12. So What is the Answer?

Early morning on June 30, 2008, two helicopters appeared over the Great Hollow. The weather was excellent, the same as it had been a century ago – a perfectly clear blue sky, bright Sun, and heat above 30°C. Through the open portholes the fresh wind of Tunguska was blowing into the passenger compartments of the helicopters. The flying machines had arrived from Vanavara (Figure 12.1), having aboard participants of the centenary Tunguska conference, as well as TV journalists.

FIGURE 12.1. Vanavara, the closest settlement to the place of the Tunguska explosion, and the Podkamennaya Tunguska river. View from a helicopter (*Photo by* Vladimir Rubtsov.).

The 100th anniversary of the enigmatic event was a good pretext to inform the public about lots of facts and strange rumors. Just the previous evening the announcer of Central Russian Television, a very beautiful lady, informed her audience that a 100 years ago an enormous meteorite had fallen in the Siberian taiga, producing a crater 1 km across. Even if, when visiting the site, TV people have

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somewhat brushed up on their knowledge of this event and know that there is no crater at all, yesterday's information had already found its way to the minds of many millions of Russian TV viewers.

The group I was with was flying more or less on the trajectory of the TSB-A, although considerably lower – at an altitude of some 800 meters. If a century ago somebody could have looked out of the Tunguska space body, he or she would have observed what we were seeing: the infinite green ocean of taiga, lakes, rivers, and no sign of humanity. This was the National Nature Reserve *Tungussky*, established in 1996 by the Federal Government of Russia, occupying an area of 3,000 km^2 and kept in its primordial state. But our impressions of this wild landscape were somewhat alarming because it seemed that time had moved backward and any moment we would see in the sky a space body performing its enigmatic maneuvers.

The helicopters first landed near the famous Kulik's Pier at the Khushmo River where, in 1927, Leonid Kulik had gone ashore from a raft and helped down the expedition's horse – the only land transport of the travelers and their last food reserve. (See Figures 12.2 and 12.3.) It was probably not easy for the horse to clamber onto the steep bank of the Khushmo – and the hordes of bloodsucking insects

FIGURE 12.2. Kulik's Pier at the Khushmo River, the place where, in 1927, Kulik's expedition debarked from its rafts. View from a helicopter (*Photo by* Vladimir Rubtsov.).

FIGURE 12.3. Vladimir Rubtsov, author of this book, at the Khushmo River.

must have been an added discomfort. More than 80 years later, similar hordes attacked us momentarily and furiously. Both journalists and scientists immediately started to button up their coats tightly and douse themselves with insect repellents. We don't know whether the meteorite hunters of the 1920s had any such repellents, or, if they did, how effective they were. Siberian bloodsuckers have never been mentioned in Kulik's publications – probably as a trifle not worth attention.

But although fighting with spiteful insects, we were already standing on the Tunguska ground, where the vast area of leveled forest was on the verge of disappearance (see Figure 12.4), but the distinct sensation of mystery still persisted. It was that very place, where a hundred years ago occurred the highly enigmatic event known as "the fall of the Tunguska meteorite." Since then its mystery has been disturbing the peace of many minds.

From the pier we headed to Kulik's *zaimka*, which is almost at the epicenter of the Tunguska explosion. On the occasion of the centenary, the authorities of Evenkya have allocated the necessary funds for the restoration of the log cabins and *labazes* (storehouses on poles) that had been built by participants of his expeditions. Near one of these has been erected a memorial sign, resembling an obelisk in honor of a crashed spaceship rather than a simple marker

FIGURE 12.4. Remains of trees, uprooted in 1908 by the blast wave of the Tunguska explosion that can still be seen in the taiga (*Credit*: Vitaly Romeyko, Moscow, Russia.).

indicating the place of a meteorite fall (see Figure 12.5). Here everyone returned to his or her own duties: journalists started to video record the landscape, and members of the international Holocene Impact Working Group studying recent impacts in the history of our planet began preparing their expedition through the surroundings of the epicenter. Several other people went on a tourist trip by the Tunguska rivers. Generally, in Russian state nature reserves, visits by tourists are forbidden, but the Tunguska nature reserve is exempted from this rule, and everyone wishing to visit this area with its unforgettable aura can do so. By the way, the first foreign tourist at Tunguska was in 1989, when the Japanese scientist Professor Kozo Kovai, a specialist in electronics, visited the region. For some strange reason he believed that in 1908 there had exploded in Siberia a spaceship piloted by a Japanese crew – and he performed a commemoration service at the site.

Yet certainly, the centenary of the Tunguska explosion has given occasion not only for excursions to Tunguska but also to more than half a dozen scientific conferences on this subject that were held in Moscow, St. Petersburg, Tomsk, and Krasnoyarsk. In Moscow two conferences were organized and three were organized in Krasnoyarsk – which is, of all large Russian cities, the nearest to

FIGURE 12.5. A memorial sign erected in honor of the centenary of the Tunguska explosion at Kulik's *zaimka*, not far from the epicenter.

the site, Evenkya being one of the administrative districts of the Krasnoyarsk Territory. Despite the area of this district exceeding that of Ukraine or Texas,[1] there live here today just 20,000 people who completely lack permanent roads, let alone railway lines. The main transport here is airplanes and helicopters, and sometimes riverboats.

The centenary of the Tunguska event, plus the 50th anniversary of the Independent Tunguska Exploration Group (ITEG) – the leading scientific research body engaged in Tunguska investigations – was a good opportunity to look back and estimate future prospects for the problem. It so happened that this author only attended the Krasnoyarsk conferences – this being the optimal choice. Pity, however, that I could not go to Tomsk – participants of that conference, as it appears to me, approached the Tunguska problem most responsibly. The conference was organized by the ITEG and its resolution states very frankly: "The Tunguska problem has not been solved as yet." At other conferences some researchers were of a different opinion, being sure that the TSB was "definitely either a comet core or a stony asteroid." Of course, they have the right to think so. But judging from a great number of mutually contradicting hypotheses that were discussed at these meetings, the Tunguska problem is still far from having been solved.[2] Its history has not been brought to an end as yet. This is a history in progress. To understand this, it is sufficient to compare what scientists had known about the Tunguska event after Kulik's expeditions of the 1920s–1930s and what they know about it today, after the ITEG expeditions of the 1960s–2000s. But this progress does have its origins in Kulik's works, and participants at the Krasnoyarsk conference felt the winds of history when the chair was taken by a daughter of Leonid Kulik – Dr. Irina Kulik, who spoke about investigations that had been carried out by her father. Sir Isaac Newton once said briefly and wisely: "If I have seen further it is by standing on the shoulders of giants." Tunguska investigators of the twenty-first century also see further than previous generations of researchers for the same reason. This is very important in science.

True, the Tunguska centenary also gave rise to new "jubilee solutions" of the problem. In the former Soviet Union the authorities liked to have politically important events and anniversaries marked by bright scientific and technological achievements that had a broad effect – sometimes all over the world. For example, the second *Sputnik* with the dog Layka aboard was launched by personal command of Nikita Khrushchev to celebrate the 40th anniversary of the October Revolution; the "Tsar-bomb" with its 50 Mt of explosive power was tested to mark the 22nd Congress of the Communist Party of the Soviet Union, and so on. So scientists and engineers participating in such projects had more chances for high governmental awards than those involved in ordinary "non-jubilee" events.

Maybe this sort of thing seldom happens in the western world, but the desire to celebrate the centenary of a problem by its solution sometimes takes place – and why not? So, Dr. M. B. E. Boslough and Dr. D. A. Crawford at the Sandia National Laboratories in the United

States provided a gift for Tunguska's 100th birthday. They devised and simulated on the world's fastest supercomputers an innovative mathematical model of the Tunguska event.

These researchers took as a basis for their computations the results of observations of the comet Shoemaker-Levy's fall on Jupiter in 1994, when an upward-directed atmospheric plume in the atmosphere of that planet had been detected, as well as the assumption that Tunguska cannot be treated as an isotropic explosion. Instead, according to Boslough and Crawford's theory, "the wake of the entry creates a low-density, high-pressure channel from the point of maximum energy all the way out of the atmosphere, so the explosion is directed upward and outward."[3]

Naturally enough, under this assumption the whole magnitude of the Tunguska explosion must have been much less than if its energy propagated evenly in all directions (Boslough and Crawford's calculations have led them to the figure of some 3.5 Mt). This result was strained: the authors stated that the terrain around the Tunguska epicenter looks like a slope of 15°. This is not so: there are there slopes directed both from the epicenter and toward it. However, this is not too important. Let the magnitude of the explosion be somewhat more than 3.5 Mt – say 5 or even 7 Mt. But which parameters of the TSB's motion have been used in the Sandia model? Alas, purely "theoretical" ones: a stony asteroid having a mass of some 350,000 tons had been flying at a velocity of 15 km/s at an angle of 45° to Earth's surface. The reader does certainly understand that this angle sharply contradicts the reliable testimonies of eyewitnesses of the Tunguska phenomenon. It is easy to calculate that flying in such a trajectory at a distance of 1,000 km from the epicenter, where the TSB was already brightly visible, its altitude would have been 1,300 km. A material space body could emit light at this altitude, in a complete vacuum, only if somebody had placed on it festive illuminations.

Also, the Sandia specialists are completely silent about the shape and structure of the area of the leveled forest after their computed airburst – promising to accomplish, with time, "a full 3-D simulation of various Tunguska scenarios using a high resolution model of the actual topography of the site." When and if such a future simulation shows something resembling the "forest butterflies" of Fast's and Anfinogenov's, the Sandia model will be worth further discussion. But for the time being it remains just another mathematical construction having a very distant relation to the Tunguska event as such. To attack the Tunguska problem, ignoring characteristics of the area of the leveled forest is the same as computing parameters of the Arizona meteorite, having no idea of the shape, dimensions, and depth of the crater it has left. Would the results of such a computation have had anything to do with the real event that had occurred in the Arizona desert some 50,000 years ago? Hardly so.

Let us add that not a single Tunguska eyewitness saw in the sky any plume – which, according to the Sandia scientists, must have been ejected backward along the TSB trajectory. Such a plume would certainly have been noticed. As for the attempts of Boslough and Crawford to use the alleged plume for the explanation of the after-catastrophe illumination in European skies, these are simply absurd: the ejected TSB substance must have dispersed in the atmosphere to the east from the place of the explosion from which the space body arrived; but Europe is located *to the west* – in the opposite direction. Finally, we must ask the same time-honored question: where is the substance of their "Tunguska asteroid," those thousands or even tens of thousands of tons of rock that had to be scattered over the Great Hollow? The Sandia scientists are referring to the work of Moscow physicist Dr. Vladimir Svettsov, according to which the TSB substance had been completely vaporized by the light flash; but Svettsov's conclusion has been convincingly refuted by Vitaly Bronshten and Andrey Olkhovatov: complete vaporization of a stony asteroid is impossible, the region of the Tunguska epicenter would have been strewn with meteoritic dust and even with fairly large pieces of the "heavenly rock."[4]

One cannot but agree with Dr. Victor Zhuravlev, who wrote in 2006: "The main distinctive feature of the contemporary stage of Tunguska investigations is the wide gap between the concrete results of expeditions which crossed the Siberian taiga, were digging in Tunguska soil and peat, measuring thousands of leveled trees, questioning eyewitnesses about the phenomenon, and, on the other hand, the theoreticians who are building computer models of the phenomenon. This gap is now the main obstacle to the further development of this field of research."[5]

Those wishing to find out what did in fact happen in central Siberia in 1908 have to consider the whole body of relevant data;

only then will a realistic model of the phenomenon be seen through the apparent chaos of this body of information. In previous chapters we deliberately paid much attention to the history of the Tunguska problem: these are not just old tales having nothing to do with the current state of the problem. Instead, this is the path of the successive approximations to its solution. Having gathered together all known material and instrumental traces of the Tunguska event, as well as having analyzed eyewitness reports, we have built on this basis a multidisciplinary picture of the phenomenon – but it turned out not to correspond with the existing hypotheses.

Probably it would be worthwhile to try and computerize this picture one day in the future, using up-to-date algorithms and programs. Then we would be able to find out which empirical data are still lacking, despite many years of hard research work at Tunguska, and to start looking for it. But even now the present picture may be considered a good approximation to the truth. And, as the famous detective Sherlock Holmes used to say, "the more bizarre and grotesque an incident is the more carefully it deserves to be examined, and the very point which appears to complicate a case is, when duly considered and scientifically handled, the one which is most likely to elucidate it."

The situation in Tunguska research would have looked much more hopeless if we had had no bizarre traces – neither the rare earth anomaly, nor indications of genetic mutations, nor the very informative barograms, nor everything else. In this case, researchers trying to unravel this mystery would probably have had to seek the help of a "natural non-local explosion." Yet at present there is no need to despair: we are perhaps within a couple of steps from the final solution of the Tunguska problem.

But what may be this final solution? How must it look and how may it be achieved? Of course, even such detailed theories as those developed by Grigoryan or by Boslough and Crawford cannot be considered as solutions, much less as final solutions. These are just hypothetical models whose validity is still to be tested in the field. All experienced Tunguska specialists agree that this problem will be solved only when a real piece of the Tunguska space body has been found. One can elaborate an imposing theory of the Tunguska explosion, full of equations and mathematical functions, but the only method of its verification may be discovering appreciable quantities of the TSB substance in an area predicted by theory. Otherwise competition between various viewpoints could last forever.

Of course, it is not difficult to call for a search for a piece of the TSB – but how can it be found if the whole Tunguska enigma had largely arisen due to the lack of such an item? Leonid Kulik expended plenty of time and effort drilling the empty thermokarst holes for nonexisting pieces of the TSB. True, at present we have in Tunguska data some hints about the substance (ytterbium, first of all – and the whole list of 12 elements), but these are just hints – literally microscopic hints. That is why, when building new Tunguska hypotheses, the majority of scientists take the liberty of ignoring them.

But as a matter of fact, the only thing of which the Tunguska investigators are today certain is the lack of considerable quantities of the TSB substance, *more or less uniformly covering the Great Hollow*. Of course, nobody can guarantee that one or two fairly large pieces of the Tunguska space body are not lying somewhere in the Great Hollow, under a layer of soil or peat. They may be hidden in Lvov's bog – a peat bog near the northwestern slope of the Ostraya Mountain. As Victor Zhuravlev remarked in 1998, just here such intriguing anomalies in the Tunguska area as mutations in pines and insects are most evident, as well as an increased concentration of ytterbium in the soil. In the 1920s, some Evenk people even recalled that after the Tunguska catastrophe they had discovered in this place some "pieces of metal, lighter in color than a knife's blade."

Dr. Zhuravlev has worked out a special research program called "Lanthanum," aimed at the search for geochemical anomalies in vertical columns of soil on the beach of Lvov's bog. The goal of this program is the gradual detection of the center of various anomalies in this part of the Great Hollow – like in geological prospecting an ore body is detected by mapping geochemical peculiarities around it. When carrying out this program, the precise coordinates of the zone of the probable fall will be determined. And a relatively large body itself might be detected, according to Dr. Vladimir Alekseev, who is also participating in this program, with the help of a new powerful georadar, made at the Moscow Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation of the Russian Academy of Sciences (IZMIRAN). This device makes it possible to study soil and rock down to the depth of 100 meters, displaying a three-dimensional (3D) picture of underground objects. Dr. Alekseev believes that some pieces of the TSB could have penetrated the Tunguska soil, forming no craters. Although such investigations are still in their infancy, they look promising. And if the scientists happen to be lucky and find the necessary funding, we may witness a return to the search for large pieces of the Tunguska space body – searches similar to those that had been pursued in the 1920s by Leonid Kulik. In the history of scientific investigations such returns sometimes occur.

Of course, it is necessary to study more the traces of radiation at Tunguska. During one of my last meetings with Professor Nikolay Vasilyev we discussed this direction of investigation in detail. According to Vasilyev, in the history of Tunguska investigations there existed a strange trend: attempts to find traces of radioactivity were made more than once and by various methods, but each time, as soon as a positive answer to this question began to turn up, the work was immediately interrupted. Researchers either stopped their work by their own initiative, blankly attributing the positive result to "chance contaminations," or the lack of money and technical means prevented the development of further work. In some cases, the researchers died. (Here we must emphasize that nothing suspicious was ever found in such cases, and there is no reason to fantasize about any conspiracies. Simple coincidences – but sad ones.)

Nikolay Vasilyev was pinning his hopes for further progress in the search for Tunguska radioactive trace on the thermoluminescent investigations that were carried out for a long time by Boris Bidyukov, Mikhail Korovkin, and other ITEG members. It is the thermoluminescent method that allows the detection of weak and old traces of radiation; other measuring techniques are too rough for that. It seems his hopes were not groundless. In particular, the "Deer-stone," an unusually large stone (photograph on Fig. 6.7) discovered by John Anfinogenov on Stoykovich Mountain, near the epicenter, although not a piece of the TSB (as John himself would have liked), does let us know something essential about the Tunguska phenomenon.

"Quartz samples, taken from a near-surface layer of the Deerstone, are remarkable for the high intensity of their thermoluminescence, which is weakening as the depth of the sampling increases," wrote Korovkin and his colleagues when reporting their experiments. "We can make a justified assumption that the Tunguska explosion was accompanied by hard radiation."[6] Having made this discovery, Mikhail Korovkin ceased his research work in this field. It appears that the trend, noticed by Professor Vasilyev, still remains in force.

Luckily, not all Tunguska researchers are yielding to it. Boris Bidyukov, who assumed responsibility for the thermoluminescent investigations in ITEG in the mid-1970s, is continuing his work on thermoluminescence. His team that collected samples at Tunguska consisted of 80 people, and this work lasted several decades. In 1988, Boris decided to publish their empirical data, not trying to explain it. But in a recent Tunguska collection of papers he said bluntly: "Formerly we were calling the factor which had stimulated thermoluminescence at Tunguska somewhat too cautiously 'unknown,' but now it's time to tell that we cannot see any rational alternatives to identifying this with hard radiation."[7]

Perhaps 99% of Western scientists and science amateurs interested in the Tunguska problem, if they happen to read this statement of Boris Bidyukov, would exclaim: that's impossible! It's common knowledge that the myth about the Tunguska radiation was rebutted by somebody somewhere sometime – wasn't it? And stating this, the same people will not fail to complain that "the Russians" are inclined to consider the Tunguska problem as something close to their private property. But indeed, the members of the Tunguska research community in Russia, Ukraine, and other CIS countries, although far from uniform in their viewpoints on the phenomenon and not too diplomatic when arguing about it, do have a grasp of the real contents of this problem, whereas their Western colleagues are as a rule dealing with its simplified and perhaps distorted pictures. Too many well-established facts have been forgotten, too much information is ignored, lots of important publications remain unknown in the West – partly because of the language barrier. Besides, scientific overspecialization, so typical in this day and age, hampers the interdisciplinary perception of the Tunguska phenomenon. At best, the researcher knows that there is in Siberia an area of leveled forest, having at the same time no idea of other Tunguska traces – both larger (the light burn and the geomagnetic storm) and smaller (from genetic mutations to the paleomagnetic anomaly) or of other "details" of this event.

One should also take into account the fact that a considerable part of the empirical information, collected by ITEG people at Tunguska, has not as yet been processed. Since 1995, members of the ITEG have been discussing the idea of creating a full electronic database on the Tunguska phenomenon, but only some preparatory steps have been taken. It is evident, however, that this database will be enormous. If we simply cast a glance at the data presented in previous chapters, we can see how astonishing it is that we already know so much about the Tunguska phenomenon, and what a great number of various hypotheses have been put forward to account for it, and how many people of splendid intellect have pondered over this enigma – and yet how poorly, despite all of this, we understand its origin and nature.

So why is this? Why has such a rich set of empirical information not yet been transformed into an accurate and rational theoretical scheme explaining this phenomenon? Do we lack additional data – or something else? In fact, we can have a deep insight into the nature of the Tunguska event only due to a creative imagination – and the main trait of the creative imagination and the first condition of its effectiveness is intellectual bravery. Logic, discipline of reasoning, ability to match theoretical considerations with factual material – all these are important in the next stage of scientific investigation, the stage of testing the proposed ideas. But by hastily rejecting ideas because of their "excessive audacity," when they are only emerging, we are erecting a stony wall across the path of the progress of science, which is far from smooth even without such walls.

Perhaps then, the starship hypothesis put forward by Alexander Kazantsev in 1946, which perturbed the still water of the meteoritic pool, is not only of historical interest. Even its opponents admit with reluctance that the role of this hypothesis in the history of Tunguska investigations was very important. Just try to imagine this history without Kazantsev's idea! Meteor specialists would have never started searching for subtle traces of radioactivity, or investigating thermoluminescence, or studying genetic mutations, and all these traces of the Tunguska explosion would have sunk into oblivion. Even the shape and structure of the area of the leveled forest would have remained vague. So, it is a respectable hypothesis that greatly contributed to the development of the problem, not just a fantastic speculation. But what place does this hypothesis occupy in Tunguska studies today?

One has to admit that it went through its apex in 1969, when Alexey Zolotov published his famous monograph *The Problem of the Tunguska Catastrophe of 1908*.[8] This book has become not only the highest achievement of the "artificial" research strategy in Tunguska studies but also its swansong. Formerly the "spaceship hypothesis" had been predicting empirical facts (the overground character of the explosion, the lack of any material remnants of the TSB at the site, and so on) which then, and with much effort, supporters of "natural" conceptions were trying to explain. But from then on the situation changed. There were no new predictions resulting from this hypothesis, and the supporters of more conventional ideas had at last become able to get their breath back and to turn their attention to the details of their conceptions. Of course, the infinite waltz, performed by astronomers and meteor specialists between a comet and a stony asteroid, sometimes incorporating a carbonaceous chondrite or a cloud of cosmic dust, does not inspire the reading public, but at least nobody disturbs its performers. Unconventional but serious "natural" hypotheses (such as the "mirror asteroid" idea) do not as yet have any influence on the Tunguska problem.

There is nothing surprising in this. An interdisciplinary problem, reformulated in the language of one of the scientific disciplines that is studying it (say, in the language of ballistics), does certainly allow for a solution, acceptable to specialists in this discipline. A specialist in ballistics will write an excellent paper for a professional periodical about a particular case of motion of a large meteor body in the atmosphere of Earth. Mathematically, the problem is posed and solved on paper quite rigorously, and its solution certainly should be published. Whether or not it has anything to do with the real Tunguska phenomenon is an abstract question and academic readers will not ponder over it.

But once again, the infinite theoretical vacillations between a comet and an asteroid became possible, first of all, because the development of the "starship model" has practically ceased. Meanwhile, many specialists on the Tunguska problem believe it is far from having been refuted. In his book, which was published in 2004, Professor Nikolay Vasilyev wrote: "Calling things by their proper names without diplomatic curtsies, I would like to emphasize that of all known impact events the Tunguska phenomenon is the only one in which a contact with extraterrestrial intelligent life might be surmised."[9] And in another work: "I think you understand well: being a science professional I do realize that what I am saying is rather risky. But it must be said."[10]

Vasilyev believed that although "there are as yet no direct proofs of the contact," they "may appear if the elemental and isotopic composition of the Tunguska space body could be reconstructed." To tell the truth, here this eminent scientist was somewhat too optimistic as it seems that even the most unusual chemical composition of the space body that exploded at Tunguska in 1908 would be, in this or that way, forced into the cometary-meteoritic TSB model. And certainly, the inability of this model to account for, say, the geomagnetic storm or anomalies of thermoluminescence would not worry anyone.

How starships may be constructed we can only conjecture; but without at least a general idea of their physical principles of motion it is very difficult to interpret in terms of Kazantsev's hypothesis even the most unusual findings at Tunguska. For example, what does the paleomagnetic or rare earth anomaly tell us? In the absence of theoretical models of extraterrestrial spaceships, they only suggest that the Tunguska phenomenon could hardly have been produced by a stony asteroid or by a comet. Alas, science does not possess as yet any theoretical models of alien starships or alien artifacts. So the scarcity of "artificial" models of the Tunguska phenomenon is disappointing but understandable. The "natural" research program is in this respect much richer. But as for the "artificial" Tunguska research program, its number of hypotheses is just one. It is that an alien spaceship perished in the final stage of its flight due to a technical malfunction. However, we have to ask: is there any sense in working out different versions of this hypothesis if we cannot evaluate their plausibility?

Perhaps there is. While working in the 1970s at the "Laboratory of Anomalous Geophysics" and studying the Tunguska problem together with Alexey Zolotov, Sokrat Golenetsky, and Vitaly Stepanok, this author got accustomed to integrating empirical Tunguska data by using what could be called the "model of an aerospace combat." According to this model, there happened in 1908 over central Siberia an aerial engagement between two extraterrestrial spaceships, after which one of them survived and flew back into space. Of course, this is not meant to be offered as the final solution of the Tunguska mystery, but as a working instrument this hypothesis proved to be helpful. And the multidisciplinary model of the Tunguska phenomenon, built in the previous chapter, does not contradict it either. In the Soviet Union, however, authorities hated the idea of "star wars" and *Glavlit* (the Soviet censorship) would never have allowed the "model of an aerospace combat" to be mentioned even briefly on the pages of the scientific or popular press. This is why we did not try to propagate it, although there were discussions with Alexey Zolotov about its possible implications. To Zolotov the aerospace battle hypothesis did appear of interest, although he doubted that it could be validated on the basis of existing evidence.

The search for extraterrestrial intelligence is a legitimate field of scientific investigation. And obviously, if the Tunguska phenomenon has something to do with this, then it must attract still more attention from the science community. But paradoxically, as Nikolay Vasilyev noted in his last book, 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 (DCOs): comets and asteroids. But if the TSB was a natural space body, then it means there exists in space another type of DCO, whose nature remains unknown. Professor Igor Astapovich, a Ukrainian scientist who contributed greatly to the Tunguska problem, wrote as far back as before World War II: "If the Tunguska meteorite had fallen 4 hours 48 minutes later then St Petersburg would have found itself in the seat of its explosion and the city would have been in ruins."[11]

Today the astronomical picture of our universe is full of catastrophes, with its Big Bang, black holes, X-ray bursters, supernova stars, and an enormous number of impact craters on the Moon, Mercury, and Mars. These don't surprise us any longer. Humanity seems to have got used to cosmic dangers, although recently the idea that impact processes could have played an essential role in the geological history of our own planet was not so well appreciated by the scientific community. The discovery in the Yucatan in 1978 by geophysicist Glen Penfield of the Chicxulub crater, 180 km across, left by a gigantic asteroid that some 65 million years ago had most likely caused the extinction of the dinosaurs, and the impressive picture of the collision of comet Shoemaker-Levy with Jupiter in 1994 have considerably weakened this negative reaction. Debates – and hot ones – are now dealing with an important issue: whether or not such collisions happened during recent human history. It would have been definitely reassuring to know that the heavens have confined themselves to the extermination of ancient reptiles and will treat mammals and humans more delicately.

However, members of the Holocene Impact Working Group, including scientists from the United States, Russia, Ireland, France, and Australia, are of the opposite opinion – that humankind is in some sense an endangered species, too.[12] According to them, gigantic tsunamis produced by large meteorites falling in oceans occur approximately every 2,000 years, destroying inhabited localities ashore and influencing thereby the course of history. This hypothesis (finding some corroborations in field investigations) has generated a squall of criticism.

Nevertheless, during the last 15 years or so science has paid some attention to potentially dangerous cosmic objects, and preliminary work for developing spaceguard systems has been carried out. This term – spaceguard – was coined by the famous science fiction writer Arthur C. Clarke, who meant by it an early warning system to detect "near earth asteroids" (NEAs) whose orbits cross the orbit of our planet. In reality, about 350 NEAs have already been detected, and scientists have found more than 200 ancient meteor craters – "star wounds" – even though they have been partly obliterated for millions of years.

In this respect, the computations of Drs. Boslough and Crawford from Sandia National Laboratories are definitely important. As they believe, "low-altitude airbursts are by far the most frequent impact events that have an effect on the ground. The next impact on Earth that causes casualties or property damage will almost certainly be a low-altitude airburst."[13] Although these considerations do not bear a direct relationship to the Tunguska phenomenon (at least not until a real 3D simulation has been made on a real 3D map and its calculated area of the flattened forest turns out to match the two Tunguska "butterflies"), their results hint that even falls of not too gigantic cosmic bodies might be fraught with grave dangers for our civilization.

Fortunately, humanity has one very useful, although sometimes thoroughly veiled quality, owing to which it survived in prehistoric times: the ability to face the truth. Let's hope it has not lost it. To hide one's head under a blanket is easy. After all, the theoretical chances for a catastrophic impact in the nearest days or months are, frankly speaking, not excessive, and conclusions of the Holocene Impact Working Group still must be confirmed by other researchers specializing in this field. But such a strategy will hardly be conducive to the further survival of humanity – if only because an "unlikely event" does not mean "an impossible event."

It would be silly to panic, repeatedly looking at the sky, waiting for a cosmic catastrophe. But it would be even sillier to forget our vulnerability on this planet. Arthur Clarke once cited a phrase of another science fiction writer, Larry Niven, with regard to the asteroidal danger: "Larry Niven summed up the situation with the phrase: 'The dinosaurs became extinct because they didn't have a space program.' And we will deserve to become extinct, if we don't have one." Sounds good, but this author would like to offer another explanation of this ancient disaster. The dinosaurs became extinct because they attempted to economize on serious investigations of Tunguska-like events that probably occurred from time to time in their Jurassic paradise.

* * *

So, dear reader, we have journeyed in this book together, through a maze of instrumental data and wild rumors, scientific hypotheses and naive inventions, and the thickets of Tunguska taiga and the near-vacuum of the terrestrial ionosphere, as well as through many other places in space and time. We hope that some Tunguska facts have become for you in this journey more understandable. Possibly, some others have become even more enigmatic.

Did we find the correct solution of the Tunguska problem when making this journey? Unfortunately not – but at least we have seen this problem in all (or almost all) its details and nuances. And a nuance is not a trifle – far from that. More often than not, the gist of a matter is hidden in its nuances. That's why it would be careless to divide them a priori into the "essentials" and "nonessentials." The Tunguska fortress has not surrendered as yet, but there are cracks in its walls and half-open doors in its towers. To enter the fortress, it only remains to make some last efforts – and the science army will win! But these efforts have to be made; nothing will happen without our effort.

Some 80 years ago there existed in the Soviet Union the so-called GIRD, the Group for Investigations of Rocket Dynamics, from which originated the Jet Propulsion Scientific Research Institute and Sergey Korolev's Designing Bureau, which launched the first *Sputnik* and Yuri Gagarin. GIRD's engineers had worked gratis, from pure enthusiasm, as scientists at the ITEG did some 30 years later and who are continuing to do so. Who knows – perhaps from the ITEG will originate a new Interdisciplinary Tunguska Scientific Research Institute, which will radically activate investigations in this field. Then it would become possible to publish a second volume of this book – in which all final answers would be given and the correct solution of the Tunguska mystery would at last be demonstrated.

But until the "scientific troops" are gathered and sent forth, the Tunguska fortress will probably continue to resist the assault of science. It is already evident that "simple" solutions, rather popular in the history of this subject, do not work. Is this strange? Not at all. Humankind is still very young and hardly completely aware of all enigmas of the world in which it lives. Many wonderful discoveries are awaiting us – perhaps just round the corner. Should we also wait for them to suddenly reveal themselves – so that the Tunguska mystery would be solved "automatically", just like quantum mechanics has made the structure of atom understandable? But such waiting may take much too long. And here let us cite an old Japanese proverb: "If you do not know what to do, take a step forward!" None of us can see what is around the corner, but we can take that first step. Take the step!

Notes and References

1. Evenkya: almost 800,000 km^2; Texas: almost 700,000 km^2; and Ukraine: a little above 600,000 km^2.
2. See *The Tunguska Phenomenon: Multifariousness of the Problem*. Novosibirsk: Agros, 2008; *The Centenary of the Tunguska Problem: New Approaches*. Moscow: Binom, 2008; *The 100th Anniversary of the Tunguska Phenomenon: Past, Present, Future*. Moscow, 2008; *The 100th Anniversary of the Tunguska Comet Body*. St Petersburg, 2008; *The Centenary of the Tunguska Meteorite Fall: A Relay Race of Generations*. Krasnoyarsk: IPK SFU, 2008 (All in Russian.).

3. Boslough, M. B. E., and Crawford, D. A. Low-altitude airbursts and the impact threat. – *Proceedings of the 2007 Hypervelocity Impact Symposium – International Journal of Impact Engineering*, in press (2007).
4. See Bronshten, V. A. *The Tunguska Meteorite: History of Investigations*. Moscow: A. D. Selyanov, 2000, pp. 223–225 (in Russian); Olkhovatov, A. Y. *The Myth About the Tunguska Meteorite. The Tunguska Event of 1908 as a Mundane Phenomenon*. Moscow: Association Ecology of the Unknown, 1997, pp. 101–102 (in Russian).
5. RB Questions and Answers: Dr. Victor Zhuravlev. – *RIAP Bulletin*, 2006, Vol. 10, No. 1.
6. Korovkin, M. V., Gerikh, L. Y., Lebedeva, N. A., and Barsky, A. M. Assessment of radiation conditions in areas of ecological instability by methods of radiation mineralogy. – *Radioactivity and Radioactive Elements in Human Environment*. Tomsk: Tomsk Polytechnic University, 1996 (in Russian).
7. Bidyukov, B. F. Thermoluminescent investigations in the region of the Tunguska catastrophe. – *The Tunguska Phenomenon: Multifariousness of the Problem*. Novosibirsk: Agros, 2008, p. 83 (in Russian).
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9. Vasilyev, N. V. *The Tunguska Meteorite: A Space Phenomenon of the Summer of 1908.* Moscow: Russkaya Panorama, 2004, pp. 12–13 (in Russian).
10. Vasilyev, N. V. Memorandum. – *Tungussky Vestnik*, 1999, No. 10 (in Russian).
11. Astapovich, I. S., Fedynsky, V. V. *Meteors*. Moscow: Gostekhizdat, 1940, p. 79 (in Russian).
12. This group includes Dr. Dallas Abbott from Lamont-Doherty Earth Observatory in Palisades, N. Y., Dr. Bruce Masse from Los Alamos National Laboratory, New Mexico, Dr. Viacheslav Gusiakov, Head of the Academic Tsunami Laboratory in Novosibirsk, Russia, and other specialists from various countries. See, for example: Masse, W. B., Weaver, R. P., Abbott, D. H., Gusiakov, V. K., Bryant, E. A. Missing in action? Evaluating the putative absence of impacts by large asteroids and comets during the Quaternary Period. In: *Proceedings of the Advanced Maui Optical and Space Surveillance Technologies Conference,* Wailea, Maui, Hawaii, 2007, pp. 701–710.
13. Boslough, M. B. E., and Crawford, D. op. cit.