LABORATORY OF DREAMS

The Russian Avant-Garde and Cultural Experiment

Edited by
John E. Bowlt
and
Olga Matich

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Michael Holquist

TSIOLKOVSKY AS A MOMENT IN THE PREHISTORY OF THE AVANT-GARDE

A close filiation between science and avant-garde movements is apparent throughout the modern period, nowhere more so than in Russia. It is to be expected that those who were anxious to go beyond the old ways in the world of art should invoke association with the world of science, where the emphasis on radical novelty is so great that its characteristic products are called discoveries. Scientists typically invoke values that are patently aesthetic in describing their work, such as the mathematicians (of whom Russia had an improbably large number) whose most complimentary term for a difficult equation was "elegant." It is not by chance that Nikolai Lobachevsky is so iconic a figure for the avant-garde, not only because of his great geometry but because his system, based on eccentricity, was so systematically antisystematic.

Natural science seemed to have access to a kind of truth that was more powerful than any other. At a time when extraordinary arguments were being advanced for certain art works not only as being innovative painting, let us say, but as constituting cognitive breakthroughs, the undoubted epistemological power of the sciences held out an irresistible model for what could be claimed. Even before the atom bomb demonstrated the awful majesty of physics, artists obsessed with novelty perceived science as paradigm for an authority they wished to achieve in their own undertaking.

There are many different registers in which this general tendency played itself out. In much of the avant-garde, the marriage between the two discourses is merely a matter of rhetorical convenience, with science invoked as no more than a pool of misappropriated terms, hasty metaphors, and spurious significance. The claim is made, for instance, that, finally, after centuries of amateur and disorganized activity, "the laws of color," or "the rules of sound" had finally been discovered. Not only art but its study would be claimed as now being more scientific in the work of the formalists. Poetics would now emulate the rigor of the precise sciences. Even such antiformalists as Mikhail Bakhtin were greatly influenced by the latest achievements in physiology, theoretical physics, and the new biology.

But for some, the association is more direct. This is particularly obvious, not surprisingly, in the work of those members of the avant-garde who had actually trained in the sciences. At this point in history it need not be argued that the natural sciences played a large role in shaping the consciousness of many avant-garde experimentalists in the world of art. As is well known, the theory and practice of Nikolai Kul'bin, medical doctor as well as painter, was based on complex theories about the physiology of perception, for instance. Less well known is the role played in attempts to marry science and art by Konstantin Tsiolkovsky (1857–1935). Tsiolkovsky was one of Russia's world-class scientists: he is universally conceded to be the father of all practical attempts at space travel, the greatest single name in the history of rocketry (Figure 28). But he was not content merely to achieve in the laboratory: together with such other actual scientists as Alexander Bogdanov, he is one of the pioneers of Russian science fiction as well.

I will not claim that Tsiolkovsky belongs in any obvious way to the tradition of the Russian avant-garde as we now conceive it. As we shall see, there *is* a direct link between Tsiolkovsky and at least one of the major avant-garde movements of the 1920s, OST (Society of Easel Painters), including such artists as Alexander Tyshler, Alexander Deineka, Kliment Red'ko, Sergei Luchishkin, Ivan Kudriashev, and others.[1] I shall have more to say on the subject of Tsiolkovsky and OST below, but it must be recognized that the larger significance of the rocket scientist lies in a more diffuse impact that his vision of free space engendered among utopian artists. Tsiolkovsky did not himself belong to any of the recognized schools within the avant-garde, and for most of his life he worked alone in his private laboratory in the provinces, at a far remove from the urban centers where suprematism and futurism made their way. Nevertheless, Tsiolkovsky relates to the general tendencies of the avant-garde in curious and suggestive ways, not only as a direct influence on OST (especially on Kudriashev) but in a more general way on all those who dreamed of an absolute break with the past through scientific means.

It should be stressed from the outset that Tsiolkovsky's influence in the arts did not result from his literary achievement. It was rather the image of his life (which was turned into one of the central Soviet myths very soon after the Revolution) as a lonely striver after new worlds in outer space that made him an iconic figure for utopians in art. Tsiolkovsky's place in literary history is honorable, but, as things now stand, considerably less secure than his scientific reputation. If he is remembered at all, it is as the author of *Beyond the Earth* (*Vne zemli*), a utopian vision of the future often bracketed with Bogdanov's *Red Star* (*Krasnaia zvezda*) as one of the early examples of a novel organized around what we now recognize as space travel.

The story of Tsiolkovsky's direct influence is quickly told. Kudriashev, an important member of the left-wing movement OST, was the son of a master model builder. In this capacity the elder Kudriashev had been invited by Tsiolkovsky to Kaluga, where the rocket engineer needed someone who could create wooden mock-ups of his machines. The young art student accompanied his father on this journey, and actually helped his father translate Tsiolkovsky's technical drawings into minuscule space ships. The relation of the new sense of cosmic, interplanetary space to the manner in which space was perceived on earth became a major preoccupation of Kudriashev. As the artist himself would write, it was his aim to provide in his paintings "a realistic expression of contemporary perception of space . . . that is the substantial novelty that today is producing the space-painting [*prostranstvennaia zhivopis'*].[2] The connection of interplanetary travel to the striving of OST members can be demonstrated in a number of ways, as in the 1922 construction by Vladimir Liushin entitled *A Station for Interplanetary Communication* (Figure 29).

In the golden years of the Russian avant-garde, the fascination with new conceptions of space that we perceive in Kudriashev and the obsession with communication across vast distances that we see in Liushin are traits not confined to these two artists or even to the school to

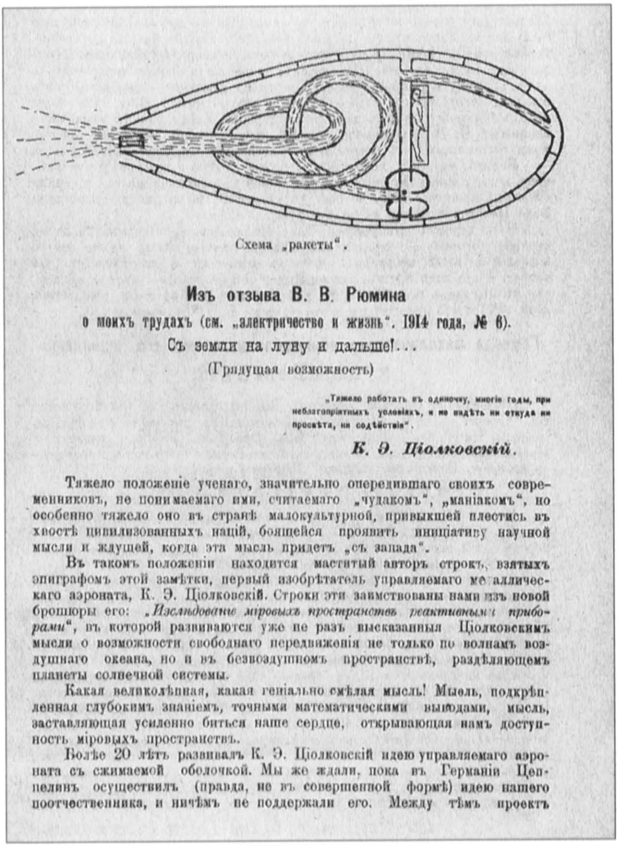

Схема „ракеты“.

Изъ отзыва В. В. Рюмина

о моихъ трудахъ (см. „электричество и жизнь“. 1914 года, № 6).

Съ земли на луну и дальше!...

(Грядущая возможность)

„Тяжело работать въ одиночку, многіе годы, при неблагопріятныхъ условіяхъ, и не видѣть ни откуда ни просвѣта, ни содѣйствія“.

К. Э. Ціолковскій.

Тяжело положеніе ученаго, значительно опередившаго своихъ современниковъ, не понимаемаго ими, считаемаго „чудакомъ“, „маніакомъ“, но особенно тяжело оно въ странѣ малокультурной, привыкшей плестись въ хвостѣ цивилизованныхъ націй, боящейся проявить иниціативу научной мысли и ждущей, когда эта мысль придетъ „съ запада“.

Въ такомъ положеніи находится маститый авторъ строкъ, взятыхъ эпиграфомъ этой замѣтки, первый изобрѣтатель управляемаго металлическаго аэроната, К. Э. Ціолковскій. Строки эти заимствованы нами изъ новой брошюры его: *„Изслѣдованіе міровыхъ пространствъ реактивными приборами“*, въ которой развиваются уже не разъ высказанныя Ціолковскимъ мысли о возможности свободнаго передвиженія не только по волнамъ воздушнаго океана, но и въ безвоздушномъ пространствѣ, раздѣляющемъ планеты солнечной системы.

Какая великолѣпная, какая геніально смѣлая мысль! Мысль, подкрѣпленная глубокимъ знаніемъ, точными математическими выводами, мысль, заставляющая усиленно биться наше сердце, открывающая намъ доступность міровыхъ пространствъ.

Болѣе 20 лѣтъ развивалъ К. Э. Ціолковскій идею управляемаго аэроната съ сжимаемой оболочкой. Мы же ждали, пока въ Германіи Цеппелинъ осуществилъ (правда, не въ совершенной формѣ) идею нашего поотчественника, и ничѣмъ не поддержали его. Между тѣмъ проектъ

Figure 28. Konstantin Tsiolkovsky, *Design for a Rocket*, ca. 1914. Reproduced from *Russian Space History*, catalog of auction (New York: Sotheby's, Dec. 11, 1993), lot 1; © 1993 Sotheby's, Inc.

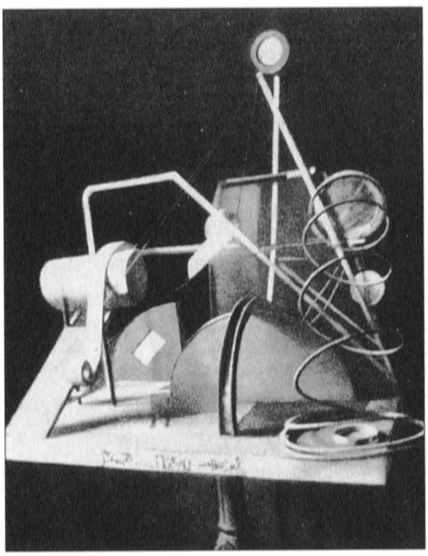

Figure 29. Vladimir Liushin, *A Station for Interplanetary Communication*, 1922, model. Whereabouts unknown. Photo: Galart.

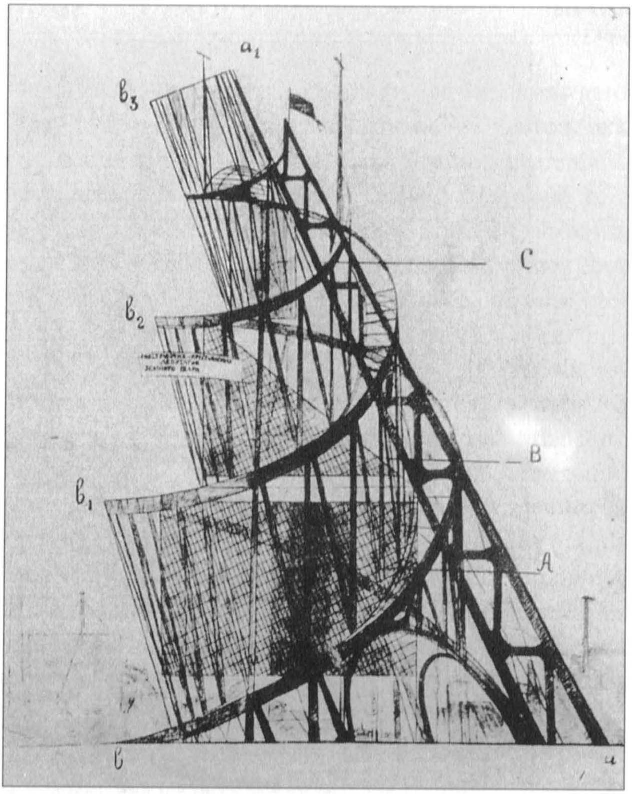

Figure 30. Vladimir Tatlin, *Design for the Model of the Monument to the Third International*, 1919–20. Reproduced from Nikolai Punin, *Pamiatnik III Internatsionala* (Petrograd: IZO NKP, 1920), p. 7.

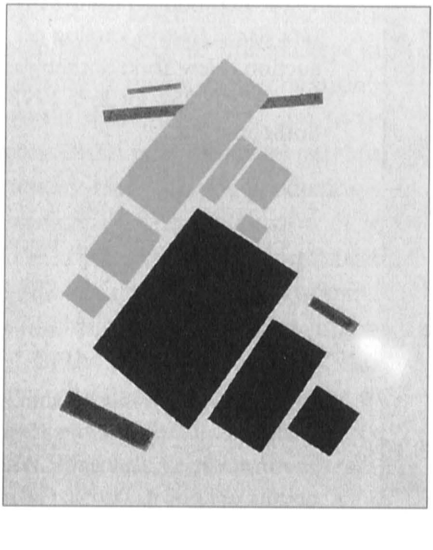

Figure 31. Kazimir Malevich, *Airplane Flying*, 1915, oil on canvas, 57.3 cm × 48.3 cm. Museum of Modern Art, New York.

which they belonged. One need only think of the general interest in electrification and radio transmitting that was to be found even in government circles at this time. Vladimir Tatlin's famous tower may be understood as part of this striving for new breakthroughs to vaster distances (Figure 30). One of the more dramatic examples of extending space was in the work of Kazimir Malevich (Figure 31), as well as his followers in UNOVIS (Affirmation of the New in Art), who went out into the city of Vitebsk, painting streets and buildings in an effort to redefine the space of performance.

All of this emphasis on striking through the mask of the merely visible in order to win a place in an immense new dimension is nowhere more paradigmatically at work than in the achievement of Tsiolkovsky. Since he was obsessed by transcending borders and thus is not easily contained within a single discipline, his place requires a term that goes beyond the two obvious but potentially polarizing categories of science and art. I propose to invoke narratology, an area that lies somewhere between the borders of science and literature, as the category that best defines Tsiolkovsky's dual achievement as it is now understood. "Narratology" has a pretentious, scientistic ring, and is compromised, moreover, by some of the excesses practiced in its name by French structuralists in the early 1960s. But flawed as the locution is, "narratology" still seems to be the most comprehensively accurate term to describe the study of narrative forms as they condition all utterance, not just literary texts.

Briefly stated, my thesis is this: Tsiolkovsky's importance is not confined to the specific features he influenced or shared with particular artists in the Russian avant-garde in the 1920s, for his career demonstrates even today the universal role that emplotment plays in any attempt to organize information, independent of discursive considerations (the intralanguages of professions, classes, generations, etc.) or speech genres. His achievement elucidates the relation between experimental method, the specific structure of perception characteristic of human beings, and what I shall call the "parabolic mandate," that is, the human imperative to shape the world through allegories.

Tsiolkovsky is concerned with experiment that will lead to new knowledge not only in his scientific work but in his stories: he uses narrative as a discovery procedure. Thus one of the more interesting aspects of Tsiolkovsky's work may well be the unexpected light it throws on two forms of thought usually considered to be mutually exclusive—thinking in the natural sciences on the one hand, and in the human sciences on the other.

Tsiolkovsky's discoveries put him in the first rank of those men who occupy the heterogeneous category of visionary inventor, creators who work in the space between the thin air of science and the thingy particularity of the carpenter or blacksmith's shop. Tsiolkovsky laid most of the foundations necessary to make, launch, and navigate rockets as we now know them. In addition, he was first to experiment with techniques to sustain life inside such ships, once they had left the earth. He developed aerodynamic testing methods for rigid air frames; he solved the problem of rocket flight in a uniform field of gravitation; he engineered gyroscopic stabilization of rocket ships in space; he invented the kind of fuel needed to overcome the earth's gravitational pull; and he discovered a method for cooling the combustion chamber with ingredients of the fuel itself (a method still used in most jet engines). As early as the 1870s he designed and built a centrifugelike contraption to test the effects of rapidly increased gravitational acceleration on living organisms, demonstrating principles that would enable the Soviets to launch not only the first sputnik but the first living beings into space. Tsiolkovsky also did original work on solid fuels, multiple-stage rockets, and space stations. Even this partial catalogue of his achievements makes it clear why he is universally recognized as the father of the space age.

Since at least the mid–nineteenth century a peculiar synergy has been at work between the political avant-garde (understood as utopian social construction) and the cutting edge of Russian scientific achievement. In no combination is this interaction more apparent than in the relation between visionary politics and the science of rocketry. One icon of this confluence is Nikolai Kibal'chich, the engineering student who designed the bomb used by the political party People's Will (Narodnaia Volia) to assassinate Alexander II. Condemned to death in 1881, Kibal'chich spent his last days in feverish activity that resulted in a blueprint for the first viable model of a jet-propulsion engine. The secret police confiscated Kibal'chich's notes, and his design resurfaced only after the Revolution, once again demonstrating the close filiation between politics and science in Russian history. Kibal'chich is important for the story I wish to tell because he so perfectly manifests the relation between utopian politics and scientific innovation that seems a distinctive trait of the Russian cultural system.[3]

It is, in any case, a paradigm that best accommodates the extraordinary career of Konstantin Tsiolkovsky, as even the briefest account of that career demonstrates. His mother died early, and his father, an itinerant forester, was seldom home. This misfortune was compounded by the fact that Tsiolkovsky was almost completely deaf; hence his prospects for getting a decent education were remote. Nevertheless, in 1873, at the age of sixteen, Tsiolkovsky left Viatka for Moscow, determined to educate himself by prodigious reading in a good library. After five years of self-directed study in the capitol, Tsiolkovsky passed the examination required to become a high school teacher, and returned to the provinces—first to Borovsk and then to Kaluga, where he remained for the rest of his life.

As early as his period in Moscow, but more intensely after settling in Kaluga, Tsiolkovsky filled notebook after notebook with abstruse mathematical formulae and strange drawings of men floating inside the gravity-free environment of asteroids, indeed, whole maps of the solar system, charted with the easy familiarity with which one might model a neighbor's yard. In the next decades the high school teacher from Kaluga virtually invented rocketry, but it was only after the Revolution that his work was recognized for the extraordinary achievement it was.

But I wish to draw attention less to the importance of Tsiolkovsky's scientific work, which is in any event well documented, than to the relation that work bears to the vision that gave it rise. Tsiolkovsky is similar to Kibal'chich in that his inventions were never supposed to be ends in themselves, but were intended rather as the means to a greater end. Although Tsiolkovsky had tinkered with inventions since early childhood, it was only when he went to work as a teenager in the Chertkov library that he found a worldview adequate to his creative gifts, for it was in Moscow that he encountered the man who was to change his life forever, Nikolai Fedorov (1828–1903).

Fedorov, the librarian of the Chertkov library, was that same scholar whose ideas were to prove so compelling not only for Tsiolkovsky but for Tolstoy, Dostoevsky, Vladimir Solov'ev, Vladimir Vernadsky, and many others. He is remembered as the author of a strange and little-read work, *The Philosophy of the Common Task* (*Filosofiia obshchego dela*, 1906/7, 1913), whose notoriously eccentric argument is that everyone on earth must stop wasting time, effort, and lives killing each other in wars and recognize that our great adversary is chaos and chance, forces which find their definitive expression in death: death conceived as entropy in the cosmos and as the end of the person for human beings. Death is the great enemy, to the overcoming of which we should bend all our efforts, for ourselves, for all others now living, and for our dead ancestors as well. This last is perhaps the most radical aspect of Fedorov's thought: the search for ways to bring back from the dead—*physically* to resurrect—our parents.

Fedorov took great interest in all aspects of science and gave science a central role in his thought because he felt that only through science would the means ultimately be found to raise the dead. The "regulation of nature," the point in history at which the human mind would introduce design and purpose into the workings of a formerly blind and chaotic world, is at the heart of Fedorov's argument.[4] It represents a new epoch in the evolutionary process: the conscious stage of evolutionary development.

Fedorov's thought is in some sense a peculiar combination of Orthodox kenoticism (a teaching about the holiness of matter) and a Frankenstein-like conviction that through science (in whose several branches he was immensely well read), man may become what Mary Shelley called, in the subtitle of her novel, "the New Prometheus." This strange mix is reflected in Fedorov's style, which brings together elements of the archaic language of Old Church Slavonic and the latest professional jargon from the avant-garde of science as it was constituted during Fedorov's lifetime. It is as if one were to describe subatomic physics in the language of the King James Bible. What we have learned to call cosmonautics interested Fedorov in particular, because he foresaw the need to find on other planets the *Lebensraum* that would become necessary after all the dead were brought back to life, as well as new sources of food and other necessities.

Tsiolkovsky's technical innovations, then, were all in the service of this great visionary scheme. The distinctive feature of Tsiolkovsky's particular appropriation of the "philosophy of the common task" is a recurring pattern of revolt against static forces he saw confining the capacity of human beings to change and innovate. It was the same rebellion against fixity as energized Fedorov, but the name of the enemy was different. Fedorov had a religious conception of life as an infinite capacity for growth and change; death was to be fought because it was the most powerful form that the great force of sameness, of stasis, took in the universe. Tsiolkovsky, too, had an essentially Manichaean conception of the struggle between the dynamic energies of plasticity and the force of stasis. But instead of conceiving the enemy as a generalized transcendental called "death," Tsiolkovsky saw his antagonist in the constraining physical force of gravity. Early and late he characterized himself as the "gravity-hater," and he constantly celebrated the metaphysical as well as the physical dimension in *svobodnoe prostranstvo* ("*free* space"), the Russian term for what we call "outer space" in English.

Tsiolkovsky conceived existence as a vast Manichaean struggle between the dark forces of stasis and the bright forces of life. This struggle he modeled most manifestly in his scientific work, all of which was dedicated to liberating humans from the totalitarian restriction of gravity so that they might realize the full potential of their plasticity in the liberty of free space. But I would like to argue that Tsiolkovsky fought this battle in his fiction as well. I refer here specifically to the feature of Tsiolkovsky's stories that has been identified precisely as making them most primitive: the degree to which they are merely crude vehicles (a term that in Tsiolkovsky's fiction must be taken almost literally) for scientific propaganda. They are indeed at this level as crude as the most egregious examples of Socialist Realism, for they have no fully realized characters and their plots exist merely to display the author's message. But the difference between most other allegories and those of Tsiolkovsky is this: the moral that energizes the apparent action of his stories is always composed of a peculiar combination of ideology and hard science, of preaching about the necessity of exploring the solar system and presentation of mathematical and chemical formulae—the actual formulae Tsiolkovsky had devised for the reactive force needed to lift a spaceship free of Earth's gravitational field or for the chemical compounds required to fuel such a rocket.

In other words, Tsiolkovsky's texts, such as the *Fantasies of Earth and Sky* (*Grezy o zemle i nebe*) or *Beyond the Earth*, are radically hybrid, in much the same way that the texts of his mentor, Fedorov, are hybrid: in both we get a bizarre mixture of wildly utopian religio-political vision and hard data from the natural sciences. The patent conflict between the stylistic levels of their work is merely the most obvious token of the more fundamental oppositions that fuel their thematics: in both, the opposition between the level represented by mathematical formulae on the one hand and the visionary project on the other serves as a formal trope for the contrast between static and dynamic, death and life, which is the ultimate antagonism driving their project.

In Tsiolkovsky's case the contrast has a particular point: his texts are parables in two senses. On the one hand, his tales served as means to publish his work at a time when no scientific organs were open to him—he was so far ahead of other Russian scientists of the time that he was regarded by them as something of a crank. So the stories are allegories of science in the sense that the adventure plots—involving castles in the Himalayas and a fantastic international community of geniuses with obviously allegorical names like Newton for the Englishman, Laplace for the Frenchman, and Galileo for the Italian—exist only to provide a thin veneer of fictive narrative overlaying the real science contained in their lectures. Tsiolkovsky was not merely doing what so many others at the same time were doing, that is, popularizing science; he was using two-layered narrative as a vehicle to broadcast his own scientific breakthroughs. On the other hand, his texts are not just parables about science; they are also parables about parables. Their major thematic impulse—the overcoming of a gravitational force that seeks to keep dynamic, energetic human beings locked in their prison of the planet Earth, with an eventual breakout to "free space"—is relatively banal, as such. But the formal registers of Tsiolkovsky's tales are more interesting than that—and accord him a more significant place of honor as an author. The most distinctive of these formal features in his tales is, as we have noted, the peculiar manner in which the most rigorously precise chemical and mathematical formulae are stitched into adventure plots that have narratological filiations going back to ancient Greek romance.

By dramatizing the opposition between stasis and dynamism (the inert repeatability of the mathematical and chemical formulae) in so patent a manner, however, Tsiolkovsky lays open a contradiction built into all narrative, the gap that the formalists called the difference between *fabula* ("story") and *siuzhet* ("plot"). There are many ways to read this distinction. But even on the most simplistic reading, as the difference between a strictly chronological order that can be assigned to events in *any* sequence (*fabula*) and the play and subversion of absolute chronology in the specific ordering of events as they are arranged in any particular narrative (*siuzhet*), it becomes clear that the distinction has a metaphorical significance greater than the claims of mere narrative analysis. The opposition between story and plot is what enables narrative as such to be read as an allegorical meditation on order and freedom. Every tale has a meaning, a life, if you will, that comes about through the loophole in fabular restrictions in its story that are created by the free play of its own plot. In all stories there is an attempt to get away from the gravitational field of brute chronology and into the free space of more imaginative orderings that are more adequate to the human desire to be free of external restraints. In all stories there is an attempt to get away from the gravitational field of brute chronology and into the free space of more imaginative orderings that are more adequate to the human desire to be free of external restraints. In the Manichaean universe of narrative, the deathly stasis, the structural rigor mortis of sequentiality, must always be resisted by playful emplotments that figure the dynamism Tsiolkovsky celebrated as life.

In other words, the two aspects whose simultaneity define the structure of narrative as such—events bound to chronology in story, and free play with events in plot—neatly capture in literary form the two aspects of Tsiolkovsky's life project: to use the mechanical, repeatable attributes of physics and chemistry (as it were, the *fabula*, or story aspects, of science) in the service of all that is precisely NOT mechanical, the value he and his mentor Fedorov called "life." It is useful to remember that Fedorov's project was to bring those trapped in the rigor mortis of death back to active life, and that Tsiolkovsky's science was dedicated to overcoming the stasis to which he felt gravity condemned people on Earth, so that they might exploit "free space" to realize the full plasticity of their potential development.

In each case, there is a kind of dialectical relation between something characterized by its *stasis* ("death," "gravity") and something characterized by its *movement* ("life," "free space"). In Tsiolkovsky's fiction this opposition is manifested at the level of thematics in the conflict between natural forces and the human striving they restrict, gravity making earth less a planet than a prison. But the opposition is also the source of energy driving the narrative that fuses the mechanical elements of his tale (the chronological story) together with the tale's playful elements (the subversion of the brute chronology whose loops and gaps constitute the plot). What I wish to argue is that the formal aspect of Tsiolkovsky's achievement enacts Tsiolkovsky's thematic project in ways that are instructive for understanding story/plot dynamics as such.

The argument I wish to make requires two steps. The first is the recognition that the central opposition of Tsiolkovsky's project—scientific as well as literary—between stasis and movement, is built into a particular way of viewing the world, the kind of thinking characteristic of the scientific method. The second step is the demonstration that "scientific method" is a particular appropriation of a narrative pattern far more pervasive than its recognition as such. Indeed, as the formal structure enabling a life to be organized into a biography, the pattern of "scientific method" is the master narrative of all master narratives.

This way of putting things may appear slightly less bizarre if I specify "scientific method" in more detail. I have in mind here what Arthur Danto has called "beautiful science."[5] Danto's account of "beautiful science" begins with his gloss on the famous 1986 issue of the journal *Science*, which contained two articles by Jeremy Nathans and his team at Stanford University. In these articles Nathans reported how his group had isolated the genes that control the perception of color: using DNA probes, they analyzed defects in the DNA of various categories of dichromates until they determined the precise protein moieties or "opsins" on the X chromosome that specify the three primitives out of which all others are made, the red, green, and violet centers excited by, respectively, long, medium, and short waves. The importance of this research was not only that it clarified issues that had historically engaged figures as important as Newton, Dalton, Goethe, and von Helmholtz but that it provided overwhelming evidence that specific *genes* determine specific *functions.*

Their work in genetics was, in other words, just as "scientific" in the sense of being an ahistorical, mathematically determined "story" as Tsiolkovsky's various formulae in the combined disciplines that make up rocketry. But unlike Nathans and his colleagues, Tsiolkovsky took a philosophical view of the determinism built into such sequentiality, seeking to complicate it in liberating "plots." It is in this move that Tsiolkovsky may be read as contributing not only to our understanding of the natural world through his science but to our understanding of the distinctively human need for narrative in his fiction.

The papers by Nathans and his associates were felt to be so important that the editors of *Science* provided an introduction by the distinguished geneticist David Botstein, who praises Nathans's work both for the particular contribution it makes to chromatics and genetics and for the illuminating way it illustrates the journey from "discovery" to "understanding" that is the necessary structure of scientific method in general. Scientific method is really a means to describe a particular form of beginning, middle, and end. Botstein lays bare this narrative structure when he writes:

> *First*, the confrontation of the human mind with a natural phenomenon, *then* its investigation through observations and experiments, the continual proposal of theories, the testing of predictions, and *finally*, in the best case, the convincing demonstration of the validity of one of the theories through confirmation of its specific predictions. The process can take only a few years and involve only a few scientists or it can span centuries and involve many. . . . In either case, a full scientific *story*, especially one that has been unfolding over historic times, can be a lovely thing, like a classical symphony or a Gothic cathedral.[6]

This, then, is what Danto calls "beautiful science." And he begins by pointing out a curious dichotomy in scientific method so understood, a dichotomy that the formalists charted between "story" and "plot," and that Tsiolkovsky works out as the contest between "stasis" and "movement."

There is in the work of the Stanford researchers much that would have been *un*familiar to scientists in the past. "To all the earlier investigators in this history, beginning with Isaac Newton, John Dalton, Thomas Young . . . von Helmholtz and James Clerk Maxwell, some components in Nathans's work would have been incomprehensible in terms of the science of their day: they lacked the theoretical matrices for understanding various of its central terms [such as 'DNA,' 'opsins,' etc.]. All of them, on the other hand, would have . . . accepted the general picture of Beautiful Science which Nathans's work, like their own, very adequately exemplifies."[7] And just as the science of Nathans and his colleagues is both the same (in its method) and different (in its content) from the science of Newton and Maxwell in the past, so it is that all *future* science will be both the same (it must always articulate the three-part story Botstein identifies as experimental method) and different (it will always plot different constituents in that sequence) from what it now is. If we think of science as Botstein and Danto do, then "we really know what there is to know about the science of the future. It will be as much like it is today two centuries hence as it was two centuries ago. Nothing can be science which greatly differs from what science is today. But if we mean the future exemplars of Beautiful Science, well, we can have as dim an idea of what they will be in time to come as Newton or Dalton would have had two centuries ago."[8] In other words, the matter of future science will always be *other*, but experimental method will always be a *limit* (although very capacious and elastic) on what that otherness can be. It will constrain scientists as a law governing their procedure in the same way that the law of gravity constrains humans to remain on Earth in Tsiolkovsky's vision of planetary imprisonment.

Beautiful Science is recognizably a post-Kantian understanding of how humans relate to the world insofar as it presupposes that the mind can know the world, but only at a remove, since things in themselves are denied to the mechanisms of our perception. Humans always and everywhere seek to make sense out of the world, and to a large extent they succeed in doing so. But their attempts are always only approximate, they never get to know nature as it is in itself (the thinginess of the "thing-in-itself"). For if they did, there would be no need to distinguish between different accounts of the relation between mind and world that have evolved in different times or in different places: there would be no need to have a history, or an anthropology, in other words. Scientific method is mandated by post-Kantian assumptions about the cutoff between mind and world: the only way we can get to know what is out there is by making experiments that will gradually establish a balance (of sorts) between what we think of nature and what nature *is*.

At the heart of "scientific method" understood in this way are two questions that need to be brought forward. In most accounts of differences between the natural and the human sciences these questions have gone unanswered. Those two questions are, first, *what* is it that the mind represents, and second, whatever that may be, how is that which gets represented affected by differences in the specific forms used to represent it? The challenge was put in starkest terms by Wilhelm Windelband, largely because he had so single-mindedly concerned himself with the question of how different professional discourses revealed different aspects of the world. As early as 1882 (in the address "Was ist Philosophie?"), Windelband had divided knowledge into two master categories, which, following Kant, he called judgments: theoretical judgments (*Urteile*), and critical judgments (*Beurteilungen*). In the former, connections between two or more representations are synthesized; in the latter the connection between representation and what is being represented is evaluated.

Theoretical judgments are related to expanding the knowledge a particular profession's discourse has of the world: they seek greater scope of connectedness. Critical judgments, on the other hand, are restrictive. They determine whether the assumptions of a discourse are valid, or *not*, in situations that call for testing relations between a particular world picture and what is "out there," that is, the world that the world picture is straining to represent. The importance of this distinction is the prior assumption on which it is based: that the feature distinguishing different professional discourses from each other was not to be sought in *what* they studied but in *how* they studied it, that is, in the categories they used to organize their representation of what they were studying. The formulation of this view that proved most influential was contained in another of Windelband's addresses, "History and the Natural Sciences" (1894). It was here that the famous distinction between generalizing ("nomothetic") pursuits that sought to formulate laws and ("idiographic") discourses devoted to unique events in all their specificity was first drawn.

I suggest that this distinction parcels out the activity of perception in many of the same ways as are to be found in the dialectic between story (*fabula*) and plot (*siuzhet*). Story can be reformulated as the aspect of narrative that is invariant and normative, and thus always prior to events contained in any particular narrative. Story then has much in common with the aspect of experimental method Botstein labels, in fact, story: "*First*, the confrontation of the human mind with a natural phenomenon, *then* its investigation through observations and experiments, the continual proposal of theories, the testing of predictions, and *finally*, in the best case, the convincing demonstration of the validity of one of the theories through confirmation of its specific predictions." Windelband's term "nomothetic," which refers to this aspect of experimental method, may be used to name the distinctive feature of scientific method. It focuses on the invariant aspect of narrative (the necessity of chronology, as in Botstein's "first, . . . then . . . and finally."

Plot in these terms is best understood as something more than the inert details of a particular telling (the aspect that makes them "idiographic" in Windelband's terms). To leave things at this level would be to fail to see the active force at work in plot. The story/plot distinction is not a mere contrast between form (nomothetic, lawlike, determined, story in its aspect of chronology) and content (a lifeless inventory of particulars organized by brute chronology). What is important about these oppositions is that their terms are defined by the pattern of their relation to each other, and not only according to categories inhering in them as hermetically closed series. The potential chaos of potential events in all their specificity is contained by plot's constant subversion of story's lawful regularities. What is significant for the argument I am pursuing is not so much the singularity of each event but the necessity of their interaction. Nomothetic thinking gives authority to the normative, abstract, structural, and formal power of story in its explanations—colors it "scientific." Idiographic thinking gives a worldview that privileges those aspects of detail, difference, and specification that in narrative terms are the proper province of plot.

Kant plays so important a role in this account because he is so deeply woven into the fabric of nineteenth-century science in which Tsiolkovsky was formed. From the publication of his first critique, Kant has constantly been invoked in this tradition, but always with an important modification: each subsequent generation has had its own means of *materializing* Kant's positing of time and space as forms of transcendental intuition. The natural sciences play an important role in this story because the facts they engage seem to hold out the severest challenge to all claims that the mind, in one way or another, intercedes between itself and things-in-themselves and thus distorts our knowledge of the world outside mind. Helmholtz agrees with Kant about the privilege of time and space in controlling all acts of perception; there is no perception without time and space, but Helmholtz locates the agency of such intuition in a positivistic world of nineteenth-century scientific facts: he insists on the principle of specific nerve energies, with the result that time is assigned to the physiology of the human nervous system, and space is understood as mathematically determined. Nevertheless, time and space in Helmholtz have an indubitably formal status. Kant's balance between mind and world has been shifted: objective facts laid up in nature are now seen to determine meaning. There has been a tilt toward the world, where "world" is understood as nature.

Tsiolkovsky wraps up, as it were, all the factors of this formal tendency to reauthorize the world's power over mind into one principle: the force of gravity. At the thematic level, his heroes escape from the dead hand of gravity into the freedom of infinite space. And at the narrative level Tsiolkovsky complicates the determinacy of his mathematical formulae by weaving them into a tale of adventure. At both levels, exploration is the major project subsuming all others. Tsiolkovsky's fiction not only celebrates the experimental method, it enacts it.

In doing so, Tsiolkovsky brings out the relation between experimental method, narrative, and freedom. If we begin by accepting the main tenets of the post-Kantian scientific tradition in which Tsiolkovsky was working, the external world is in the strictest sense unknowable. Not only do we choose to make and test hypotheses, then, but we are in the most essential features of our constitution as human beings *condemned* to experiment. All our worldviews are more or less fictions, the difference between them being the degree to which they manifest different degrees of effectiveness as judged by the subjects who construct them, where "subject" is understood as both the individual person and the collective of subjects we call society.

We are all, then, scientists in the laboratory of our own lives. Conscious life is a process of constant experiment as we seek through our categories and inventions to know and use the givens of the world. It follows that the narrative pattern hidden in scientific accounts of experimental method ("*First*, the confrontation of the human mind with a natural phenomenon, *then* its investigation through observations and experiments, the continual proposal of theories, the testing of predictions, and *finally* . . . the convincing demonstration of the validity of one of the theories through confirmation of its specific predictions") is only the appropriation within a particular set of discourses ("science") of a structure whose presence is far more pervasive.

Science's connection to the master narrative that underlies it becomes more apparent if we recognize that "experimental method" is essentially a form of allegory, an "other speaking" in which objects and persons in the tale are equated with meanings that lie outside the narrative itself. A parable is the form of allegory that most rigorously seeks to parallel each aspect of its form with precise analogues in the structure of meanings to which it refers for its meaning. In addition a parable usually has a moral. In its etymological sense of "throwing beside," a parable is a story that illustrates the presumed truth of something else. Thus all scientific formulae are parabolic in at least this: they seek to model in the series of mathematics something other, a structure in the world of nature.

But the world will always transcend in its totality the finite and limited description of it available in any account we give. It is the case that the totality to which the scientist's descriptions must apply is never given. Thus all systems are condemned to leak, which is why such thinkers as Bakhtin in his most new-Kantian phase will valorize the ineluctability of loopholes as a key to our freedom as subjects.

By turning his science into fiction (in quite the way he did), Tsiolkovsky the avant-garde rocketeer creates parabolic illustrations, then, of the ineluctability of parable, and the hint of freedom such apparent necessity holds out for other avant-gardes yet to come.

112–14; see also Prof. Biksbi [Bixby?], "Ot luchei Rentgena k sushchestvovaniiu dushi," *Rebus*, 1899: 48, 57; on the occult reading of X-rays in the West see Henderson, "X Rays," p. 326.

47. Henderson, "X Rays," p. 332.

48. Crafton, *Cohl*, p. 353.

49. See Glasser, *Roentgen*, p. 369; Henderson, "X Rays," p. 333.

50. Alexander Belenson, *Kino Segodnia* (Moscow, 1925), p. 81.

51. On monodrama, particularly in connection with Boris Geier's experimental playlets, see Laurence Senelick's excellent "Boris Geier and Cabaretic Playwriting," in Robert Russell and Andrew Barratt, eds., *Russian Theatre in the Age of Modernism* (New York: St. Martin's Press, 1990), pp. 33–65.

52. John E. Bowlt, "An Eventful Interior: Some Thoughts on the Russian and Soviet Cabaret," in Stephen C. Foster, ed., *"Event" Art and Art Events* (Ann Arbor, Mich: UMI Press, 1988), p. 87.

53. *Life as the Theater: Five Modern Plays by Nikolai Evreinov*, trans. and ed. Christopher Collins (Ann Arbor, Mich.: Ardis, 1973), p. 25; for the Russian original text see N. Evreinov, *Dramaticheskie sochineniia* (St. Petersburg: Tip. Sirius, 1913), 3: 34.

54. Gunning, "Horror of Opacity," p. 11.

55. John L. Greenway, "Penetrating Surfaces: X-Rays, Strindberg and *The Ghost Sonata*," *Nineteenth-Century Studies*, 5 (1991): 41.

56. Homo Novus [A. Kugel'], "Zametki," *Teatr i iskusstvo*, 35 (1913): 682.

57. On this project in connection with contemporary tendencies in architecture see M. Iampolsky, "Stekliannyi dom kak kinematograf," *Kino* (Riga), 8 (1986): 11–23; by the same author, "Le Cinéma de l'architecture utopique," *Iris*, 7 (1991): 1.

58. S. Eisenstein, "S. Eisenstein's *Glass House*," ed. N. Kleiman, *Iskusstvo kino*, 3 (1979): 95–96. The original is in English.

59. Ibid., p. 107. The spellings "nudiste" and "succombes" are in the original.

60. Ibid.

61. Henderson, "X Rays," p. 331.

62. Eisenstein, "S. Eisenstein's *Glass House*," pp. 103–4.

63. Laszlo Moholy-Nagy, "A New Instrument of Vision," in Richard Kostelanetz, ed., *Moholy-Nagy* (New York: Praeger, 1970), p. 52.

Holquist: Tsiolkovsky in the Prehistory of the Avant-Garde

1. V. Kostin, *OST (Obshchestvo stankovistov)* (Leningrad: Khudozhnik RSFSR, 1976). See especially the chapter "Istoriia vozniknoveniia Obshchestva stankovistov i ego ideino-khudozhestvennye osnovy," particularly pp. 24–26. For reference to OST, I am grateful to my friend—and in all matters having to do with Russian art, my mentor—John Bowlt.

2. Quoted in Kostin, *OST*, p. 25.

3. We should remember in this regard the dissimilar but telling cases of Lomonosov in the eighteenth century, Sechenov and Mendeleev in the nineteenth, and Bogdanov and Vernadsky in the twentieth.

4. The "regulation of nature" is also the aspect of Fedorov's thought linking him to Vernadsky's concept of "noosphere."

5. Arthur C. Danto, "Beautiful Science and the Future of Criticism," in Ralph Cohen, ed., *The Future of Literary Theory* (New York: Routledge, 1989), pp. 370–85. I note in passing that Danto has dedicated a whole volume to the theme of narration in knowledge (*Narration in Knowledge* [New York: Columbia University Press, 1985]), so it is perhaps not surprising that he is sensitive to the narratological implications in any epistemology, and in science in particular.

6. Quoted in Danto, "Beautiful Science," p. 370, my emphasis.

7. Danto, "Beautiful Science," p. 370.

8. Ibid., p. 372.

Misler: Toward an Exact Aesthetics

1. E. A. Nekrasova (1905–89) graduated in art history in 1929 from the University of Moscow, where she also taught the subject later on. Her specialty was the visual arts of Russia and Europe. Her description of Florensky (below) comes from an interview that I conducted with her in Moscow in July 1986.

2. No exhaustive appreciations have been published on RAKhN/GAKhN. Founded officially in October 1921, RAKhN was divided into three departments: the Psychophysiological Department, directed by Vasilii Kandinsky; the Philosophical Department, directed by Gustav Shpet; and the Sociological Department, directed by Vladimir Friche. There were subsections within these departments devoted to the visual arts, literature, music, and the theater, as well as so-called laboratories. RAKhN changed its name to GAKhN in 1925 and then, in 1930, was reorganized into GAIS (State Academy of Art History) and transferred to Leningrad. However, after the arrest and exile of many of its primary members, GAKhN lost its original profile, even though it survived as an institution until 1936. For some information on RAKhN see Anon. [A. A. Sidorov], "Akademiia khudozestvennykh nauk," *Nauka i iskusstvo*, 1 (1926): 208–12; P. Kogan, "Gosudarstvennaia Akademiia khudozestvennykh nauk," *Pechat' i revoliutsiia*, 7 (1927): 293–99; T. Pertseva, "O deiatel'nosti Akademii khudozestvennykh nauk (1921–1930)," *Problemy istorii sovetskoi arkhitektury*, 3 (1977): 52–57; and A. Sidorov, ed., *GAKhN—Otchet: 1921–1925* (Moscow: GAKhN, 1926). I will use the acronym RAKhN throughout my text.

3. P. Florensky, *Analiz prostranstvennosti i vremeni v khudozhestvenno-izobrazitel'nykh proizvedeniiakh* (Moscow: Progress, 1993).

4. Letter from Florensky to his daughter Olga, sent from Solovki on May 13, 1937, in Igumen Andronik [Trubachev], M. S. Trubacheva, T. V. Florenskaia, and P. V. Florensky, eds., *Sviasch. Pavel Florensky. Detiam moim.*

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