

Drenka Dobrosavljević

Nikola Tesla

(1856–1943)

Knowledge, Thought and Work

Nikola Tesla's Self-Education with References to His Schooling

Editor
Zoran Kolundžija

Cover design
Frano Kršinić *The Monument of Nikola Tesla* in front of the Faculty of Electrical Engineering in Belgrade, detail
Photographed by
Dragan Bosnić

Copyright © IK Prometej, 2023.

This project is co-financed from the budget of the Republic of Serbia – Ministry of Culture and Information
and supported by company VISAN

DRENKA DOBROSAVLJEVIĆ

NIKOLA TESLA

(1856–1943)

Knowledge, Thought and Work

Nikola Tesla's Self-Education, with
References to His Schooling

Translated from Serbian by
Angelina Čanković Popović



PROMETEJ

*To my mother, father,
brother
and my Zvonko*

*I had studied a dozen languages, delved in literature and art, and had spent my best years in ruminating through libraries and reading all sorts of stuff that fell into my hands. I thought to myself, what a terrible thing it was to have wasted my life in those useless efforts. If I had only come to America earlier and devoted all my brain power to inventive work, what might I have done? In later life though I realized I would not have produced anything without the scientific training I got, and it is a question whether my theory as to my possible accomplishment was correct.**

Nikola Tesla

* Nikola Tesla, “Speech on Behalf Edison Medal Prize” in: *Lectures*, scientific editor Vojin Popović, 279–289 (Beograd: Zavod za udžbenike i nastavna sredstva, 2016), 286.

CONTENTS

Foreword	11
Introduction.....	25
On Realschulen, Polytechnische Schulen and Universities, and about the Researches in Tesla's Schooling	31
<i>'Real Subjects', Polytechnic Schools and Universities</i>	35
About Tesla's Intuition and His Most Significant Contributions to Power Engineering, Wireless Transmission and Mechanical Engineering	43
Knowledge, Scientific Principles – the Principles in Physics, Mathematics, the Method and Mental Elaborations.....	53
<i>Protopresbyter Milutin Tesla</i>	57
<i>The Method</i>	69
<i>Mathematics</i>	74
<i>Professors and a Few More Words about Mathematics</i>	81
Lectures, Studies, Articles	87
What do we learn from Tesla's scientific/technical lectures about his familiarity with philosophy, history of science and the philosophy of sciences?	87
<i>Studies and Articles</i>	108
A Conclusion on What We Learn about Tesla's Self-Education and Thought from his Lectures, Studies and Articles	127

Toward a Summary:	131
References	153
<i>Correspondences and transcripts as sources</i>	162
<i>Original documentary materials as sources</i>	162
About the Author	163
<i>Selected works</i>	164
Supplements	
<i>K. K. Ober-Realschule zu Rakovac</i>	175
<i>Kaiserlich-königliche Technische Hochschule in Graz</i>	181
<i>Universitas Carololo-Ferdinandea</i>	183
<i>To the Glorius Matica Srpska</i>	184
<i>Last Notes: Latest Calculations</i>	186
<i>My Dear Sir</i>	188
Index of Topical Terms.....	189
Index of names	195

A great many books have been written about Nikola Tesla.

The objective of this one is to get a picture of his realm of education, cognitive searches and interests, so that these could lead us to broader and deeper insights into his thought and creative work.

Tesla's education is an important key thread that unravels the hank of scattered and incompletely articulated or exposed elements, found at many different places, which we have to identify if we wish to compose as coherent a picture of Tesla's quandaries as possible, to find answers to the questions of his attitude to knowledge and of the way he acquired it, and – on the whole – to decipher the structure, the (directions of his) reaches, and the aspirations of the realm of his reflexions – in addition to and beyond the field of inventions itself.

Nikola Tesla has not left behind any narrative about the universe of his education, self-education implied, but he *has* left a number of reminiscences in his thoughts about the road he had covered, as well as numerous condensed hints that he concisely yet quite clearly and with evident experience lying behind them used to articulate the 'territory' and/or points of his statements, interpretations and views.

It is such hints and reminiscences regarding the route he had taken that lie in the focus of this exploration. In this book, an insight into the full scope of Tesla's cognitive realm, and the systematic manner in which he was acquiring knowledge, has

been gained through a contextual analysis of relevant content in his scientific/technical studies, popular-science articles, lectures, speeches and autobiographical writings, all in correlation to the elements essential for the understanding of his thought. Helpful reliance thereby has been found in the history of science, of educational levels, of the progress of university education and the education in the engineering fields; the subjects studied/attended/registered for by the Inventor and those he took examinations in; some marginal remarks about what and when he had read; his library and the facts related to the libraries he used to visit.

Structuralism, its research procedure and scientific method, proven fruitful in linguistics from which it arose, is inescapable in various disciplines of social sciences and humanities, and their analyses and hermeneutical reflexions in which – for the understanding of the meaning of the given discourse or a fact or a lead – it is necessary to systematically and all-encompassingly observe the totality of the factors which demarcate it through their designations and their correlations and interdependence without neglecting the sphere of modality thereby.

In this book, this approach has not left us empty-handed either.

It reveals an enormous scientific and technical reading Tesla studied as a student. Moreover, we learn therefrom a lot about his non-institutional education in his family home and his self-education prior to his departure for centres of higher education. Furthermore, we become aware of his incessant, thorough and systematic lifelong gathering of information about nearly all fields of man's knowledge and creative expression, even those related to the legal, economic(al) and administrative issues of everyday life.

We follow his thought and major contributions in all three domains of his creative output as an inventor and engineer:

power engineering, wireless transmission and mechanical engineering.

Thereby, we observe the continual progress of that thought, beginning with the first intuition of his earliest youth, and the fact that the Inventor did not tackle engineering issues only.

We get familiar with the Inventor as a “scientific man, the thinker and reasoner”¹ and what he meant by the attributes..

We step in the wake of his thoughts which – the further, the more involvedly – usher us into the complex world of his searches – insight-bringing, cognitive, experimental, invention-al ones. Detection of their inter-relatedness, uninterrupted synchronicity and the sameness of the aspiration for accomplishments while aiming at an integrated realm of harmony – that is what helps us understand Tesla’s view of the world as one and merged, and his philosophy of technologies to the nascence and/or development to which he himself had contributed.

Tesla spoke about his views and reflexions in his lectures, speeches and articles.

As to the lectures and speeches, he used to prepare these studiously. He even gave them the written form.

We learn of Nikola Tesla’s endeavour to know all about everything – from the world of science, entire learning, religious thought and art; to know all about cultural, social and political life, both through the overall history of mankind and at the moment he was a contemporary of. And that has been the ideal of the Renaissance man and enlightened personalities.

Owing to his extraordinary memory and exceptionally well set up personal system of searching within his library, carefully gathered scientific and technical materials, as well as the broadest literature concerning all of his interests – he would promptly and easily reach for his treasure of knowledge to use it in his verbal articulation, written and oral alike.

¹ The expression has been borrowed from Nikola Tesla, in: Nikola Tesla, “Tesla on Electricity. The Address on the occasion of the commemoration of the introduction of Niagara Falls Power Plant in Buffalo at Ellicott Club, January 12, 1897”, in *Lectures*, scientific editor Vojin Popović, 267-289 (Beograd: Zavod za udžbenike i nastavna sredstva, 2016), 269

The erudition and information he possessed were inexhaustible sources of his charisma that charmed his contemporaries, to the extent equal to his brilliance, genius, spirituality and wit.

The listeners of his lectures would literally be enchanted by the breadth and depth of his learnedness and his scientific/technical knowledge.

Tesla won the respect of the highest scientific, educational and technical institutions and engineers' associations owing to – in addition to his brilliant leaps in inventions and discoveries – his lectures, truly scientific orations and written studies.

At the same time, we find out that his uninterrupted, life-long and – most significant to his mind – cognitive preoccupations were mathematics, hard sciences and the idea/view of the world.

All of Tesla's unlimited interests bore significance for his thought. In addition to the scientific and technical reading, he studied philosophy (natural philosophy, primarily) and ethics and religious thought (Christian and Hebrew, Buddhism, Hinduism, Taoism, as well as Pythagoras' religious enquiries), and the literature pertaining to the issues of the unity of science and religion.

Seeking cognitions, he attentively looked wherever he could find some. Additionally, he was loyal to the scientific rigour of the hard sciences. He studied mathematics, physics, chemistry, astronomy, astrophysics, celestial mechanics, cosmogony, biology, Darwin's theory of evolution... When he wrote that the world is one, that we are all parts of a whole, describing how he felt that, he immediately added that it was just a matter of time that it would be possible to confirm the fact by experiment.

Within that relatedness, the acts of each individual participate in the living organism of the universe with one body and one soul. This view, deeply inherent to the reflexions of Nikola Tesla, was woven into his *modus vivendi*. Laxity of morals is a

terrible evil which poisons both mind and body. Taking care of one's way of life, health, hygiene, as well as numerous religious rules is inseparable from the moral laws and their implications for human life and mankind's development just as the deep meaning of virtue – and not only in the Christian understanding of values in keeping with which he had always lived. He perceived these in other religions, too. He also found them in the views of the philosophers from the age of Antiquity, the teachings of Pythagoras and the Stoics.

Tesla was particularly interested in the issue of the Self. He also contemplated the external impacts on human consciousness and the impulse of man's mobility, searching for these throughout the related comprehensions until his time and writing about his own observations in several essays and in the form of reflexions in a number of his writings.

Tesla's visions of the purpose and objective of technologies which he was to bestow to the world and humanity for better and more comfortable life (which should be accessible to all in terms of profitability), as well as the technologies he envisaged in his *World Wireless System*, took two directions: one of information and communication, and the other, of the wireless transmission of electrical power in huge amounts. His ideas concerning the former lied along the tracks of the need for improvement of education and improvement of the dissemination of knowledge, as well as the possibilities to embetter absorption of information and instant exchange of information/pictures/messages. They are today's reality. As to the latter direction, it was likewise in the line of Tesla's aspiration to the transmission of energy which could become immeasurably profitable and free from losses (that is, with negligible losses). The Inventor quit his work on that project due to the lack of financial supports, the mishap which befell him at the beginning of the 20th century. Yet there remains an important fact: Nikola Tesla per-

ceived and pointed out the necessity to develop techniques for generating power out of inexhaustible reserves, and to improve the methods which excluded spending or wasting any material. Man was spending material in order to provide heat, light and mechanical energy – the Inventor warned, wondering what man was to do once the forests disappeared and the coal mines got exhausted. He saw the solutions in power transmission at long distances, for – as he said – waterfalls, ebbs and tides are the ‘storages’ of one part of nature’s immeasurable energy. We can read about this reasoning of his in the writings presented in this book. The Reader is also offered a closer presentation of experts’ views of the directions Tesla had set out to follow in his research work. Let us also mention at this point that Nikola Tesla – soon after his demonstration of remote control of a model boat (as early as when he was preparing himself to improve the methods of individualization and isolation of power transmitted, which was the reason why he left for Colorado Springs) – realized that it was going to cause deep changes sooner or later. He promptly expressed his hope that the change would be for the good, for otherwise he would wish he had never put that invention into practice. As can be seen hereinafter, he wrote about that in an article published in *The New York Sun* in November 1898.

All of that draws attention to the fact that Tesla constantly cherished his thoughts regarding the philosophy of technologies and scientific/technological ethics and that they were an essential aspect of his inventional, that is, scientific, thinking.

Although industrial growth had just begun to upswing, Nikola Tesla saw the threats of pollution on the Planet and of the exhaustion of its resources. He was among the first – if not the very first – to define the most important issues of sustainable development, accentuating the necessity to seek alternative sources of energy and writing about the directions he found to be leading to the solutions.

He was convinced that knowledge and mutual familiarity of various peoples/nations were the best way to prevent tensions, frictions and wars between them.

Mathematics was among his favourite mental preoccupations.

During the student days, he found the most complicated mathematical assignments to be an intellectual delicacy. Mathematics also offered an unavoidable reliance to his work method.

This fact, despite its presence in his writings – and the same refers to Tesla's attitude to scientific education and learning in general – has so far remained in the shadow of his intuition and his ability to visualize.

As a very young man, Tesla got into the habit of putting all of his thoughts and reasoning “onto the mathematical base and into mathematical formulas”.² And he kept on doing so even when he had ceased working on inventions.

The said habit is testified to through many of his articles, through the books he had been buying for his library even at a late age, as well as through Tesla's latest notes found on his night table when he passed away. By courtesy of Nikola Tesla Museum in Belgrade, they have been published for the first time – in this very book.

One of the essential 'layers' of this book and the analysis of broad and complex material therein is the search for the concrete scientific, technical and all other reading studied by Nikola Tesla. I was also interested in the time/moments in which he read particular books.

This inquiry proved also useful for the insight into Tesla's cognitive journey and for the perception of the comprehensiveness of his thought manifested even in those periods of his work which we usually narrowly connect to the current projects he was engaged in. Such and similar details detected within and *between* the lines of his writings reveal the lifelong existence of

² Nikola Tesla told about this to Jovan Krajnović during their encounter. See: Jovan Krajnović, “Susret sa Nikolom Teslom” [“Meeting Nikola Tesla”], *Politika*, March 17, 1915, in: Branislav Jovanović, *Teslin čudesni svet* [Tesla's World of Miracles], Beograd: Vulkan 2014, 283–284.

the thoughts that shaped his view of the world which was essentially and substantially inherent to his creative work.

* * *

Speaking of man's creative endeavours, there is no creation *ex nihilo*; correspondingly, this book has not come into being out of nothing either.

My priority interests concerned the history of sciences and education, the encounters and dialogues of knowledge, cognitions and ideas, including the outcomes of their migrations and combined impacts.

What leaves a visible imprint on the evolution of knowledge and the development of science are the influences of the society, philosophy of sciences and the prevailing views. The area of cognitive, cultural and sociocultural mobility is inexhaustible, diversified and – in terms of the courses it may take – unpredictable. It evades determinism at a point when it seems that no further changes or new cognitions are possible. Most of my research and contributions to scientific gatherings, symposia and reviews have been devoted to some points of the cross impacts among sciences, engineering/technology, art, culture and society; also, all of my essays have been motivated by such reflexions, and these shaped the profiles of my radio programs *Dijalog kultura* (*Dialogue of Cultures*) and *Nauka, kultura i društvo* (*Science, Culture and Society*) that were broadcast for many years.

The overall road of humanity's development (the road on which – of all ever-existing technologically and mentally proven *homo* species – only *homo sapiens* set out to change and build new conditions of his life and environment using his intellect; to technologically capture new areas; to adjust nature to himself; to develop technologies, produce and improve tools, weap-

onry and means for his increasingly fast and farther-reaching movements and communication – in various directions; to use speech and written word in order to articulate what he knows and wants to tell; to develop abstract thought theoretically and in various directions; and, finally, to conduct his capability of synthesizing toward desired goals) – has been 'woven' by live transfer and exchange of cognitions and cognitive accomplishments, by numerous (not all) merges of cultural values, or by diverse cross impacts of the elements of culture, in unlimited directions and forms of their movements.³

Poring over the progress of human thought and the evolution of knowledge through various epochs, cultures and civilizations mirrored in the biographies of the individuals that have left their imprints on the history of sciences, I also noticed the tendency, inherent to thinkers and scholars since earliest times, to aspire for mastering all the knowledge of the world they were aware of – until their own time; likewise, they aspired to master the world language(s) of their age plus as many others as possible, and to seek knowledge beyond their milieux.

In a like manner, my research in the elements, content, form and routes of cognitive and cultural mobility opened to me a realm of 'secret pathways' leading to new paradigms or novel approaches – all firmly grounded in critical thinking and open-mindedness to *all* knowledge, including also reconsideration of some 'forgotten' cognitions, or to the knowledge from geographically and culturally faraway communities, as well as to the consideration of different and seemingly incompatible facts.

It is to a large degree owing to the abovesaid research and interests of mine that this book has come into existence.

They smoothed my way toward understanding of Nikola Tesla within the reaches included herein.

It has been for some thirty or more years that I would – from time to time – devote myself to some details of Tesla's creative

³ For more on these movements, see: Drenka Dobrosavljević, "Dijalog kultura. Tragovima kulturne mobilnosti" ["Dialogue of Cultures. In the Wake of Cultural Mobility"] in: Zbornik radova VIII naučnog skupa Tehnologija kultura i razvoj [Proceedings of the 8th scientific Gathering Technology, Culture and Development] (Beograd: Udruženje Tehnologija i društvo; Institut Mihajlo Pupin – Centar za istraživanje razvoja nauke i tehnologije, 2002, 34-45 []; and in the text "Dijalog kultura" ("Dialogue of Cultures") by which Drenka Dobrosavljević opened a serial of the same name of one-hour scientific radio programs of the third-program type. The latter text was broadcast by Radio Novi Sad on May 2, 1997; the Author maintained the serial using her own essays and interviews/talks about science and sciences, from May 2, 1997 to May 24, 2015

output. Such poring over particular fields of his work or particular periods in his personal biography have significantly contributed to this book.

Several writings of Nikola Tesla that are characterized by philosophical thinking and a number of those which enter the spheres of the history of science and the philosophy of science and technology repeatedly drew my attention, suggesting the question:

Did the Inventor turn to these topics *ad hoc* only, or some phenomena and a view of the world and of the technological progress were inherently woven into his thought and his interests?

Thus, in the summer of 2017, I undertook an analysis which resulted in the paper entitled "Searching for the Reality: Contacts, Dialogues and Cognitive, Cultural and Sociocultural Mobility. Case Study: Nikola Tesla".⁴ Therein (following an introductory survey of the characteristics of the science in the second half and at the very end of the 19th century, the time of Nikola Tesla's education and the period when he reached his cognitive and creative *akmé*), I focused my attention onto the texts in which he unambiguously wrote about his understanding of the world as oneness. In these writings⁵, one can discern his philosophy of technologies which conformed to the harmony of nature and the unity of the world, his familiarity with the history of philosophy/philosophy of nature with particular interest in generalization of natural forces and phenomena that – as Tesla concisely put it – "this idea which has long ago taken possession of the most advanced minds". Besides, one can detect in these certain parallels between the cognitive searches of Nikola Tesla and Pythagoras.⁶ Additionally, the meticulous and fundamental knowledge he exposed in the introduction to the article "The Wonder World to be Created by Electricity"⁷ led me to the conclusion that in this writing we identify him as an excellent and true historian of science and invention, one who contemplated the history of inventions/discoveries and

⁴ Drenka Dobrosavljević, "Searching for the Reality: Contacts, Dialogues and Cognitive, Cultural and Sociocultural Mobility. Case Study: Nikola Tesla", translated from Serbian by Angelina Čanković Popović, *Phlogiston*, 26 (2018): 9-32.

⁵ The references pertain to the following writings: Nikola Tesla, "The Problem of Increasing Human Energy. The Onward Movement of Man – The Energy of the Movement – The Three Ways of Increasing Human Energy", in *Articles*, scientific editors Vojin Popović et al, 83-134 (Beograd: Zavod za udžbenike i nastavna sredstva, 2016); Nikola Tesla, "How Cosmic Forces Shape Our Destinies", *New York American*, February 7, 1915.

⁶ Drenka Dobrosavljević, "Searching for the Reality. Contacts, Dialogues and Cognitive, Cultural and Sociocultural Mobility. Case Study: Pythagoras", translated from Serbian by Angelina Čanković Popović, *Phlogiston*, 29 (2021): 199-223.

⁷ Nikola Tesla, "The Wonder World to be Created by Electricity", in *Articles*, scientific editors Vojin Popović et al, 371-379 (Beograd: Zavod za udžbenike i nastavna sredstva, 2016).