A Space Key to the Riddle of the Tunguska Catastrophe

Vladimir Rubtsov

What is Tunguska? This is a region in Central Siberia, where there are several rivers with this word in their names. But also this is a short designation of one of the most enigmatic events that happened in the last century: the flight and explosion of a cosmic body of unknown nature. From the remaining material traces, instrumental records and eyewitness reports we know that in the morning of June 30, 1908, there occurred in this region a powerful high-altitude explosion. It happened over the so-called Southern swamp, a small morass not far from the Podkamennaya Tunguska river. The site's coordinates are 60° 53′N & 101° 54′E.

Russia, Siberia, Tunguska…

Over an area of 200 square kilometers vegetation was burnt by the flash. The explosion devastated about 2,150 square kilometers of the taiga, twice as large as the territory of New York City, flattening some 30 million trees. If the Tunguska meteorite had fallen some five hours later then St-Petersburg would have found itself in the seat of its explosion and the city would have been in ruins. But the settlement nearest to the place of explosion was a little trading station of Vanavara, some 70 kilometers away.

Vanavara, the closest settlement to the place of the Tunguska explosion, and the Podkamennaya Tunguska river. View from a helicopter.

Some minutes before the explosion, local inhabitants saw a luminous body fly in the cloudless sky. It was seen at many settlements in the region, its flight being accompanied by thunderous sounds. Some years later, this body was designated as the Tunguska meteorite. Whether or not this was a *meteorite* in the strict sense of this word still remains unknown. It would therefore be more correct to call it the "Tunguska space body" (TSB).

The moment of the Tunguska explosion has been determined with an accuracy of 10 sec. It occurred at 0 h 13 min 35 sec (± 5 sec) GMT (Pasechnik, 1986). The accuracy of determination of the altitude of the explosion is not so good, but it is generally agreed that it was in the range from 5 to 8 km. But as for the total energy released at Tunguska, here the discrepancy between various estimations reaches almost two orders of magnitude:

Scorer 1950: 90 megatons (Mt) of TNT
Martin 1966: ~50 Mt.
Posey & Pierce 1971: 50 Mt.
Pasechnik 1986: 30 to 50 Mt
Bronshten 1969: 30 Mt
Ben-Menachem 1975: 10 to 15 Mt.
Zolotov 1969: 10 Mt.
Levin & Bronshten 1985: 10 Mt
Korobeynikov et al. 1974: 9.5 Mt
Boslough & Crawford 2007: 3.6 Mt

The Southern swamp. Here exploded the Tunguska “meteorite”. View from a helicopter. Photo by Vladimir Rubtsov.

In the former USSR almost every reading person knew the meaning of the word “Tunguska”. Not so in the West. Although any Internet search engine will immediately react to the keyword “Tunguska” offering more than a million webpages, I regularly meet with western people who have no notion of the Tunguska event. But even those who have heard something about it know little about the subject. Just that a space body fell in Siberia and leveled many trees. They believe that “science has proved” that it was either a stony meteorite or the core of a comet. In fact, the picture is not so simple…

The main hypotheses proposed since 1927 to explain the Tunguska event can be listed as follows:

1. It was the arrival of a huge iron meteorite that broke into pieces high above the Earth’s surface. Its large pieces and “a fiery jet of burning-hot gases” struck the surface and leveled the trees (Kulik, 1927).
2. The impact of a huge iron or stony meteorite (Krinov, 1949).
3. The forest devastation in the Tunguska taiga was caused by the bow wave which accompanied the meteorite flying in the atmosphere and hit the ground after the meteorite had been disrupted by the forces of air resistance (Tsikulin & Rodionov, 1959).

4. Thermal explosion of the icy core of a comet (Krinov, 1960).
5. A lump of “space snow” of extremely low density that completely collapsed in the atmosphere. Its bow wave leveled the taiga (Petrov & Stulov, 1975).
6. The fast fragmentation of a stony asteroid or a comet core (Grigoryan, 1976).
7. Low-altitude airburst of a swiftly moving stony asteroid (Boslough & Crawford, 2008).
8. Chemical explosion of a comet core (Tsynbal & Schnitke, 1986).
9. Chemical explosion of a fragment of Comet Encke that was caught by the gravitational field of the Earth and made three revolutions around it, after which it entered the atmosphere and evaporated, forming an explosive cloud over Tunguska. Then the cloud detonated (Nikolsky, Medvedev & Schultz, 2008).
10. Annihilation of a meteorite consisting of antimatter (La Paz, 1948).
11. Natural thermonuclear explosion of a comet core (D’Allesio & Harms, 1989).
12. Nuclear explosion of an alien spacecraft (Kazantsev, 1946).

Alexander Kazantsev, whose hypothesis about the catastrophe of an extraterrestrial starship near Vanavara gave the main impetus to the Tunguska studies in the USSR

It was 1946 when the Russian engineer and science-fiction writer Alexander Kazantsev put forward his hypothesis that the Tunguska “meteorite” had been the catastrophe of an alien spaceship. He predicted that notwithstanding the most meticulous searches no crater or meteorite remnants would be found at Tunguska.

All meteor specialists in the USSR and abroad utterly disagreed with this supposition. In their opinion, there must have been a crater and remnants of the meteorite at Tunguska. But, the first post-war academic expedition sent to Tunguska in 1958 did acknowledge that there was no crater and no large meteoritic masses. Kazantsev's prediction has therefore been verified, but somehow its author was not mentioned in the final report of the expedition even in passing.

Having been inspired by the fact that the "heretical hypothesis" about the high-altitude character of the Tunguska explosion had been tested and proved correct, several young Siberian scientists and engineers created the Independent Tunguska Exploration Group (ITEG). These people lived and worked in the city of Tomsk, which in 1878 had become the first University center of Siberia.

Initially the Group included a dozen specialists, mainly physicists and mathematicians. Within a few years, the "core" of this organization consisted of some fifty scientists, while a hundred specialists were taking part in fieldwork each year and a thousand researchers working in various scientific institutions all over the Soviet Union were analyzing relevant materials.

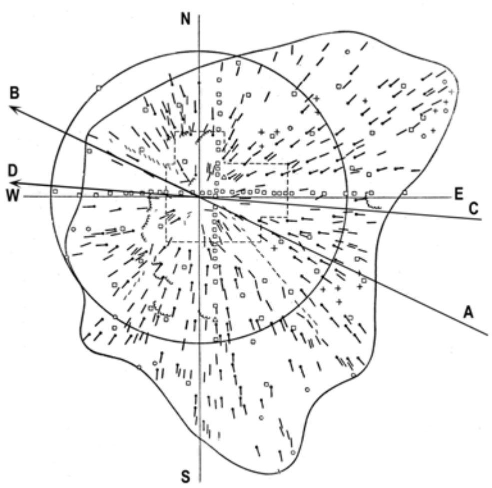
As a matter of fact, the Independent Tunguska Exploration Group was conceived for the purpose of solving one question only: whether or not the Tunguska space body had been an extraterrestrial spaceship. Some said jokingly "We must find a nozzle of the spaceship!" But since the first expeditions sent by the Independent Tunguska Exploration Group to Tunguska early in the 1960s did not find the "nozzle", they realized that the Tunguska problem would require a lot more research, involving high-level specialists applying the latest know-how and technology. By attempting to take the "Tunguska fortress" by storm the scientists had failed, and a long period of siege lay ahead.

Although traces of the Tunguska explosion begin to disappear with time, some of them are still well visible. Examining these traces, the Independent Tunguska Exploration Group carried out a really huge amount of the work, and its results have been published, more than once, in scholarly journals. Nonetheless these results remain virtually unknown in the West.

Here is how the picture of the Tunguska event is usually presented in papers and books by western scientists: **One space body** flew over Central Siberia approximately south to north, **performing no maneuvers** and generating in its flight a bow wave. It then **exploded due to overheating** (the so-called thermal explosion) over the Southern swamp producing a blast wave, leveling a lot of trees and **totally destroying the space body.** But, of course, **the explosion could never have been nuclear,** since **there are no signs of hard radiation**.

In fact, these are rather rumors than reliable data. The real picture is different. Let's look into the details.

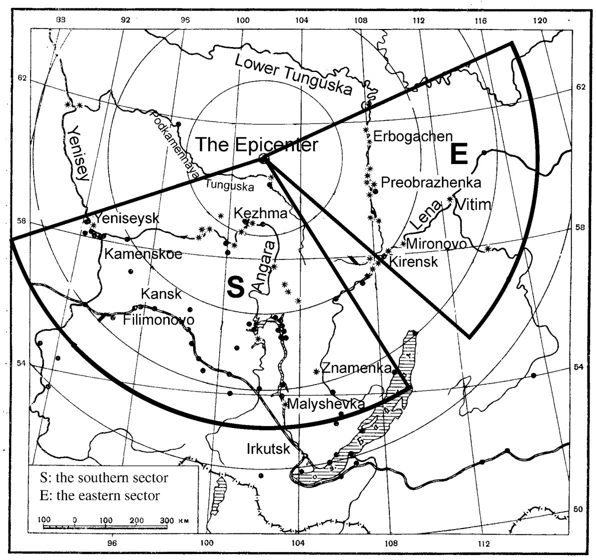
First. Was there only one space body? Hardly so. More likely there were **two** bodies.



The outlines of the leveled forest at Tunguska, 2150 square kilometers in size, according to the results of the ITEG expeditions

The Tunguska trees have been leveled over a butterfly-like area 70 km across and 55 km long. Over this area, the trees were found lying mainly in a radial direction. However, there are in the leveled forest two bands of leveled trees that form feeble but noticeable herring-bone patterns. One of them is running from the east-south-east to the west-north-west; the second nearly from east to west (lines AB and CD). These appear to be imprints of bow waves of **two** bodies that flew over the taiga in these directions.

The idea of two “Tunguska meteorites” is also confirmed by reports of eyewitnesses. The total number of eyewitness testimonies is about 700 (Vasilyev et al., 1981). The Tunguska space body was seen at a distance of up to 1000 kilometers from the place of its explosion. There are, however, two main areas of eyewitness reports.



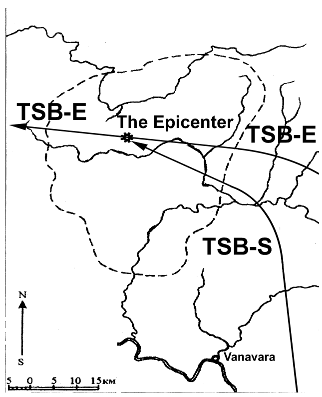
The southern and eastern sectors, from which came reports of eyewitnesses observing the flight of the Tunguska “meteorite” (Rubtsov, 2009)

First this is the southern sector where the Tunguska space body had been seen by inhabitants of settlements situated on the banks of the Angara river, and second the eastern sector (the upper reaches of the Lower Tunguska and Lena rivers). Data obtained inside each sector made it possible to create a statistically reliable and coherent image of the Tunguska phenomenon, but these two images are different. In the south the phenomenon (including thunder-like sounds) lasted half an hour and more. The brightness of this Tunguska space body (let's call it "southern") was comparable to the Sun. The body looked white or bluish. It had a short tail of the same color. After its flight there remained in the sky iridescent bands resembling a rainbow and stretching along the path of the body's motion. And it flew south to north.

In the east the brightness of the "eastern" Tunguska space body was much lower than the Sun. Its color was red, and the shape was that of a ball or "artillery shell" with a long tail. Usually eyewitnesses said simply: a "red sheaf" was flying. It was swiftly moving in the western direction, leaving no trace behind. The duration of this phenomenon did not exceed a few minutes.

Second. Did the TSB fly not maneuvering? Quite the contrary: it seems that **both** space bodies did maneuver.

At a distance from the Southern swamp the "southern" body flew approximately south to north, but it approached the swamp from the east-south-east. Judging from that, it must have turned to the left for about 70 degrees shortly before the explosion.



Directions of approach of the southern (TSB-S) and the eastern (TSB-E) Tunguska space bodies to the epicenter; the trajectory of departure of the surviving body (TSB-E)

As for the “eastern” object, it also maneuvered at a considerable distance from the Southern swamp. Materials collected in the eastern sector appear to testify that. There are *five* “eastern” reports in which eyewitnesses describe how the flying body changed its direction of flight. Here for example is the testimony of Vladimir Penigin who was born in 1893 and saw personally the Tunguska space body. His point of observation was on the right bank of the Lena river (some 500 kilometers from the epicenter to the east-south-east).

He describes: “Then I was a boy and helped to bring manure to the fields. We were upstream from the village. The fiery flying body was well seen. It resembled an airplane without wings, or a flying sheaf. It was as long as an airplane and flew as high, but more swiftly. The body was as red as fire or a tomato. It was flying horizontally, not descending, and passed in front of the cliff of Tsimbaly, at about two thirds of its height. Then the body covered some two kilometers more and made a sharp turn to the right, at a very acute angle”. (Vasilyev et al., 1981)

Third. Was the Tunguska object completely destroyed in the explosion? Again, this is hardly so. It turned out that another herring-bone pattern, as long as 20 kilometers, existed not only in the eastern part of the Tunguska territory (that is, **“before”** the epicenter) but in the *western* part as well (**“after”** it), being an extension of the imprint of the bow wave of the “eastern” TSB. It appears, therefore, that it was the “southern” TSB that exploded, whereas the “eastern” one had survived and had continued its flight to the west.

Fourth. The Tunguska explosion was by no means nuclear. It could only have been a thermal explosion. Right?

No, not right. As a matter of fact, it could **not** have been thermal. Since the “southern” TSB was seen at a distance of some 1000 kilometers from the epicenter it means that it was flying at a small angle with respect to the Earth’s surface. This angle could not have exceeded 10 to 15 degrees, otherwise the altitude at which the TSB began to emit light would have been too great. But in this case, the speed of the “southern” TSB before its explosion (that is, near the Southern swamp) could not have exceeded 1 to 2 kilometers per second, otherwise the body, flying in a flat path, would have left in the leveled forest a more pronounced imprint of its bow wave than it did leave. At this velocity no “thermal explosion” – or any other type of explosion due purely to the kinetic energy of a small space body – is possible. So the explosion of the “southern” TSB must have been due to its internal energy (chemical, nuclear, or other).

Besides, a complex set of serious ecological consequences has been revealed in the region of the explosion. First, a very fast restoration of the forest after the catastrophe and accelerated growth of trees, both young and those which survived the incident (Nekrasov & Emelyanov, 1963; Emelyanov et al., 1967).

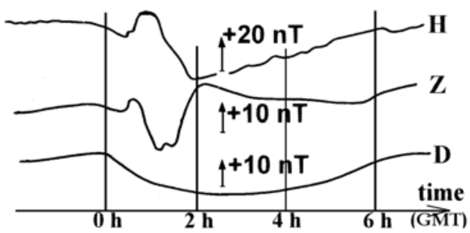
A section of a larch that survived the 1908 disaster. Its rings after 1908 are noticeably wider than before. *Credit*: Vitaly Romeyko, Moscow, Russia.

Second, a sharply increased frequency of mutations in the local pines (Plekhanov et al., 1968; Dragavtsev et al., 1975). There was also discovered a rare mutation among the inhabitants of the region, which arose in the 1910s in one of the settlements nearest to the site of the explosion (Rychkov, 2000). It was found by the leading Russian specialist in the field of human genetics, Dr. Yury Rychkov, who carried out an ambitious program of composing the complete Atlas of Genetic Geography of the USSR. Dr. Rychkov has positively associated this mutation with the Tunguska explosion. And it is well known that the most typical cause of genetic mutations is ionizing radiation.

Also, there was the local geomagnetic storm that started soon after the Tunguska explosion and lasted about five hours. It was recorded on magnetometers of the Irkutsk Magnetographic and Meteorological Observatory, but forgotten for many years to come.

The Magnetographic and Meteorological Observatory
at Irkutsk, Russia

Only in the summer of 1959 Dr. Kim Ivanov, a young but already experienced geophysicist working at this Observatory found these records in its archives. The effect looked as follows…



The local geomagnetic storm, dated June 30, 1908, as recorded by
instruments of the Magnetographic and Meteorological Observatory
at Irkutsk (Ivanov, 1961)

During seven hours before the explosion of the Tunguska space body, the geomagnetic field was very calm. Six minutes after this body exploded, the intensity of the geomagnetic field abruptly increased by several nanoteslas and remained at that level for about two minutes. This was the initial phase of the local geomagnetic storm (or the so-called "first entry"). Then started a second phase – "the phase of rise". The geomagnetic field reached its maximum intensity at 0 h 40 min GMT, and remained at the same level for the next 14 minutes. It then began to drop, the amplitude decreasing by some 70 nanoteslas. It returned to its initial level only five hours later. Such effects have *never* been observed by astronomers studying meteor phenomena – neither before nor after the Tunguska event. Dr. Victor Zhuravlev, one of the most experienced Tunguska researchers, has emphasized that this storm is identical to the artificial geomagnetic storms that occurred in 1958 over Johnston Island during the high-altitude nuclear tests (Zhuravlev 1998).

Then thermonuclear charges some four megatons in magnitude exploded at altitudes of 76 and 42 kilometers. Later it was ascertained that such effects occur only if nuclear bombs explode at high altitudes. Even the most powerful surface explosions leave the magnetosphere calm. Very soon, scientists uncovered the cause of this effect. It was the fiery ball of the nuclear explosion, producing intense radiation, as well as neutron fluxes. Under the influence of this radiation, the level of ionization of the ionosphere increases sharply, there appear in it electric currents, and a magnetic disturbance occurs. The only model that convincingly explains the Tunguska geomagnetic effect is the model in which this effect was produced by the ionizing radiation of the fiery ball of the Tunguska explosion.

By the way, in 1986, when talking with Victor Zhuravlev, Dr. Kim Ivanov confessed that he had at once recognized this analogy, as well as its far-reaching implications, and had discussed this question with Alexander Kazantsev and another enthusiast of the spaceship hypothesis, Dr. Felix Zigel. They attempted to convince the geophysicist that he should tell this publicly. Zigel and Kazantsev were certain that the scientific community would listen to the expert opinion of such a competent specialist. Yet Ivanov did not dare to do so, since he believed that strong evidence in favor of the spaceship hypothesis would not be accepted by official science. Instead, it could even have hampered the Tunguska studies.

And last but not least, the presence of feeble but noticeable radioactive fallout after the Tunguska explosion is another fact, confirmed by finding the peaks of radioactivity dated 1908 in trees that had withered before 1945 (that is, before the year when nuclear tests in the atmosphere started and the artificial radionuclides began to fall from the sky in plenty). Only the increased radioactivity of the samples taken from the trees that continued their growth after this year may be explained as contamination from contemporary nuclear tests (Mekhedov 1967; Zolotov 1969). Note that the Tunguska radioactivity was studied not by amateurs, but by the most distinguished Russian radiochemists, in particular by Academician Boris Kurchatov, the father of Soviet radiochemistry, and his close associate Dr. Vladimir Mekhedov.

Now, summing up all of the above, we can conclude that there were **two** space bodies at Tunguska in June 1908, **both of them maneuvering in flight**. One of these bodies (the “southern” TSB) **exploded over the Southern swamp due to its internal energy**, this explosion **being accompanied by ionizing radiation and radioactive fallout**, whereas the second body (the “eastern” TSB) **had survived this fiery bath and had flown farther west**.

Well, all this is nice, but where is something more material? That is, where are the remnants of the Tunguska space body (or bodies)?

The lack of cosmic substances at Tunguska has always been the primary matter of concern for researchers. Actually, the very "problem of the Tunguska meteorite" originated when it became clear that there was there nor a meteorite crater neither noticeable quantities of meteorite substance. Before that, it was seen just as a relatively simple task: to reach the site of the meteorite's fall, to unearth its remnants, and to bring these to Moscow. Having started a more intricate search in the soil and peat, the meteor specialists were looking, naturally, for the so-called cosmochemical elements that are prevalent in space – namely, nickel, iron and cobalt.

Both silicate and metal spherules some 100 microns in diameter containing such elements were discovered in the peat, including the layer dated 1908. But, the number of these spherules was much too small even for a comet core, to say nothing about a huge stony meteorite. The overall mass of space matter spread over Tunguska in 1908 was somewhere between 200 kilograms and one ton. But, according to the well-justified estimation of astronomers, the mass of the hypothetical Tunguska comet could not have been less than a million tons. A powerful explosion of the comet core entering the Earth's atmosphere could have happened only if both its mass and velocity had been very considerable. And now – two hundred kilograms… Strange indeed. So most likely these microscopic spherules were due to the usual background fall of extraterrestrial matter.

A very systematic search for chemical anomalies in Tunguska soils and peats has been made by specialists of the Independent Tunguska Exploration Group. They have found an increased concentration of some rare earths (lanthanum, ytterbium, cerium and yttrium). Soon it turned out that the samples enriched by rare earths are found only around the epicenter of the Tunguska explosion and in the north-western direction from it. This chemical anomaly was spread through soils, plants and peat, having a peak in the peat stratum dated 1908.

Astronomers and meteor specialists have flatly ignored this data. Their logic was simple: since neither meteorites nor comets contain essential quantities of lanthanides these elements could not have had anything to do with the Tunguska meteorite. However, it was found that the pattern of ytterbium's distribution at Tunguska *follows the projection of the "southern" TSB's path on the ground*. Similar shapes have been formed at Tunguska for the surface distribution of lanthanum, lead, silver and manganese (Zhuravlev & Demin, 1976). Only these five elements have patterns of distribution in Tunguska soils and peats that follow the projection of the TSB path on the ground, and only ytterbium follows this path strongly enough to be considered as the most likely main ingredient of the TSB substance.

This is an amazing outcome, one should note. This soft silvery-white rare-earth metal, discovered in 1878, is now used mainly for improving the hardness of stainless steel, as well as in making high-power lasers. Definitely, if the chief chemical component of the TSB was ytterbium it hardly could have been a natural space body. In this respect astronomers are certainly right. As far as we know there are no natural small space bodies in the Solar System consisting mainly of ytterbium.

In the 1990s, Dr. Sergey Dozmorov, a specialist in the chemistry of rare earths, who ran a chemical laboratory at a research institute in the Siberian city of Omsk, became interested in this enigma. He tested samples of soil, taken at Tunguska, looking for all lanthanides, not only of lanthanum, cerium and ytterbium. Dozmorov discovered that apart from ytterbium these samples were enriched by thulium, europium and terbium as well. And their ratio had been sharply disrupted. The contents of terbium exceeded the norm by 55 times, that of thulium by 130 times, that of europium by 150 times, and that of ytterbium by 800 times. Such things never happen in nature – only in special alloys. Even being a cautious scientist, and not a sensation-seeking journalist, Sergey Dozmorov had to conclude that:

"Together with the known data on the above-average barium content in the area of the Tunguska explosion, the results obtained may mean that there were in the Tunguska space body some systems that contained a superconducting high-temperature ceramic made on the basis of a combination of barium – a lanthanide – and copper. Such a ceramic keeps superconductivity up to the temperature of liquid nitrogen (that is, minus 196 degrees Celsius) and can be used for constructing effective energy and information storage devices. Obviously, such a substance cannot be natural". (Dozmorov, 1999)

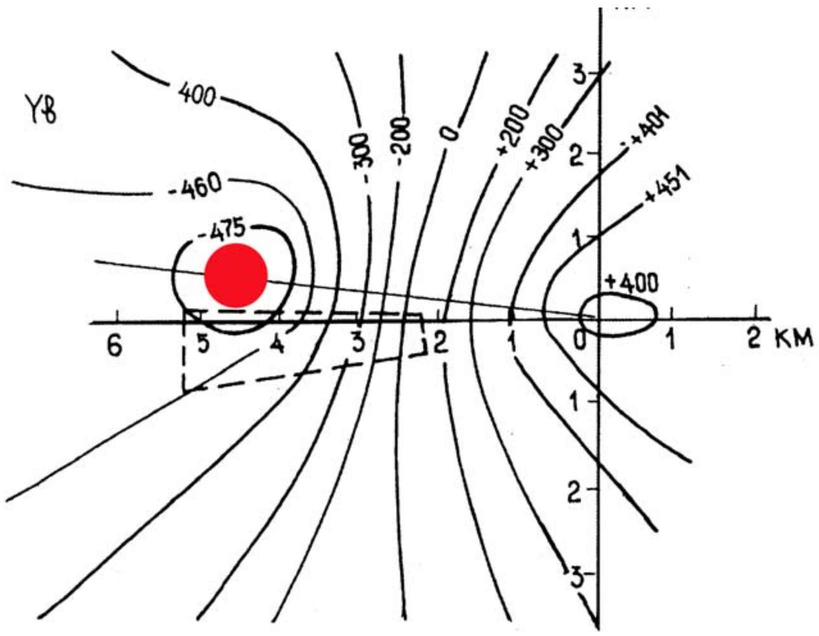
Dozmorov was planning to continue and develop his research, but soon after obtaining this striking result he perished at night in his laboratory. Police investigators, who looked into this case, concluded that it was just an accident: somehow the experienced chemist was poisoned by a toxic chemical compound. Such things happen. At that moment Sergey Dozmorov was 36 years old and was one of the leading Russian specialists in rare earth elements.

Now, due to Dozmorov's discovery, we can say with a good degree of certitude that the bodies that flew over Tunguska in June 1908 could be artificial. And very likely, extraterrestrial. They flew, maneuvering, towards one point from different directions; one of them exploded due to its internal energy, the explosion being accompanied by hard radiation, and its substance contained a superconducting ceramic.

What does this picture resemble? First of all, of course, it resembles an aerospace combat, or a "more pacifist" failed rescue operation. Which of these versions looks persuasive is a matter of taste… When I was younger I preferred the former interpretation; now I am more inclined to the latter. But certainly, other hypothetical interpretations could also be suggested.

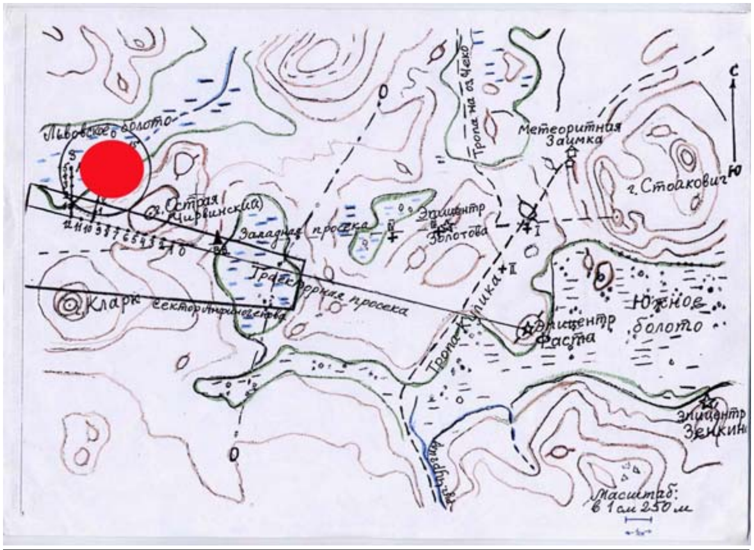
Can we say that the alien spaceship hypothesis has been proved beyond doubt? Of course not – even though it does look more convincing than other Tunguska hypotheses. All experienced Tunguska specialists agree that this riddle will be solved only when a real piece of the Tunguska space body has been found. This search has at present a good chance for success.

As you can see, the pattern of ytterbium's distribution at Tunguska has its maximum concentration at about four kilometers from the epicenter, near the Chirvinsky mountain.



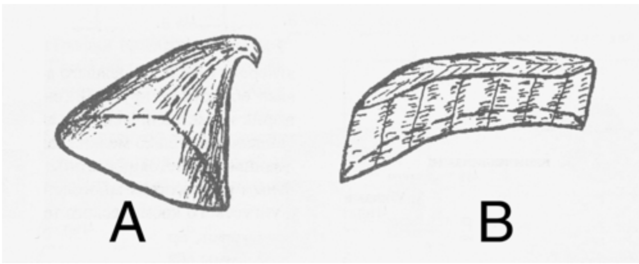
Pattern of ytterbium's distribution at Tunguska following the projection of the TSB trajectory on the ground
(Zhuravlev & Zigel, 1998)

It is here that Leonid Agafonov and Victor Zhuravlev working at the Siberian Branch of the Russian Academy of Sciences found in 2004 in the peat layer dated 1908 several artificial metallic particles.



We can hope to find in this area, near Chirvinsky mountain, a larger remnant
of the Tunguska space body...

It was for the first time in the history of Tunguska investigations that someone had discovered microscopic artifacts in the peat layer dated 1908. And these are definitely not small pieces of Evenk teapots.



Peculiar microscopic artifacts discovered by Dr. Leonid Agafonov at the Institute of Geology of the Russian Academy of Sciences in the Tunguska peat layer dated 1908. The small trihedral pyramid A consists of pure titanium; the “shaving” B of aluminum.

The particles were curiously shaped and had an unusual chemical composition. There was a small pyramid with an edge of one fourth of a millimeter consisting of pure titanium with some quantity of rhodium. A second particle looked like a bent microscopic plate (a “shaving”) of about 250 microns in length. It consisted of aluminum with slight manganese and copper impurities. There were also found in these samples two small flattened balls of pure gold. As the researchers noted, “We should not jump to conclusions from these findings. Yet we can hope to find in this area, near Chirvinsky mountain, a larger remnant of the Tunguska space body. There seems to be at this area a 'geochemical halo' surrounding the place of its fall" (Zhuravlev & Agafonov, 2008). It is very likely that a relatively large remnant of the Tunguska space body may still be lying in a small morass not far from the epicenter of the explosion waiting for the spades of daring investigators.

The search for extraterrestrial intelligence is a legitimate field of scientific investigations. And obviously, if the Tunguska phenomenon has something to do with this, the science community must pay still more attention to it. But paradoxically, if it is not so the Tunguska problem may turn out even more important – and not only for science but for all inhabitants of this planet. Astronomers used to think that there are only two types of dangerous cosmic objects (DCO): comets and asteroids. But if the TSB was a natural space body, then it means that there exists in space another type of DCOs, whose nature remains unknown.

By the way, a group of Russian Tunguska researchers (Heinrich Nikolsky, Edward Schultz, Vladimir Schnitke, Maxim Tsynbal, and Yury Medvedev) have recently put forward a new hypothesis, according to which the Tunguska space body was after all a comet. Having touched the Earth's upper atmosphere, it was captured by the gravitational field of our planet and settled into an elliptical circumterrestrial orbit, its perigee being over Antarctica. This comet made four revolutions around the Earth, during the last of them moving along the meridian of 101°E and gradually losing altitude. Somewhere over the Angara river the space body divided into several parts, whose explosions devastated the taiga.

Whether or not this model fits well *all* circumstances of the Tunguska event – particularly, the radioactive fallout, the local geomagnetic storm and maneuvers of the space bodies – remains an open question, but the model itself is certainly interesting and worthy of further development.

In a short paper it is impossible to describe all the fascinating facts established and promising ideas proposed during a century-long search for the solution of the Tunguska riddle. But I would like to stress: we do now have an opportunity to solve it. For that we need to harness the facts discovered and build a multidisciplinary picture of the Tunguska catastrophe. Or maybe we simply should take spades and go to the Chirvinsky mountain…

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Since the number of references in this paper is – of necessity – somewhat too great, the author is forced to restrict the list to 20 references only. For the full list of references please see my book *The Tunguska Mystery* (Springer NY, 2009, ISBN 9780387765730).