

## Contributions from the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD, President, and H. H. NININGER, Secretary

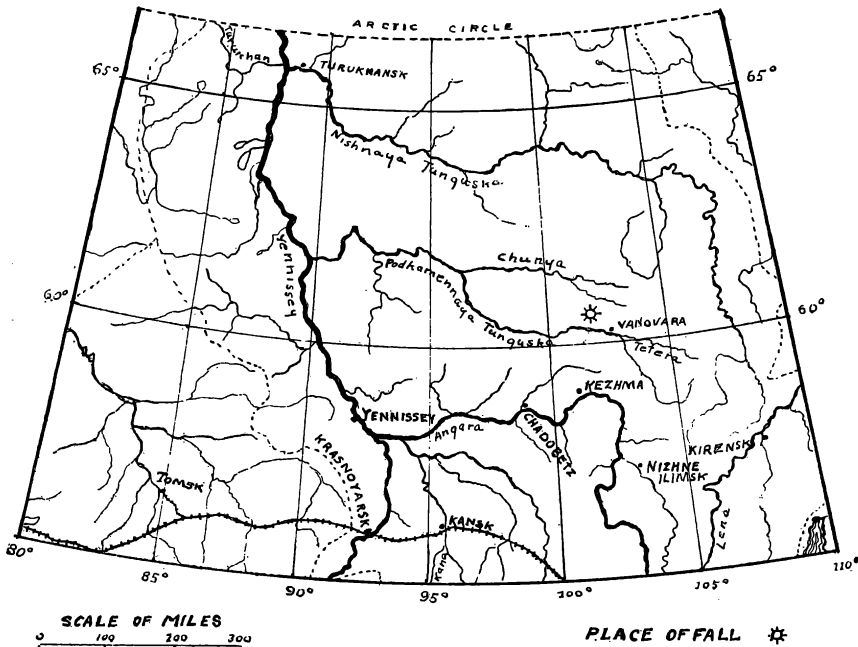
"On the Fall of the Podkamennaya Tunguska Meteorite in 1908,"

By L. Kulik\*

Translated by LINCOLN LA PAZ and GERHARDT WIENS,  
of The Ohio State University

In the month of February, 1927, an expedition, with the author as leader, was equipped by the Academy of Sciences of the U.S.S.R. for the investigation of the place of fall of the meteorite of June 30, 1908, in the basin of the upper part of the Podkamennaya Tunguska river.

In the latter part of March, 1927, I began my investigations to the north of the Podkamennaya Tunguska, having my base at the factory [trading post] Vanovara, lying near this stream in approximately the 72° of longitude east of Pul-kovo. After repeated attempts to penetrate the marshy forests north of this river,



**Fig. 1**

MAP OF THE PLACE OF FALL OF THE PODKAMENNAYA  
TUNGUSKA METEORITE IN 1908

\*Published originally in the *Journal of the Russian Academy of Sciences*, 1927A, pp. 399-402; read by the Academician V. I. Vernadsky on Nov. 7, 1927.

Translated from the Russian of L. Kulik by Gerhardt Wiens, Department of German, The Ohio State University, at the suggestion and with the cooperation of Lincoln La Paz, Department of Mathematics, The Ohio State University. Words inclosed in square brackets have been inserted by the translators.

advancing to the northwest on small rivers by means of a raft, I reached the central part of the area of the fall in the month of June and made a hurried survey of the place and its neighborhood.

On account of the absence within hundreds of kilometers of any astronomical points and because of the complete unreliability of the maps available for this region, I can only approximately determine the place of fall as lying in  $61^\circ$  north latitude and in  $71^\circ$  east longitude from Pulkovo; [In 1934, the accurately determined coordinates of the place of fall were given by I. S. Astapowitsch (*Quar. Jour. Roy. Meteorol. Soc.*, **60**, pp. 493-504) as lat.  $60^\circ 54' N.$ , long.  $101^\circ 57' E.$  of Greenwich.] *i.e.* about a hundred kilometers to the northwest of Vanovara [see Fig. 1].\*

The central part of the fall, lying on the plateau which forms the watershed between the basin of the river Chunya [Chuna] and the Podkamennaya Tunguska proper, consists of an area several kilometers in diameter which has the appearance of a huge crater surrounded by an amphitheatre composed of chains of hills and isolated peaks. To the south, along a tangent to this circle of mountains, the river Khushmo, the right hand tributary of the river Chamba, which enters the Podkamennaya Tunguska about 30 km below Vanovara, flows from west to east. This system of tributaries was for the most part my road from Vanovara to the place of fall and back. In the previously mentioned crater, there are in turn chains of hills and isolated peaks, marshy plains, swamps, lakes, and small streams. Very recently, according to the testimony of local residents, there was here a typical marshy woods. At present the entire marshy woods inside and outside of the crater is practically destroyed, being altogether blown to the ground, where it lies in generally parallel rows of trunks (stripped of branches and bark), the tops of the trunks pointing in the direction away from the center of the fall; this peculiar "fan" of broken-down woods can be especially well seen from the summits of the chains of hills and individual heights which form a peripheral ring about the basin. However, here and there the marshy woods remained in the form of trunks standing on their roots (usually without bark and branches). Similarly, in spots, unimportant strips and small copses of green trees remained. But these exceptions are a rarity and can be easily explained in every individual case. The whole former vegetation of both the crater and the surrounding hills, as well as the zones for several kilometers around them [the hills], carries the characteristic traces of a uniform and continuous burning not resembling the effects of an ordinary [forest] fire; moreover, this burning is shown on the broken-down trees as well as on the standing trees [and] on the remnants of bushes and moss on the summits and the sides of the hills as well as in the marshy plains and on the isolated islands of dry land in the midst of the swamps covered with water. The area with traces of burning is several tens of kilometers in diameter. The central region of this "burned" area, which measures several kilometers in diameter, exhibits in that part of it which is occupied by marshy plains covered with bushes and woods, traces of something like a sidewise pressure which gathered up the soil and vegetation in flat folds with depressions several meters deep, drawn out on the whole perpendicularly to the northeast direction. Moreover, this region is strewn with dozens of freshly formed flat "craterlets" [funnels], which have various diameters, ranging from several meters to tens of meters, with a depth also of several meters; the walls of these "craterlets" are usually steep, although there are

\*[The figure referred to (based on the most recent maps of the region of the fall) is substituted for the original sketch map of L. Kulik (*loc. cit.*, p. 399).]

also some sloping ones; the bottom of the craters is flat, swampy, and mossy, and carries sometimes the traces of a central eminence. On the northeast end of one of these marshy areas, the moss cover seems to be pushed several tens of meters away from the foot of a hill and replaced by a bog. Opposite, on the southwestern side of the crater, the swamp ends in a chaotic accumulation of the moss cover. A test excavation in the marshy plain of one unimportant "craterlet" (1.5 to 2.0 meters in diameter) which was filled with a tiny swamp showed: (1) that from such a "craterlet" one can pump [bail] out the water by pailfuls; (2) that at the depth of a meter from the surface of the marshy plain, at the end of June, one finds frozen peat at the bottom of the "craterlet"; (3) that the layer of water in the crater is 30 cm thick and the layer of slime under it also is 30 cm thick; (4) that the seepage of the water during twelve hours did not exceed 30 cm, *i.e.* half of the original quantity.

To the preceding, it is necessary to add that the collection of testimonies from local eyewitnesses of the fall, made by myself, gave me a number of interesting narratives from which I quote the following.

The peasant S. B. Semenov related to me in a letter:

"It was in 1908 in the month of June about 8 o'clock in the morning; I lived at that time on the Podkamennaya Tunguska at the factory Anovara (Vanovara, L. K.) and was occupied with work around my hut. I sat on the open porch with my face toward the north and at that time there arose, in a moment, a conflagration which gave off such heat that it was impossible to remain sitting—it almost burned the shirt off me. And it was such a flaming wonder that I noticed that it occupied a space of not less than two versts [one verst = 0.663 mile]. But to make up for that, this conflagration endured only a very short time; I had time only to cast my eyes in that direction and see how large it was, when in a moment it vanished . . . After this vanishing it grew dark, and at the same time there was an explosion which threw me off the open porch about seven feet or more; but I did not remain unconscious for very long; I came to myself and there was such a crashing sound that all the houses shook and seemed to move from their foundations. It broke the window panes and window frames in the houses, and in the center of the square, near the huts, a strip of earth was torn out, and at the same time the so-called shore [bracing strip] of iron on the door of the barn was broken, but the lock remained whole."

Another peasant, P. P. Kossolapov, personally informed me on March 30, 1927, that in June, 1908, at 8 o'clock in the morning, he was getting ready at the same factory to go hay cutting; he needed a nail; not finding one in the room, he went out into the yard and began pulling a nail out of a window with his pincers. Suddenly something very strongly scorched his ears. Reaching for them and thinking that the roof was burning, he raised his head and asked S. B. Semenov, who sat on the open porch at his house, "Say, did you see anything?" "How could one help seeing it?" answered the other; "It seemed to me too as if heat embraced me." P. P. Kossolapov there and then went into his house, but scarcely had he entered the room and got ready to sit down on the floor to his work when an explosion occurred, the sod fell from the ceiling, the oven door of the Russian stove broke loose and flew on to a bed standing opposite the stove, and one window pane was broken, falling into the room. After this, there was a sound similar to the rolling of thunder, vanishing gradually to the north. When it became somewhat quieter, Kossolapov rushed out into the yard but did not notice anything more.

Finally, on the 16th of April, 1927, the Tungus Luchetkan told me that the whole central region of the wind-felled trees was occupied before this event by his relative, the Tungus Vasilij Ilyich (the brother of the mother of his first wife), who used it as a pasture for reindeer. Vasilij Ilyich was a rich Tungus; he called up to fifteen hundred reindeer his own; he had in this region many sheds in which he kept clothes, utensils, reindeer equipment, *etc.* With the exception of several dozen tame ones, the reindeer were permitted to roam at will in the hills in the region of the river Khushmo. But down flew the fire and broke down the woods; the reindeer and the sheds were gone. Thereupon the Tunguses went in search of them. Of some reindeer they found the charred carcasses; the others they did not find at all. Of the sheds nothing remained; everything was burned up and melted to pieces—clothes, utensils, reindeer equipment, dishes, and samovars; they found only a few “kettles” [buckets] intact. All of these places are known to the brothers of Vasilij Ilyich, Boorootsh and Moogotsh.

Other witnesses among the Tunguses and Russians asserted that: (1) the forest at the center of the fall lies in the form of a “fan,” with the [tree] tops directed away from the center of the fall; in the latter, “the earth was turned up”; (2) up to the time of the fall there was here the normal green marshy woods; (3) until and after the time of the fall and the general destruction by the “fire” [“everything was black”], there were no fires at this place.

The investigation carried out by me is of a superficial character: this circumstance is due partly to the lack of time at my disposal and the limitation of supplies and partly to the lack of necessary technical means. The continuation of a detailed study of the whole region of the fall before any excavations are made, appears urgently necessary.

In the literature on meteorites, if we do not include chronicle [*i.e.* old and unreliable] accounts, there has not been until now any description of the devastation of wooded areas caused by the fall of meteorites, although references to such phenomena have been made.\* In the fall of the Podkamennaya Tunguska meteorite we have the first case of a colossal breaking down of woods by wind, the detailed study of which is both possible and unconditionally necessary. Besides, we notice here, apparently for the first time in the history of meteorites, one of the rarest cases in which a large meteorite arrived at the surface of the earth without stopping at the point of retardation [disruption]; *i.e.* the case of *a contact between the surface of the earth and that cloud of incandescent gases* [*italics ours*] which surrounds a meteorite entering into our atmosphere and which accompanies it usually [only] up to the point of its retardation [disruption].\* Finally, the manner in which the craters are strewn over the area of the fall, itself requires detailed study, since this fall differs from an ordinary fall, both in the mass of the material and in its relative velocity; moreover, such study will give us information concerning the choice of the place which would be most profitable for excavation. The most rational method for this purpose appears to be the execution of a photographic survey from a hydroplane [airplane]. In addition, these things are desirable: a magnetometric [magnetic] or an electric survey of the area strewn with craters; a determination of the heights of the plateau and the surrounding hills; and also the determination of several astronomical points for the control of surveys to be undertaken in this district.

\*[The translators wish to express their appreciation of the kind assistance rendered by Dr. N. T. Bobrovnikoff, Perkins Observatory, Ohio Wesleyan University, in connection with the translation of this sentence.]