ANNEX 2

The discovery of homogeneous and heterogeneous fragments inside Russian, Roman and Greek chronicles, as well as the Bible

By *B. E. Brodsky, B. S. Darkhovskiy, A. T. Fomenko* and *G. V. Nosovskiy*

1. INTRODUCTION

Modern mathematical statistics managed to find a wide variety of applications for the momentous discrepancy method created by A. N. Shiryaev. The present work provides a brief rendition of the results of an interesting numerical experiment conceived and carried out by A. N. Shiryaev and A. T. Fomenko. The concept and experiment in question were discussed at the scientific seminar by the name of "Geometry and Statistics" held at the V. A. Steklov Institute of Mathematics (The USSR Academy of Sciences) and presided over by A. N. Shiryaev and A. T. Fomenko. The aim of the experiment was the application of the discrepancy method to the important problem of finding "homogeneous fragments" inside fairly large historical texts (and narrative texts in general), as well as distinguishing between those. Among such texts are historical chronicles in particular, chronographs etc. The theoretical basics of the discrepancy method are given in the article by B. E. Brodsky and V. S. Darkhovskiy, which can be found in Annex 1 to the present book.

The discovery of the informative quantitative characteristic of texts, as well as the preliminary processing of historical texts – in particular, Russian chronicles and the historical books of the Bible, was made by A. T. Fomenko and G. V. Nosovskiy. Their statistical analysis and related computer experimentation was carried out by B. S. Darkhovskiy and B. E. Brodsky. We have also been greatly assisted by T. Tolozova, A. Gromova and L. Mishchenko.

Let us remind the reader of how the problem is formulated. Many historical sources were compiled from fragments of a different nature. These separate fragments could have been written by different authors in different epochs and countries. Then these assorted fragments were united into a single book by some later chronicler. They began to exist as a single unit – a single chronicle dating to a later epoch. Multiple copies of chronicles and the alterations introduced by various editors made the external differences that existed between multiple old fragments comprising the "new large text" disappear gradually. Nowadays, such compiled texts are often perceived as uniform, since the history of their creation was erased from memory a long while ago.

One wonders whether a numerical statistical analysis of various frequency characteristics could allow for the discovery of such individual fragments inside a single large chronicle.

The method related below is based on the idea that each primary ancient fragment was "homogeneous" to some extent. For instance, it may have been written by a single author, thus bearing the distinctive characteristics of his individuality in style, manner and so on. Since this hypothetical individuality was apparently subject to few changes in the process of a single text's creation, one can formulate a natural hy-

pothesis, or a model of "initial homogeneity" of the fragments written by a single author, in a single epoch, or by a single historical school of chroniclers.

This apparently simple idea formulated by A. N. Shiryaev and A. T. Fomenko proved useful in the analysis of actual historical texts. Furthermore, we discovered that the results stemming from the application of this idea and the statistical research conducted by B. S. Darkhovskiy, B. E. Brodsky and G. V. Nosovskiy to actual historical texts concur well with the independent results obtained by other methods, also of a statistical nature.

We took the function of volume introduced in CHRON1, Chapter 5:1, as the quantitative characteristic of the text under study. Let us remind the reader of its definition. Let us assume that the historical text X is separated into "chapters" $X(t)$, each of these "chapters" being a fragment of the text dedicated to relating the events of a single year t. This is the structure of many ancient chronicles, which is presented as a scheme in fig. d2.1. For instance, on the left of a given chronicle page we encounter a dating, with the years given either counting from the Genesis, or in the B.C./A.D. chronology. Near them we see a fragment of text that relates the events that took place that particular year (according to the chronicler's opinion).

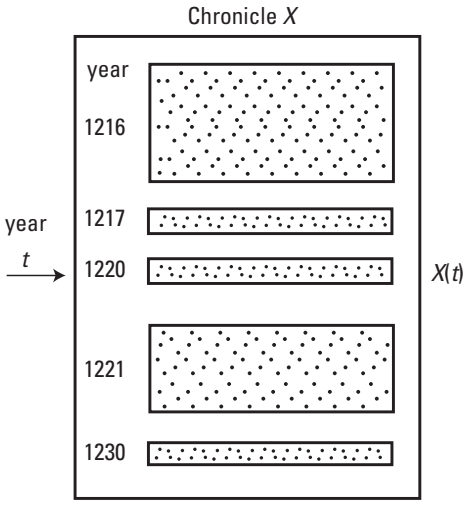

Fig. d2.1. The structure graph of an annual chronicle. The chroniclers separated the text into chapters referring to the events of a given year. Some of the years which they had no knowledge of may be omitted.

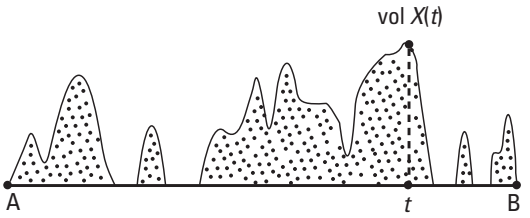

Fig. d2.2. The annual chronicle volume graph.

These are the $X(t)$ fragments. We can then proceed to calculate the volume of each fragment, which can be measured by either the quantity of lines, or pages, or characters. As a result, we obtain a numerical sequence reflecting the volume of each $X(t)$ chapter. It is convenient to represent these numbers as a graph, qv in fig. d2.2. The choice of a volume measurement unit is of no importance here, since the change of such a unit would only result in a different vertical scale of the graph in fig. d2.2.

The method of separating large historical texts into homogeneous and heterogeneous fragments is applicable to other quantitative characteristics than the text volume graphs. For the sake of simplifying our narration, we shall just refer to volume functions herein.

Above we have mentioned the homogeneous fragments of historical texts; however, in reality we shall separate the texts into the so-called stationary fragments which aren't merely homogeneous, but also contain virtually no alterations in their "process parameters".

2. DISCREPANCIES IN RUSSIAN CHRONICLES

We shall begin with the analysis of Russian chronicles contained in the ***Complete Collection of Russian Chronicles*** (Moscow, Nauka Publishing House) – see [36], [460], [671], [672], [716] and [747]. The fragments selected from each chronicle contain a distinctive separation of data into years, which allows for calculating the annual fragment volume. The matter is that certain chronicles may contain fragments describing large periods with no distinct separation into actual years. Such fragments were not analyzed, since the absence of a time scale makes the calculation of

the volume function impossible. We have processed the volume functions calculated by A. T. Fomenko for the following historical texts:

1) ***Dvinskoy Letopisets*** (short edition): main part of the chronicle describing the events of 1390-1717 A.D.

2) ***Dvinskoy Letopisets*** (extended edition): main part of the chronicle describing the events of 1340-1751 A.D.

3) ***Povest Vremennyh Let*** (main part of the chronicle describing the events of the alleged years 850-1430 A.D.)

4) ***Nikiforovskaya Letopis*** (main part of the chronicle describing the events of the alleged years 850-1430 A.D.)

5) ***Supraslskaya Letopis*** (main part of the chronicle describing the events of the alleged years 850-1450 A.D.)

6) ***Volynskaya Letopis*** (main part of the chronicle describing the events of the alleged years 860-1555 A.D.)

7) ***Kholmogorskaya Letopis*** (main part of the chronicle describing the events of the alleged years 850-1850 A.D.)

8) ***The chronicler of Prince Vladimir of Kiev*** (main part of the chronicle describing the events of the alleged years 970-1237 A.D.)

9) ***The chronicler of Rachinskiy*** (main part of the chronicle describing the events of the 1401-1548 A.D.)

10) ***Yevreinovskaya Letopis*** (main part of the chronicle describing the events of 1401-1547 A.D.)

11) ***Akademicheskaya Letopis*** (main part of the chronicle describing the events of 1339-1446 A.D.)

The volume functions for these chronicles are given in CHRON1, Annex 5.1. The results of their statistical analysis can be seen in figs. d2.3, d2.4, d2.5 and d2.6.

On each diagram we point out the discovered homogeneity zones, as well as the fragments which contain little data and are thus of little utility for obtaining dependable statistical analysis results. The discrepancy moments are plainly visible. Each such moment, or a modal change, is naturally defined approximately. The dotted lines on the diagrams define the boundaries of zones containing the discrepancy or mode alteration moments, as well as respective probability indications.

Let us also cite some of the consequences of the results obtained, the most interesting being the dis-

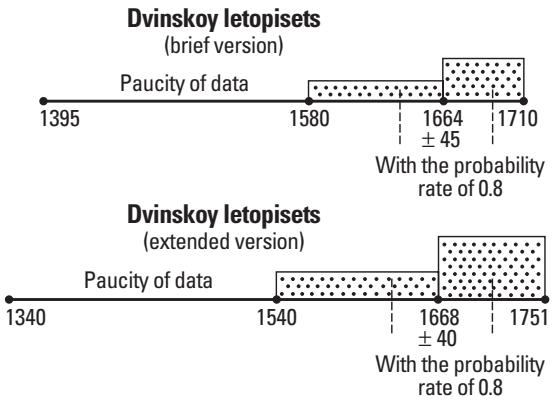

Fig. d2.3. Discrepancies in the brief and the extended version of the ***Dvinskoy Letopisets***.

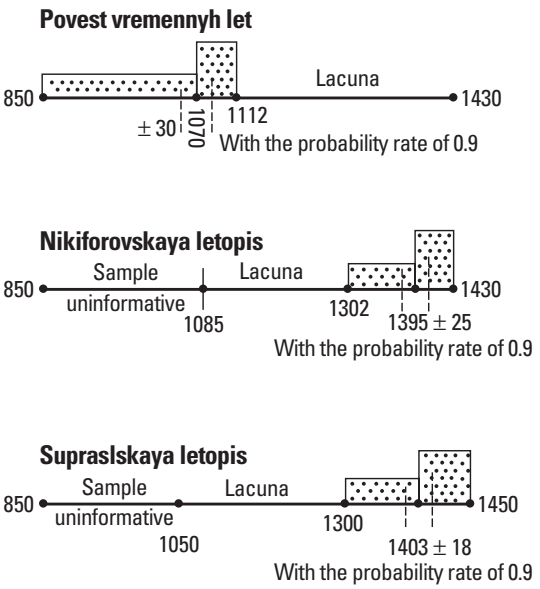

Fig. d2.4. Discrepancies in the ***Povest vremennyh let***, the ***Nikiforovskaya letopis*** and the ***Supraslskaya letopis***.

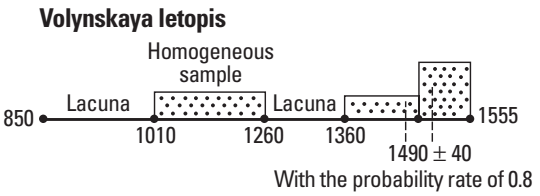

Fig. d2.5. Discrepancies in the ***Volynskaya letopis***.

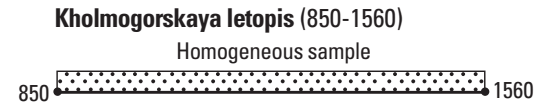

Fig. d2.6. No discrepancies were found in the ***Kholmogorskaya letopis***.

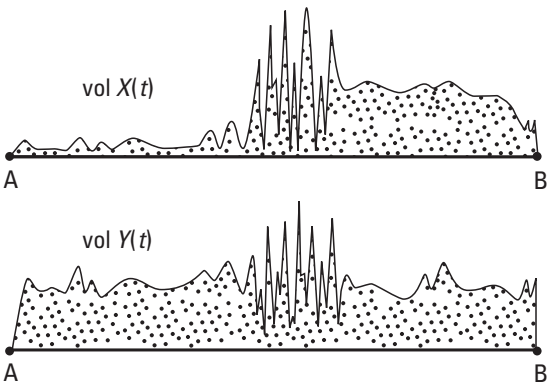

Fig. d2.7. The homogeneity zones in dependent chronicles should "resemble each other".

covery of ostensible dependencies between various texts. Bear in mind that the texts are called "dependent" if they refer to the same events in the history of the same region over a single time interval. In Chapter 5 of Chron1 we described the statistical methodology of distinguishing between dependent and independent texts. Insofar as Russian chronicles are concerned, we have discovered a dependency between the following texts:

The short and the extended versions of the ***Dvinskoy Letopisets.***

The dependency of these chronicles is perfectly natural, since they are but two different versions of the same chronicle – a brief version and its more detailed sibling. It is of the utmost interest that the fact of their dependency can also be discovered with the use of the method of distinguishing between homogeneous and heterogeneous fragments, as well as the discrepancy moments. It would be natural to expect the homogeneous fragments within dependent texts to be "roughly similar" – see the diagram in fig. d2.7. Indeed, the analysis of actual historical texts confirms this hypothesis.

In fig. d2.3 we can distinctly observe the correlation between the homogeneous fragments in the brief and the extended editions of the ***Dvinskoy Letopisets.***

In Chapter 5 of Chron1 we have discovered the dependencies between the ***Nikiforovskaya Letopis*** and the ***Supraslskaya Letopis.*** This dependency is also manifests in the results obtained by the method related herein. Indeed, the correlation between the homogeneous fragments of both these chronicles can be seen clearly in fig. d2.5. It would be interesting to compare these results to the structure of the famous ***Povest Vremennyh Let***, which also manifests a degree of dependency in relation to the ***Nikiforovskaya Letopis*** and the ***Supraslskaya Letopis.*** However, the ***Povest Vremennyh Let*** is a great deal more detailed than the other two chronicles, being at the same time a lot shorter. Therefore, this dependency is not manifest in fig. d2.4, apart from the virtually synchronous beginning of the "lacunae period". Since the method in question processes the amplitudes of the volume graphs, the difference between the chronicles rich in detail and their less detailed kin plays an important role. In the present example, the ***Povest Vremennyh Let*** is a detailed chronicle, and the other two contain less data. The amplitude correlations between the dependent "rich" and "poor" texts are related in the works of S. T. Rachev and A. T. Fomenko, qv in Chapter 5 of Chron1.

Therefore, the comparison of chronicles whose level of detail saturation is roughly the same, demonstrates the concurrence with the conclusions made earlier based on altogether different conceptions.

Apart from the Russian chronicles mentioned above, we have also processed the following ones contained in the ***Complete Collection of Russian Chronicles:***

The ***Akademicheskaya Letopis.*** It turns out that we do not encounter a sufficient amount of data here to use the discrepancy eduction method with any degree of confidence at all. The duration of the annual intervals equals roughly 100 years, with a 400-year lacuna.

The chronicler of Prince Vladimir of Kiev. Also a paucity of data here. The time interval related is less than 80 years, and contains a number of lacunae.

The chronicler of Rachinskiy and the ***Yevreinovskaya Letopis***. Not enough data here. Both chronicles cover a time interval of 150 years with a lacuna of roughly 50 years.

3. DISCREPANCIES IN THE WORKS OF TITUS LIVY AND BARONIUS

Apart from the Russian chronicles, we have processed the following two fundamental texts on "ancient" and mediaeval Roman history:

1) ***Ab urbe condita*** by Titus Livy ([482]). We have used a fragment thereof that contains annual reports of events between the 1st year of the City's foundation (allegedly Rome), and the 465th without large lacunae. This chronicle refers to the events that took place in the "ancient" Rome between the years 753 B.C. and 288 A.D. in Scaligerian chronology. A. T. Fomenko had calculated the volumes of generation chapters that Livy's book can be separated into in the natural manner. After that, a discrepancy in Livy's text was discovered in the course of our research (two discrepancies formally, but they are very close to each other, and the relevant trust intervals are virtually coincident, qv in fig. d2.8). This discrepancy falls on the period of roughly 390-400 ab urbe condita, which corresponds to approximately the alleged year 350 B.C., according to the Scaligerian chronology. The trust interval is between the years 360 and 440 ab urbe condita, or the alleged years 400 and 310 B.C. The volume function of Livy's œuvre is given in CHRON1, Annex 6.2.

2) ***Annales ecclesiastici a Christo nato ad annum 1198*** by Baronius, Moscow Publishing House, 1913, Volume 1, [50]. This text relates the events that took place in mediaeval Rome. We have taken a fragment containing annual descriptions pertaining to the period between the alleged years 1 and 400 A.D. Then we considered the volumes of annual fragments that result from a natural division of the book by Baronius. The volume function for the book of Baronius is given in CHRON1, Annex 6.3.

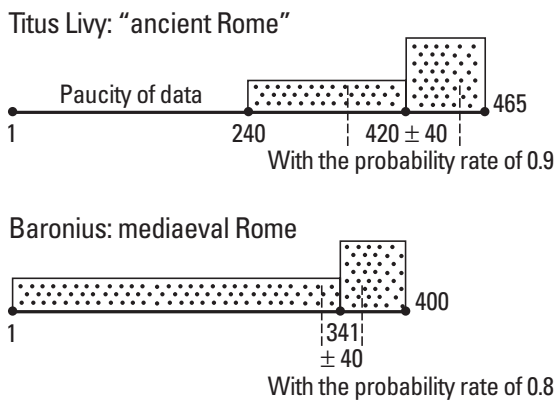

Fig. d2.8. Discrepancies in the "ancient" work of Titus Livy and the mediaeval œuvre of Baronius.

The statistical dependency between these two texts was already pointed out in Chapter 6 of CHRON1. In fig. d2.8 we see stationary zones discovered as a result of the statistical experiment discussed in the present work. Once again we compare the texts whose degree of detail saturation varies, therefore the dependency between the texts may not be all that conspicuous. As one sees it in fig. d2.8, the stationary zones are distributed in a similar enough manner; nevertheless, the present method makes it rather difficult to evaluate the degree of proximity, which results from the fact that the initial part of Livy's work is not informative enough for the text comparison method described herein.

4. DISCREPANCIES IN THE "HISTORY" OF HERODOTUS AND THE "HISTORY" OF TACITUS

We have also studied the ***History*** of Herodotus (Leningrad, Nauka, 1972). The volume functions are given in the auxiliary table 2.1.

As a result, the following two discrepancies were found in the Herodotean œuvre ([163]):

1) Book 3, fragment 83 ± 56. The trust interval is covered by the entire third book.

2) Book 8, fragment 88 ± 80. The trust interval covers Book 8 as well as the very beginning of Book 9.

COROLLARY.

We have thus proven that the text of the ***History*** by Herodotus is of a heterogeneous nature, therefore being a compilation of at least three substantially different texts. This compilation may have been made by either Herodotus himself, or the mediaeval editors who introduced his text into scientific circulation. The same is true for Livy's ***Ab urbe condita*** (qv above), which we have discovered to contain a single discrepancy.

We have also studied the ***History*** and the ***Annals*** by Tacitus ([833]), having discovered the following:

1) The ***Annals*** of Tacitus are homogeneous and contain no discrepancies. This may indicate that their text was written by a single author.

2) The ***History*** of Tacitus contains a single discrepancy: Book 3, fragment 50 ± 23. It falls over the moment of Vespasian's coronation approximately; the presence of a discrepancy may indicate that Tacitus' ***History*** is a collation of two different texts.

3) The complete text of Tacitus containing both of the abovementioned chronicles contains a single discrepancy inside the ***History***, which coincides with the one discovered as a result of studying this work separately.

Corollary.

This result rather unexpectedly pours some light over the famous historical problem, the matter being that the issue of whether the ***Annals*** and the ***History*** belonged to the same author had already been mentioned for quite a few times in scientific literature. See Chapter 7 of Chron1 for the details concerning this scientific discussion. Our results imply that the ***Annals*** and a part of the ***History*** were apparently written by the same author or compiler. As for the second part of the ***History*** that begins with the description of Emperor Vespasian's reign, it is most likely to have been written by another person. It is also possible that Tacitus was a compiler and not an author, and his text is simply a collation of two heterogeneous chronicles.

5. DISCREPANCIES IN THE BIBLE

We have finally processed the Bible, including both the Old Testament and the New. The text of the Bible that was used for the purpose was published by the Patriarchy of Moscow in 1979. It is common knowledge that every Biblical book contains the canonical division into separate chapters, which, in turn, consist of individual verses. A. T. Fomenko and G. V. Nosovskiy calculated the volumes of these canonical chapters, measured as follows:

a) in the number of lines (in the standard edition of the Bible),

b) in the number of verses.

Since the quantity of lines differs from verse to verse, these two characteristics of chapter volumes shall also be different. It would be interesting to compare the results obtained from processing these two various volume functions. The volume table (in verses and lines) in given in the auxiliary table 2.2. The entire Bible contains 1357 canonical chapters.

The statistical analysis, which was subsequently performed, by B. S. Darkhovskiy and B. E. Brodsky, demonstrates the following (see fig. d2.9):

a) The Old Testament studied separately contains the following five discrepancies:

1) 159 ± 42 (= Deuteronomy 6; trust interval begins with the fist chapters of Numbers and ends in the middle of Joshua).

2) 341 ± 53 (= 1 Chronicles 3; trust interval begins with the end of 2 Samuel and ends in the middle of the second book of Chronicles).

3) 517 ± 31 (= Job 42 = the last chapter of the Book of Job; the trust interval begins with the first chapters of Job and ends at the beginning of the book of Psalms).

4) 724 ± 49 (= Words of the Wise 6; trust interval begins in the middle of the Proverbs and lasts until the end of [the book of Joshua, son of Siragh? *Not found in the Bible!*].

5) 966 ± 62 (= Daniel 1; trust interval begins at the end of Jeremiah and lasts until the end of Haggai).

b) The New Testament studied separately contains a single discrepancy that separates the Gospels, and, possibly, The Acts of the Apostles, from the rest of the New Testament (the Epistles and the Revelation). The exact location of this discrepancy is 1212 ± 18 (= The Acts of the Apostles 23; the trust interval begins with the first chapters of the Acts and lasts until the end of the Second Epistle of Peter).

c) The entire text of the Bible comprising both the Old Testament and the New was studied as well; here we found the discrepancy separating the Old Testament from the New.

Corollary 1.

It would be of the utmost interest to compare these results to the previous analysis of the Biblical chronology as performed by A. T. Fomenko (see Chron1). Let us remind the reader that the analysis in question demonstrated the existence of a series of "short" duplicates in the Bible, separating large sec-

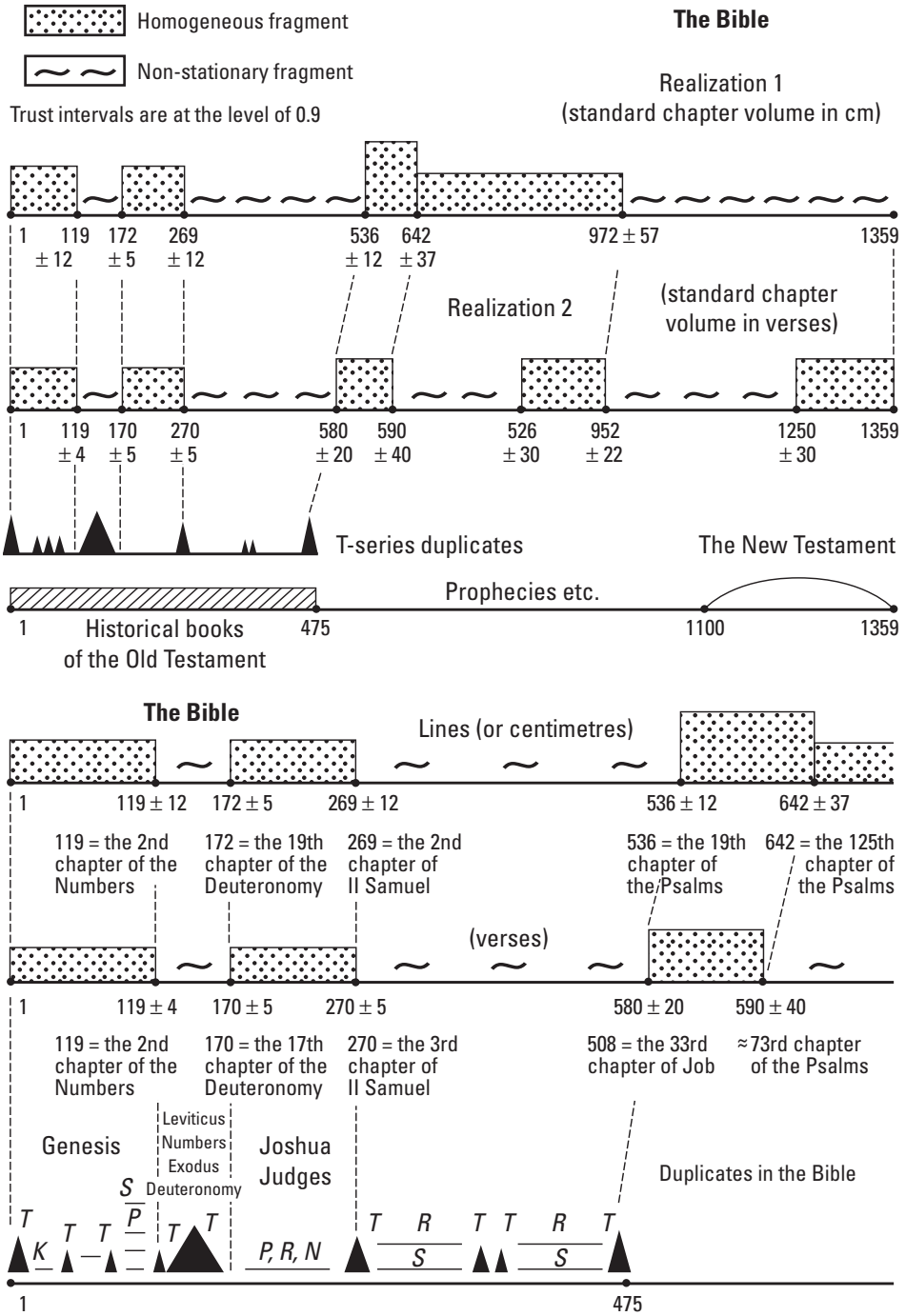

Fig. d2.9. Discrepancies in the Bible. The volume was calculated for the canonical division of the Bible into chapters and verses. One sees a perfect correlation with the system of duplicates that were discovered in the Bible with the use of altogether different statistical methods.

tions of books, duplicating each other and, generally speaking, acting as reflections of the same chronicle. The short duplicates in question (referred to by A. T. Fomenko as the "T-series" in later publications) usually surface at the beginning and at the end of said chronicle.

It would be natural to expect the discrepancy points to be found in the same places as the duplicates of the T-series. This hypothesis is confirmed; indeed, all the discrepancies contained in the so-called historical part of the Bible – from its beginning to the books of the Prophets, fall over the exact same locations where the T-duplicates are found. They are the first and the second discrepancy from the Old Testament list, qv above.

Corollary 2.

The third, fourth and fifth discrepancies from the Old Testament are all perfectly natural from the point of view of the classical Bible studies. In particular, the division of the Bible that they create concurs perfectly with the well-known division mentioned in all of the standard comments, namely:

The third discrepancy falls right over the beginning of the so-called "Scripture section" (The Psalms, the Proverbs, the Ecclesiastes, the Song of Solomon, [the Book of Solomon's Wisdom and the book of Wisdom of Joshua, son of Siragh]).

The fourth discrepancy indicates the beginning of the Greater Prophet section (Isaiah, Jeremiah and Ezekiel).

The fifth discrepancy separates the "greater prophets" from the "lesser prophets".

Corollary 3.

The separate nature of the Gospels within the New Testament is a well-known fact, which is also vividly confirmed by our analysis; it is manifest in the existence of the discrepancy that we found in the New Testament, which is the only one there (!).

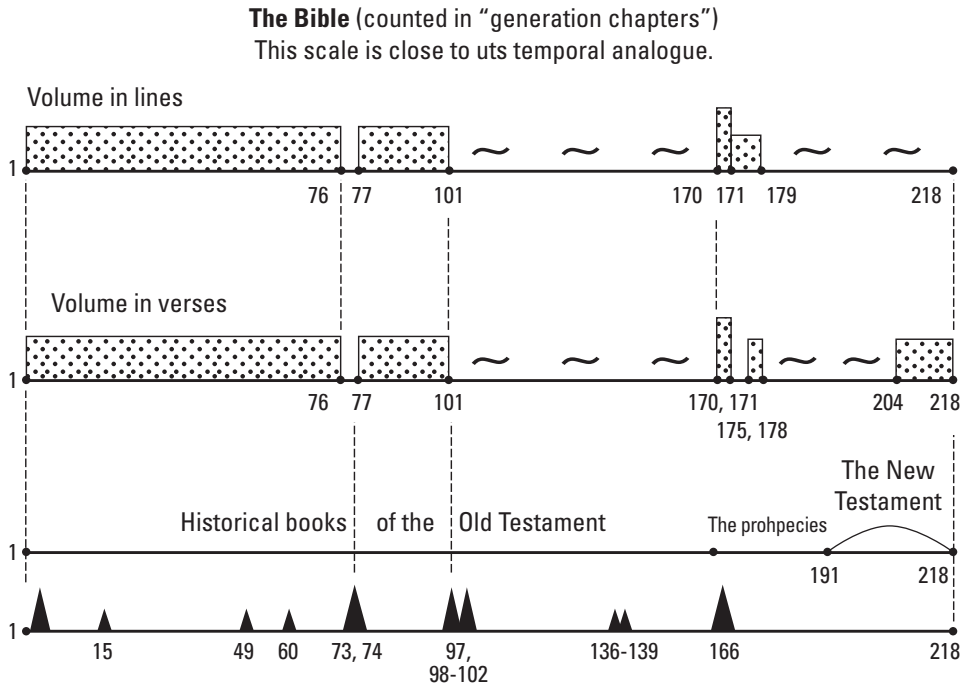

Fig. d2.10. Discrepancies in the Bible. The volume was calculated for the Bible divided into "generation chapters". We see a perfect correlation with the system of duplicates discovered in the Bible with the aid of completely different statistical methods.

Summary.

All the discrepancies found outside the historical part of the Bible have a natural explanation, reflecting the previously known boundaries between the heterogeneous parts of the Bible. As for the discrepancies contained in its historical part – they are a new phenomenon that remains unknown to the classical Biblical science. We have already pointed out the fact that they have a natural chronological interpretation within the framework of "statistical chronology".

The full picture of the Biblical discrepancies can be seen in fig. 2.9. For every discrepancy we give its statistical pinpoint evaluation, as well as the boundaries of the trust interval, which contains the true value of the discrepancy with the probability coefficient of 0.9. The probability coefficient of a "false alarm", or the indication of a nonexistent discrepancy, equals 0.05. The rectangles of varying height mark the homogeneous stationary zones within the Bible.

It is most noteworthy that the boundaries of the stationary homogeneous zones discovered in the Bible all but coincide with the Biblical homogeneity zone boundaries discovered by altogether different methods. See more details in Chapters 5 and 6 of Chron1. The methods suggested therein are of a more precise nature than the discrepancy location method, and they therefore demonstrate a more precise division of the Bible in to "homogeneous fragments".

In fig. d2.10 the discovered homogeneity zones are drawn on a different scale. The Bible is represented here as a collection of fragments referred to as "generation chapters" in Chapter 5 of Chron1. This division differs from the canonical division into chapters. Generally speaking, a generation chapter corresponds to a fragment of text that relates the events that took place in the history of a single generation (or the lifetime of a single important character). Some of the generation chapters may contain several standard chapters of the Bible (which are usually shorter than the generation chapters). Therefore, the use of a new scale may result in the collation of several standard chapters into a single generation chapter. In fig. d2.10 we see this conversion, and it demonstrates which standard chapters exactly comprise a single generation chapter. The same diagram contains a comparison of the results obtained with the use of the discrepancy method to the division of the Bible into groups of generation chapters that results from the use of other methods. We see a very good concurrence indeed.