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On the cartography of Rigas *Charta*

Keywords: Rigas Velestinlis; Rigas *Charta*; Greek enlightenment; Eighteenth century cartography; map design; Delisle map tradition; Pantograph.

Summary

The *Charta of Greece* (Map of Greece) by Rigas Velestinlis (1757-1798) printed in Vienna in 1796 and 1797 is a remarkable case in the modern history of maps: Although the aspects of this twelve-sheet map, a monument of the Greek national resurgence, concerning its historic, ideological, political, revolutionary, literary and full of symbolic messages were more or less widely analyzed, mainly in Greek language, very little has been done up to now for the investigation of this great map's purely cartographic content, from the stand point of the science and technology of Cartography. Many issues associated to the cartographic analysis of *Charta* remain still open as it is e.g. the geographic placement of the map-framing (the geographic window of the map), the proper georeferencing of the map, the proper union of the map-sheets in a unique two by two metres map, the compatibility of the coastline and of the geometric content with other maps taken as standards, the study of scale variation, the analysis of its projective properties, its deformation analysis, the geometric placement and reference of *Charta*'s thematic elements (toponyms, verbal elements, symbols, images etc.) as well as a number of other issues related to the theory and practice of scientific and technological cartography.

In the last years, the revolutionary development of digital technologies, as applied in Cartography's mainstream, allow a broader and deeper approach to a great number of topics related to the old (historical) maps. Thus, Rigas *Charta* gains a new and attractive research interest which is coming to refresh and enrich the up to now historic and literary production about this top cartographic work of Greek Enlightenment.

In this paper the cartographic research on *Charta* is presented with the use of modern tools of map analysis with the use of digital technologies for the study and interpretation of the geometric and thematic map-content. In addition an attempt is made for the first time to approach the technical and practical procedures possibly followed by Rigas Velestinlis in designing his *Charta.*

Introduction

For Rigas Velestinlis *Charta,* this monumental cartographic work of Greek Enlightenment and Greek Cartography in its ensemble, the bibliographic references either merged into more general approaches to Rigas work or dealing with the Rigas authorship or even regarding *Charta* itself, are generally limited. Focusing especially on *Charta* we easily find that the greatest number of reference is included partially in thematically broader treatments of Rigas work. The specialized reference to *Charta* as an independent and discrete outcome of Rigas' intellectual and practical production is indeed limited and in general mostly recent, almost all coming from the stand point of humanistic sciences and approaches.

Three years just after the Greek national uprising of 1821[1], Constantine Nicolopoulo[2] refers to Rigas' early inclination for "comparative geography" among his "*...more pleasant occupations*"

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[1] The *Greek Revolution* as it is called in Greek history.

[2] C. Nicolopoulo 1824, *Notice sur la vie de Rhigas*, Paris, p. 2.

which explains his later cartographic activities[3]. Later in the whole course of 19th century[4], but also during the 20th century[5], the references to *Charta* to this "*...masterpiece of erudition and patience"*[6], are included in studies dealing with Rigas with a first monograph focused on this map by Ubicini in 1881[7], the year of the annexation of Thessaly (the birth land of Rigas) in the modern Greek state.

The focus on *Charta* comes back in the second half of 20th century with a study by Laios in 1960[8], and continuous later in some other studies which accumulated at the end of the last century (1997) in the occasion of the hundred years from its publication in Vienna[9]. The interest about *Charta* is intensified in the first years of 21st century with different contents: from the analysis of the cultural and ideological environment which influenced Rigas in his itinerary to *Charta*[10], the advanced semiologic, sociologic and artistic quests about the evident and hidden context and connotations of the depictions and the texts in the emblematic cartouche[11], to archaeology[12], to the

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[3] A. Nikarousis points out that in his school at Zagorá (Pileion, Thessaly) Rigas "had the opportunity to study various geographic essays relevant to the Greek lands" (see "Rēgas, ē skholē kai ē vivliothēkē tēs Zagorás", *Deltion Istorikēs kai Ethnologikēs Etaireias Ellados,* (nea seira), t. 1, 3, (1929) pp. 53-88.

[4] See, e.g., in the works of Christophoros Perraivos 1860, *Syntomos viografia tou aoidimou Rēga Pheraiou tou Thettalou,* Athens [in digital form: http://books.google.com]; A. Dumon 1867, *Les Bulgares,* Paris; Legrand, E. 1892: *Documents inédits concernant Righas Velestinlis et ses compagnons de martyre,* Paris.

[5] See, e.g., in Phanis Michalopoulos 1930, *Rēgas o Velestinlēs 1757-1798,* Athens: Sakellarios, some reference in A. Dascalakis 1937, *Les œuvres de Rhigas Velestinlis*, Thèse, Paris or in the study by Leandros Vranousēs 1963, *Rēgas Velestinlēs 1757-1798,* 2nd ed., Athens: Syllogos pros Diadosin Ophelēmōn Vivliōn.

[6] "*...chef-d'œuvre d'érudition et de patience*" by an anonym in *Magasin Pittoresque*, 1861, vol. XIX, p. 191 (see Michalopoulos, p. 66).

[7] J.-H. A. Ubicini 1881, "La Grande Carte par Rhigas"*, Revue de Géographie*.

[8] G. Laios, 1960, "Oi Khartes tou Rēga. Ereuna epi neōn pēgōn", *Deltion Istorikēs kai Ethnologikēs Etaireias Ellados,* t. 14, pp. 231-312.

[9] See Victor Melas 1997, *Ē Kharta tou Rēga,* Athens: MIET - Cultural Foundation of National Bank of Greece (also in: Hellenic Cartographic Society 1998, *200 Khronia tēs Khartas tou Rēga 1797-1997*, Proceedings, Kozani 18 October 1997, Thessaloniki: Paratiritis, pp. 36-49); D. Karaberopoulos 1998, "Mēnymata tou Rēga Velestinlē mesa apo tē dodekafyllē Kharta tou" in: *200 Khronia tēs Khartas tou Rēga 1797-1997*, pp. 8-35 ; V. Penna 1998, "Ta nomismata tēs Khartas tou Rēga", in: *200 Khronia tēs Khartas tou Rēga 1797-1997*, pp. 50-66 ; G. Tolias 1998, "Oi khartes tou Rēga. Ta Valkania, ē 'eurykhorē Ellada tōn Phanariotōn'", *Kathēmerinē / Epta Ēmeres,* special issue dedicated to Rigas Velestinlis, 22 March, pp. 20-23. Also D. Karamberopoulos 1998, "Ē Kharta tēs Ellados tou Rēga. Ta protypa tēs kai nea stoikheia" in: *Ē Kharta tou Rēga Velestinlē*, Athens: Epistēmonikē Etaireia Meletēs Fērōn-Velestinou-Rēga.

[10] Aikaterine Koumarianou 2007, "Rēgas Feraios: Ē poreia pros tē Kharta" in *Ē Kharta tou Rēga Feraiou (1797-2007),* Symposium at the Bank of Cyprus Cultural Foundation, Nicosia 27 October. Also, G. Tolias 2007, "The Righas *Charta* in the context of Greek Enlightenment" presented at the Second International Workshop on *Digital approaches to cartographic heritage*, Athens, 18-19 May 2007, organized by the International Cartographic Association on Digital Technologies in Cartographic Heritage in cooperation with the Hellenic National Research Foundation at the section *A digital look at Righas Charta*, 1796-1797, *The cartographic masterpiece of Greek Enlightenment, from a digital point of view,* see http://cartography.web.auth.gr/ 2ndW/Programme.pdf; G. Tolias 2007a, "Patriōtismos kai neo-oumanismos: Gnōstikes kai symvolikes leitourgies" in: *I Kharta tou Rēga Feraiou (1797-2007),* Nicosia 27 October; G. Tolias 2007b, "Ē Kharta tou Rēga sto perivallon tou ellēnikou Diaphōtismou" in: *Ē Kharta tou Rēga ston Psēfiako kosmo,* Aristotle University of Thessaloniki / Tellogleion Arts Foundation, 11 November. G. Tolias 2008, [in this *e-Perimetron* issue, Vol. 3, No. 3].

[11] See A. Liakos 2001, "O Ēraklis, oi Amazones kai oi 'traganistes voukitses'. Anaparstaseis tou fylou kai tēs exousias sto ergo tou Rēga", *Mnēmōn*, 23, pp. 99-112. Also Also A. Skoutari 2007, "To plaisio tou titlou tēs Khartas: Mia anagnōsē" in *Ē Kharta tou Rēga Feraiou (1797-2007)*, Nicosia 27 October.

[12] See M. Manoledakis 2007, "A note on the ancient sites on Righas *Charta*", presented at the Second International Workshop on *Digital approaches to cartographic heritage*, Athens, 18-19 May 2007, organized by the International Cartographic Association Working Group on Digital Technologies in Cartographic Heritage in cooperation with the Hellenic National Research Foundation at the section *A digital look at Righas Charta*, 1796-

search of survived copies[13] and to the come-back in the historic geographic analysis of its map-content[14]. A further impulse in this direction was given also in the occasion of the 250 years from the birth of Rigas (1757-2007)[15].

Summarizing the approaches to *Charta* as they are seen from the stand point of the so called "humanistic" sciences, we could distinguish them in a rich series, i.e., the historic approach, the political, the sociologic, the ideological, the patriotic, the literary, the archaeological, the educational, the folklore, the semiologic etc. of any type and style of approaches from the traditional to the postmodern!

Until now any, say, "cartographic" approach and reference to the *Charta* content from a whatever "humanistic" point of view was always focused on the "thematic" component of the map[16]. The topics of interest in this approach was mainly the cartouche, the great number of coins depicted on the entire surface of the map, the texts (descriptions, explanations, comments), the inserted plans of the selected historic areas, the toponymy, the geo-historic references and other "thematic" elements, always according the tradition and methodology followed in humanities.

For a "cartographic' approach of Rigas *Charta*

In the late 20th century it is attempted a first "pure" cartographic reading of *Charta*[17] from a cartographer's point of view. Following the methodology offered by modern cartographic science which defines the basic rules according to which a map either of "geometric" or of "thematic"

1797, *The cartographic masterpiece of Greek Enlightenment, from a digital point of view,* see http://cartography.web.auth.gr/ 2ndW/Programme.pdf; M. Manoledakis 2007b, "Oi arkhaies poleis stē Kharta tou Rēga. Ē periptōsē tēs Kentrikēs Makedonias" in: *Ē Kharta tou Rēga ston Psēfiako kosmo,* Aristotle University of Thessaloniki / Tellogleion Arts Foundation, 11 November.

[13] G. Schinas 2002, "Ē Kharta tou Rēga: Sōzōmena antitypa kai katagrafē tous", *Ypéreia*, t. 3, Conference Proceedings (D. Karamberopoulos, ed.) Athens: Epistēmonikē Etaireia Meletēs Fērōn-Velestinou-Rēga, pp. 965-979.

[14] Bλ. Jean-Yves Guiomar et Marie-Thérèse Lorain, 'La carte de Grèce de Rigas et le nom de la Grèce', in *Annales historiques de la Révolution française*, Numéro 319, [En ligne], mis en ligne le : 11 mai 2006. URL : http://ahrf.revues. org/document106.html. Consulté le 25 juin 2007.

[15] A series of events marked this anniversary in which *Charta* was privileged, e.g., the scientific meetings followed the proclamation of 2007 as "2007 Rigas *Charta* Year" by the Faculty of Surveying Engineering, Aristotle University of Thessaloniki (http://cartography.web.auth.gr/Righas/Righas_Charta.htm) celebrating the 250 years from the birth of Rigas Velestinlis: Hellenic National Research Foundation, Athens 9 March; Tellogleion Arts Foundation, Thessaloniki 11 November; the contributions by the Faculty staff and doctoral students at the 22nd International Conference on the History of Cartography in Berne, July and at the 23rd International Cartographic Conference in Moscow, August.

[16] According to the scientific and technological cartographic theory and practice the map content is generally seen as "geometric" and as "thematic". See standard cartographic bibliography e.g. Arnberger E., 1966: *Handbuch der Thematischen Kartographie,* Wien: F. Denticke; Robinson A. H., 1982: *Early thematic mapping in the history of cartography,* Chicago: University Press; Robinson A. H., J. L. Morrison, P. C. Muehrcke, A. Jon Kimerling, S. C. Guptill, 1995: *Elements of cartography,* John Wiley.

[17] In 1998 E. Livieratos includes a chapter on the cartography of Rigas *Charta* in the book *Khartographias kai khartōn periēgēsis: 25 Aiōnes apo tous Iones ston Ptolemaio kai ton Rēga,* Thessaloniki: Ethniko Kentro Chartōn kai Chartografikēs Klēronomias, pp. 229-249 (Ibid., "Mia khartografikē anagnōsē tēs Khartas tou Rēga" in: *200 Khronia tēs Khartas tou Rēga 1797-1997,* pp. 67-83). Addenda and more information about Rigas *Charta* in the new updated edition of 1998 book: E. Livieratos 2007, *25 Aiōnes khartografias kai khartōn. Mia periēgēsē apo tous Iōnes ston Ptolemaio kai ton Rēga,* Thessaloniki: Ziti, pp. 233-255.

content is "recognized" according to its "external" and to its "internal" reading[18] regardless its construction method either from field measurements or as derivative from already existing maps.
However, even in this case of cartographic recognition of *Charta,* the necessary study will start only in 2007[19] when for the first time will appear a scheme for the analytical geometric approach of *Charta'*s "cartography". This was feasible thanks to the abundant assistance offered today by the technologies which transform the analogical maps (e.g. the paper maps) into digital copies in a unique environment of numerical and graphical analytic processing[20]. It was the time when a research flow-chart will be introduced concerning the content of *Charta* on the basis of digital coordinates as were originally introduced by Hypparchus in 2nd BC century and developed up to our digital era.
This approach covers both the "geometric" and the "thematic" content of *Charta*:
In the field of geometric analysis is faced e.g.

a) The geographic framing (map geo-windowing),
b) The geographic reference (map geo-reference) with respect to the actual (today) expression of the geospatial parameterization with coordinates,
c) The projective compatibility (similarity) to other cartographic standards of its era,
d) The linear, angular and surface (area) deformations with respect to modern and/or older map standards,
e) The compatibility of the shape of the coastlines with relevant coastlines in other maps,
f) The practical (but sometimes disturbing) issue of sheets union in a unique map for the unified study of the maps overall surface,
g) The non-negligible corrections and reductions which should be applied to the digital map copies, coming either from digital scanning or from digital photography. This is particularly important in the case of the digital copies requiring facsimile properties, namely copies in 1:1 scale.

In the field of "thematic" analysis of map it is faced e.g.

a) The so called "rasterization"[21] of the different "themes" depicted in *Charta,* as it is among other, the toponyms, the texts (textual images), the graphs, the images, the coins, the map symbols, the names, the archaeological references etc.
b) The georeference of the "themes" i.e. the connection of thematic information with the coordinates which parameterize the map surface. This is done either with

[18] See J. Bertin, 1967: *Sémiologie Graphique,* Paris : Gauthier-Villars.

[19] E. Livieratos 2007a, 'On the cartography of Righas *Charta'*, presented at the Second International Workshop on *Digital approaches to cartographic heritage*, Athens, 18-19 May 2007, organized by the International Cartographic Association Working Group on Digital Technologies in Cartographic Heritage in cooperation with the Hellenic National Research Foundation at the section *A digital look at Righas Charta*, 1796-1797, *The cartographic masterpiece of Greek Enlightenment, from a digital point of view,* see http://cartography.web.auth.gr/2ndW/Programme.pdf.

[20] See for this issue, E. Livieratos 2006, 'On the study of the geometric properties of historical cartographic representations', *Cartographica*, 41 (2), 165-175, C. Boutoura, E. Livieratos 2006, 'Some fundamentals for the study of the geometry of early maps by comparative methods', *e-Perimetron*, Vol. 1, No. 1, 60-70 ; C. Boutoura and E. Livieratos 2004, "Fitting ottimali numerici delle rappresentazioni cartografiche storiche. Un'applicazione alle Isole Ionie", in: *L'Eptaneso nelle carte da Tolomeo ai satelliti*, (E. Livieratos et al., eds.), Padova: Il Poligrafo, pp. 181-190.

[21] "Rasterization" (or "mosaiking") is the result of the digitization of images (graphs, sketches, etc.) where the physical continuity of the image is spited in a sequence of discrete "tessera" of regular or irregular shape and size relative to the density (resolution) of digitization. In this way, to the position of each "tessera" which composes an element of the image can be assigned a set (or interrelated sets) of coordinates and placed in order on the map surface. This is an important property in digital archiving and retrieval of the thematic content of map.

Charta's intrinsic coordinates[22] or with extrinsic geographic coordinates (e.g. those used today) or with coordinates related to the system of digitization,

c) The management of the "themes" relating to the Data Bases (DB) of the thematic map content. These DBs can be structured and accessible for the documentation, analysis and diffusion of the rich thematic elements contained in *Charta*,

d) The design, study and implementation of issues about *Charta* related to the wider social and educational demand of the general public for access in the world of cartographic heritage for the acquaintance and communication with this important and fascinating component of cultural heritage in the large. A demand which is already international and feasible thanks to the modern digital information and communication technologies[23].

Some cartographic prerequisite

Rigas Velestinlis prepared and publish his *Charta* in a period in which cartography made great progress mainly due to the relevant advances in military mapping. Actually in the last quarter of 18th century in Austria, the country where Rigas deployed his activism, the first major mapping decided by Maria Teresa, following the Prussian standards, was implemented thanks to her successor Joseph. In 1780 "Josephinische Aufnahme" gave results in four thousand map-sheets in the impressive 1:28.000[24] scale. But neither this cartography was publicly known or the maps series available because they were classified under military secrecy.

Thus, Rigas follows the map standards which were generally known and available products of the classic cartography of 18th century. He follows mainly the maps of the so called "Delisle typology" (or "Delisle standard") published in the course of 18th century, until at least 1795, not only by Delisle but also by other cartographers and map publishers in Europe. They not only copied the Delisle standard following Delisle's typology but were adding their own knowledge and experience in the map content. Many cartographers and publishers like e.g. Lotter, Seuter, Ottens, Weigel, Homann, Blair and others copy or follow Delisle's typology producing almost identical maps. It is such the similarity of these 18th century maps following the Delisle standard that one should be cautious in concluding on what was actually the "real" map-model of Delisle's typology used by Rigas for the design of his *Charta* as well as on the actual dating of his model. Besides, the idea that Rigas used more map-models in designing his map, apart the Delisle standard, even if not yet proved analytically, maybe plausible.

According to the up to now "cartographic" approaches from humanities, as models in constructing *Charta* Rigas were mainly used two supplementary Guillaume Delisle maps, from the early 18th century[25] under the general title *Graeciae Antiquae tabula nova* in two sheets: [*septentrionalis*]

[22] Recalling of course, in this case, the problems on the intrinsic coordinates of *Charta* first reported by C. Boutoura, 2008: On the map projection of Rigas Velestinlis "Charta", the late 18th century cartographic monument of Greece, [in this *e-Perimetron* issue, Vol. 3, No. 3], first presented in Greek in: *Ē Kharta tou Rēga ston Psēfiako kosmo,* Aristotle University of Thessaloniki / Tellogleion Arts Foundation, 11 November 2007.

[23] See the research agenda and the actions since 2005 of the International Cartographic Association Working Group (Commission since 2007) on "Digital Technologies in Cartographic Heritage" [http://web.auth.gr/xeee/ica-heritage] and E. Livieratos (ed.) 2006, "Digital approaches to cartographic heritage", Proceedings of the First International Workshop *Digital approaches to cartographic heritage*, Thessaloniki 18-19 May 2006.

[24] See W. Witt, 1979: *Lexikon der Kartographie,* Wien: Franz Deuticke, pp. 423-424.

[25] A most "careful" reference to this issue is by Guiomar et Lorain 2006, 'La carte de Grèce de Rigas…' : They refer to the 1708 publication of these maps without rejecting some other models.

for the northern part and [*meridionalis*] for the southern part without ignoring other previous references to other cartographers but not to specific maps and dates of publishing. This last point deserves a particular attention since, as it is known from map history, many times the same maps are published (as copies) by the same or other cartographers in different periods of time. Thus it is, in principle, risky to insist on a certain specific copy as the *Charta* map model[26].

Here, as an example (Fig. 1) we properly compose in one single map the two Delisle-standard maps mentioned above (septentionalis and meridionalis) as the main models for *Charta* from early 18th century[27]. The one (α) it is an English edition of the Delisle-standard from 1794 and the other (β) it is a German edition of the same maps by Lotter from 1778! We see that it is not safe to insist on a secure conclusion concerning the exact model Rigas followed for his *Charta* and above all about the dating. Both examples used here are anticipating in time Rigas *Charta* and especially the sheets by Lotter are published before Rigas starts the preparations for his map in Bucharest. There are also other relevant examples on this issue[28] which make insecure any adoption about the actual map model followed by Rigas and its dating. This is important in respect to the shape of the coastline in *Charta* which is the prime element in the "external" recognition of the map[29]. Nevertheless, it is apparent and finally proved analytically[30] that *Charta* follows a general coastline pattern which is typical of Delisle-standard introduced by the prominent French cartographers since 1700.

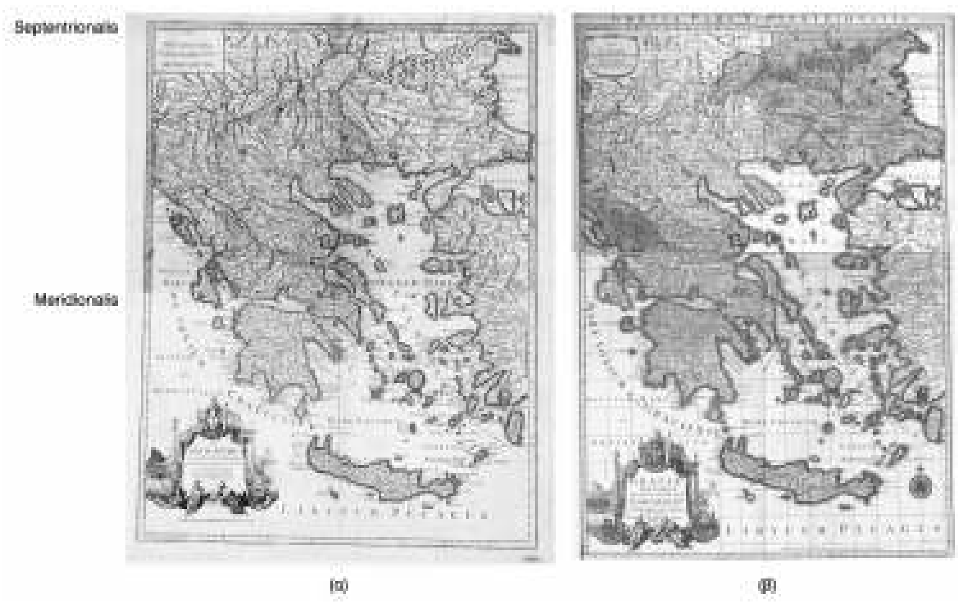

Fig. 1. a) The composition (stitching) of the two sheets (septentrionalis and meridionalis) of the English edition of Delisle maps from 1794; b) The same composition of Lotter maps from 1778.

Another issue which complicates the discussion on the map model followed in *Charta* in relation with the Delisle-standard is the geographic window adopted by Rigas in his cartographic representation. As it is easy to confirm, the geographic window of the two map-sheets of Delisle's *Graeciae Antiquae tabula nova* (Fig. 1) it is only a part of *Charta's* geographic window covering

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[26] This point is well treated by Boutoura 2008 in studying the projective properties of Rigas *Charta.*

[27] For a complete time-history of this map, see the map catalogue C. G. Zacharakis, 1992: *A Catalogue of printed maps of Greece 1477-1800,* Athens: Samourkas Foundation, pp. 73-74.

[28] Boutoura 2008.

[29] According to the general theory of map recognition by Bertin 1967.

[30] Boutoura 2008.

60% of the effective map surface. On the contrary, another map by the French cartographer entitled *Accurata totius Archipelagi et Graeciae Universae tabula / Carte de la Grèce* from 1700[31], (Fig. 2, α) covers wider geographic space, included in *Charta,* except of the north part to which Rigas is extending his mapping which is represented in another Delisle map like that e.g. entitled *Orbis Romani Descriptio* from 1784[32] (Fig. 2, β) depicting the division of Byzantine Empire in "Themata" at the period of Constantine Porphyrogennitos. This map, belonging obviously to the morphology of Delisle maps, completes with the other two the totality of the geographic space represented in *Charta,* in three different map scales.

These three Delisle type maps depending on the extension of the represented area, from the smaller to the larger, are called here Delisle–A (*Graeciae Antiquae tabula nova*, Fig. 1)*,* Delisle–B (*Accurata totius Archipelagi et Graeciae Universae tabula*, Εικ. 2, α) and Delisle–C (*Orbis Romani Descriptio*, Εικ. 2, β). The physical dimensions of these maps are all almost the same per map-sheet, of the order of ca. 65 X 50 cm, and their scale vary from ca. 1:1.250.000 in Delisle–A to ca. 1:2.500.000 in Delisle–B and in scale ca. 1:3.500.000 in Delisle–C. This means that Delisle–A is drawn in two times larger scale than that of Delisle–B and in three times larger than that of Delisle–C. The last one is drawn in one and half smaller scale than that of Delisle–B. From this finding about the scales, it comes out that if Rigas used all the three Delisle maps of type A, B and C, for designing the phases of his *Charta,* then he had to magnify almost two times the type A map, four times the type B map and six times the type C map.

But, the geometric comparison of *Charta* with these three types of Delisle maps gives evidence of using only the map of Delisle typology A in doubling its scale. It is obvious that the remaining few parts of east Asia Minor as well as the three northeast map-sheets[33] of *Charta* are coming from other maps. The areas at the east part of *Charta* which are not represented in the map of Delisle–A typology may come from a map of Delisle–B typology with a four times scale magnification or for some other map. In Fig. 3, α, it is shown the best fitting of Delisle–A type map into Delisle–B type map.

(α) (β)

Fig. 2. α) The major part of *Charta* (except the north) is included in the Delisle map *Carte de la Grèce,* here from 1707; β) The geographic surface of *Charta* is totally included in Delisle map *Orbis Romani Descriptio,* here from 1784.

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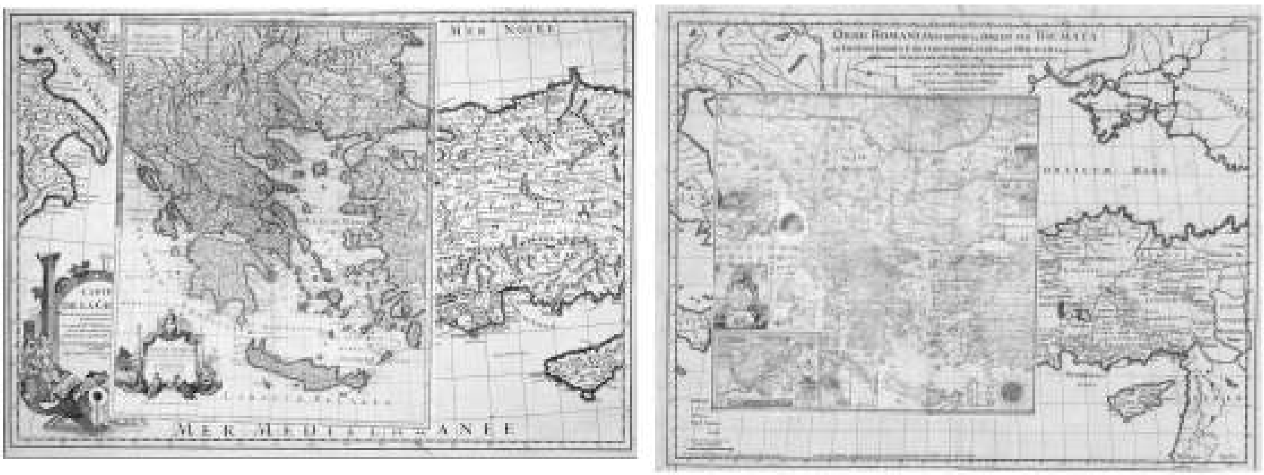
[31] Zacharakis 1992, p. 73.

[32] Zacharakis, p. 74.

[33] Guiomar et Lorain, note that the part of *Charta* along the Danube area is coming from the map of the Transilvanian engineer Ferdinand Joseph Ruhedorf published at Vienna in 1788 by the same *Charta* publisher Franz Müller.

Even if the total area represented in *Charta* is part of Delisle–C map typology (Fig. 3, β), Rigas is not using this map (in six times smaller scale) as it is seen from the *Charta* large deviations in the representation of the Dalmatian coasts but also in that of the course of Danube. In Fig. 4, it shown the best fitting of Delisle–A map into *Charta*, from which it is clearly shown the delimitation of the parts of *Charta* which are not coming from a Delisle–A map.



(α) (β)

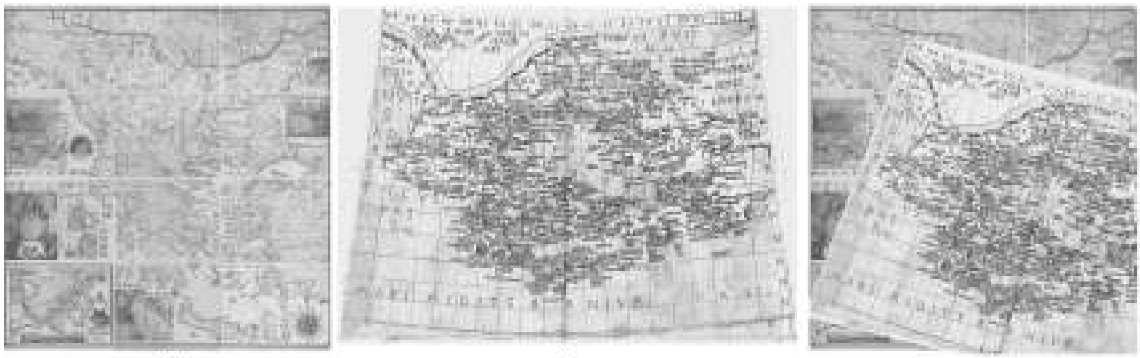
Fig. 3. α) The Delisle–A type map best fitted into Delisle–B type map. The original scale of type –A is double than that of type –B; β) *Charta* best fitted into Delisle–C type map. The original scale of *Charta* is six times bigger than that of Delisle–C type map.

Εικ. 4. The Delisle–A type map best fitted into *Charta*. The scale of *Charta* is double the scale of Delisle–A type map. It is shown precisely the actual cartographic space of *Charta* which is not derived from Delisle–A map typology (the east zone and the whole north part around the course of Danube).

The discussion on the broad geographic window represented in Rigas *Charta* could not be independent of older relevant depictions. It is indeed interesting to search to which map models are closest the *Charta* window. This can be done today by trying the best fitting analysis applied to *Charta* and to presumed map model. Testing this window fitting on maps of Ptolemy typology we observe the following: Although the spatial definition of Tabula X in Ptolemy's *Geographia* is only part of the window represented in *Charta*, in the first printed edition of *Geographia* in Bologna (1477) the map representing Tabula X[34] is extended considerably eastwards including the western Asia Minor and in a limited area northwards depicting a part of the Danube in the upper part of Moesia (Fig. 5).

From all the geographic windows of the older Ptolemaic type maps representing Tabula X, stereotypes and modern (Tabulae Modernae) that of Martin Waldseemüller in the series of modern maps included in Ptolemy's *Geographiae* under the title *Tabula Moderna Bossine - Servie - Gretiae et Sclavonie* (Strasburg Scott edition from 1513[35]) is the closest to the *Charta* window (Fig. 6), according to best fitting tests respecting the similarity (conformality) in shapes[36].

The relevant best fitting tests, under the preservation of shape similarity, applied to later maps of Ptolemy type e.g. to the that by Nikolaos Sophianos (1540-1552[37]) show that this window[38] though also extended, following the "Tabulae modernae" typology (Fig. 7), is not close to the window of *Charta* as it is the fitting of Waldseemüller's representation.



(α) (β) (γ)

Fig. 5. α) The geographic window of *Charta*; β) The geographic window of Tabula X in the first printed edition of Ptolemy' *Geography* with map (de Lapis, Bologna 1477); γ) The best fitting of the de Lapis map into *Charta*.

(α) (β) (γ)

Fig. 6. α) The geographic window of *Charta*; β) The geographic window of *Tabula Moderna Bossine - Servie - Gretiae et Sclavonie* by Waldseemüller, 1513; γ) The best fitting of Waldseemüller map into *Charta*..

[34] See E. J. Finopoulos and L. G. Navari 1990, *Ptolemy's Greece*, Athens: Society for Hellenic Cartography, p. 21.

[35] Finopoulos and Navari, p. 34.

[36] For more on the issue see Boutoura and Livieratos 2006, "Some fundamentals…".

[37] See G. Tolias 2006, "Nikolaos Sophianos's 'Totius Graeciae Descriptio': The resources, diffusion and function of a Sixteenth-century map of Greece", *Imago Mundi,* Vol. 58, part 2, pp. 150-182.

[38] This geographic window is followed as "Sophianos typology" by many later famous cartographers (e.g. A. Ortelius).

Fig. 7. α) The geographic window of *Charta*; β) The geographic window of Sophiano's *Totius Graeciae Descriptio,* 1540-1552; γ) The best fitting of Sophiano's map into *Charta.*

"Geometric" approach and digital support

The geometric approach to *Charta,* as to any other old and/or new map is carried out through the coordinates, this apical invention of Hypparchus which goes back to the 3rd century B.C., according to which the use of ordered pairs of numbers allow the positioning at any point in geospace of a variety of geometric and thematic geographic entities. As it is known in elementary mathematical geography and cartography, the coordinates is an important numerical tool because apart its possibility to allow positioning and the reference to positions of any geographic entity referring to the physical and the human worlds, allow the classification analysis and interpretation of geographic shapes and quantities. In other words the coordinates compose and analyze the extrinsic and intrinsic geometry of map and all the depictions on it allowing in this way a deeper understanding and offering useful tools in cartographic research even in its classes departing from methodologies and implementations common in humanistic sciences.

In this paper the notions, the definitions and the variety of coordinates (e.g. spherical and/or plane) as used in mathematical geography and cartography are considered generally well known. For a supporting discussion on the issue see Appendix A. In general, analyzing the geometric content of Rigas *Charta* four sets of coordinates should be used: a) the own pairs of geographic coordinates of *Charta*; b) the relevant and in some way derived georeferenced pairs of geographic coordinates; c) the plane pairs of coordinates associated to the Delisle system of projection and c) the plane pairs of coordinates derived from digitization.

The digital know-how offered by modern technology in historical cartography[39] and generally in cartographic heritage[40], is distinguished mainly for offering a magnification in our originally limited physical visual ability to perceive the "point size". While in the past, during the so called "analogue" period of cartography, the map measurability or the cartometric analysis was based on the conventional assumption that the minimum dimension of a point is 0.2 mm (point visual graphic resolution), today digital technology offers almost three times better resolution for mini-

[39] See E. Livieratos, 2007b: 'Digital analysis of cartographic heritage', Invited presentation at the International Cartographic Association session: *Teaching history of cartography*, Berne 7 July, 22nd International Conference on History of Cartography. Also E. Livieratos 2008, *Cyprus on historic maps. Placement, shape and orientation from a digital point of view,* Nicosia: Bank of Cyprus Cultural Foundation (in print).

[40] E. Livieratos, 2008: "The challenges of Cartographic Heritage in the digital world", Introductory speech at the opening of the Third International Workshop on Digital Approaches to Cartographic Heritage held at Institut Cartogràfic de Catalunya, Barcelona 26-27 June 2008.

mum point determination up to 0.085 mm[41]. But this high resolution which is possible today thanks to digital technology requires special attention in its processing and management and high image acquisition standards for the digital cartographic copies and the ways of treatment and analysis.

The problem in the digital cartographic approach and due to the specific characteristics and properties of “map” is not at all the same to the problems appeared in the procedures followed in the general digitization mainstream as applied in digitizing pieces of art, textual and graphic documents and images which have nothing to do with maps, as it is the old books, the paintings, the photographs etc. It is in other words erroneous to consider a map or a cartographic object in general as a “painting” or as a common graphic representation with no need to particular and specialized care in digitization.

The map, of any historical period, is distinguished from any other graphic representation and/or common image from a fundamental characteristic which is unique in maps. This is the underlying “geometry” or “geometric” which is inherent in any map of all periods of cartography either apparent or hidden under a topological generality or a geometric roughness. Even in maps (e.g. of the early medieval period) where the “geometric” is not all an issue, a hidden or rough geometric network is always present in terms of topological sequence. This “geometric” is actually the fundamental cartographic property, once rigorous once loose, which separates the maps from the other graphic representations and images. This “geometric” of maps should be preserved keeping the digital map copy unaltered in any digitization process. Therefore cartographic digitization is a process per se requiring special know-how and higher digitization standards in comparison to the “main stream” digitization. The issue becomes critical in the case of the “facsimile level” of digitization requiring the preservation of one-to-one (1:1) scale in the digital copy[42]. Cartographic digitization is a complex process not only because of the needs to secure the geometric properties and the scale of the original map content into the map copy but also because, among other implications, digitization may affect and sometimes harm the original map material even its communicational properties[43]. In Appendix B a selection of some of the main issues related to the proper digitization of old maps and cartographic documents are selectively listed and evaluated.

Framing (geographic windowing), scale and georeference of *Charta*

Rigas *Charta* is a map in twelve sheets of dimensions ca. 70 cm in longitude and 50 cm in latitude[44] for a total dimension of ca. 2 X 2 m covering four square metres surface which is indeed large for that period. Each sheet is numbered eastwards from south to north ordered three in the longitudinal and four to the latitudinal sense (Fig. 7, α). The first sheet (No. 1) at the southwest of

[41] This is the metric dimension of a pixel at the 300 dpi image resolution.

[42] M. Daniil, V. Tsioukas, K. Papadopoulos, E. Livieratos 2003, ‘Scanning options and choices in digitizing historic maps’, in: Proceedings *New Perspectives to Save Cultural Heritage*, CIPA, XIX International Symposium, Antalya, Turkey, 30 Sept.-4 Oct. 2003. [see: http://cartography.web.auth.gr/Maplibrary/New/Scanning.pdf]; Also Tsioukas V., M. Daniil, E. Livieratos 2006, ‘Possibilities and problems in close range non-contact 1:1 digitization of antique maps’, *e-Perimetron,* Vol. 1, No. 3, 230-238.

[43] Livieratos, 2008: “The challenges of Cartographic Heritage…”

[44] It is a rather stereotype paper dimension used in 18th century. In almost the same paper dimensions are printed all map of Delisle’s typology which are mentioned in this study.

the *Charta* twelve-sheet setting (known as the Constantinople sheet) was published independently first at Vienna in 1796[45], whilst the other eleven sheets published in 1797.

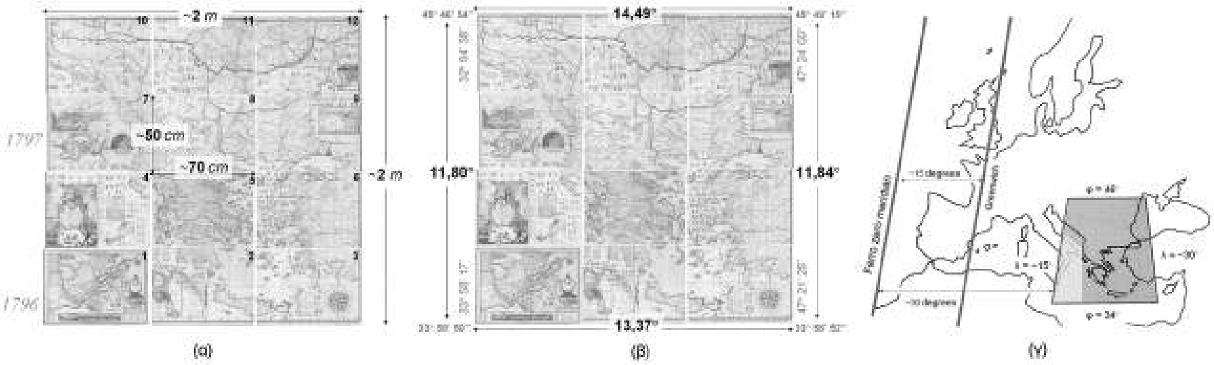


Fig. 7. α) The numbering and the dimensions of *Charta*'s sheets; β) The geographic coordinated framing of *Charta*'s window in the proper coordinate reference system and the relevant angular length of edge meridians and parallels; γ) The placing *Charta*'s geographic window in the actual system of meridians and parallels.

According to *Charta*'s own geographic coordinate system, with zero reference meridian at Ferro, the four edge-frame coordinates assigned to *Charta*'s window (Fig. 7, β) are: $\lambda = 33^o\ 58'\ 17''$, $\varphi = 33^o\ 58'\ 50''$ at SW, $\lambda = 47^o\ 21'\ 25''$, $\varphi = 33^o\ 58'\ 52''$ at SE, $\lambda = 32^o\ 54'\ 38''$, $\varphi = 45^o\ 46'\ 54''$ at NW and $\lambda = 47^o\ 24'\ 00''$, $\varphi = 45^o\ 49'\ 19''$ at NE. From these coordinate values it seems that exist a deviation from the expected values, a problem which is treated and explained recently by C. Boutoura[46], with the actual georeference (Fig. 7, γ) of the map in the context of its projective properties and deviations from the Delisle-standard.

Concerning the *Charta* scale, simple calculations lead to the conclusion that it is not unique all over the map area but varying from 1:650.000 at the east and west edges of the frame to 1:600.000 at the south and up to 1:550.000 at the north.

Shape and projective similarity with other map standards

An important issue in any comparative cartographic treatment is the testing of geometric similarity of maps under comparison which are considered to have any sort of cartographic affinity. In this case it is necessary to control the following cartographic features and map characteristics as are:

a) The *coastline*, gives the map its dominant and particular shape. This holds both for the general image of the coastline and for its details. Especially for maps representing Greece, the coastline is of major importance linear shape map element.

b) The *projective system*, as it is characterized and defined in the map by the grid of the meridians and the parallels and by the coordinate calibration of the map framing (the geographic window). The shape of the grid is an indication of the (at least) general class of projection to which the map belongs.

c) The *spatial placement of points* within the geometric content of the map and their absolute and relative positioning. These points are characteristic and discrete in the map content as are the cities, spatial point-form features of geometric and/or thematic type etc.

[45] Most probably to support financially the *Charta* publishing project, as it was the usual practice at that time in publishing Atlases.
[46] Boutoura, 2008.

Based on the comparative type of analysis it is possible to test and control the best fifing of *Charta*'s cartographic elements and features concerning either the coastline pattern or the projective properties or the spatial placement of characteristic points on the map. This can be done for the map as a whole or at parts or combining the areas of the comparison. The comparative process is done using the best fitting methods and techniques[47] from which important results can be obtained regarding the cartographic model used for derivative maps as it is *Charta*. Especially for this map we are interested, such type of analytic cartographic studies have never been carried out before. All the up to now attempts for relevant comparisons are extinguished at the level of empiricism and phenomenology without entering into experimental and measurable tests[48]. From the first evidence it looks that though there is an impressive compatibility of Rigas *Charta* with the Delisle–A map typology concerning the coastline feature and the spatial geometric content of the map, there is a considerable degree of disagreement between *Charta*'s projective properties and to that of Delisle–A typology, which is the map-model reference for the design of almost 60% of *Charta*'s surface.

In Fig. 8 it is shown, as example, the clear coastline shape similarity of the largest part of *Charta* in comparison with Delisle–A map typology, as it is obtained by the proper best fitting of the two maps, with the exception of the NW part of *Charta* (cf. Corfu isl.) and some other parts at the SE (cf. Rodos isl.) and at the NE (cf. the west coasts of Black Sea).

The deviations of the projective pattern in Rigas *Charta* from the Delisle map-standard is partially shown in Fig. 9 and are extensively treated by C. Boutoura[49].

The weaknesses in the projective properties on *Charta* in contrast to the impressive agreement of the coastline and the geometric spatial content with Delisle map-standard, may formulate the conclusion that Rigas copied in a certain technically proper way Delisle's map content but he has rather improvised in adding the longitude and latitude calibration in the map frame, thus the apparent map projection. In terms of cartographic theory, according to J. Bertin[50], Rigas *Charta* is compatible to the Delisle projection as far as its "internal" recognition is concerned but erroneous as far as its "external" recognition is concerned.

[47] For the best fitting approaches to the comparative cartographic analysis and the applicability of each approach, see Livieratos 2006 and also Livieratos and Boutoura 2066.

[48] These issues were introduced for the first time by the author in May 2007 in the at the Second International Workshop on *Digital approaches to cartographic heritage*, Athens, 18-19 May 2007, at the section *A digital look at Righas Charta*, 1796-1797, *The cartographic masterpiece of Greek Enlightenment, from a digital point of view,* see http://cartography.web.auth.gr/ 2ndW/Programme.pdf. In this context Boutoura, 2008, made a step forward treating the projective properties of Rigas *Charta.*

[49] Boutoura, 2008.

[50] J. Bertin, 1967: *Sémiologie graphique,…*

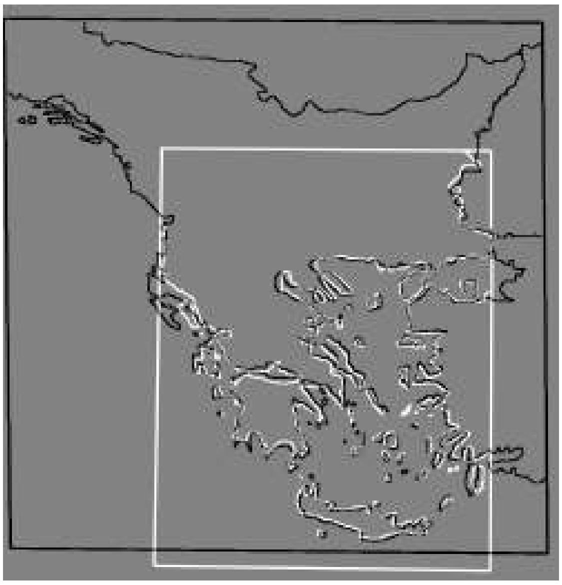


Fig. 8. The generalized coastline shape relation of the major part of Rigas *Charta* (black coastline) with Delisle–A map-standard (white coastline) as a result of a proper best fitting process.

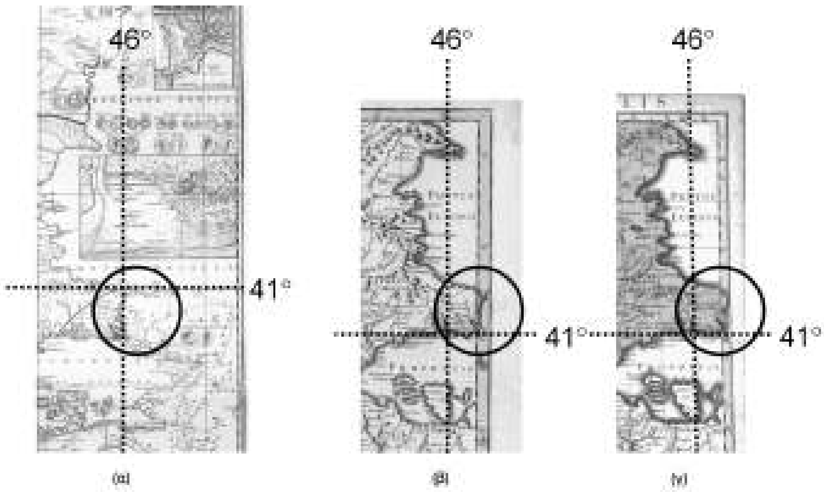


Fig. 9. α) In *Charta* the 46 degrees longitude meridian (from Ferro) passes from Constantinople and the 41 degrees parallel from the north top of the Straights of Bosporus. In the Delisle–A map-standards e.g. the Delisle map (β) and the Lotter map (γ) the 46 degrees meridian is passing half degree west of Constantinople and the 41 degrees parallel from the south end of Bosporus.

Stitching in a unique map

As *Charta* is a map in twelve sheets, in the case a unique copy is needed then the relevant necessary stitching concerns seventeen sheet edges. (Fig. 10, α).

The discussion on *Charta*'s stitching has mainly sense when dealing with the case of 1:1 copies derived either from digital scanning of from digital photography of the original. Both methods of scanning and especially the contact common scanning and digital photography introduce indeed non-negligible alteration in the geometric spatial map content of the copy. Without eliminating, reducing or absorbing these alteration stitching is not an easy task (sometimes even impossible) and the derived unified copy is far of being a facsimile of the original map. To avoid such shortcomings it is necessary to apply the specialized cartographic know-how mentioned in the previous chapter.

The stitching issue becomes more complicated and not easy to handle in the case the map sheets are cut in more pieces for the shake of map folding. This was a common practice in the past so that many surviving *Charta* copies[51] are cut in eight pieces per sheet (Fig. 10, β) which means that the stitching concerns ninety six pieces for the whole map![52]

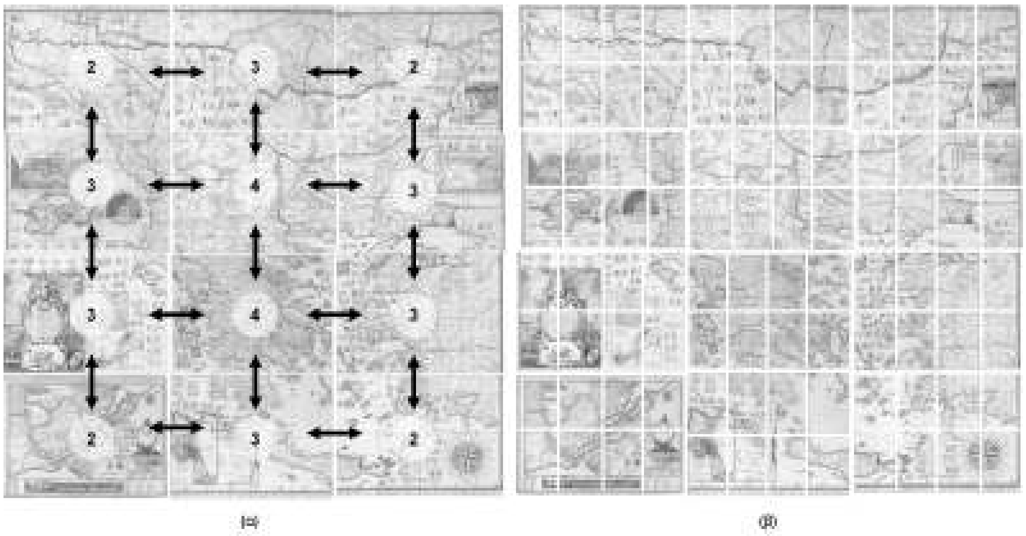


Fig. 10. α) The stitching of *Charta*'s twelve sheets. Seventeen edge unions are necessary. The two central sheets have each four neighbouring sheets; the four sheets at the four corners have each two neighbouring sheetsand the remaining four sheets at the middle of the right (east) and left (west) edges have each three neighbouring sheets; β) The cutting of each sheet in eight parts (it is common in many surviving *Charta* copies) for facilitating the sheet folding, generates ninety six pieces of map which make stitching a much harder procedure.

The "thematic" approach

The "thematic" cartographic approach to *Charta* is the second field of analysis of the map content according to its distinction in the geometric and in the thematic parts. In a generalized phrasing the thematic content of a map refers to whatever not included into the geometric content and it is usually referring to geographic data[53] coming from the physical and/or the human-borne worlds. In this way we apply a clear separation between the geographic data of geometric character which compose the geometric content of the map and the geographic data of physical and/or human-borne nature which compose the thematic map content. When the cartographic thematic content is treated digitally then to any thematic attribute which are represented on the map can be assigned coordinates as we have already said. In this way all "themes" spatial distributed on the map can be placed with respect to the map coordinates (curvilinear geographic, plane cartographic, digital).

The thematic content of *Charta* is impressively rich and densely distributed on the map surface. A great number and variety of themes depicted in excellent graphic quality and visualization efficacy are e.g. toponymy, coins, geographic and conceptual symbols, descriptive and reference

[51] For example, the *Charta* copies with the Aristotle University Library, Thessaloniki and the *Charta* with the Sylvia Ioannou Map Collection belong to this category. On the other hand, uncut *Charta* copies are e.g. with the Gennadeios Library Map Collection in Athens, with the Cartography Archive of the Hellenic Space (Victor & Niovi Melas Map Collection) at the National Bank of Greece, at the Koventareios Municipal Library (Lassanis Map Library) of Kozani.

[52] For the complexity of this problem especially in the case the digital scanning of the original is not a high quality (high cost) scanner of the non-contact type A. Tsorlini made in 2005 a dedicated study in the frame of her specialization thesis in her post-graduate project: "Provlēmata Metaschēmatismōn stēn epeksergasia chartōn se fylla. Efarmogē stē *Kharta* tou Rēga Velestinlē", Thesis, Postgraduate Studies Programme in *Cartographic production and geographic analysis,* Faculty of Surveying Engineering, Thessaloniki: Aristotle University.

[53] Or equivalently "geographic entities" or "geographic elements".

texts, individual graphic representations and images, names of persons and facts, historic and archaeological references plus specific illustrations, plans and maps within the map etc[54] (Fig. 11).

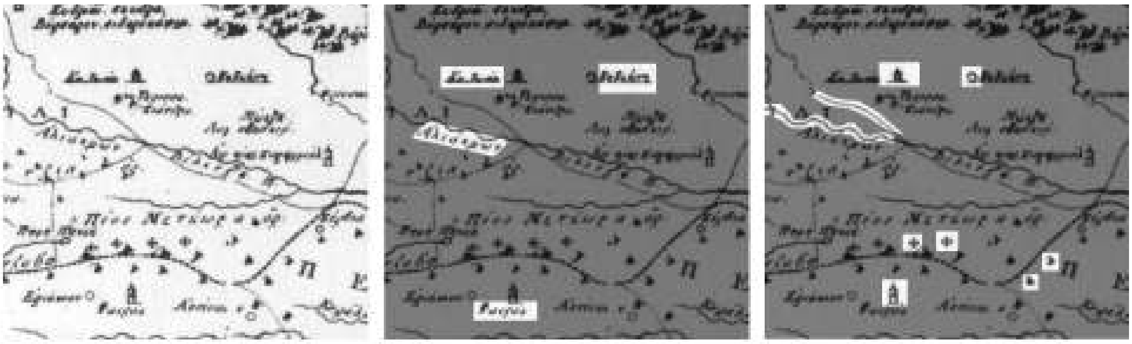


Fig. 11. α) Detail of *Charta*'s thematic content (here form sheet No. 8); β) Toponyms of places and geophysical entities, themes coming form the physical and human-borne worlds (river, towns); γ) thematic symbols (point and linear) related to the previous (and other) themes.

All the thematic elements of *Charta,* on the basis of digital approach to its content, can get a precise spatial placement identity labeled with coordinates. The position of the theme is determined with coordinates either it is represented as a point-theme or a line-theme or a surface-theme. In this way all map themes can be easily georeferenced and introduced in properly selected or designed graphic data base management environments. This gives the possibility for a manifold of important research on Rigas *Charta* thematic content never attempted before.

A special citation should be given here about the toponymy of *Charta* for the study on the toponymy sources and on his own contribution on the issue but also for the development of a *Charta* digital interactive dictionary of toponyms[55]. The digital tools offered for this research are multiple, e.g. the use of "digital transparency"[56] with which the positional and naming affinity of *Charta* with other map-standard models are clearly shown as it is the case of Delisle–A[57] map typology (Fig. 12).

Another issue among the very many of thematic character in *Charta* is the quantity of the coins (162 are depicted all over the map surface) which are illustrated in this map. The representation of coins in *Charta* has raised the interest of numismatic research[58] and all of them are now fully

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[54] It is so rich the thematic content and so multi-sourced and variant the thematic attributes that I had elsewhere (1998) called *Charta* as a sort of a "multimedia" type of product of its time, recognizing in its formalism, visualization and content an extraordinary communication power.

[55] The Cartography Group at the Faculty of Surveying Engineering, Aristotle University of Thessaloniki (http://cartography.web.auth.gr) is working in the last years on the issue of the digital documentation and management of *Charta*'s toponyms (see K. Papadoulos, N. Ploutoglou, M. Pazarli, K. Pappa, P. Sarikianou, C. Alitsis, 2006: "Ēlectroniko lexiko toponymiōn tēs *Khartas* tou Rēga", Proceedings 8th Hellenic Cartographic Conference, 24-26 November 2004, Thessaloniki: Hellenic Cartographic Society, pp. 45-50.

[56] Βλ. M. Daniil 2006, 'Comparing by digital transparency the differences between two almost identical 17th century maps of the Aegean Sea', *e-Perimetron,* Vol. 1, No. 4, 287-296.

[57] Livieratos 2005.

[58] See V. Penna 1998; M. Pazarli 2001, 'Enas "agnōstos" khartēs, apo tēn syllogē tēs Ethikēs khartothēkēs, pēgē empneusēs gia tē *Kharta* tou Rēga", Thessaloniki: Ethiko Kento Khartōn kai Khartografikēs Klēronomias [http://cartography.web.auth.gr/ Maplibrary/New/Har_Paz.pdf]; L. Michaelidou 2007, "Ta nomismata tēs *Khartas*: Mia ermēneia" in the Symposium *Ē Kharta tou Rēga Feraiou (1797-2007),* Bank of Cyprus Cultural Foundation, Nicosia 27 October.

identified. The coins a major thematic element in *Charta,* is also among other concerns, a subject of spatial digital management as shown recently by M. Pazarli[59].

Fig. 12. Digital technology supports the research of *Charta*'s toponymy sources. Here, in a detail of the sheet No. 8 it is shown the affinity of *Charta*'s toponymy with Delisle–A map-standard both spatially and in the naming. The results of the comparison is evident using the "digital transparency" technique.

The digital support of the *Charta* rich cartographic thematic content and the visualization options offer additional possibilities for the development of derivative thematic data bases and the linking with other relevant archives. This allows the introduction of modern multiple multi-thematic and interrelated data bases with visualization support and web extensions to remote data bases for a complete and integrated management of a variety of themes strengthening the communication efficiency in satisfying research and curiosity visits of *Charta*'s thematic content.

The thematic component of *Charta*'s content approached from the digital stand point offer new perspective in accessing, using and communicating with the historic, technological, cultural and educational resources of this top Rigas work bringing also *Charta* closer to the international cartographic community, since the cartographic importance of this map is far beyond the narrow domestic interest.

Reflection of the map-construction of *Charta*

A subject which was never treated before and it is obscure in the literature are the technical procedures used by Rigas in constructing *Charta*. In other words who Rigas organized and performed the design and the graphic preparation, the drawing, of the twelve map-sheets. For a map-maker who ever constructed a map "from scratch" literally from "white paper"[60], it is of special interest an attempt to simulate the methods and techniques adopted and followed by Rigas in making *Charta.* The lack of historical evidence on this technical issue allow the development of technicall hypotheses concerning the planning and the implementation of practical map-making procedures which may have followed by Rigas in designing the twelve map-sheet at Bucharest before bringing the original to Vienna for engraving by Franz Müller and printing.

This is not of course an easy task. The facts which complicate the formulation of a hypothesis on the *Charta* technical construction are mainly four:

[59] M. Pazarli 2007, "A note on the coins represented in Righas *Charta*", presented at the joint international workshop on *Digital approaches to cartographic heritage*', Athens, 18 – 19 May 2007.

[60] Here we refer to the procedure of making a "derivative" map (from other map sources).

a) The unusually large overall dimension (~ 200 X 200 cm) of the map.
b) The much smaller dimensions (~ 66 X 98 cm) of the Delisle–A map-standard used by Rigas in compiling his *Charta.* The surface of the Delisle standard is 6.5 times smaller than that of *Charta.*
c) The design technique used for the "transfer" of the cartographic content from the original to *Charta.*
d) The dimensions of the material working support surface used by Rigas for the design of *Charta*.

Judging from the high level linking of the *Charta* twelve map-sheets an experienced map-maker can easily conclude that Rigas draw the map on a unique piece of paper of the same dimensions as the final printed product assembled in a unique piece. Obviously he fitted together twelve pieces of paper in a single piece on which he draw the map taking under consideration the future separation in twelve sheets. This means that Rigas made a meticulous preparation in planning the drawing strategy of his *Charta*.

The map-model used for the drawing of *Charta,* of Delisle–A typology with total dimensions 66 X 98 cm in the direction of longitude and latitude respectively after fixing together the two relevant sheets (*septentrionalis* και *meridionalis*)[61] is slightly shorter in the longitudinal direction compared to *Charta*'s relevant dimension of a single sheet (70 cm)*,* whilst is almost equal in the latitudinal direction to *Charta*'s relevant dimension of two sheets (50 cm + 50 cm = 100 cm).

The difference in dimensions between the map-model and *Charta* and their known scale relation[62] as well as the percentage of the surface coverage of the *Charta* content from Delisle–A map-model[63], lead to a rather safe simulation of the methodology and technique which might have followed Rigas for the transfer of the coastline and of the geometric content form Delisle–A map-model to his working paper surface. From the morphology of the best fitting of the coastline and of a number of relevant geometric characteristics in *Charta* map content as illustrated recently by C. Boutoura[64], it results that Rigas should have used a pantograph[65] (Fig. 13, Left) for the transfer of cartographic features on his map from the map-models he used. This conclusion is supported by some historic evidence according to which when Rigas was moving from Bucharest to Vienna in order to publish his maps *"…he was carrying with him tools (instruments) for his cartographic work…"*

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[61] Zacharakis, 1992*,* pp. 73-74. Here Zacharakis reports that in certain versions of the sheets of this map the total dimensions of the whole are slightly smaller, 58 X 92 cm.

[62] As mentioned in previous chapter the scale of *Charta* is almost double the scale of Delisle–A map-model.

[63] It covers almost 60% of *Charta*'s total surface, whilst the remaining 40% concerns the northern part and the eastern zone of *Charta* which are not depicted on Delisle–A map-model.

[64] Boutoura, 2008.

[65] The pantograph was a designing instrument used for proportional copying of original drawings in equal, enlarged or reduced scale with respect to the scale of the original, on the basis of the geometric principle of "homothètie". It is known from the first half of 17th century and used in drawing, painting and cartography. A stereotype tool, well known and generally used in Rigas' times carried with its accessories in a proper case. We read a complete description followed by detailed illustrations in the widely diffused at that time *Encyclopédie* by Denis Diderot and Jean le Rond d'Alembert, edited from 1751 to 1780. It is documented that Rigas Velestinlis was familiar with *Encyclopédie* and used it in his work.

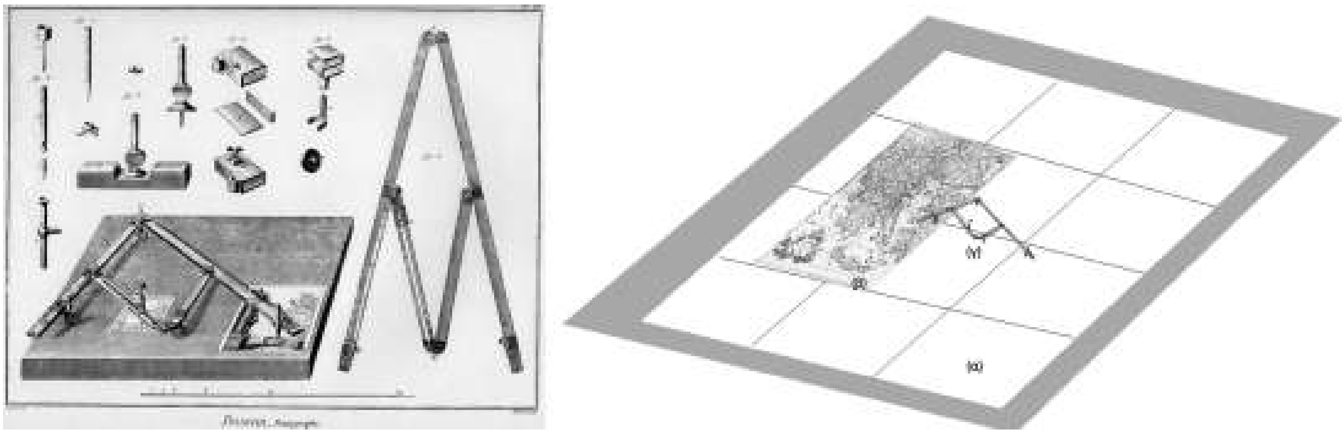

Fig. 13. Left: Detailed illustration of the pantograph in *Encyclopédie* by Diderot and d'Alembert (1751–1780). Right: The dimensional relation of *Charta* in twelve-sheets assembled in one (α), with the map-model of the Delisle–A typology in two sheets (*septentrionalis* and *meridionalis*) assembled in one (β) in association to the pantograph apparently used by Rigas Velestinlis (γ).

According to the graphic scale on the illustration of pantograph in *Encyclopédie* given at that time in French "pouces"[66] each pantograph leg has a length of ~ 52 cm. It is then easy to reconstruct in a way the dimensional proportions (Fig. 13, Right) between the pantograph, *Charta* and the Delisle–A map-model used by Rigas for the transfer of the 60% of *Charta*'s map content from the map-model.

As far as it is concerned the dimensions of the material working surface (i.g. the drawing table) used by Rigas as support for the drawing of *Charta*, this might have dimensions larger than that of *Charta* in its totality. The two sheets (*septentrionalis* and *meridionalis*) of Delisle–A map-model of total dimensions 70X100 cm (or 70X50 cm for each sheet) should be shifted on the unified surface of the twelve *Charta* sheets in order to be operational the use of pantograph. Given that the material working surface it would not be the floor, because the drawing quality of the map excludes such a case, Rigas should have used as supporting working surface a table of relevant dimensions (larger than 2X2 m) offering drawing commodity and the possibility for a stable and permanent installation of the unified twelve sheets for a time-consuming mapmaking. Such a large table for such type of work should be located in a roomy space within a house of authority in which it was possible to make available such spaces and facilities for lengthy, delicate and dedicated use. It is known that such houses were familiar to Rigas during his stay in Bucharest where he completed the drawing of *Charta* before he came to Vienna for its engraving and printing.

Concluding remarks

The approach to Rigas Velestinlis *Charta* from a pure scientific and technological cartographic point of view seems to lead to a series of interesting general and specific findings. A point of view not only based on modern cartographic theory and practice but also related to the frame of principles and methodologies introduced by cartographic heritage principles and the analytic and implementation possibilities offered. Among the general findings we notice that in the context of international 18th century cartography the importance of this map is such that it is not more acceptable to treat it only literarily or almost *en passant* in the frame of the treatments carried out in humanities, as it happened until now. It is necessary to treat *Charta* systematically also form the scientific and technological point of view. It has also to be noticed that even in the Greek language bibliography, the scientific cartographic treatment of *Charta* is indeed limited as well as

[66] A French "pouce" equals 2.71 cm.

very limited are in the international cartographic bibliography the appearance of contributions about the pure cartography related content although *Charta* overcomes the narrow space of domestic cartography taking full part in the history of international late 18th century cartography.

The specific findings concern the cartographic approach to *Charta* when done in the context of the map content separated in its "geometric" and in "thematic" component and in the context of map recognition differentiated in its "external" and "internal" component. While the "thematic" cartographic approach of *Charta* has been attempted for the historic, dialectic and/or phenomenological view and has given interesting results, the geometric cartographic approach has started recently. This approach comes to open not only a new field of research on *Charta* in general but also to enrich the map thematics by assigning geometric reference to the thematic cartographic map content. The decisive tool in this direction is digital technology which is generously offere today to assist the analytical, synthetic and communicative possibilities with means which were simply inconceivable just few years ago.

As any other map of cartographic heritage, the transformation of *Charta* in digital form, preferably of facsimile type, but not necessarily, is the first step in the field of cartographic research, in which thanks to the digital it emerge and rise the "coordinates" not only as a relevant concept but also as the tool in the geometric implementation of map content analysis and interpretation. The coordinates this original core of analytical geometric thinking and practice which determines and defines, from antiquity, the overall applied geometry and comes back powerful and in current use from the map transformation into digital form. Based on coordinates it is now possible the geometric analysis of *Charta* in the fields as it is e.g. the relation of the geographic window (framing) with the surrounding geography or the relation between the *Charta* coastline and the coastline depiction of the map-models apparently used by Rigas or the relation between *Charta*'s projective basis and the rest of the geometric content or the scale issue and the deformation induced by the digitization process or due to the stitching of the map sheets in one map unit.

From the digital analytic applications via coordinates new findings are derived about the cartography of Rigas *Charta* as it is e.g. that the oldest geographic map window which is the closest to the *Charta* map window is the "modern" representation of the "Tabula" of Greece (and the Balkan hinterland) which is part of the Strasbourg Schott edition of Ptolemy's *Geographia* edited by Martin Waldseemüller in 1513; or that though the coastline and the rest geometric *Charta*'s content are almost identical with Delisle–A map typology, this is not the case with the longitude and latitude calibration of the *Charta*'s frame (the projective framing) which means that Rigas first has transferred with diligence and care the coastline and the geometric content from his map-model with the use of a pantograph in almost double scale and then he adds separately the projective framing which deviates noticeable from his map-model especially with respect to the placement of the meridians.

The use of coordinates for the digital cartographic approach to *Charta* allows the treatment of the thematic content in order to identify, differentiate, classify and manage the great amount of various themes which are depicted on *Charta.* This is done through the development of interrelated data bases with geographic reference supported by visualization options which lead to facilities related to linking and web access. A major outcome of this approach is the construction of digital dictionaries of toponymy and other thematic names and graphic data useful in the field of analysis of the thematic cartographic content.

In conclusion, the "pure" cartographic approach of Rigas *Charta*, thanks to modern digital technology, opens new horizons for a deeper understanding of this monumental multi-value map not only of the Greek but also of the international cartographic heritage. This is accomplished through the analysis of *Charta*'s intrinsic geometric properties which leads to the development of a strong and fascinating visual medium of communication. A medium due to which one could come closer to the historicity and the message of this map, a high undertaking of the Greek Enlightenment, and to the cultural and educational dimension contained in the cartographic work.

Appendix A

The concept of geographic latitude and longitude, of meridians and parallels, of the origin of determining the latitudes (i.e. the Equator) and the meridians (i.e. the zero meridians[67]) as well as their images (straight or curved lines) on the map plane are concepts more or less familiar to anyone dealing with cartography and maps. What is important to stress here is that the positioning of any point depicted on a map can be labeled by a variety of coordinates according to the system used for this positioning. Thus, to any and the same point it can be assigned various types of coordinates (pairs of numbers) i.e. the geographic (spherical) coordinates longitude and latitude λ, φ (or λ*, φ; λ, φ*; λ*, φ*; etc) according to the definition of the zero meridians and the placement of the Equator (Tab. 1, Fig. A1, α).

	Origin of longitudes (Zero meridian)	Origin of longitudes* (Zero meridian*) [*considerably different*]
Origin of latitudes (Equator)	λ, φ	λ*, φ
Origin of latitudes* (Equator*) [*slightly different*]	λ, φ*	λ*, φ*

Tab. 1. To any point on earth (and on map) can be assigned pairs of geographic coordinates, longitude and latitude, according to the definition of their origin (Zero meridian and Equator respectively), as e.g. λ,φ; λ*,φ; λ,φ*; λ*,φ*; etc.

Transforming the geographic coordinates into plane cartographic coordinates (according to a selected map projection, as in Fig. A1, β) we obtain the corresponding plane projective (cartographic) coordinates x, y (or x*, y; x, y*; x*, y*; etc) on the map (Fig. A1, γ). Digitizing the map (Fig. A2, α) a digital copy is obtained (Fig. A2, β) with the corresponding digital coordinates x_{dig}, y_{dig} (or x^*_{dig}, y_{dig}; x_{dig}, y^*_{dig}; x^*_{dig}, y^*_{dig}; etc) on the digital copy. All transformations from the curvilinear geographic coordinates of any type to the plane map (projection) coordinates and finally to the plane digital coordinates are one-to-one correspondences controlled by rigorous mathematic relations, well known in scientific cartography. A general mathematic scheme of these transformations are given by the systems of equations (1) and (2),

$$\left.\begin{aligned}(x, y) &= m(\lambda, \varphi)\\ (x_{dig}, y_{dig}) &= d(x, y) = d(m(\lambda, \varphi))\end{aligned}\right\} \quad (1)$$

$$\left.\begin{aligned}(x, y) &= d^{-1}(x_{dig}, y_{dig})\\ (\lambda, \varphi) &= m^{-1}(x, y) = m^{-1}(d^{-1}(x_{dig}, y_{dig}))\end{aligned}\right\} \quad (2)$$

Where *m* is the map projection function transforming geographic coordinates into map coordinates and *d* is the digitization function transforming the map coordinates into digital counterparts. The functional transformations should be invertible which presuppose the existence of m^{-1} and d^{-1}.

[67] For example, the Forunate islands in the Antiquity and later the Ferro islands, Paris, Greenwich etc.

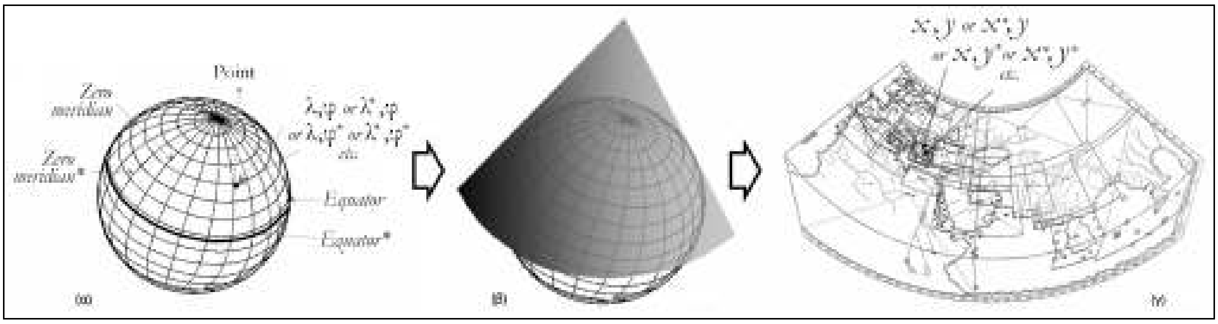

Fig. A1. α) The earth sphere with the meridians and parallels parameterized with spherical (geographic) coordinates according to the selected origin of longitudes (Zero meridian) and the placement of the Equator (the origin of latitudes). To any and the same point on the sphere are assigned pairs of geographic coordinates (e.g. λ,φ; λ*,φ; λ,φ*; λ*,φ*; etc.). β) A projection of the sphere is selected (here a conical projection) and γ) a map is obtained. The geographic coordinates are now transformed into plane map coordinates (e.g. x,y; x*,y; x,y*; x*,y*; etc.).

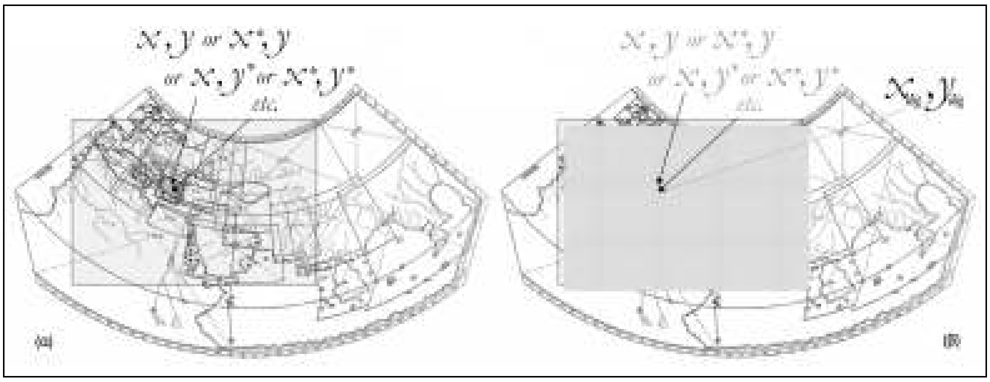

Fig A2. α) The digitized area of the map and β) the digital copy (in pixel form). The plane map coordinates (e.g. x,y; x*,y; x,y*; x*,y*; etc.) are now transformed into digital coordinates (e.g. x_{dig},y_{dig}; x^*_{dig},y_{dig}; x_{dig},y^*_{dig}; x^*_{dig},y^*_{dig}; etc.) referred to the reference system of digitization.

Appendix B

A selection of some of the major issues for proper old map digitization is enough to demonstrate how the know-how needed here is far beyond the relevant standards which are enough in the digitization "main stream": If cartographic digitization is distinguished in the two major acquisition methods, the digital "scanning" and the digital "photography" and each method in the "contact" and in the "non-contact" techniques then some of the problems which should be taken under consideration are:

a) How safe is the digitization process with respect to the "vulnerability" of the map material.
b) The available dimensions for digitization of the used acquisition tool with respect to the map dimensions (2-D or 3-D).
c) The deformations induced by digitization in the intrinsic and extrinsic geometry of the map content. This maybe caused either due to the optical-mechanical function of the digitization tool or due to the, by definition, alterations implying to the digital copy the central projection of the photography. In this point the colour alterations should be also of major concern[68].
d) The request for preserving the 1:1 scale in the digital copy.

[68] See A. Granis, 2008: "Introduction to the ICC colour management framework", presented at the Third International Workshop on *Digital Approaches to Cartographic Heritage,* ICA Commission on Digital Technologies in Cartographic Heritage, Institut Cartogràfic de Catalunya, Barcelona 26-27 June.

e) The eventual need for stitching together either map-sheets or the cuttings of the map surface in more pieces which is common for the folding of maps.

f) The overall cost of the whole digitization process with respect to the instrumentation needed, the labour and the how-how which has to be invested.

To tackle the above problems it is necessary to apply special know-how in points c, d and e: Respectively the correction of the alterations implied by digitization in the extrinsic and intrinsic geometry of the map content as well as to the preservation of colour , the preservation of the 1:1 scale in the digital map copy with respect to original map and the eventual need for stitching of the digital copies. As far as the above digitization problems are concerned Fig. B1 shows a qualitative "degree of difficulty" for each one of the digitization methods (scanning / photography) and the digitization techniques involved (contact / non-contact) for a 1:1 scale copying. The degree of difficulty from 1 (low) to 2 (average) and 3 (high) is a qualitative graduation in order to give a general idea for the particularity of cartographic digitization.

The qualitative evaluation table in Fig. 10 shows that before the introduction of the cost factor the lower total degree of difficulty is within the non-contact digital scanning of the original map to be digitized. It follows with equal degree of difficulty the contact digital scanning and the digital photography and finally the digital reproduction of slides (a case which is still in use only when high quality slides are available). But, when introducing cost into evaluation the image may change according to the special weight the cost is evaluated. In general the non-contact scanning is much expensive requiring high cost instrumentation whilst on the other side digital photography is less expensive but demanding costly now-how especially for a posteriori processing[69].

		Vulnerability	Dimensions [tool]	Geometry [map content] (Know-how)	Scale (Know-how)	Stitching (Know-how)	Cost
Digital scanning	Contact	2	3	3	1	1	2
	Non-contact	2	2	2	1	1	3
Digital photography	Slide	1	1	3	3	3	2
	Non-contact	1	1	2	3	3	1

Fig. B1. Methods and techniques for cartographic digitization and the qualitative "degree of difficulty" of the problems involved. The evaluation of difficulty from 1 (low) to 3 (high) is indicative. The solution of the problems in the box (black frame) requires specialized know-how. The evaluation of the cost is under a relevant weighted option.

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[69] The case of 3-D digital photography is a special case requiring advanced know-how and special acquisition techniques. See, e.g., V. Tsioukas and M. Daniil, 2008: "3-D digitization of historical maps", presented at the Third International Workshop on *Digital Approaches to Cartographic Heritage,* ICA Commission on Digital Technologies in Cartographic Heritage, Institut Cartogràfic de Catalunya, Barcelona 26-27 June.

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