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THE AUDIO-AESTHETIC EFFECT OF READING THE TEXT OF THE *ARGONAUTICA*

Greek texts were universally recited in accordance with two traditional ways of pronunciation: similar to Modern Greek and to Erasmus' scheme. Modern linguistics offers different opinions on the tradition to follow. Such discussion started in the XVI century and the most important was the work of Erasmus "Dialogus de Recta Latini Graecique Sermonis Pronunciatione" (Dialogue on Pronunciation of Latin and Greek Words) published in 1528, where the author proved suitability of reading in accordance with the pronunciation established in the Classical Period. Approximate restoration and reconstruction of ancient pronunciation were carried out in accordance with the pattern of phonological system. Moreover, scholars take into account data of ancient writers, grammarians and scholastics as well as etymology of words and hyphenation pattern for Ancient Greek.

Since then the issue about which tradition is more reasonable for reading of ancient Greek texts has been hotly debated.[1] The majority of classical scholars favors reading ancient Greek texts in accordance with Erasmus' scheme, while the greater part of Modern Greek scholars maintains for opinion that the reading of ancient Greek texts in accordance with Erasmus' scheme is not science-based taking into account the fact that pronunciation strongly varied in different geographical areas as well as at different periods of language development; therefore, it must have been impossible to use similar rules for all texts.[2] Taking into account their opinion, the reading of

[1] For additional information and bibliography see Gordeziani R., Darchia I., Shamanidi S., Ancient and Modern Greek Grammar (Comparative Grammar), Logos, Tbilisi 2001, 23.

[2] For details see Μπαμπινιώτης Γ., Ερασμική και Νεοελληνική προφορά, Ιστορική γραμματική της Αρχαίας Ελληνικής Γλώσσας, Εκδόσεις Γ. Γκέλμπεσης, Αθήνα 1985, 38-39.

ancient texts using Modern Greek pronunciation will help people who know Ancient Greek, to study Modern Greek Language.[3] In my opinion the reading of ancient Greek texts in accordance with Erasmus' scheme will help people who study Modern Greek Language, to understand phonetic system of Ancient Greek and consequently, to study orthographic issues of Modern Greek Language.

Since the moment when comparative historical linguistics of the XIX century admitted the superiority of pronunciation in accordance with Erasmus' scheme, scholars started hot debates on how to read ancient Greek texts – "εξ επασυνθέσεως" (reconstructed), according to Erasmus' scheme or "εξ εξελίξεως" (developed), according to Modern Greek Pronunciation.

There is no doubt that the phonetic system of the Ancient Greek language differed from Modern Greek. The majority of scholars, including Greek scholars, acknowledge that Erasmus' scheme is more precise for reproducing phonological system of Ancient Greek language. However, it remains unclear whether the use of reconstructed pronunciation for reading all text, is to be approved. Thus, according to G. Babiniotis, on the one hand reading digrams given in texts from the VII/VI centuries B.C. up to the II century as diphthongs diverts attention from different pronunciation of true and non-true diphthongs[4] and on the other hand, we do not consider their monophthong phonation in different districts. For both cases, using i.e. "correct" ("ορθή") or "Erasmus'" pronunciation we deny scientific truth.[5] Naturally, different periods of language development and different geographical areas were characterized with different pronunciation as well as dialect differences of Ancient Greek language. Thus, it was impossible to take into account all possible dialect differences. Generally, we use Attic dialect to study the phonetic system of Ancient Greek language, and consequently, using Attic dialect, we compare Erasmus' pronunciation with Modern Greek.

Our research issue does not consider which pronunciation is more correct from the scientific point of view, but we want to expose, which one has an audio-aesthetic effect on audience. Thus, we can determine which pronunciation will be more efficient for the study of ancient Greek texts.

For this purpose we carried out phonetic experiment using phonetic software "Sound Forge". We recorded a short fragment of the first song of the "Argonautica" by Apollonius Rhodius recited in accordance with Erasmus'

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[3] Χαραλαμπάκης Χ., Η Ερασμική προφορά, Ιστορία της Ελληνικής γλώσσας, Επιστημονική επιμέλεια: Κοπιδάκης Μ. Ζ., Ελληνικό Λογοτεχνικό και Ιστορικό Αρχείο, Αθήνα 1999, 124-125.

[4] For true and non-true diphthongs of Ancient Greek Language see Соболевский С. И., Древнегреческий язык, издательство литература на иностранных языках, Москва 1948, 8.

[5] Μπαμπινιώτης Γ., op. cit., 38-39.

scheme as well as with the principles of Modern Greek. Afterwards, the third and the forth year students of the Modern Greek Studies department at the Iv. Javakhishvili Tbilisi State University, listened to the texts and were later asked to present a written opinion on the pronunciation they appreciated or disliked as they listened to ancient Greek texts. Before presenting, we will proceed to statistical results of the experiment, which will help to determine reading efficiency in accordance with Erasmus' scheme during the study of ancient Greek texts, we would like to introduce graphical results of phonetic records as well as phonetic differences between readings in accordance with Modern and Erasmus' Schemes.

Ancient Greek language had short and long vowels. Short vowels are – α, ϵ, ι, ο, υ. Long vowels are – α, η, ι, ω, υ. Modern Greek Language has only short vowels. The loss of long vowels started in the Ancient Period and finished in the VIII-X centuries A.D. There is an opinion that the loss of short-long vowels was caused by the changes in the stress-accent system. Namely the length of vowels lost its function when the musical stress was replaced by an expiratory stress. This process must have accelerated by the 100 years A.D. and finished in the middle of the third century.[6] Thus, it was impossible to reveal differences between long and short vowels during the recording.

Ancient Greek language had a very large system of diphthongs, replaced by, digraph system in Modern Greek. The conditioning factor of different phonetic records was different pronunciation of diphthongs and sounds: η – e (Ancient Greek), i (Modern Greek), υ – iu (Ancient Greek), i (Modern Greek) etc.

Consonants were altered as well. Changes can be observed in pronunciation of the following sounds: β, γ, δ, ζ, θ (Modern Greek Language) and b, g, d, zd (dz), th (Ancient Greek language).

Aspiration and stress-accent are very important for diagrams. Naturally, it was impossible to distinguish acute (accentus acutus), circumflex (accentus circumflexus) and grave (accentus gravis) accents, but the metres of texts were of great importance as well. Taking into account that we have analyzed the text of the "Argonautica", naturally, the difference between Modern and Erasmus' pronunciation depended on dactylic hexameters. Apollonius Rhodius tried to keep to the language and style of ancient epos in the "Argonautica". The poem was written in Ionic dialect with Aeolic elements of Ancient Greek language. Here and there the poet tried to use modern forms, so, his language varied between Ancient and Modern forms.[7]

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[6] Allen W. S., Vox Graeca, The Pronunciation of Classical Greek, Cambridge University Press, Cambridge 1974, 88-89.

[7] Urushadze A., Introduction, Apollonius Rhodius, "The Argonautica", Metsniereba, Tbilisi 1970, 22.

We have processed a fragment of the "Argonautica" (Apollonius Rhodius, "The Argonautica", with an English translation by R. C. Seaton, Harvard University Press, MCMLXVII, Book I, 3, 1-17) using phonetic software Praat.[8] The software developers are Professors Paul Boersma and David Weenink, Institute of Phonetic Sciences, University of Amsterdam. The program provides phonetic analysis of records, composition of diagrams and curves. Program Praat – is a tool for comparative analysis, synthesis and manipulation of speech. Using the program we can analyse the following data: pitch of sound, intensity, shimmer, interval between sounds, duration of sound, spectral analysis (spectrograms, spectral slices etc.) etc.[9] Generally, the program is used for experimental phonetics. So, we can meter and calculate articulation.[10]

See diagram N1-2

The diagrams show 17 lines of the first volume of the "Argonautica". Horizontal line shows record time; its duration is 95.790000 seconds. Vertical line shows frequency, which is calculated in HZ. Spectrogram is given under the record diagram. The starting point of spectrogram is 0 HZ, its peak is equal to 5000 HZ. Dark lines given on spectrogram show that the pronunciation of sound produces large amount of power, while less dark lines indicate less power. Blue lines or points show pitches of sound. Pitches of sound increase as a result of jitter increase and decrease – as a result of jitter decrease. Pitches of sound change in accordance with type of phrase, emotional load or sound timbre.[11] Especially important is who the voice belongs – to a female or a male. For a male voice the minimum pitch equals 75 HZ, the maximum – 300 HZ; for a female voice – 100 – 600 HZ. On the diagrams, yellow lines show intensity, red lines – sound formants (generally, vowels), and blue lines – sound impulses.

What kind of differences was revealed between the two diagrams? Naturally, vowels pronunciation is especially relevant. It is impossible to see difference between short and long vowels. Very important are stress-accent, aspiration and diphthongs. After pronunciation of vowels we shall determine their formants, which are acoustic representatives of vowels and depend on sound frequency. Using formants we determine sound timbre, which provides melodic pattern of sounds. Melodic pattern has an impact on human brain.

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[8] http://www.praat.org.

[9] For additional information about Praat see Lobzhanidze I., Modern Methods of Experimental Phonetics for Fragments of Udian Language, Tbilisi 2006, 19-20.

[10] For experimental phonetics see Akhvlediani G., Introduction to General Phonetics, Ganatleba, Tbilisi 1996, 19-21.

[11] Матусевич М. И., Введение в общую фонетику, Учпедшиз, Москва 1959, 19.

To have a more accurate idea, we have to consider spectrogram of a word. Let us take a word, where the pronunciation of vowels (taking into account that we don't distinguish short and long vowels) does not differ in Ancient and Modern Greek, but gives different spectrograms. E.g. a word – ἀρχόμενος.

See diagrams N 3-4

For us the most important is the number of formants and their numerical signs. Apparently, the first diagram recited in accordance with Erasmus' scheme has less formants than the second recited in accordance with Modern Greek principles. Though, the quantity of vowels is similar. Vowel has a different number of formants, but generally its number does not exceed four formants per frame. For some languages the initial two formants (vowel height (F1) and vowel place (F2) are enough to determine a vowel. So, Greek Language needs determination of the initial two formants. Apart from this, we have some cases, when the formants of i and e or, u and o coincide with each other. In such cases, the decisive importance belongs to intensity of formants. Intensity of the second formant is higher for o and e than for u and i sounds.[12]

Formants of a word read in accordance with Erasmus' scheme can be observed at the beginning of a word – "a" vowel and at the end – "o" vowel, while, a word read in accordance with Modern Greek has a great number of formants. Formant number for "a" vowel given on the first diagram is the following:[13]

F1 = 1169.875977, F2 = 2739.800049

Whereas, the formant number on the second diagram is the following:
F1 = 1215.073120, F2 = 2223.470703

We have similar conditions for the other sounds, e.g. "o" vowel:
F1 =314.390472, F2 = 1472.985352

On the second diagram
F1 = 365.693726, F2 = 1493.943726

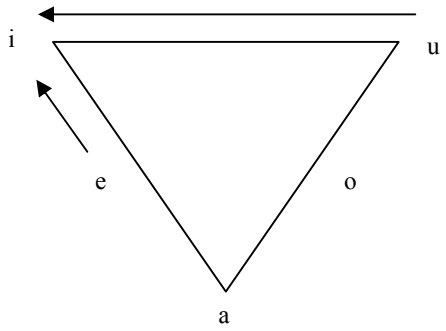
What can we conclude from the above-mentioned? The first formants are higher in HZ for the text read in accordance with Erasmus' scheme than for text read in accordance with Modern Greek pronunciation. It means that Erasmus' pronunciation is characterized with low-HZ frequencies. The second formants depend on vowel place: in the first case we have "a" front

[12] Кибрик А. Е., К вопросу о методе определения дифференциальных признаков при спектральном анализе (На материале гласных новогреческого языка), Вопросы языкознания, 5, Наука, Москва 1962, 83-84.

[13] We have considered only initial two formants taking into account that the initial two formants are sufficient for vowel system of Greek Language.

vowel and "o" back vowel. Differences in HZ of formants depend on epic metre or dactylic hexameter of the "Argonautica".

Differences are caused by different pronunciation in Ancient and Modern Greek Languages: η – e (Ancient Greek), i (Modern Greek),[14] υ – iu (Ancient Greek), i (Modern Greek) etc. We come across these sounds in text, e.g. ἐφημοσύνη. Differences mentioned above can be observed in the diagrams. We will not consider each word separately, but it is important to highlight that Greek Language, as a result of development, tends to simplication, while Greek phonetic – tend to become more melodic. So, changes in pronunciation of η sound – from "e" to "i" show that the middle vowel became high vowel,[15] and changes in pronunciation of υ sound – from "iu" to "i" show that the high hard sound became soft. We can present the above-mentioned using vowel triangle approved all over the World, which is known as V-shaped scalene triangle.[16]



So, the vowel system of Greek Language is transformed to high, closed and soft sounds. Modern Greek becomes more melodious as compared to Ancient Greek language.

Ancient Greek language was characterized with a large diphthong system. Diphthongs are widely presented in different languages worldwide, but their phonological value is different. Each language represents diphthongs

[14] For details about "η" vowel in Ancient Greek see Μπαμπινιώτης Γ., Ιστορική γραμματική της Αρχαίας Ελληνικής Γλώσσας, Εκδόσεις Γ. Γκέλμπεσης, Αθήνα 1985, 34.

[15] The fact can be confirmed by a formant number for "η" sound given on spectrogram of a word "ἐφημοσύνη", which is the following: F1 = 450.951924 HZ according to Erasmus' scheme and F1 = 409.298004 HZ according to Modern Greek pronunciation. F1 for high sounds is always less than for middle or open vowels.

[16] Трубецкой Н. С., Основы фонологии, Издательство иностранной литературы, Москва 1960, 123.

differently,[17] sometimes they are considered as difficult vowel phoneme or a liaison of two vowel phonemes. Ancient Greek had two types of diphthongs: diphthongs with two pronounced vowels and diphthongs with one pronounced vowel.[18] Modern Greek transformed diphthongs to monophthongs. So, their pronunciation was changed as well.

Let us consider a word μνήσομαι with "αι" diphthong, which was pronounced as "ai" in Ancient Greek and "e" in Modern Greek Language.

See diagrams, N 5-6

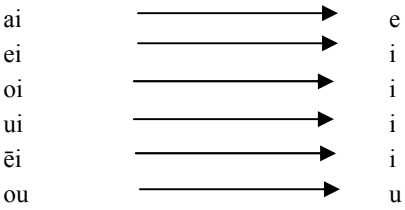
The most interesting are diphthongs given at the absolute end of the word, which are differently represented on both diagrams. Let us consider formants of the diphthong. Formant number for "αι" diphtong given on the first diagram is the following:

F1 = 321.566437, F2 = 2341.126709 HZ

On the second diagram:

F1 = 536.485657, F2 =1696.898315 HZ

So, we see that both parts of the diphthong were pronounced at lower frequencies in Ancient Greek than in Modern Greek. As concerns the second formant – middle vowel was replaced by front vowel in Modern Greek. So, the formant value was more in Ancient Greek than in Modern Greek. We shall pay attention to the tendency of sound replacement in diphthongs by high and soft vowels.



We should take into account that the changes took place as a result of iotization (ιωτακισμός), which supposed more close pronunciation of vowels and diphthongs or their replacement by closed front high "ι" sound. This process must have started in the Hellenistic period, and finished in the Byzantine period – the IX-X centuries.[19]

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[17] Матусевич М. И., op. cit., 19.

[18] For details about diphthongs see Gordeziani R., Darchia I., Shamanidi S., op. cit., 19-20.

[19] Μπαμπινιώτης Γ., op. cit., 35.

Differences between the above diagrams included in pronunciation of consonants as well:

β – b – v,
γ – g – ǧ,
δ – d – đ,
θ – t – ð,
ζ – dz – z[20]

Likewise, in intensity of sound waves, impulses and sound heights. We will not dwell on each sound separately, but will consider the data necessary for our research. Naturally, intensity of sound waves is represented with different numbers for different sounds, but the most important is the fact that the number is higher for the text read in accordance with Erasmus' scheme, than for the text read in accordance with Modern Greek pronunciation. The intensity is calculated in dB-s. So, the following illustrates the comparison between Ancient and Modern Greek is the following:

Ancient	Modern
53.221355 dB	52.677667 dB
53.277973 dB	52.699902 dB
53.128075 dB	52.630135 dB

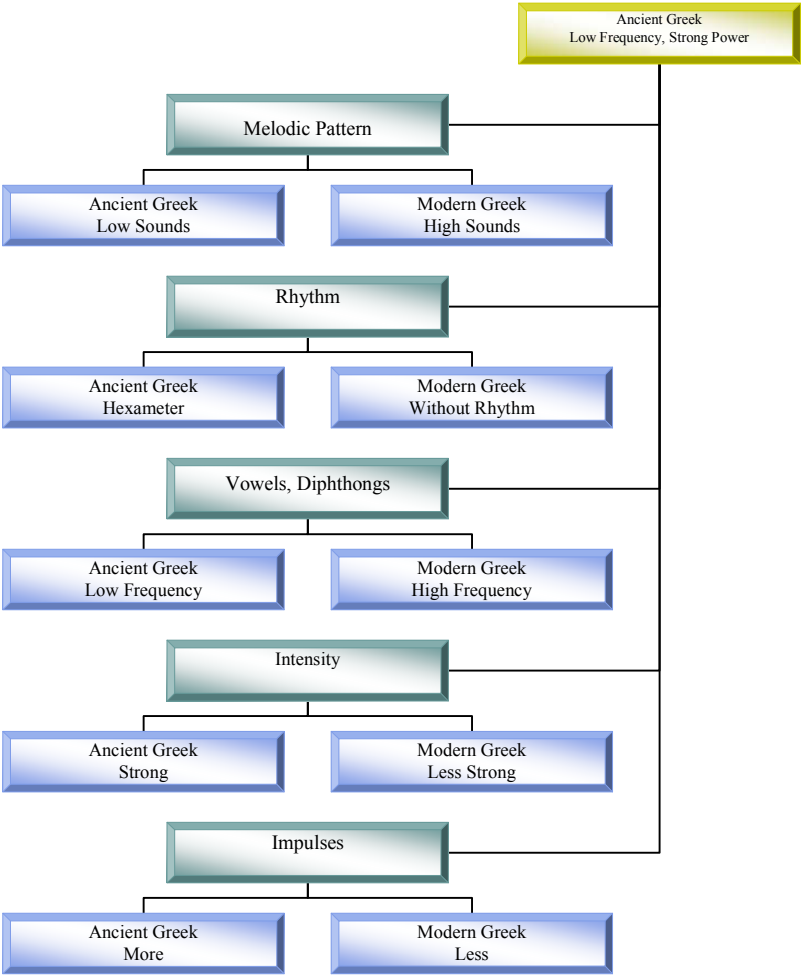
Also, the quantity of sound impulses is more in Ancient than in Modern Greek. So, e.g. within a line of the text read in accordance with Ancient Greek the number of impulses is as follows: 521 impulses with average duration of 6.03356 seconds; and within a line according to Modern Greek: 462 impulses with average duration of 4.92377 seconds. As concerns sound height, maximal levels calculated in HZ-s vary within 499-500 HZ, and minimal level for Ancient Greek equals to 66.69 HZ and for Modern Greek – 150.38 HZ.

As a result of psychological surveys, it was determined that sounds pronounced with low frequencies, defined rhythm and jitter implemented with special power and intensity have very high emotional impact on human brains. Very often in spite of pleasant phonation the text read with melodic phonation has no emotional impact on the listener. As a result of neurological survey it was determined that sound pronounced with low frequency as well as musical sound activates cells of the right cerebral hemisphere of human brains. So, it has very high emotional impact on the listener.

[20] For changes of consonants see Μπαμπινιώτης Γ., Συνοπτική ιστορία της ελληνικής γλώσσας, Αθήνα 2002, 125-129.

Psychoacoustics has revealed that a human being perceives sounds using the following parameters: height, timbre, duration, frequency variation and localization.[21]

If we compare the two ways of reciting of the "Argonautica" we'll receive the following scheme:



[21] Смирнов А., Элементы психоакустики, http://www.theremin.ru/lectures/psycho-acoustics.htm

Thus, Ancient Greek is characterized with sounds of low frequency and high intensity. Nowadays, a lot of destructive weapons were developed as a result of physical impact on human brains caused by sounds. Naturally, we mean the impact of very low frequency sounds that are inaudible to humans, but the most significant is that sounds of very low frequency and high intensity were used for the development of such weapons.[22] Ancient Greek texts read in accordance with Erasmus' scheme do not cause destructive impact on humans, but great emotional effect on cells of human brains concluding in subconscious sense of catharsis.

As about students' opinion about reading in accordance with Erasmus' and Modern pronunciation, the majority voted for Erasmus' pronunciation. Out of 16 students taking part in the experiment 14 voted for Erasmus' pronunciation, 1 – for Modern pronunciation and 1 abstained from voting. Although, the majority could not answer the question – why have they chosen Erasmus' pronunciation? 9 students answered that they found it original, 1 student answered that the principle was more usual, and 4 students could not answer. It prompts us think that the phonetic structure of the text has subconscious effect on the listener.

It is impossible to look through all aspects within the framework of a paper. But we tried to consider a short fragment of the "Argonautica" from the phonetic-acoustic point of view and to determine on audio-aesthetic effect of two traditions of reading.

[22] Altmann J., Acoustic Weapons – A Prospective Assessment, *Science and Global Security*, Princeton University 2002, vol. 9, 165-234.

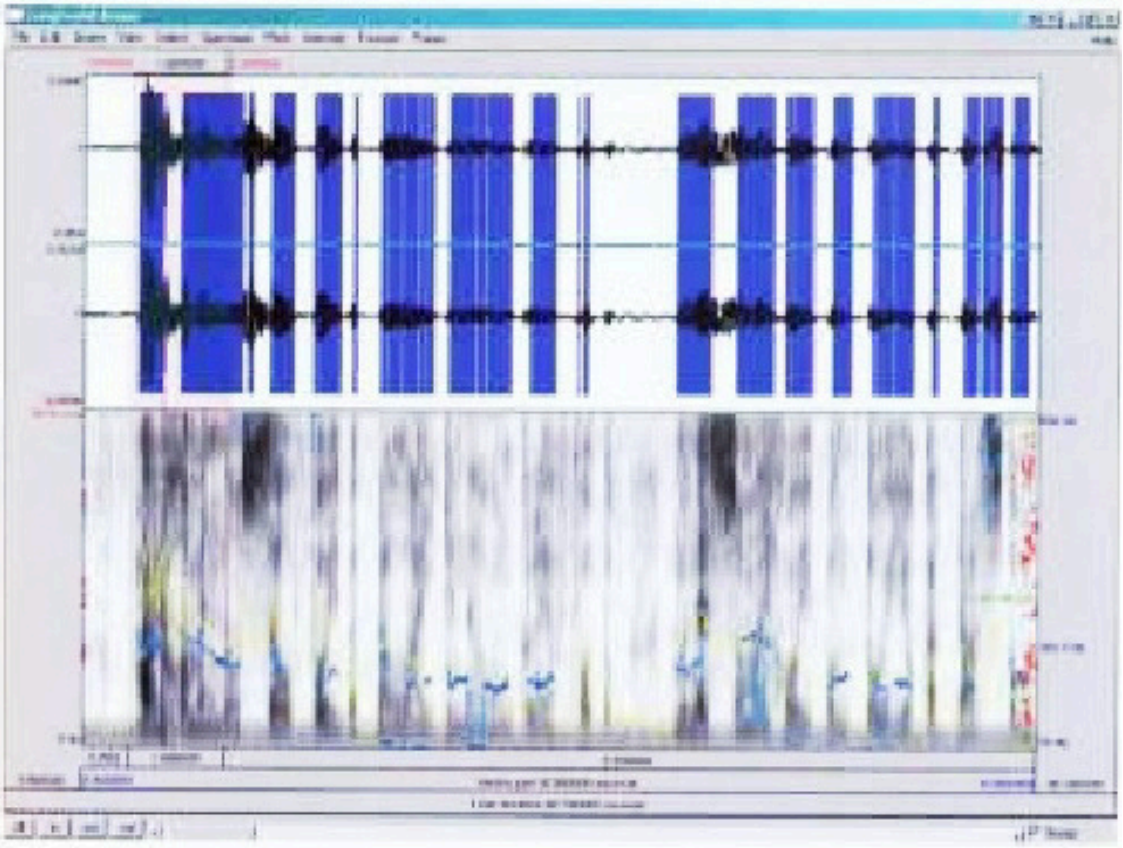


Diagram № 1. Recorded fragment of the *Argonautica* in accordance with Erasmus' reading.

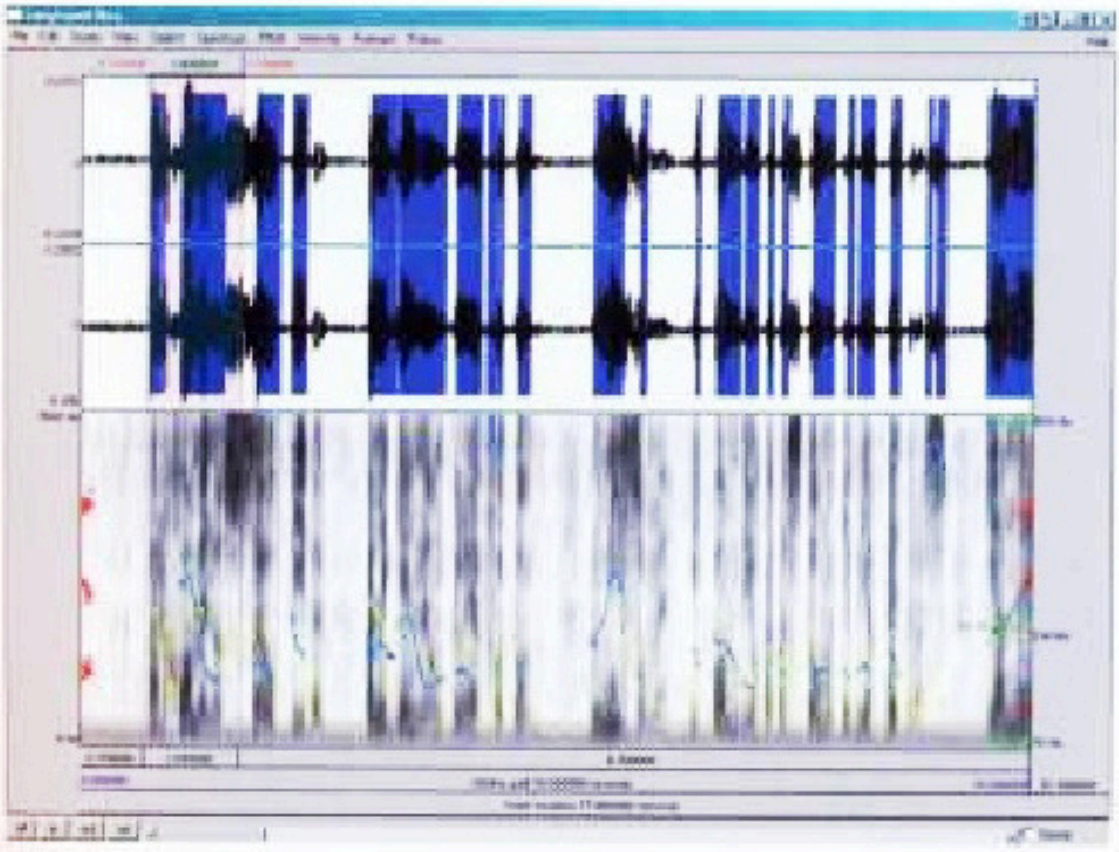


Diagram № 2. Recorded fragment of the *Argonautica* in accordance with Modern Greek reading.