2. The Big Bang of More than Regional Significance

Let us look back about a 100 years and imagine that we live at the beginning of the twentieth century. This is the starting point of a scientific and technological revolution that will not only transform the world and the material life of European civilization but also transform science itself. But that revolution is only just beginning. Science is not as rich as it will become, but it is freer. Narrow specialization is not that popular in the scientific community, which still has scholars with encyclopedic knowledge who venture to think about things outside their specialty. And there are plenty of naturalists who are interested in the real world more than in the theoretical schemes that represent it. But the mechanisms of human cognition are already undergoing deep changes: science and technology are forming a conglomerate that will soon alter civilization on this planet.

The Wright Brothers' *Flyer I* has just felt air under its wings while a modest schoolteacher in Russia is already developing the theory of jet propulsion that will take humanity into space. That schoolteacher's name is Konstantin Tsiolkovsky, and his paper "Investigation of outer space with jet devices" is published in 1903 by the Russian journal *Nauchnoye Obozreniye* (*Scientific Review*). Max Planck in 1900 lays the foundation of quantum mechanics on which, 13 years later, Niels Bohr will build the first floor of this great edifice, postulating the conditions needed for the existence of stable orbits for electrons in atomic theory. A decade later, a handful of unbelievably gifted people, including Werner Heisenberg, Louis de Broglie, Erwin Schroedinger, and Max Born, will erect on this foundation the edifice itself: a construction of singular beauty and depth. Albert Einstein in 1905 had created the Special Theory of Relativity, and after 10 years of thought experiments and calculations the General Theory of Relativity.

There was also research to confirm new sensational physical theories, in particular Eddington's observations of a solar eclipse

V. Rubtsov, *The Tunguska Mystery*, Astronomers' Universe,
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that confirmed Einstein's theory of gravitation. Such advances turned human eyes to the heavens, and the prestige of astronomy, though still a science distant from terrestrial needs, rose swiftly, as did the study of meteorites, an interdisciplinary field combining astronomy, geophysics, and geology. Large collections of meteorites – straight from space – had already been gathered. The once heretical conclusion of German naturalist Peter Pallas and physicist Ernst Chladni that meteorites are genuine rocks from space had by then been fully accepted by the scientific community. So 40 years before the Tunguska explosion, the British scientist Nevil Story-Maskelyne had developed in the 1860s the first classification system for meteorites, putting them into three major classes: aerolites (stones), siderites (irons), and mesosiderites (stony irons).

Nowadays we find nothing odd in the fact that stones can fall from the sky – sometimes very large stones. To be convinced of this, just look at the famous Arizona meteor crater. But at the beginning of the twentieth century, some geologists believed that an explosion of volcanic steam had produced this crater. It was not until 1906 that the mining engineer Daniel Moreau Barringer and the mathematician and physicist Benjamin Chew Tilghman published their hypothesis that this immense hole had been formed when a huge meteorite struck Earth that scientists began to take this subject seriously. But even in 1906 not everyone was ready to believe such a mad idea, and it took some years to prove the hypothesis. Nevertheless, the idea spread that the heavens are not always serene and may even be a source of danger. In 1910, lots of people thought that the gigantic tail of Halley's comet, which was known to contain carbon monoxide and cyanogens, might poison the atmosphere and destroy all life on Earth. Consequently, in this context, news of an enormous flying bolide that exploded over distant Siberia should have attracted serious interest both in the science community and among the general public. But due to an unfortunate concurrence of circumstances nothing of this sort happened – at least not in 1908. Several factors affected the situation, the remoteness of the site of the explosion being one factor but not the main one.

So what should have attracted the attention of the science community to this event? There were four initial sources of information that might have stimulated scholars to start investigations:

(1) The descriptions of optical anomalies in the atmosphere over a great part of Eurasia, which occurred from June 27 to July 2 and especially on the night of June 30–July 1.
(2) Data about the flight of an enormous bolide over central Siberia that was recorded in many newspaper articles containing eyewitness testimonies.
(3) The answers from members of the official net of earthquake observers to special questionnaires sent out by Arkady Voznesensky, Director of the Magnetographic and Meteorological Observatory in Irkutsk.
(4) The data on the explosion of the "meteorite" recorded by instruments at the Magnetographic and Meteorological Observatory (and at other observatories) and correctly interpreted by Voznesensky.

Yet all this did not provoke a shift toward recognizing the existence of a big problem that should be solved. Why did it happen so?

Let us first consider the anomalous atmospheric phenomena that both preceded and followed the Tunguska explosion. This is crucial because these phenomena proved to be the *global* trace of this event. Already in the summer of 1908 a possible connection between the atmospheric phenomena and the impact of a large bolide somewhere was suspected. The Russian astronomer Daniil Svyatsky suggested as much although he was then still unaware of the Tunguska event.[1] Some scientists of the time also knew that these optical anomalies lasted from June 27 to July 2 – and even later.[2] These atmospheric anomalies obviously presented a problem because the arrival of a stone or iron meteorite could not account for them. The terrestrial atmosphere could not "prepare itself" for a visiting meteorite, however large, during several days *before* its actual fall. Having seen similar but weaker phenomena in 1910 – after Earth traversed the tail of Halley's comet – the German astronomer Max Wolf, then Director of the Heidelberg Observatory, suggested that the atmospheric illuminations of 1908 had been due to the tail of a comet penetrating Earth's atmosphere.

Actually the cometary hypothesis, which would have better explained the nature of the Tunguska event, was not developed until the 1930s, though it could presumably account for the observed and reported "preparatory stage" – the atmospheric anomalies that preceded the event. Yet for the next decades, the enigma of these "Tunguska precursors" was almost forgotten. It was only in the early 1960s that Nikolay Vasilyev and other scientists brought the subject back to life when they carried out a detailed analysis of the anomalous atmospheric phenomena of the summer of 1908. In 1963, with the aid of the Rector of Tomsk Medical Institute, the Independent Tunguska Exploration Group (ITEG) sent out a questionnaire to most observatories that had existed in 1908 (to more than 150), asking colleagues both at home and abroad to report back on any natural phenomena that were recorded at their observatories in the summer of 1908. This was an ambitious project. Let's not forget that it was almost the climax of the Cold War and even postal contacts by Soviet citizens with foreigners were considered as suspicious by Party and State authorities. However, more than a 100 of the research bodies responded to the inquiries, and the agreement in the data received confirms its reliability. The ITEG researchers also read many Russian and foreign periodicals from the late 1900s for more first-hand information. They examined more than 700 Russian newspapers and journals, as well as the logbooks of ships that were at sea in the summer of 1908. The information collected was analyzed and the results published as the scholarly monograph *Noctilucent clouds and optical anomalies associated with the Tunguska meteorite fall*.[3] Even today, more than 40 years after its publication, that book is considered the most complete work on the subject.

So what conclusion did the scientists arrive at? As mentioned in Chapter 1, the strange atmospheric phenomena started as early as June 27, 1908. However, before June 30 they were observed only in certain places of western Europe, the European part of Russia, and western Siberia. The anomalies included unprecedented bright and prolonged twilights, an increase in the brightness of the night sky, and the formation of silvery clouds. In the early morning of July 1, these phenomena reached their peak, literally exploding in intensity and diversity. And throughout a territory of about 12 million km^2, there was no night separating June 30 and July 1 (see maps on Figures 2.1 and 2.2). How did these anomalies originate and why did they develop in this way? This remains a mystery, defying a final explanation, but later we will consider possible and probable solutions.

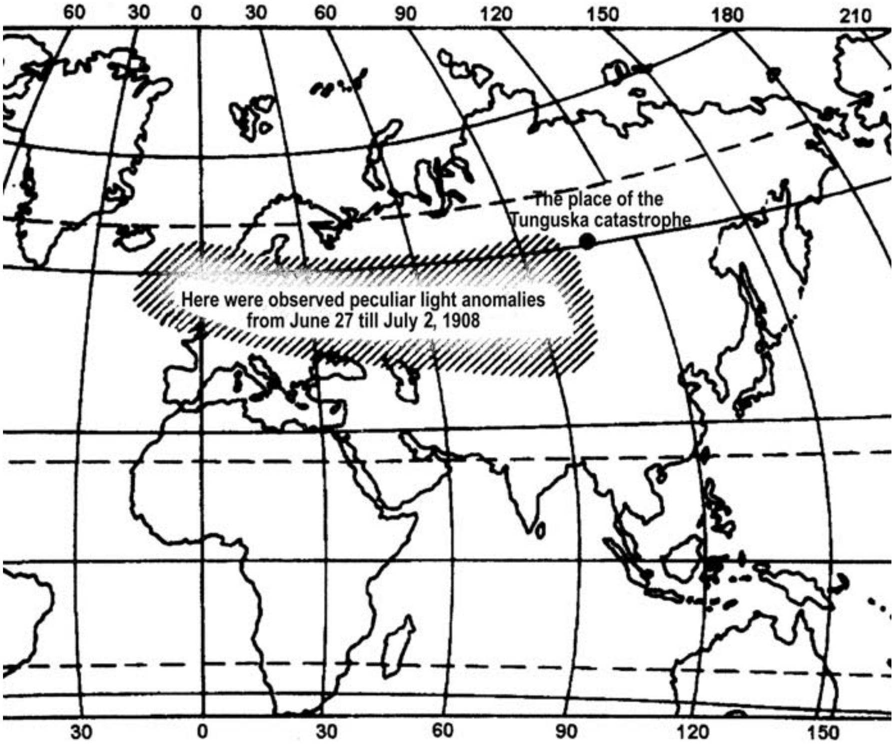

FIGURE 2.1. The region over which, from June 27 to July 2, 1908, peculiar light anomalies were observed in the atmosphere both before and after the Tunguska explosion (*Credit*: Vitaly Romeyko, Moscow, Russia).

In 1965, Nikolay Vasilyev and his colleagues at the ITEG analyzed information on the atmospheric phenomena that had been reported from 155 places of western, central, and eastern Europe, central Asia, and western Siberia. They found that until June 27, the twilight anomalies, even if reported, were few and far between. On June 29 they were seen in nine places, but on June 30 in more than 100 places. They then rapidly decreased (see diagram on Figure 2.3). Nothing like this had ever been seen before or since.

The journals and newspapers of those days reacted immediately to such amazing atmospheric phenomena. The St. Petersburg newspaper *Novoye Vremya* (*New Times*) of July 13 published an article by Sergey Glazenap, then professor of astronomy at St. Petersburg University, in which he described "light nights" that spread across regions of Russia. He said: "I have reports from several

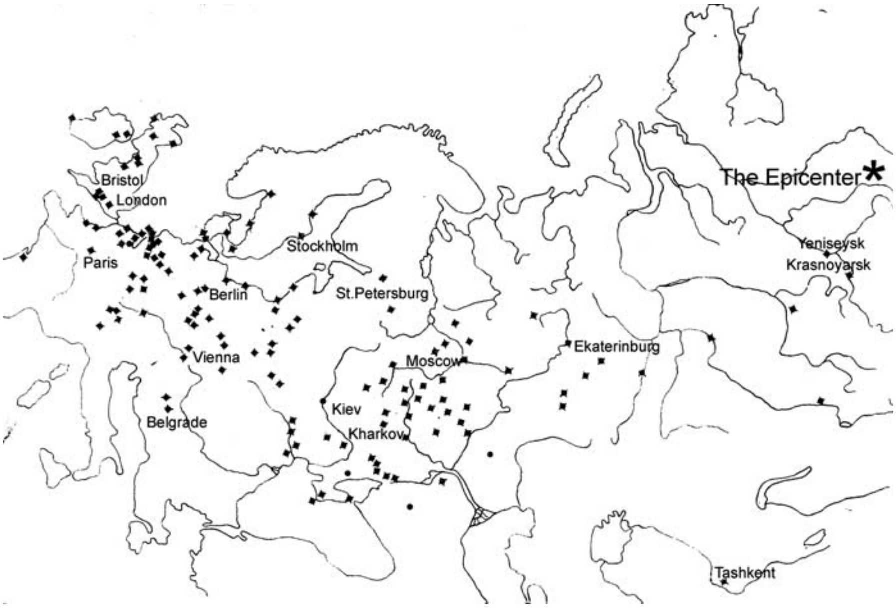

FIGURE 2.2. Points from where especially intensive optical anomalies on the night of June 30–July 1, 1908, were reported (*Source*: Vasilyev, N. V., and Fast, N. P. Boundaries of the areas of optical anomalies of the summer of 1908. *Problems of Meteoritics*. Tomsk: University Publishing House, 1976, p. 126.).

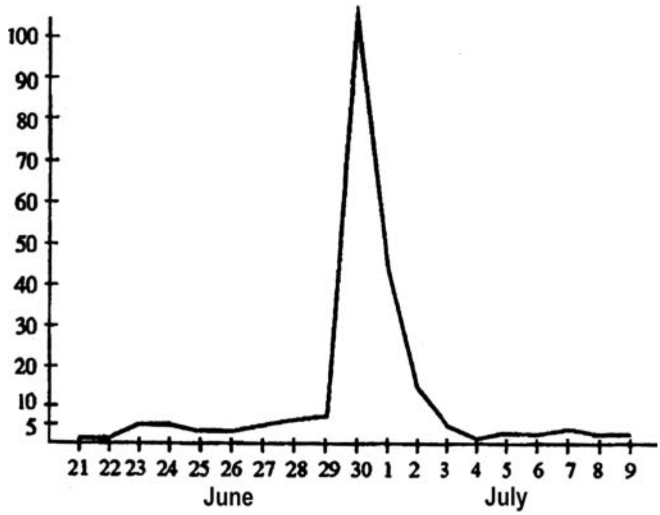

FIGURE 2.3. Diagram of the intensity of atmospheric optical anomalies in June and July of 1908 (*Source*: Vasilyev, N. V. *The Tunguska Meteorite: A Space Phenomenon of the Summer of 1908.* Moscow: Russkaya Panorama, 2004, p. 42.).

amateur astronomers about a phenomenon they believe to be northern lights. There was information in some newspapers about the Aurora Borealis occurring on June 30, and recently Mr. M. Taldykin from Lomzha sent me a detailed description of this night light, adding his opinion: 'northern lights, no doubt.' Yesterday, on July 10 here in Domkino, in the Luga district, after a rainy day the sky cleared up and the night was cloudless. I was then able to see the phenomenon myself, and I should state that it is quite different from a usual Aurora Borealis. It is rather a lucid twilight, similar to those observed in 1885 after the violent eruption of the Krakatoa volcano." [This is a misprint. The eruption actually happened in 1883.] Glazenap continues: "In Luga after sunset the northwestern part of the sky was intensely red. Far more than normal. By 10.30 pm the redness had disappeared, leaving behind a golden tinge so intense that when one looked at it the eyes could not bear its brilliance. This phenomenon lasted until midnight, when it began to weaken. It definitely resembled the red twilights we had in 1885, which were caused by the Krakatoa eruption, but the colors were much redder." So the conclusion here is that this was nothing like the Aurora Borealis.[4]

The Soviet astronomer Vasily Fesenkov was, in 1908, a student preparing in the evening of June 30 at Tashkent Observatory for his regular astronomical observations, but he waited in vain for night to fall. Nothing of this sort arrived.[5] In Heidelberg, the atmospheric phenomena over Germany were observed and described by Max Wolf, who reported that the sky after sundown became covered with unusual high-altitude cloudlets. They resembled cirri but were much higher than usual cirrus clouds. They looked rather like layers of smoke in the sky at sunset. The intensity of the nighttime luminosity was considerable. At midnight one could easily make out the hands and figures of a pocket watch. At 1.15 it was as light as daytime.[6]

The anomalies were reported from an area bounded by the Atlantic coast in the west, by the Yenisey River in the east, and by the Krasnoyarsk–Tashkent–Stavropol–Sevastopol–Bordeaux line in the south. Their northern boundary remained unknown. Amazingly, no atmospheric anomalies occurred in the area of Tunguska, which had its usual summer nights. There were observers in the area, but they did not see any. What this means remains unclear, even though some attempts to propose an explanation have been made by scientists in Russia and abroad. Anyway, the nearest point to the Tunguska event where the anomalies did appear was 600 km away.

In the town of Yeniseysk, Mrs. O. E. Olfinskaya, who lived there in 1908, later described her impressions: “Usually in this season (June 30) midnight in Yeniseysk is the darkest time of the day. But it was so light in the street that I was completely astonished. Other inhabitants of the town were also astonished. After an hour in the street I saw no sign of darkness.”[7]

The intensity of the anomalies seemed to increase from East to West. In the very heart of Russia, in Kursk province, a local inhabitant, Mrs. Tomilina, had a similar experience to that of Mrs. Olfinskaya. “About 10 pm, after the evening twilight, it somehow became lighter instead of darker. The north-western part of the sky, and then the northern part of the horizon, brightened up as if just before sunrise, and soon everything was illuminated by a golden light. After a few minutes it got so light that one could read and discriminate things in their smallest detail. Even objects three to five kilometers away could be seen as distinctly as at dawn on a clear morning. Meanwhile an afterglow was flaring up in the north and north-east. A pale-azure sky on the horizon became golden and the clouds were tinged with pink. Then the sky was flooded with a crimson color. The unusual dawn woke birds. Poultry got upset and noisy. In the field quails were singing and flocks of awakened pewits took to the wing. About 11 pm the luminous phenomenon began to fade and had almost vanished by midnight, although the ‘white night’ lasted till morning.”[8]

During these perplexing nights, in dozens of settlements across Europe and Russia, many photographs were taken of luminous clouds and buildings lit by this strange illumination. In 1991, the Russian astronomer Vitaly Bronshten estimated its brightness by examining these photographs. According to the photometric methods he used, the illumination was about a hundred times the normal brightness of the night sky.[9] In 1991, Vitaly Romeyko (a Moscow astronomer who took part in two dozen expeditions to Tunguska) used another method to estimate the brightness. He selected witness reports of the atmospheric anomalies and used 19 parameters that could be digitized, such as visibility of buildings, separate stars, the Milky Way, and printed notices shown in the photographs that could be read. The result is impressive: the level of the anomalous luminosity on the night of July 1 exceeded the nighttime norm by up to 800 times.[10] And, strange as it may seem, the highest levels were recorded far from Siberia.

The first analysis of the atmospheric anomalies of the summer of 1908 was actually carried out in 1908 by Alexander Schoenrock, Director of the Central Physical Observatory in St. Petersburg.[11] According to the data he analyzed, the night glow covered a quarter of the horizon. More often than not, it was an orange or reddish color, resembling the glow of a large fire, but sometimes it was evenly white or greenish. Schoenrock considered three explanations: first, the Aurora Borealis; second, a layer of thin high-altitude clouds illuminated by the Sun; and third, a penetration of dust into the upper strata of the atmosphere. None of these proved to be convincing enough. The first explanation seemed the least probable. The second looked somewhat more acceptable, but, as Schoenrock noted, the enormous territory on which the phenomenon was observed did not favor high-altitude clouds. Therefore, there remained the third possibility: increased dust in the atmosphere. But the fact that the imposing spectacle of light nights had completely stopped after 2 days did not support this explanation, either. At the time, of course, Schoenrock was not aware of the Tunguska event. So for him the atmospheric anomalies were just a strange phenomenon – especially as they ceased very quickly. In 1883, after the eruption of Krakatoa, unusually bright twilights had lasted several months, so how could dust from the Tunguska event disappear from the atmosphere so quickly? Obviously it could not have done so. And for current research on the subject, this seems to rule out the possibility that what happened at Tunguska was the fall of a usual meteorite, the impact of which, judging from the damage caused, would have put an enormous amount of dust into the atmosphere.

True, some decrease in the air's transparency in the summer of 1908 (through more dust being in the atmosphere) did in fact take place, but evidence of this was found only much later. In 1949, astronomer Vasily Fesenkov processed data for this period that the Mount Wilson Observatory in the United States had recorded. He concluded that a decrease in the transparency of the atmosphere not only took place, but was considerable, its magnitude and duration being unprecedented for the whole period between 1905 and 1911. It looked as if an enormous dusty cloud was moving over California in late July and early August of 1908.[12]

So the question is, did this cloud consist of the dispersed material from the Tunguska space body? Fesenkov believed it was probable, but the truth proved to be more complicated. In the 1980s, the Leningrad researcher Academician Kirill Kondratyev, an eminent Russian geophysicist and planetologist, along with Dr. Henrik Nikolsky and Edward Schultz, found that contemporary data showed that a decrease in the air's transparency because of dust had occurred in 1908, not only after but also before the Tunguska explosion. In that period scientists at the Astrophysical Laboratory of the Smithsonian Institute at Mount Wilson Observatory regularly measured levels of transparency of the atmosphere at various optical wavelengths. And for the first time – on June 4, 1908 – they detected an extensive dusty cloud that passed over Mount Wilson. Any decrease in transparency due to a higher level of dust almost a month before the explosion could hardly have had anything to do with the Tunguska space body. The dusty cloud detected in California continued to circulate around the globe with a period of 60 days while it gradually dispersed. But it appeared over Mount Wilson again on August 4 and on October 4.

Scientists calculated from the rate of the cloud's dissipation and the velocity of its motion through the atmosphere that it was formed from the impact of a large meteorite (mass no less than 100,000 tons) that had entered the atmosphere in the middle of May 1908 over the Pacific Ocean, not far from the Kuril Islands. It seems that due to the gentle slope of its trajectory, it did not hit the ocean but disintegrated in the atmosphere and completely burnt up, leaving behind a cloud of meteoritic dust. This meant there was no tidal effect that could have been observed. It was a normal meteor, one of many pieces of stone or iron that collide from time to time with Earth. It had nothing to do with the Tunguska space body.

But according to data on the optical density of the atmosphere measured by the Mount Wilson Observatory from July 14, 1908, there appeared over California yet another air mass that contained some strange substance. It was not dust.[13] The spectral signature of this substance, obtained in 1908 by Mount Wilson astronomers and processed in 1987 by Academician Kondratyev, does not correspond to dust but to an aerosol of ultramicroscopic particles suspended in the air. What is interesting here is that the date of its appearance in the United States is consistent with the time needed for such a cloud to travel from Central Siberia to California, so this substance could have been an actual product of the Tunguska explosion. And it could have been due to its aerosol composition that the optical atmospheric anomalies decreased so quickly after their culmination on July 1 (as distinct from similar cases of atmospheric dust from volcanic ash).

Alexander Schoenrock, at the Central Physical Observatory, who pondered in vain over possible explanations for the strange night glow, was both right and wrong at the same time: the dust did not disappear from the atmosphere because there was no Tunguska-related dust in the atmosphere. There was instead some other stuff whose nature still remains unclear, something that the reports from witnesses seem to confirm as the presence of a strange fluorescent substance in the atmosphere.

Alexander Polkanov, then a student but later a distinguished Soviet geologist, wrote in his diary in the summer of 1908: "A very unusual and rare phenomenon was observed in the night from June 30 to July 1 here, near the city of Kostroma. The sky is covered by a thick layer of clouds, and it is raining cats and dogs, but at the same time it is unusually light. It is already 11.30 pm but it is light, and it is still light at 1 am and is bright enough to read in the open. It can't be the Moon. The clouds are illuminated with a yellow-green light which sometime merges into pink. It is the first time I have seen such a phenomenon. As I watched I saw a layer of golden-pink clouds at a great altitude. . ."[14]

And that was not all. The nocturnal atmospheric anomalies of 1908 certainly looked spectacular; but apart from them there were the less-impressive daytime anomalies such as intense and prolonged solar halos, mother-of-pearl clouds, and a Bishop's ring. The so-called Bishop's ring, which is a diffuse brown or bluish halo around the Sun, occurs when there are large amounts of dust in the atmosphere. The first recorded observation of a Bishop's ring was made by the Reverend S. Bishop of Honolulu after the Krakatoa eruption. In Germany, W. Krebbs reported the presence of a Bishop's ring: "Starting from late June the light crown named after the

Reverend Bishop became a frequent associate of the Sun's disk during the first and last 15 min of its presence in the sky."[15] In another report, the same author provides a photograph of a Bishop's ring taken in Hamburg soon after June 30.[16]

Some meteorologists initially believed that all the atmospheric anomalies of June 27–July 2, 1908 were produced by a powerful volcanic eruption in a remote corner of our planet. However, investigations carried out both immediately after these phenomena and in the following decades by Russian and foreign specialists did demonstrate the fallacy of this explanation. Today the evidence indicates that these anomalies were directly related to the Tunguska event, which was not just a "local meteorite fall" and even something "more than regional."

The idea of a possible connection between the atmospheric anomalies of the summer of 1908 and the Siberian "meteorite" was suggested in 1922 to Leonid Kulik by Daniil Svyatsky, who was in the early 1920s the chief editor of the *Mirovedeniye* (*Cosmography*) journal.[17] But in 1908, neither Russian nor European scholars could find any such connection. It was even supposed that academics in the European part of Russia remained completely unaware of the event. However, in 2000, astronomer Vitaly Bronshten found that on September 25, 1908, the Russian newspaper *Sankt-Peterburgskiye Vedomosti* (*St.-Petersburg Records*) had told its readers about the fall of a huge meteorite in the Siberian taiga. And it was after reading this article that Permanent Secretary of the Imperial St. Petersburg Academy of Sciences, Sergey Oldenburg, became interested in the subject and had sent an official inquiry to the Governor of Yenisey Province, A. N. Girs – the nearest government official to the event. By that time, Girs had already received the report from the Yeniseysk District police officer I. K. Solonina about the bolide seen in the sky over Kezhma some 215 km from the place of the Tunguska explosion.

Solonina reported: "On the 30th day of June at 7 am in clear weather a bolide of enormous size flew at a great altitude over the village of Kezhma. It produced a number of loud sounds like gunshot reports and then disappeared. . ." But Mr. Girs for some reason feigned that he had no information on the Tunguska event. On October 10 he replied to Academician Oldenburg that he had ordered the Kansk District police officer S. G. Badurov to check the rumor about the bolide, that the official did investigate but could not confirm the rumor. Why the Governor behaved in this way remains unknown. Most probably he simply wished to avoid any complications. On October 21, 1908, the Physical and Mathematical Branch of the Academy of Sciences, after hearing an account of the alleged Siberian bolide, resolved to "make a note of the information," which meant that the question had been closed.

Well, Siberia is far from St. Petersburg (where the *St.-Petersburg Records* was published) and academicians did not then consider newspapers a reliable source of information, but the Siberian scientists of that period did not show their true worth, either. Soon after reports of the bolide's flight and the devastating explosion had appeared in local newspapers, geologist Professor Vladimir Obruchev, who then lived and worked in Tomsk, tried to check the newspaper reports but failed to find out whether the event they described had actually taken place. This may have been because he was 1,100 km from Vanavara, the settlement nearest to the Tunguska explosion.

However, it's difficult to be equally indulgent toward Arkady Voznesensky, the Director of the Irkutsk Magnetographic and Meteorological Observatory (see Figure 2.4). The manner in which he treated the information about the flight and explosion of the Tunguska space body collected by him in 1908 seems inexplicable. The observatory at Irkutsk had been established in 1884, and meteorological observations and magnetic measurements started there in 1886. Very soon the observatory became a leading geophysical center in Siberia. And in 1895 the noted geophysicist and climatologist Arkady Voznesensky became its director. Nobody would have called Voznesensky a conservative scientist. In 1907, he made two flights over Irkutsk in a balloon (a daring deed at the time), taking the first bird's eye photographs of the city and marking the beginning of regular aerial observations in that region. Equipment at the observatory was therefore always up to date. Voznesensky also created a special corresponding network of observers, aimed at collecting information about earthquakes, which were frequent in the region. This network included keepers of meteorological stations, postal employees, schoolteachers, and other representatives of the local intelligentsia. They could report earth tremors either on their own initiative or by filling out the forms that were sent from the observatory.

FIGURE 2.4. Dr. Arkady Voznesensky (1864–1936), Director of the Magnetographic and Meteorological Observatory at Irkutsk from 1895 to 1917, the first scientist who understood that a gigantic space body had entered the Earth's atmosphere and exploded over central Siberia (*Source*: Bronshten, V. A. *The Tunguska Meteorite: History of Investigations*. Moscow: A. D. Selyanov, 2000, p. 18.).

On the eventful day (June 30, 1908), two seismographs at the observatory recorded a weak tremor that was entered in "The List of Earthquakes Occurring in 1908." The tremor lasted from 0 h 19 min GMT to 1 h 46 min (see Figure 2.5). Two days before the Tunguska event, another tremor had been recorded that was more powerful and had a more normal signature of an earthquake. Arkady Voznesensky immediately sent out a questionnaire to his seismic network, asking his correspondents to provide details of these two earthquakes.

The director of the observatory, being totally unaware of the explosion at Tunguska, could have put nothing in the questionnaire to his seismic network that related to that event. He only asked questions about the characteristics of the two quakes. The first tremor (on June 28) was recorded by almost all of Voznesensky's correspondents. The second tremor – which was due to the

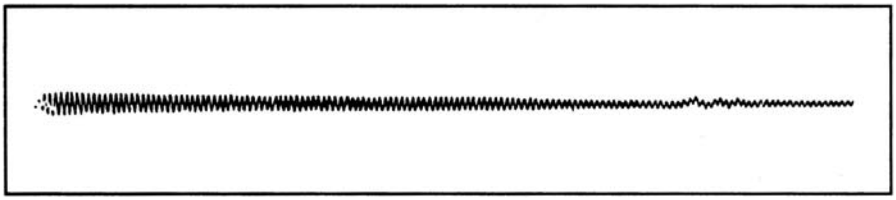

FIGURE 2.5. A seismogram of the Tunguska earthquake of June 30, 1908. These oscillations were produced by the explosion of the Tunguska space body and recorded by seismographs from the Irkutsk Magnetographic and Meteorological Observatory. Subsequently the Russian specialist in powerful explosions, Professor Ivan Pasechnik, used them to determine the exact moment of the Tunguska explosion (*Source*: Vasilyev, N. V. *The Tunguska Meteorite: A Space Phenomenon of the Summer of 1908.* Moscow: Russkaya Panorama, 2004, p. 86.).

Tunguska event – only by a few, although most respondents did hear sounds like thunder or the firing of large caliber pieces of ordnance on the morning of June 30. Sounds from the exploding Tunguska space body were heard in an area with a radius that exceeded 800 km from the epicenter, and some observers described a luminous body that could have been an enormous fiery meteor. The loudest sounds were reported by observers between the Lena and Yenisey rivers and Lake Baikal, although sounds were heard over an area of about 1 million km^2. The flying body was seen by 17% of those who replied to the questionnaire, all of them in the eastern part of the area. And 30% of the respondents reported the earth tremors.

Among the replies Arkady Voznesensky received, G. K. Kulesh at the Kirensk Meteorological Station wrote on July 6, 1908: "On June 30 to the northwest from Kirensk [a town some 500 km south-east from the site of the Tunguska explosion] local people observed an event that lasted from about 7.15 am till 8 am.[18] I myself could not see it, since having taken readings from my meteorological instruments I returned to the house and set to work. Although I did hear some thuds, I mistook them for gunshots from the nearby shooting-range. After work I looked at the barograph's band and noticed to my great surprise an additional line on the graph near the 7 am time marker, which indicated an abrupt and short jump in atmospheric pressure…"

Kulesh also reported on what local inhabitants had experienced. "At 7.15 am there appeared in the northwest a fiery pole like a spear about eight meters in diameter. The pole then vanished and one could hear five powerful abrupt and thunderous sounds. They followed each other quickly and distinctly. There then appeared at the same place a dense cloud. Within about 15 min one could hear similar thunderous sounds and still more 15 min later. A ferryman (a veteran soldier and clever man) counted 14 in all. Owing to his duties he was on the river shore, where he observed and heard the whole event from beginning till the end. Many people saw the fiery pole and even more heard the 'cracks of thunder.' Peasants from nearby villages came to the town and asked: What was that? Doesn't it betoken a war? They were told that an enormous meteorite had fallen. I should add that the 'cracks of thunder' came in three groups. As for the earth tremor, it was both felt and recorded by my barograph."

Mr. Kokoulin, an agronomist from the village of Nizhne-Ilimskoye, told Arkady Voznesensky in his letter of August 10: "On June 30, at about 7.15 am, workers who were building a bell-tower saw a fiery log flying from southeast to northwest. There were two sounds like gunshots followed by a very loud thunder and an earth tremor. The local people felt the earth trembling. One girl, a housemaid of a priest, fell down from a bench. People were afraid. Witnesses reported that clouds of black smoke rose like a pillar where the space body fell – or rather where it went below the horizon. The Tungus people who wandered behind the settlement of Nizhne-Karelinskoye (to the west-northwest from Kirensk) say that there were terrible crashes of thunder. . ."

A. A. Goloshchekin, living in the village of Kamenskoye (about 600 km west-southwest from the explosion site), reported in his letter of June 30: "At 7 am in this village there were three succeeding underground thunderclaps from a northwestern direction. At the same time people felt an earth tremor. From questioning local inhabitants I learnt that several minutes earlier they saw a flying oblong body that narrowed towards one end. It seemed as if the body had broken away from the sun, for its head was as bright as the Sun while the remaining part was a misty color. The body, having covered some distance, fell in the northeast."

It's unfortunate that the questionnaire sent out by Voznesensky at the Irkutsk Observatory was aimed at collecting information only about seismic phenomena, and did not ask questions about the direction and angular heights of the bolide's flight, or the flight itself. Some respondents did report the bolide's flight, but others who saw it may have refrained from mentioning it, either because they were not asked about this directly or from fear of ridicule. But anyway, the data Voznesensky collected, being obtained very soon after the event, are definitely the most important initial source of information about the Tunguska space body. He processed the data and determined, using readings from the seismometers, that the probable coordinates of the body's fall were 60°16′N, 103°06′E, and the probable time of the fall as 0 h 17 min 11 s GMT.

So, Voznesensky in 1908 had achieved an enviable precision in his calculations that were based mainly on the reports of witnesses. He also calculated that the trajectory of the Tunguska space body was from south-southwest to north-northeast. What seems astounding is that Voznesensky at once understood that the Tunguska space body did in fact explode in the air, even if he called this process the "rupture of the meteorite" and overestimated the altitude of the explosion by a factor of three. (In the 1970s, the altitude of the Tunguska explosion was determined fairly accurately by several methods at somewhere between 6 and 8 km.) Voznesensky thought the meteorite had broken into pieces at the height of 20 km and that fragments then fell to the Earth's surface to produce the tremors that were reported. This informed guess was going to be rather important. But the main discovery that he made was the association between two seemingly unrelated facts: the earthquake tremors and the arrival of the space body.

An account of what was thought to be a weak earthquake in central Siberia on June 30, 1908, was presented to the Seismic Committee of the Imperial Academy of Sciences. However, Arkady Voznesensky did not dare include any information about the flight of a huge bolide, or his calculated coordinates of the epicenter of its explosion. Igor Astapovich, a Ukrainian astronomer, once said that Voznesensky feared his report would have looked "fantastic."[19] Only in 1925 did he decide to publish the data.[20] But by then it was too late for him to become *the* pioneer of Tunguska studies. This title already belonged to Leonid Kulik.

It was Kulik who ventured to believe in the testimonies of witnesses and newspaper articles, while at the same time being unaware of the instrumental detection of the Tunguska event at the Irkutsk Observatory. However, the "meteorite hypothesis" for the space body was not authored by Kulik. And whether this hypothesis is correct still remains doubtful. An iron meteorite had definitely been rejected as a possibility, but some specialists believed that a *stony* meteorite could explode in the air and produce all the Tunguska effects. Yet others strongly disagreed, proving mathematically that it was impossible and pointing out that if a stony meteorite had exploded the whole place would have been strewn with its remains. And after many expeditions to the site, nothing like this sort of evidence had been discovered in the Tunguska taiga. In any case, the very word "meteorite" was first used by Siberian newspaper reporters who were in no way noted for their scientific accuracy, though they didn't fear to tell the public what they saw and heard, or to use such a term as "a huge meteorite" – which the distinguished scientist Arkady Voznesensky decided against doing.

Perhaps in the data Voznesensky collected there was "something more," something that did not fit the accepted view of meteorites, and that "something" he decided to keep to himself. We're guessing of course, but the unnatural behavior of this Russian geophysicist provides good reason to mention such a possibility. To instrumentally record an earthquake produced by a meteorite fall (for the first time in history!) and to gather data from professional observers to determine the probable coordinates of the meteorite's fall are remarkable. Using the data he possessed, Voznesensky could have written an important scientific paper that would have been accepted for publication by any scholarly periodical of the time. After all, by 1908 the study of meteorites had become a completely legitimate discipline within science. Meteorites were an accepted part of the Solar System – and they often hit Earth. If Voznesensky's paper of 1925 had been published in 1908, there would have been no reason to blame him for an unscientific approach to the event. But he postponed writing that paper for 17 years.

A normal scientist – and Arkady Voznesensky was quite normal – could not have acted in such a manner without a real reason. So did Voznesensky – not being a specialist on meteorites – think it best to refrain from expressing his opinion? Hardly so. In his time, scientists were not as narrowly specialized as they later became. And meteoritics itself was still in its infancy. It was astronomers, geologists, chemists, and geophysicists who were participating in this new branch of science. In 1925 (2 years before Kulik reached the site of the Tunguska meteorite fall), nobody said Voznesensky's paper was unscientific. Colleagues actually expressed their regret that such a paper had been published so late.[21]

Of course, we may have underestimated the power of scientific conservatism. A meteorite of decent dimensions would have been a respectable subject for a scholarly paper, but a *gigantic* meteorite...? This had the smell of a sensational newspaper story. Besides, as we know, several minutes after the explosion, a local geomagnetic storm began that the instruments at Voznesensky's observatory recorded. The director could hardly have missed the strange coincidence of this magnetic storm. And its significance must have puzzled this noted geophysicist. So, it could have been this strange geomagnetic disturbance from the explosion that made him keep back the recorded data from the St. Petersburg academic authorities and from the scientific community as a whole. This, of course, is only one explanation for why Voznesensky might have kept things to himself. Even on its own, the very first post-meteoritic earthquake was quite a discovery. But if one adds that the first and the last post-meteoritic geomagnetic storm was also recorded, one can begin to see why this may have been too much for the science community of the time. And let's not forget the widespread nighttime illuminations, the nature of which remained far from clear and might have had something to do with the Tunguska event. Silence is sometimes more expressive than words, and the fact that Voznesensky's paper of 1925 completely ignores both the optical atmospheric anomalies and the geomagnetic storm of June 30, 1908, is intriguing. But he has taken this mystery with him to the grave.

Anyway, judging from his paper of 1925, Arkady Voznesensky had no doubts that the Tunguska space body had been a meteorite. The only thing for him was the choice between a stone and an iron meteorite. He wrote: "There is a good probability that a future investigator of the site where the meteorite has fallen will find there something similar to the Arizona meteor crater." His prediction was wrong, but at least his mistake was excusable – as distinct from his dead silence in 1908. For if we are trying to find the *main* reason for the oblivion into which the subject of the Tunguska meteorite had almost fallen, it was certainly because of the extreme scientific caution of the director of the Irkutsk Magnetographic and Meteorological Observatory. All other factors (such as the remoteness of the area of the meteorite fall or even the prevarication of Mr. Girs, the Governor of Yenisey Province) were far less significant. Was his silence due to the very strange and inexplicable geomagnetic effect that accompanied the explosion? Nobody at present can say, but if it was so, this provides another paradox in the Tunguska story. For, as we will see, the geomagnetic effect is perhaps the most specific and unusual aspect of the whole subject.

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