



New Applications of Mathematics - Investigation of the Correctness of the Historical Dating.,

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In modern times mathematics has become an inseparable part of human culture, in which it plays a fundamental role. It is impossible to imagine how our civilization could function without mathematics. Throughout the centuries mathematics has been a crucial tool in the hands of mankind. It has allowed us to understand the fundamental principles of the universe, for example Newton's law of gravity, Einstein's equivalence of mass and energy, Maxwell's equations of electromagnetism, the laws of quantum mechanics for elementary particles, even the Big Bang theory. The achievements of modern technology, in particular our advances in interplanetary exploration and computer technology, wouldn't have been possible without mathematics.

Scientists, in their struggle to improve our understanding, have untangled the principal problems of biology and unveiled the secrets of life. However, the times when it was sufficient for a biologist to know only elementary arithmetic and graphs of functions are long gone. Today, they need much more advanced mathematics like linear and multilinear algebras, mathematical analysis, the theory of differential and functional equations, statistics and discrete mathematics. Branches of biology like genetics or ecology are also considered to be part of mathematics. Mathematics opens also new possibilities for medicine. Mathematical models are used to understand our bodies and to find optimal treatment for diseases.

More and more mathematics is used in the social sciences. We are not going to discuss here economics, which during the last century owes its development to mathematics. There is a growing need for mathematics in psychology, sociology, demography, social epidemiology and criminology.

Not surprisingly, mathematics is also trying to make its contribution in areas that are quite distant from mathematics, such as history. Here we are not talking about technical applications of mathematics to explain or clarify development dynamics of nations or their level of culture and technology, but the more serious problem of reliability of the accounts of historical events. How can we be sure that the historical events that we learn about in school or from books really took place? Maybe some of them are simply fairy tales that because of some mysterious cir-

cumstances are considered now to be historical facts. In general, according to most historians there is no reason to worry about the accuracy of history. Their work provides us with clear and comprehensive explanations of every historical epoch, new details and new information emerge and there are more proofs to support the claims of historians. It is somehow strange to our common sense that as time goes by, instead of losing our memories of the past, we are getting more and more new information.

History as We Know It.

A description of the general history of Humankind can be found in history textbooks or historical atlases. We all know that our civilization began with the development of a primitive society when people were trying to subdue seemingly boundless space. They learned how to use fire, to domesticate animals, produce tools, first using stones, then bronze and iron. As many of us like to read novels or watch movies about the lives of primitive people, it is not surprising that sometimes we mix fiction with this distant reality.

Then there came the epoch of the Ancient World which was dominated by small countries governed by despotic and ruthless rulers fighting each other, destroying, slaughtering and looting. There was a continuous struggle for power, territory, slaves, etc. World empires like Assyria, Egypt, Persia, Asoka (India), Han (China), ...etc. and also (the closest to our culture) Ancient Greece and Rome emerged. In fact, we consider our culture as the continuation of the Greek and Roman cultures which gave us the idea of democracy, our juridical system and principles of the law. Ancient Greece and Rome gave us the first great thinkers, philosophers, poets, writers, scientists and artists. In our time there are preserved many picturesque descriptions of the everyday life in these countries. At the peak of its power the Roman empire was spread over an enormous territory including North Africa, all South and Western Europe, Britain, Asia Minor and part of Asia.

On the horizon were appearing the Middle Ages. The declining Roman empire was looted by neighboring barbarian nations looking for riches and wealth in Roman cities. The dark Middle Ages lasted almost one thousand years. The most precious cultural treasures like manuscripts and writings were preserved in ancient monasteries and the courts while the nations were ravaged by global wars, Arabic expansion, Norman invasions, Crusades, Mongol invasions, burning of witches, the Black Death and the Inquisition. In this time after bloody battles emerge European countries like England, France, Germany, Spain, Russia, Turkey etc. The discovery of America and the New World initiated a new epoch.

On this immense ocean of ignorance in the Middle Ages

suddenly, first in Italy then in Western Europe, surfaces a new image of life called today the Renaissance. Ancient culture, science and knowledge are rediscovered, ancient manuscripts are studied and new science is flourishing. This was a great period for arts. As the old feudal system couldn't accommodate the new developments and ideals of freedom, equality and fraternity, bourgeois revolutions followed, first in Holland, then in England, North America, and France. A new world order was created. However, this new world is not only marked by the blooming of culture and arts, the growth of science and technology, the spread of democracy, but it is also marked by two horrific world wars that terrified almost all of humanity, inhuman states with murderous dictatorships, organized crime and famine.

History of the Global Chronology.

The fundamental question that should be asked is what is the origin of our historical knowledge which we briefly described above. We all learned our history at school and generally accepted it as a true description of the actual events. However, in our lifetime some of the recent historical events that we witnessed are not always described in the way we remember them. How can we be sure that the description of the events that took place centuries ago is accurate in detail? Moreover, why should we believe that these historical events really happened at the time and place that is allocated to them? In order to answer these questions we must look at the history of history.

The early historians (for example Thucydides, Herodotus, Ssu-ma Ch'ien and others) were describing the history of small territories over a short period of time. Ancient and medieval manuscripts that are available today usually present accounts of events in separate countries over a time scale of no more than one or two centuries. The fundamental problem encountered by historians working on reconstruction of the global history of mankind was putting together in chronological order all of the manuscripts, chronicles and other historical documents to obtain a unified and consistent account of all historical events. This was an extremely difficult problem. The main obstacle was that most of the manuscripts were not dated, or used an unknown or archaic system of dating, and contained only a description of a sequence of successive events. It was also difficult to determine the exact origin of these manuscripts due to the fact that the names of towns, countries, cities etc. were sometimes wandering from one place to another together with migrating nations. On the other hand, sometimes descriptions of the same event in different documents contradicted each other. In addition, the available historical documents do not cover all the periods of time for all locations. Most historical documents that

we have today, related to ancient and medieval times, are not original but only copies made some time ago, often under suspicious circumstances.

The idea of reconstructing global history emerged during the late Renaissance. The official historical chronology presently commonly acknowledged was originated by the Italian theologian and scientist I. Scaliger (1540-1609). He was the first who, based on the Christian tradition and strict scientific methods, tried to determine the exact dates of the most important historical events like the Peloponnesian War, Trojan War, founding of Rome, etc. He used astronomical methods to determine exact dates of eclipses of sun and moon, horoscopes and other celestial incidents described in ancient and medieval documents. His followers continued this work and it is commonly accepted that the official chronology was given its final shape by D. Petavius (1583-1652). It is strange that the dates of the basic historical events assigned by Scaliger and Petavius were very rarely modified by other historians in spite of the fact of our scientific advantages. One exception is the chronology of ancient Egypt. Some dozen years ago most historians held to the long chronology of Egypt, but presently the short chronology is generally accepted - the difference between them being about one thousand years.

In summary, according to Scaliger, Petavius and their followers, the events of the ancient world took place from about 3,500 years B.C. till the fifth century A.D., and the Middle Ages, which followed, lasted till the fifteenth century. As their results were never independently confirmed, there is an outstanding question of the credibility of this chronology. But not all of the scientific achievements of Scaliger turned out to be true, as for example, his geometrical proof of the quadrature of the circle¹, which he defended ferociously all his life.

Critics of the Traditional Chronology.

Not all scientists who were contemporaries of Scaliger and Petavius supported their chronology. For example, in the sixteenth century D. Arcilla, a professor of Salamanca University, claimed that all ancient history was made up during the Middle Ages. The most famous scientist of this epoch, Sir Isaac Newton, was also against this chronology. The most damaging critique of the traditional chronology was written in the 1920s by N.A. Morozov (see [17]). He published the results of his research in a fundamental monograph composed of seven large volumes, entitled "*Christ (The History of Human Culture from the Standpoint of the Natural Sciences)*". Morozov analyzed

¹This was one of the geometric problems of antiquity in which a square of equal area to a circle was required to be constructed using only a straightedge and compass. It was determined, when π was proven to be transcendental by Lindemann in 1882, that it is impossible.

the traditional chronology using the latest discoveries in mathematics, astronomy, linguistics, philology and geology. According to his results, ancient history should be moved forward in time more than one thousand years.

The monographs of N.A. Morozov were widely discussed in the Soviet Union during the twenties and thirties, and many objections were expressed, however there were no serious arguments brought up against Morozov’s theory. It is difficult to explain why in the following years all the books of Morozov, as well as the responses of his opponents and supporters, disappeared from the public view. Probably the theory of Morozov became a victim of Stalinist censorship. Nevertheless, in the mid seventies the theory of Morozov was revived by the famous Russian mathematician, author of numerous books and monographs on geometry and other branches of mathematics, Prof. M.M. Postnikov, who presented a series of lectures on this theory to a group of students in the Faculty of Mathematics at Moscow State University. Postnikov also tried to explain the theory to historians working at the History Institute of the Academy of Sciences of the U.S.S.R. However, the resulting discussion was quickly reduced to a total denial of Morozov’s arguments without presenting convincing arguments.

Anatoli T. Fomenko and His Efforts to Correct the Chronology.

As a result of Postnikov’s efforts, a group of young mathematicians and statisticians, lead by Professor, presently Academician, A.T. Fomenko, began an analysis of the general problems related to the global chronology of Humankind. A.T. Fomenko proposed a new hypothesis, based on global concepts of modern geometry. As Morozov was inclined to regard the ancient documents as a result of falsification and considered our history to be “fairy tales” produced by dishonest scientists-charlatans, A.T. Fomenko presumes that most of the ancient documents are genuine, but they were simply incorrectly arranged together into the composition we know today as world history. The mistakes were done due to incorrect dating and allocating wrong places to these documents.

It is an interesting question, how the above claims could be made and justified.

It is very simple. It is enough to consider a large chronological table covering all periods of human history and try to discover some unusual phenomena, contradictions and disagreements, simply something that could never happen.

Apparently, this simple idea is not easy to carry out. First of all, there are no large chronological tables that cover the whole of history. Numerous heavy books devoted to the chronology are arranged in a frustrating manner (see [1-3]). They present separate fragments of the gen-

eral chronology devoted only to certain regions and epochs without showing the connections between them. Consequently we get the impression that, since long ago, historians composed such global tables but because of their complexity it is not possible to publish such tables in the usual reference books, regardless their size. A reader gets the impression that whenever a specialist in history needs such tables there are some places where it is possible to consult this material. However, this is not true. For instant, in the library of the University of Alberta there are only a few titles on the global chronology.

A.T. Fomenko and his collaborators attempted to set up a global chronology table using all available sources, beginning with Blair’s canonical chronological tables and finishing with the most recent material. In spite of the fact that the available data from different sources didn’t always match, they were able to build global chronology tables enclosing the whole history of the mankind. This massive work could be done only with the use of computers. We should emphasize that these chronological tables represent the traditional, presently accepted historical chronology. However, it is very strange that similar tables were not published earlier by any historical institute.

New Mathematical Methods Used to Investigate Dating of Historical Events.

From the point of view of mathematics, the chronology tables represent an object called a function. More precisely, we can write it as a function denoted by $H(t, x_1, x_2)$, which depends on the three variables: t - the time of a historical event and (x_1, x_2) - the geographical coordinates (longitude and latitude) of the place where this event occurred, or we can simply say that its domain is the Cartesian product of numeric half line and the sphere. The values of the function $H(t, x_1, x_2)$ represent the fragments of historical recordings describing this particular event.

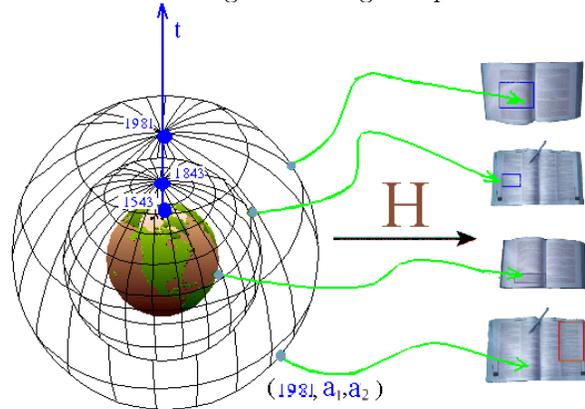


Fig.1

The above Figure 1 illustrates the history function H . On the left hand side of Figure 1 the concentric spheres represent the domain of H . More precisely, the red arrow

stands for the time axis where the points corresponds to specific dates. The inside colored sphere illustrates possible locations on the Earth for the events from the year 1543. The larger sphere corresponds to the year 1843 and the exterior sphere is related to the events in the year 1981. In this way, with every date in history there is associated a sphere on which we can localize the corresponding events. Consequently, to every place on the Earth corresponds a ray originating at the center on which we can mark the dates of the events that occurred at this place. On the right hand side of Figure 1 there are several books. Passages from these books provide descriptions of the historical events. The green arrows indicate the exact fragments of the available descriptions corresponding to certain concrete events. Briefly, for mathematicians history is a data base parameterized by points of the Cartesian product $\mathbb{R}_+ \times S^2$, i.e. the product of the half-axis \mathbb{R}_+ and the sphere S^2 .

Naturally, this function is not convenient for mathematical analysis. Clearly the set of values of the history function H does not have any natural mathematical structure. However, the information contained inside the function H allows us, on the one side, to construct a variety of scalar (numeric) functions which can be easily analyzed with mathematical methods, and on the other side, to provide essential information on the nature of the historical events. An example of a simple scalar function, which can be easily extracted from the historical data base, is the functions of the time-span of the reign of subsequent rulers belonging to a certain specific dynasty. Such a ‘dynasty’ function can be illustrated by its graph, see Figure 2.

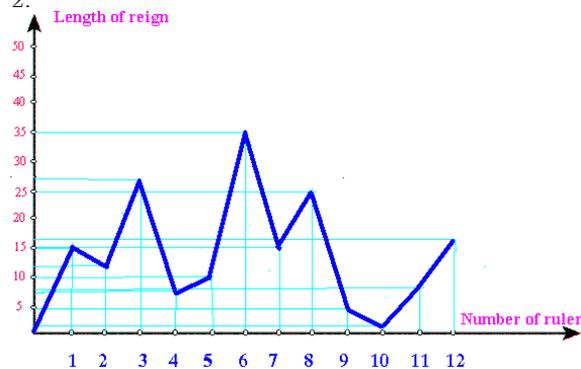
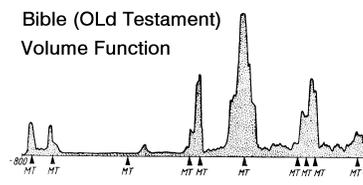


Fig.2.

On the horizontal axis are placed the numbers of the consecutive rulers (or names of kings, emperors, etc.) and on the vertical axis is marked the length of the reign of the corresponding ruler. It is convenient to consider such a sequence of rulers as a sort of a *dynasty*. The dynasty analyzed in the above example consists of 12 rulers.

It is also possible to analyze chronicles by extracting numerical information from them. For example we can asso-

ciate with a text X a sequence of integers, corresponding to each year T described in the chronicle, which represent the number of words $H(X(T))$ in the chapter describing the year T (or simply its *volume*). We will call $H(X(T))$ the *volume function* associated with X . There are also possibilities for other numerical functions like the number of references to the year T in subsequent years, the number of all the names of historical persons listed in the text, or the frequencies showing how often these names were mentioned in the whole text. In his monograph [10], A.T. Fomenko used these functions to analyze similarities and differences between documents referring either to the same epoch or two different epochs. It is clear that for two different documents X and Y the functions $H(X(T))$ and $H(Y(T))$ can be completely different even if they refer to the same epoch. However, it turns out that in the case of the same epoch, the functions $H(X(T))$ and $H(Y(T))$ seem to have similar local maxima, what can be explain that for more significant years there exist relatively larger descriptions, even if some of the information was lost. A.T. Fomenko calls this regularity the *principle of maximal correlation*. Therefore, the locations of the maxima constitute the numerical data that can be associated with the text X in order to characterize the epoch it is referring to. The following graph illustrates the volume function associated with the genealogies of the Old Testament.



It is also possible to express numerically the information contained in the texts. Fomenko, introduces certain vector-valued functions (in \mathbb{R}^{34}), where each of coordinate represents encoded information about particular rulers like the sex of the ruler, age at the death, length of reign, circumstances of his/her death, wars, their durations and results (defeat or victory), peace treaties, location of the capital, reforms, religion, power struggle etc.

The methods of Fomenko are based on theoretical and numerical analysis of the set of all the above functions describing historical data. He introduces a routine for distinguishing functions referring to different dynasties. He defines a certain *measure of distinctiveness* between them (or a probability measure for distinctiveness). In simple words, he found a way to measure a ‘distance’ between the above numerical functions (like for example dynasty functions) in a similar way to measuring distance between two different locations on the earth. Mathematicians say that in such a situation they are dealing with a metric space. The geometry of such metric spaces is definitely different from the geometry we learn in schools, but the usual

properties related to the measurement of distances are still valid in these spaces. In particular, based on our usual geometrical reasoning if a distance between two towns is less than one kilometer we are justified in thinking that this is just a one town. Similarly, if in the space of these numerical functions a distance between two dynasty functions is sufficiently small we may think that indeed they represent the same dynasty. These methods were extensively tested on the data referring to well documented epochs and it was established by A.T. Fomenko that if two dynasty functions (for 15 rulers) or volume functions were not related, the measure of distinctiveness between numerical functions associated with these dynasties was between 1 and $\frac{1}{1000}$. However, in the case of related events (i.e. the same epoch), the measure of distinctiveness was never higher than $\frac{1}{100000000}$.

The work of Fomenko and his collaborators proves that the statistical analysis can be successfully applied to analyze the numerical data contained in historical documents. A.T. Fomenko also developed several other statistical criteria for distinguishing or recognizing identical sequences of historical events. We should mention for example the methods of small misrepresentations, of damping frequencies, of duplicating frequencies and the method of improving historical maps.

What is Wrong With the Traditional Chronology.

It is difficult to imagine that two different dynasties could have identical or almost identical dynasty functions. The probability of such a coincidence is extremely small already for dynasties made of more than half a dozen rulers. Therefore, it is hard to believe that among all the dynasty functions there could be several identical or almost identical functions. Nevertheless, the number of such coincidences turns out to be unexpectedly large. The first such cases of identical pairs of dynasty graphs were discovered by N.A. Morozov who noticed the coincidences when studying chronological tables of ancient Rome and ancient Jewish state. A formal method to study such coincidences was introduced by A.T. Fomenko.

Certainly, it is not right to identify two dynasties if their dynasty functions coincide (in spite of the fact that the probability of such coincidence is extremely small). However, it is possible to return to the graphs of these dynasty functions and compare the sequence of the activities and the events related to the lives of the corresponding rulers (i.e. having the same ordering numbers) in these two dynasties. Here we find another surprise – besides coincidence of graphs of the dynasty functions, the other numerical functions confirm with very high probability that these dynasties indeed coincide, so having such enormous coincidence it brings us to a suspicion that here we are

in fact dealing with the same dynasty. Using this method Fomenko discovered dozens of such coincidences, sometimes between three and more dynasties. It is also very astonishing that there is no more occurrence of such coincidences when analyzing the historical data of the better documented epochs, for example starting from the sixteenth century.

As an example we would like to discuss two dynasties, one the dynasty of the Holy Roman-German Empire (X-XIII A.C.) and the another of the Jewish kings according the Bible (IX-V B.C.). Here we represent the time line vertically with the lengths of reign for each ruler arranged one opposite to another for better comparison. As it is not clear what should be the dates for the dynasty of Jewish kings, we start this dynasty in the hypothetical year zero which is not a date that should be associated with the beginning of this dynasty. According to the Encyclopedia Britannica, the beginning of this dynasty is the year 922 B.C. This table was copied from the monograph [4].

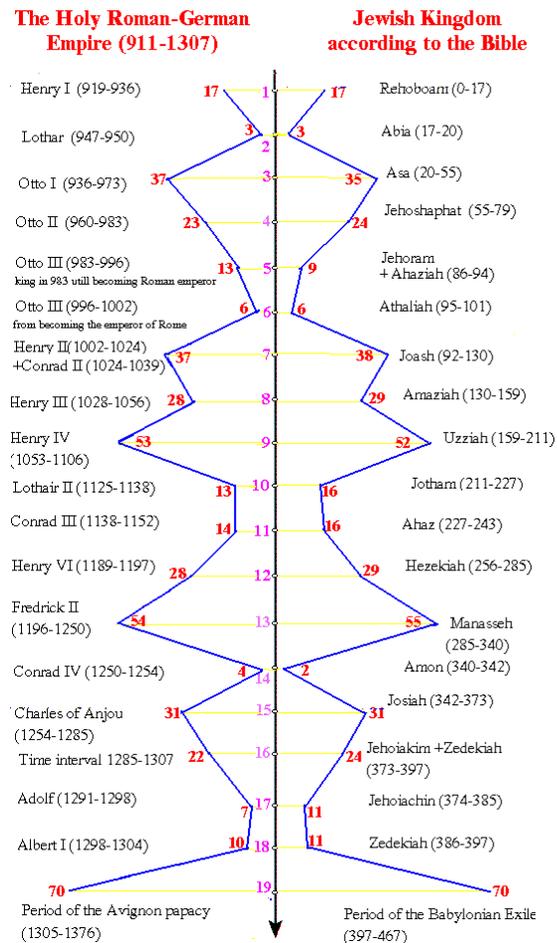


Fig.3

We have another parallel between the first period of the Roman episcopate in 141-314 A.D. and the second period of the Roman episcopate in 314-532 A.D. (see Fig.

4). Everybody can easily recognize that the dynasty functions in these two graphics are very similar. Below, we present several other pairs of graphs, this time without annotations. All these graphs were also taken from the monograph [4].

tory would be only multiple recounts of the same events scattered in many locations at various times.

First period of the Roman episcopate in 141-314 A.D.

Second period of the Roman episcopate in 314-532 A.D.

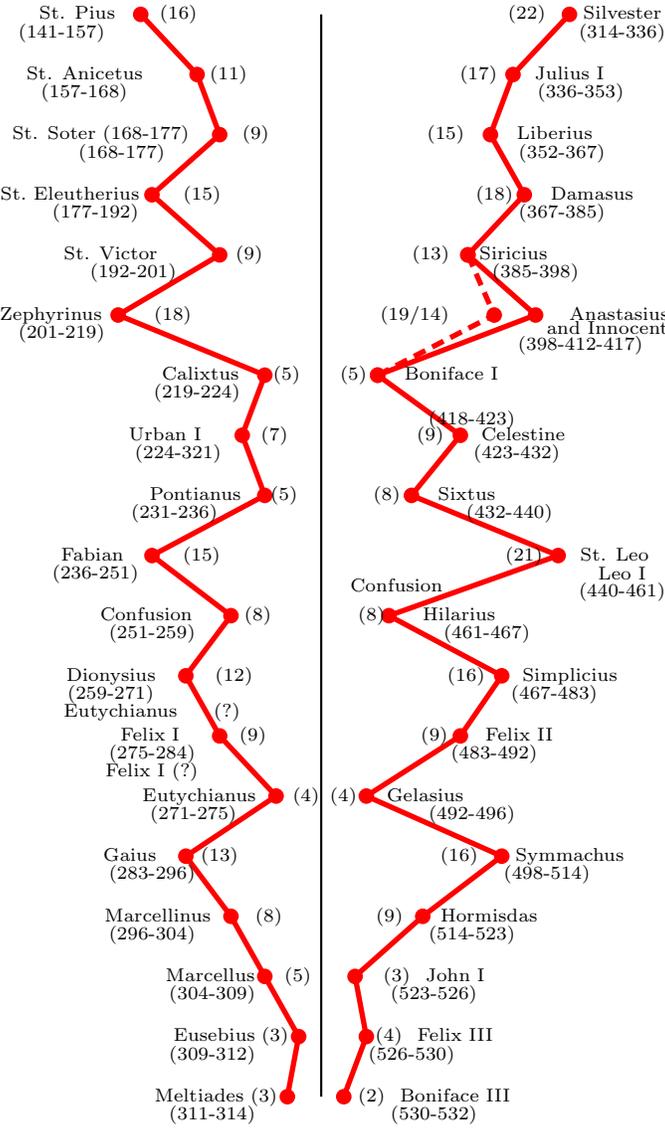


Fig.4

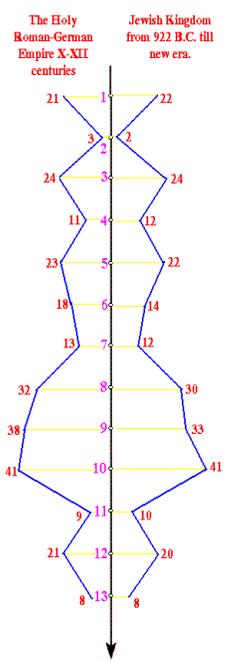


Fig.5

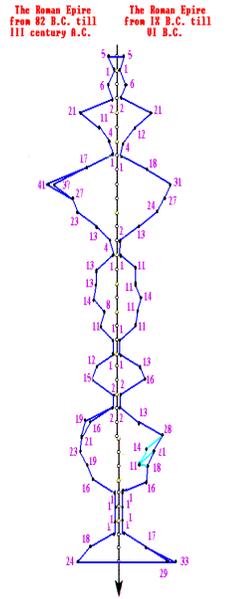


Fig.6

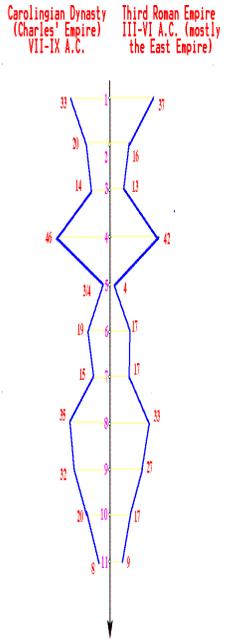


Fig.7

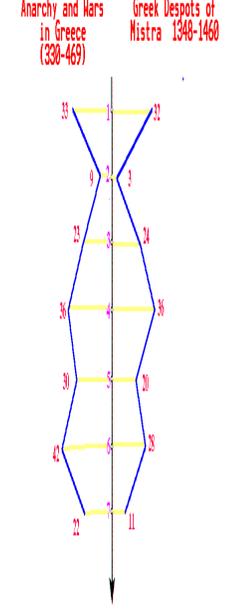


Fig.8

What can we conclude from the comparison tables (see Fig.4-10)? Certainly, almost every attentive person can suspect that every of these graphs describes the same sequence of rulers or kings. Consequently, traditional his-

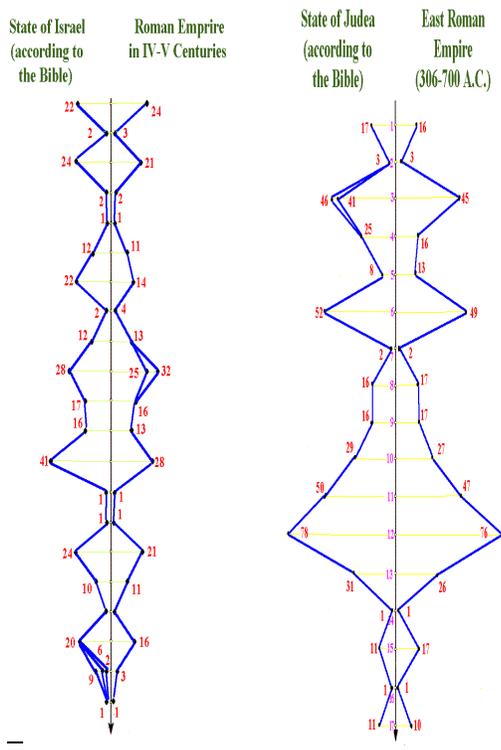


Fig. 9

Fig. 10

The work of A.T. Fomenko and his collaborators leads to a very strong statement that there are serious problems with the traditional chronology. There should be no repetitions in history. The probability, even for one such repetition, is extremely low but nevertheless, there are dozens of such repetitions detected by Fomenko and all of them occurred in the ancient and medieval history. The only reasonable explanation is that several mistakes were made by J. Scaliger and D. Petavius. As their result, many ancient and medieval documents were dated with wrong dates what in consequence created these strange duplications and paradoxes. To determine the real chronology there should be another investigation of the original ancient documents, using modern methods and computer technology. As many historical conclusions and interpretations depend on the dates allocated to the events described in ancient documents, this problem is of great importance. It is also a very complicated problem with possible social repercussions.

What Does Analysis of Astronomical Data Confirm?

After reading the above analysis, a reader can get the impression that these strange results were obtained because the mathematical tools were applied incorrectly or that it is inappropriate to use any mathematics for his-

torical analysis. One can expect that other, more suitable methods of verification would confirm correctness of the traditional chronology tables and disqualify the arguments of Morozov, Fomenko and their followers, as creation of 'insane mathematical minds.' However, it is not so simple.

The most important and convincing method used for the dating of historical events are astronomical computations. This was exactly the method used by Scaliger and Petavius to construct the chronology of the most significant events of the antiquity and the Middle Ages. Since that time the methods of computations of the star configurations on the firmament have been essentially improved. It turns out that many of the fundamental dates, determined by Scaliger and Petavius, can not be completely confirmed. For instance, the new astronomical computations indicate that the Peloponnesian war took place not in the sixth century B.C. but in the eleventh century A.C., or even later.

The Peloponnesian war was described in the *History of the Peloponnesian War* by its contemporary historian Thucydides, who recounts the struggle between Athens and Sparta in the 5th century BC. accordingly to the traditional chronology. The war that lasted 27 years is described sequentially accordingly to the seasons: spring, summer, autumn and winter. The *History* describes three eclipses. The first two were eclipses of the sun separated by the interval of 7 years, which were followed 11 years later by an eclipse of the moon. Thucydides provides a lot of details about these eclipses, for example the first eclipse was full (one could see the stars) and occurred around the noon during the summer time, the second happened at the beginning of the summer and the third one at the end of the summer. D. Petavius attributed to these eclipses the dates August 3, 430 B.C, March 21, 412 B.C., and August 27, 412 B.C. However, not all of the characteristics described in Thucydides' manuscript were satisfied by this choice of dates. For example the first eclipse wasn't full ($\frac{1}{6}$ of the sun was visible). In fact there are two exact solutions that satisfy all the characteristics described by Thucydides. The first match are the dates: August 2, 1133 A.D., March 20, 1140 A.D., August 28, 1151 A.D., and the second: August 22, 1039 A.D., April 9, 1046 A.D., September 15, 1057 A.D.

We should mention the mysterious case of Ptolemy's Star Catalogue, the '*Almagest*' (i.e. the 'Great Creation'). Traditionally, the authorship of this catalogue is attributed to Ptolemy, who lived in the second century A.C. If this catalogue was indeed created in the second century then it should be showing the picture of the star configuration observed in the second century. However, as many specialists remarked, this can not be the case (we recommend to any interested reader the book [18] of R.

Newton *The crime of Claudius Ptolemy*). The computations done by Fomenko, Kalashnikov and Nosovskii, based on the data contained in ‘Almagest’ proves that the most probable time of creation of this catalogue was sometimes in the tenth century A.C. and it is impossible that the astronomical data was collected in the second century. That concludes that either the catalogue has nothing to do with Ptolemy or Ptolemy lived in the tenth century (or later).

(see [4-16]).

What Fomenko’s Critics Say?

We will present some of typical arguments against the hypothesis that the dynasties with identical dynasty functions are the same. First of all, we can say that the names of the corresponding rulers in the compared dynasties are completely different! If we reject the possibility of intended falsification of ancient and medieval scriptures, this would present a very strong argument against the above claim. However, in the ancient times the manuscripts were written without using vowels (which were added later by the interpreters) so, in fact, we do not have the knowledge of the original names but only their interpretations. Moreover, the names were used like nicknames today to describe some qualities of a person like “Tall”, “Short”, “Great”, “Wise”, “Bold”, etc. Clearly, the names of such type sound different in different (local) languages, so gathering historical material from different sources would result in different names of the same rulers.

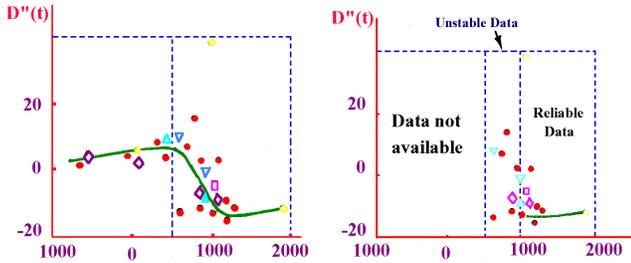


Fig.11

Fig.12

Another even more surprising fact is that the list of records of all the observed eclipses of the moon leads to the following graph of the function $D''(t)$, representing the second derivative of the moon elongation characterized by the acceleration of the moon motion (see Fig. 11). We do not want to scare our readers with exotic mathematical terminology, so we will just say that this function represents a certain function describing properties of the moon motion. On the other hand, the graph itself is scary. The sharp slope of the function $D''(t)$ in the interval between eight and tenth century indicates that at that time some events of cosmic character happened in our solar system. However, the existence of such cosmic phenomena is not supported by any other sources. The graph in Fig. 11 was scrupulously analyzed by A.T. Fomenko and his collaborators. Their results, represented in the graph Fig.12, show that there was no cosmic event between eight and tenth century and support their own chronology.

The analysis of the global chronological tables, done by A.T. Fomenko and his collaborators, leads to astonishing conclusions. It turns out that substantial part of history of the Western Europe covering approximately XIV-XVII centuries is repeated earlier in Western Europe history three times, first it is moved backward in time about 330 years, next it is moved backward about 1053 years, and finally the third time it is moved again backward 1800 years. Early history of England strangely repeats history of medieval Byzantium. Similar situation occurs in the case of the Eastern Europe, in particular for Russia, where there were discovered only two repetitions. We are not able to discuss all the patterns of repetitions recognized in the global chronology and we advise all the interested readers to consult the books of Fomenko and his colleagues

There is another argument, of different type, claiming that there is nothing abnormal in coincidence of dynasty functions for different dynasties. For instance, we know that the probability of having winning lottery is very small but still there are communities that have one or more lottery winners, so even very unlike events could happen. In addition, some people say that some biographies of certain rulers, like Napoleon and Hitler (both dictators) are quite similar, so by applying the method of Morozov and Fomenko we should consider them to be the same person and ultimately make a statement that the first 20 years of XIX century is simply the years thirties and forties of XX century. Nevertheless, calculations of the probability of the coincidence of two different dynasty functions covering few centuries and composed of a sequence of dozen or more rules, in addition exhibiting similarities in the numbers of wives, children, co-rulers, etc., leads to an unimaginably small number. Even some historians, upholders of the traditional Scaliger-Petavius chronology, are overwhelmed by the shocking correspondence between certain sequences of events in history of the ancient and medieval Greek states, antic Roman empire and the medieval Holy Roman empire.

There are also other arguments against the method of Morozov-Fomenko. There is a claim that there is no real coincidence between different dynasty functions. This coincidence can be removed by making appropriate corrections of the historical data. Therefore, according to this claim, the method of Morozov-Fomenko is incorrect by principle. This type of argumentation can be also challenged. In fact, all the dates in the traditional chronology were computed with significant margin of error. Moreover, these dates were adjusted in such a way they are compat-

ible one to another. In history, like in all natural sciences, every information is merely an estimation, so it is not uncommon to find in various sources differences in dates, but they are rarely larger than one or two years. Even with the modified dates the probability arguments continue to hold.

Archeological dating is mostly based on the study of the excavated objects, determination of the materials from which they were made, placing of the objects in environmental and cultural contexts and historical interpretation. For example finding objects of identifiable style or origin can lead to a conclusion of the age of the whole site. This process is highly subjective and based on presumptive evidence that can not be considered as a valid proof against the arguments of Fomenko.

There is one last, which some call the most “powerful” argument in support of the traditional chronology. How it is possible to deny the traditional chronology if it is supported by strictly scientific methods like the *carbon-14 dating* method?

The carbon-14 method, which was discovered by Willard Libby, is based on the measurement of the radio-carbon level in organic samples. It assumes essentially uniform level of the isotope carbon-14 in every living material, but it is now clear that that carbon-14 is not homogeneously distributed among today’s plants and animals. It is also possible that the level of carbon-14 due to atmospheric changes was not the same all the time. Therefore, in order to improve its accuracy, the carbon-14 method is *calibrated* using samples of known age. It is done by constructing the so called *calibration curves* using certain materials of historically established ages according to the traditional chronology. That means the carbon-14 dating method is secondary and therefore is not able to either confirm or discard any chronology theory. In addition, the errors induced by this method exceed all time intervals acceptable from a historical point of view. We would like to point out that if the global chronology was changed, the carbon-14 dating method would also work nicely with the new dating system and will support it as well. Consequently, referring to the carbon-14 method as a proof of the correctness of the traditional chronology is a vicious circle.

Summary

The investigation of A.T. Fomenko and his collaborators shows that there are many justified reasons for rearrangement of the world history in general, and in particular its chronology. This is a monumental task involving a gigantic number of new obscure problems leading to seemingly impossible results. Nevertheless, we would like to mention that in the history of human culture there were many turning points when, with hesitation and lots of pain, mankind rejected established knowledge to accept new concepts.

Such reversals happened before in astronomy, mechanics, chemistry, physics and even in mathematics. There were also reversals in economics and psychology as well. This is history’s turn.

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