere towards higher latitudes, and also a redistribution of the Earth's mass closer towards its axis of rotation probable caused an increase in free oscillations of movement of the Earth between 1906 and 1908 [56]. H. Kimura [57] reported that the amplitude of the vertical z-component of Chandler wobble grow specifically in 1907-1908, and possibly in 1909. Especially strong change in movement of the North Pole for all the period 1907-1910 [58] was recorded between 14 June, 1908 and 2 July, 1908. There are numerous attempts to link variations in the Chandler wobble to earthquakes and volcanic eruptions. Probably a susceptibility of Eötvös force to change of gravitation by an amplitude of 20 mGal explains an effect of polar movement [59]. We find that the amplitude of 20 mGal accords well with a magnitude of lunisolar tidal forces.

The theory of torsional oscillations in the Earth's core is developing, and an attempt is made to evaluate the associated geomagnetic variations using of the assumption about a superimposition of a quadruple field on a main dipole field in the terrestrial core, provides a simple explanation of the reversals of the Earth's magnetic field [60]. We remind that a pole of the quadruple momentum of the Earth is located near Tunguska area [61]. In addition, in Eastern Siberia an agonic line (zero declination) has an anomaly: western declination is observed instead of the eastern one. It is known that this line turned clockwise towards the sublatitude orientations from 1900 to 1920 [62]. The largest changes were observed in 1901-1909, especially in the Irkutsk-Krasnojarsk region (i.e., an area of the Tunguska phenomenon) [63].

During the last hundred years an excursions (an inversion) of geomagnetic poles that are possibly connected with processes on the Sun and with the changes in IMF is observed. A "competition" of influence on the Earth between the solar and cosmic (galactic) rays (this influence is currently estimated through the Forbush-factor which decreases during solar flares) could also be the important factor in global warming (because clouds contain less liquid water following Forbush decreases, etc.). Recently it has been proved that a new index of the solar rotation M, defined by integrating the angular momentum density over the whole solar surface, reached a maximum at solar cycle 14 (1901.7-1913.6) [64] (a next maximum at cycle 21 had a relatively small amplitude). The vortex structures observed on the Sun during the years 1907-1908 [38] probably reflect an acceleration of surface layers during transport of angular momentum from, or into, deeper layers (due to a radial gradient because an equatorial gradient reached a minimum at cycle 14). Although the nature of solar fields is not well understood, we can assume that the whole complex: and discrepancy of a longitude of the Moon in the beginning of 20th century, as well as physical phenomena during a solar eclipse on June, 28th 1908 [46] and an anomalous lunar tide [49] which triggered the tectonic Tunguska phenomenon on 30 June, 1908 could be connected with changes in solar rotation, and as a consequence, with changes in solar inner fields and IMF at that time.

6. CONCLUSION

Both the solar activity and the anomalous linisolar tide during the Tunguska phenomenon could lead to changes in the Earth's core-mantle layer and in the terrestrial magnetic dipole, and thus could trigger the tectonic activity. The Tunguska event was most probably an explosion of kimberlite paleovolcano caused by solar-lunar gravitational phenomena about the time of the solar eclipse on 28 June, 1908, but not an encounter of the Earth with a fragment of an asteroid or a comet.

We strongly argue that the concept of a dominating role of the NLC in the mechanism of "bright nights" can no longer serve in favour of the cometary hypothesis for the Tunguska event. In our report it was shown that ionospheric spread-effects are responsible for so-called "lights of earthquakes" which were observed as "bright nights" from 30 June to 2 July, 1908. This conclusion is also confirmed by the polarization effect and registrations of geomagnetic pulsations during the Tunguska phenomenon.

We suppose that most likely, climate change concern the geomagnetic excursions and are correlated with processes on the Sun.

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