Enabling modernity: innovation in modulated Greek typefaces, 1998-2007

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Abstract

This article discusses the associations with tradition, modernity, innovation, and revivalism contained within, and enabled by, three seminal Greek typefaces for continuous reading in a modulated style, developed from 1998 onwards outside Greece. The article starts with an analysis of the historical model of types cut by Firmin Didot; this style was later adopted by the Monotype Corporation for hot-metal composition, and survived across technologies well into the digital era. It provides a reference point for subsequent work, and informed new digital typefaces, starting with Adobe Systems' Minion Pro (1998). The article discusses Adobe's programme of developing large typographic families with Greek complements, which explicitly pushed the design envelope with each iteration. It examines the approaches taken for features such as the first pairing of monotonic and polytonic diacritics, the pioneering of functionally correct diacritics over small capitals, and their impact on wider practice. Parallel efforts that reinforced this trend by Microsoft, as well as notable independent work, are referenced in the context of active explorations of the relationship between Latin and Greek styles by non-Greek designers. The article concludes that the period 1998–2007 has been revolutionary for Greek typefaces for continuous text.

1. Introduction

The modern Greek typographic script draws on a legacy that is pioneering, unique, contested, and maligned. Discussion of early typography is inconceivable without reference to Greek: printed characters appear within a decade of the invention of printing, and the number of books in Greek — exclusively or paired with Latin — are central to any consideration of Renaissance culture, and scholarship leading to the Enlightenment. It is the first typographic script that captured in printed form a connected, fluid script, where complex problems of type-making and typesetting were addressed successfully (Barker, 1985), and with a quality of capturing the calligraphic nature of the handwritten script that set a standard that predates by decades any example from other complex scripts — not least Arabic, the usual reference point for connected typesetting.[1] The Greek typographic script was developed (and experimented on) entirely outside the geography associated today with Greece until well into the nineteenth century, and overwhelmingly for readers that had little in common with the communities sharing Greek as a native language. It provides the focus for a deep confrontation between tradition and modernity, and touches on issues of cultural identity, the friction of imported internationalism, and the relationship of makers to their tools. It also carries the burden of fundamental developments being determined by circumstances extraneous to the communities of users, technological expediencies, and decisions made with little reference to historical precedent.

The focus of this paper is a relatively recent and very narrow period, which may reasonably raise doubts as to the validity of its analysis. Indeed, digital typefaces are present at least from the early 1970s (Karow, 1987), and

[1] Greek and Arabic offer a useful contrast of typographic scripts developed in close regions and periods, but with different access to expertise on the written form of the script and its correct use in manuscript forms. The importance of script expertise on the quality of new typographic implementations can be observed also in South Asian scripts, many of which were first produced typographically in the 18th and 19th centuries by missionaries. This is the subject of recent and ongoing research at the University of Reading, UK.

environments such as Ikarus offered digital tools for designers long before the period we are concerned with here (Carter, 1985). However, these typefaces were intended for proprietary typesetting systems, which were the main product of companies such as Monotype and Hell (Unger 1979). Digital typefaces were also generated in the Metafont format for use in the TEX typesetting system (Knuth 1979), but at the time were not portable to other environments. For the purposes of discussing design practice, the beginning of digital typography is conventionally placed in 1985. This marks the confluence of hardware and software that disrupted the production processes and business models of capital-intensive typesetting: the Macintosh computer and the Apple Laserwriter printer, the Aldus PageMaker layout application, and the Fontographer typeface design application. Although these developments initiated a period of intense experimentation and innovation in the field of Latin typeface design (Kinross, 1992), the first twelve years of platform-independent fonts offer no significant contributions in Greek typeface design. There are several small-scale localising efforts by national and regional distributors of hardware equipment (Apple, 1992) and some mostly amateur efforts in academic institutions outside Greece, but little that can be discussed in terms of typographic quality, let alone a research-informed original contribution.

However, 1998 marked a turning point in Greek typography. Two years after Microsoft launched its "Core fonts for the web" project, the flagship typeface Georgia was updated to the WGL4 character set, which included monotonic Greek.[2] At the same time Microsoft commissioned Sylfaen, a new typeface family by John Hudson and Ross Mills, with the monotonic Greek by Geraldine Wade[3]. Sylfaen is notable for being the first original digital typeface

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[2] Standard Modern Greek is written with a single accent to indicate a stressed syllable (monotonic). All texts before 1982 (and several since) were written with a range of diacritics to indicate different kinds of stress and voicing, rooted in classical Greek (polytonic).

[3] https://www.microsoft.com/typography/fonts/family.aspx?FID=263 There is very little evidence of Sylfaen in use, especially for longer texts.
Georgia v. 2 was made available in August 1998.
(http://web.archive.org/web/20020214105139/http://www.microsoft.com/typography/fonts/fonttest.asp?FID=4&FNAME=Georgia&FVER=2.05)

with a multi-script character set as a key feature of the design brief. (Wide-character set typefaces such as Lucida preceded Sylfaen, but had been originally conceived for Latin character sets, and later expanded (Bigelow & Holmes, 1993). The same applies to older multi-script typefaces, such as Jan van Krimpen's Romulus, 1931 onwards.) In the same year, Adobe commenced the development of a redesigned and expanded version of its Minion family, which would ship eventually in 2000 as Minion Pro[4] (Figure 1). Work on the Greek complement of Minion Pro had commenced in 1998, and took advantage of OpenType technology to claim several milestones. These included the parallel design and shipping of monotonic and polytonic Greek in the same font file, and an attempt to address particular challenges of Greek typesetting, most notably case conversion. This marked a shift in handling within the font file typographic matters that were previously in the domain of the proofreader and typesetter.

2. Historical framework

The importance of printing in Greek, and in Greek alongside other languages – overwhelmingly Latin, for the first two centuries – is well attested by the works of early printers (Barker et al, 2001). Greek texts comprise a substantial proportion of early printing output, and claim exquisite editions in notable libraries, such as the editions by Robert Estienne for the library of King Francis I of France, a high point for text typography that was echoed for nearly three centuries (Pattison, 1949; Schreiber, 1982). However, two notable characteristics in all these editions had long repercussions in Greek printing. The first concerns the nature of the texts that were reproduced: without exception, the classical Greek corpus contains texts of an exceptionally flat hierarchy, where a

Verdana v. 2.10 had been updated to WGL4 in 1997 already. http://web.archive.org/web/20020126185617/http://www.microsoft.com/typography/fonts/fonttest.asp?FID=1&FNAME=Verdana&FVER=2.35

4 https://store1.adobe.com/cfusion/store/html/index.cfm?store=OLS-US&event=displayFontPackage&code=1721

single typographic style is used for the main body of the text, with only occasional headings. The Homeric epic poems, for example, require a simple heading and several pages of hexameter verse, repeated 24 times. There is no articulation within each section. Indeed, page numbers aside, there is little to distinguish in terms of typographic structure the *Homer* of Dimitrios Chalcocondylis' editio princeps of 1488, and the Oxford monolingual edition of 1800. The most complex classical texts are in the form of interlocution, as in the Socratic dialogues or Aristophanes' plays. However, in those editions the same typeface is used for the speaker's name and the spoken text. Indentation aside, capitalisation is the only differentiation employed— the effect diminished by the frequent convention of abbreviating the name. Religious texts, most notably the New Testament, were also typeset in Greek, but their typographic structure follows very closely the pattern of classical texts, and requires only a single or a very small number of typeface styles to typeset. This focus of the market for Greek texts on educated elites reading a limited range of typographically narrow texts meant that there was no pressure to develop the stylistic range of Greek typefaces. It is not until the second half of the eighteenth and early nineteenth century that documents that require more refined typographic palettes are printed, like pamphlets, texts for schools, and ephemera. However, even these editions mirror the relatively limited typographic articulation of earlier texts.

The second notable characteristic of historical Greek typography concerns the models for Greek typefaces in the first four centuries of printing. Unsurprisingly, early Greek typefaces are modelled on the hands of contemporary scribes. The pattern was established when Michael Apostolis' hand was used for Damilas's *Homer*, referenced above. This is stylistically related to the hand of Zacharias Kalliergis, captured in the type he cut for the 1499 *Etymologicum Magnum* that he edited with Nicolaos Vlastos. The hands of Emmanuel Rhusotas and Marcus Musurus served as models for two of Aldus Manutius' typefaces (Barker, 1985), and Angelos Vergikios' hand was the model for Garamond's grec du roi (Figure 2). Although the style represented by Apostolis and Kalliergis was eclipsed by the Aldine and Garamond model, the pattern of modelling Greek types on confident, elaborate cursive styles persisted for centuries. Gradual simplifications focused on reducing the character set by eliminating complex ligatures and abbreviations (Lane, 1996).

The implications of the large character set required for Greek have to be seen in terms of investment in raw materials, type-making effort, storage of cast type, and the handling of multiple cases required for typesetting. In this light, it is obvious that the typographic complexity of a single style of Greek type would act as an additional brake to the development of wider complements (Figure 3). Indeed, even radical simplifications of the character set of Greek typefaces, such as the ones undertaken by Alexander Wilson for the Foulis Press in Glasgow and John Baskerville's Greek type, both in the eighteenth century, did not extend the typographic repertoire for Greek typesetting in terms of the styles available to printers.

The nineteenth century clarified Greek typeface styles into two parallel strands, one dominated by the cursive upright style exemplified by Firmin Didot's types, and an inclined cursive with somewhat greater variety, dominated by type foundries in Leipzig. For all their success, the most notable new typefaces of the period – the 1806 cut based on Richard Porson's hand, Robert Proctor's 1904 Otter Greek and Victor Scholderer's 1927 New Hellenic – follow the established pattern: typefaces in a single style, based on a written exemplar (or a previous typeface, itself based on writing). All three were intended for typesetting classical texts, with no acknowledgement of the changing typographic environment, especially from the middle of the nineteenth century onwards (Twyman, 1993; n.a., 1928). Indeed, the developing market for Greek printing for the native audience included genres such as newspapers and ephemera, but text sizes were typeset in a very narrow range of typefaces, mostly uninventive variations on the Didot model. These observations underline the conclusion that typographic innovation in Greek typefaces is limited to line-level developments: the typographic forms of individual letters change, but there is little innovation in the typographic complement presented to readers. Script-based models persist well into the hot-metal era, without the imperative of developing wide typographic families. When document articulation requires a rich typeface repertoire, printers fall back on non-alphabetic structures, such as decoration, and a growing offering of display styles. Text setting is remarkably consistent in utilising a very small range of styles (Figure 4).

Although there is some innovation connected to typefaces developed for Greek newspapers in the twentieth century (Mastoridis, 1999), the strong

scribal connection, and the lack of Greek typefaces developed explicitly as families persists until well into the twentieth century. Some typefaces are presented as families by hot-metal manufacturers, notably Monotype's much-imitated Times in the 1950s. However, the design of the typefaces follows closely the models set by the existing Latin typefaces that the Greek was complementing: the overriding requirement appears to have been the adaptation of a Greek historical style to the upright stress of the Latin original, an effort with distinct echoes in some Greek typefaces of the end of the eighteenth century (Leonidas 2017).

The picture changed with the introduction of new typefaces for phototypesetting by Linotype, from 1971 onwards, in stages throughout that decade. Starting with Helvetica Greek, which was initiated as a response to an order for new typesetting equipment by Doxiadis Associates (Lekka 2014), and continuing with Optima, New Century Schoolbook, Baskerville, and Times, these typefaces defined a particular strand in Greek typeface design. The systems they were developed for assumed typeface families with two weights (Regular and Bold) and coordinated upright and italic styles, which was without precedent: existing "pairings" like Monotype's Series 90/91/92 drew much on the combination of pre-existing styles that were shoehorned into family associations (Leonidas 2002). Additionally, typesetting practice in Greece at the time often made use of the convention of spacing out upright letters to indicate emphasis. This convention drew on the German tradition imported during King Otto's reign, and undermined the strength of Anglo-American conventions for typesetting typographic hierarchies. More importantly, four of the five new families (all except Helvetica) were Greek adaptations of modulated styles, with a vertical or transitional stress for the upright style, and italics that followed the historical conventions for secondary styles in the Latin script: an angling of the main strokes to the right, uniform stress, narrower proportions, and flowing instrokes and outstrokes that contrast the serifs of the uprights. (Optima did not have serifs, but the structure of the modulated strokes followed closely the four serif families.)

These typefaces represented a desire to differentiate from the historical models for Greek typefaces, and to enable documents that reflected a modern, internationalist, technologically-confident, and Western-orientated perspective. These values were associated with the arguably enlightened approach

Konstantinos Doxiadis brought to many of his projects.[5] Indeed, Doxiadis' publications as well as many typeset by phototypesetting in the period stand in stark contrast with a lot of publications by small-scale printers, as well as ephemera of the period. Focusing on text sizes, the typographic environment in Greece in the 1970s and beyond presented contrasting trends, corresponding — via the technology of type-making and typesetting — to radically different approaches to publishing. These variant trends should also be seen as one more aspect of the dichotomy within Greek culture at the time, and the tension between Eastern roots, multifaceted traditions, and Western aspirational models (Figure 5).[6]

The stylistic cues that these typefaces represent survived well into the 1990s, and infused mostly periodical publications and ephemeral documents, in strong contrast with the historical styles employed almost exclusively for literary and learned publications. There is ample evidence in the type specimens of digital Greek typefaces of the 1980s and early 1990s that designers saw the deconstruction and copying of forms from Latin fonts to assemble Greek letterforms as a valid methodology that would imbue their work with novelty and resonance with Anglo-American trends. These observations rely on analysis of primary sources, in the form of type specimens (Kosmopolis 1999) and related ephemera in specialist collections, and digital data (Figure 6). However, ephemera and specimens are rarely dated properly (e.g. Parachute n.d.) and digital data can carry misleading dates. Regardless, close examination of the digital data of many such typefaces reveals that the Greek forms were not the product of a coherent approach to letter formation, let alone composition of typographic textures at paragraph- or document levels (Figure 7). Rather, they were overwhelmingly products of a sampling methodology, aiming to impart

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[5] Doxiadis (1913–75) was an architect and urban planner based in Athens. He had a significant involvement in the documentation and reconstruction efforts of Greece during and after the Second World War through a range of ministerial positions, and subsequently founded a major planning and urban development company with activities worldwide. One of his companies, the Athens Publishing Centre, was amongst the first to make extensive use of phototypesetting technologies in Greece.

[6] For a wider discussion of the subject from a historiographical perspective, see Liakos 2002 and 2008, noting that the history of typographic design does not feature explicitly in these narratives.

association with the original Latin style though a superficial loan of letterform elements. This practice is consistent with the absence of typographic education in Greece at the time, and the focus of training in graphic design away from text-intensive applications (Sakellaridis 1972 and Kardari 1992).

The context, therefore, of the new Greek typefaces developed from the middle of the 1990s onwards is one of three contrasting typographic styles: well-established but narrow traditional models (exemplified by Monotype's Series 90, and used overwhelmingly in book publishing), well-considered but culturally biased models (Linotype's adaptations from the 1970s), and superficial adaptations which echoed imported styles, and heavily orientated towards display uses. None of these genres could claim to combine typographic competence with timeliness: Greece in the 1990s was well-established as a member of the European Union, and — despite periodic political turbulence and the neighbouring war in the Balkans — was experiencing considerable growth in urban, middle class communities, and a strengthening of the service sectors (Kalyvas 2015). During this time the typographic environment for text-intensive applications continued to be fragmented along the lines of document genres, with a persistent use of the somewhat dated Didot styles in longer texts which can be ascribed to the simple fact that these typefaces simply got the job done. In parallel, the gradual adoption of personal computers exposed a growing proportion of the population to screen-based typography, just as much as desktop publishing technologies foregrounded the importance of Postscript digital typefaces.

In this environment, new Greek typefaces shipping with operating systems and applications for graphics professionals had the potential to redefine core styles for text typography. Microsoft's Greek extension of Georgia proved to be a competent adaptation, but did not stray far from the patterns established by Monotype's Times Greek, and the Linotype Greeks of the 1970s. Furthermore, Georgia did not supplant Times as the default typeface in the Microsoft Word application, which diluted any improvements the newer typeface had to contribute.[7] The environment was, therefore, receptive to the prospect

[7] Although Georgia was developed alongside Verdana with optimisations for screen rendering, its brief reflected its roots in the Scotch Roman style, and the

of a completely new Greek typeface for texts, informed by recent research in the field, and developed with a wide typographic palette in mind.

3. Typographic ground-breaking

Following the decision to develop new text typefaces in the late 1990s, Adobe faced the challenge of defining the parameters for Greek complements for typefaces with a high degree of typographic refinement. Unlike Microsoft, which focused on the office and general use market for Georgia and Sylfaen, Adobe was championing the then new OpenType format as a step change in technology that enabled high quality typography, and addressed chronic problems for the professional designers, such as platform incompatibilities, and character set limitations (Lemon, 1997). Minion, first released in 1990, (Adobe 1990) was one of the flagship typeface families of the Adobe Originals programme. Its designer, Robert Slimbach, drew on late Renaissance models to develop a family that would be suitable for a wide range of texts, while maintaining the texture of the historical models. Publishing the OpenType family with a new name allowed Adobe the freedom to redesign the typeface at the level of individual glyphs, as well as define a wider family. The full complement includes a range of weights, widths, and optical sizes, with corresponding italic secondary styles.

Although research into the historical adaptations of the Greek script to typographic forms constituted the foundation of this (and later) projects, it could not inform sufficiently the design direction of the new typefaces (Leonidas, 1998). This is primarily due to the narrow typographic environment of Greek texts in the first three and a half centuries of printing (see section 2 above), which did not offer any clues for addressing a wide design space. Additionally, Minion drew its influences from a period when Greek typefaces foregrounded the cursive, connected aspects of the script. Contemporary Greek

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intention to render longer texts. The continued use of the Latin complement in e-readers and print applications demonstrate the utility of a typographically refined style with low-resolution competence, a category in which Greek typography is underserved.

readers have no familiarity with 16th century models. Adobe's Greek typefaces, therefore, sought to address contemporary typographic problems that were outside the historical corpus, and represented novel design challenges. In this sense, new Greek typefaces from Minion Pro onwards can be described as eclectic in their references, and potentially ahistorical through their selective engagement with references (Figure 8). In this respect, we can argue that Minion Pro Greek may be the first post-modern Greek typeface, echoing the discourse surrounding Latin typefaces of the first Postscript years, although in a typographically more benign space.[8]

The main challenge was represented by the need to invent a style for the Greek that would resonate with the Latin complement, while bearing no direct relationship to the design cues that identified the Latin with the genre of late Renaissance revivals. In formal terms, this implied an abandonment of the cursive, connected nature of Greek Renaissance types, and the appropriation of general letterform proportions and stroke characteristics from the Latin complement. This outcome was facilitated by Robert Slimbach's calligraphy-based approach, which reinforced consistency across letterforms. However, Slimbach's design does not indulge in the excessive normalisation of letterform proportions witnessed in the early digital Greek typefaces. This is in no small part due to the methodology of writing out letterforms that were subsequently digitised, rather than resorting to the assembly of Greek forms out of deconstructed Latin letters. This approach was supported and reinforced by the research into historical publications, which emphasised the persistence of a written ductus even as Greek typefaces lost their connected appearance. In

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8 Kinross 1992 and Keedy 1995 contain pertinent entries in this discourse. However, many typefaces produced at the time should be considered "texts" themselves, since they were published not as commercial products, but as statements in a debate on what constitutes a typeface, and the relationship of a new typeface to canonical historical themes. In this category the typefaces included with the FUSE issues (Brody & Wozencroft 2012) are an essential point of reference.
Contrasting with the Linotype typefaces of the 1970s mentioned above, the Adobe project was not initiated by a local client with specific needs, and intentionally moderated cultural associations. In this process a critical factor was the integration of feedback that was informed by research in both printing history and typographic theory.

Minion Pro this results in a lack of serif-like appendages appearing on the Greek letterforms: the letters follow the logic of the originating tool, even if their overall proportions are much more homogeneous. We can therefore credit the central role of written forms in the origination process as a key differentiator of the new typeface from other digital typefaces developed at the time. This approach imparted a strong, if formally indirect, connection to the dominant Didot style that represented "normality" for longer texts in the eyes of Greek readers.

Gentium (SIL 2002) had already demonstrated the possibility of designing a new Greek typeface with excellent performance in text-intensive applications without any formal features at letter level copying directly from the Latin complement. However, that typeface was originally developed in an academic environment, and was distributed through channels that did not register strongly within Greece. On the other hand, we cannot underestimate the importance of a new typeface for text that would ship with the page layout applications of the key software publisher for the graphics industry. Coupled with the bias towards Adobe fonts in the pre-press industry, Minion Pro would be guaranteed the attention of graphics and publishing professionals, and laid the ground for later typefaces by Adobe and other publishers to explore a design space that departed significantly from the historical models, yet maintained the connection with the roots of the Greek script.

Minion Pro was produced in four weights (Regular, Medium, SemiBold, and Bold), four optical sizes (Caption, Regular, Subheading, and Display), and two widths (Regular and Condensed). Including italics styles, the full family reached 50 separate fonts. The corresponding design space can be visualised as a cube, with weight along one axis, optical size along the second, and width along the third. A master set of outlines in each apex allowed the interpolation of intermediate fonts; for example, the Bold and the Regular could be used to interpolate the Medium and Semibold. (In practice, intermediate master outlines for the most commonly used styles were also used.)

Crucially, the design space defined by these three axes (weight, optical size, and width) produces variations where the extreme members of the family represent very different design challenges. For example, a Bold Caption style may require particular attention in the design of counters to ensure a readable, smooth texture — a problem absent from a Display Condensed style, where the

optical effects in stroke overlaps are paramount. Adobe's conception of a typeface family for texts with a very wide design space represented a key challenge in the development of the Greek complement.

Research into historical typefaces for Greek confirmed that there are no examples of typefaces spanning more than the most elementary range of weights, and no coordinated range of typefaces adjusted for optical sizes. A small number of heavier typefaces used for headings or headwords existed, but they were either individual styles, or emboldened variants of a base style. Document genres where conventionally multiple weights are employed, such as dictionaries and reference works, would instead make use of different typefaces altogether (Leonidas, 2013). The typographic palette of Greek text-intensive documents remained narrow, or comprising small collections of single-style typefaces, well into the twentieth century (Figure 9). Indeed, the profusion of Greek bold letterforms listed in type specimens across typesetting technologies is almost entirely evident in display styles, and overwhelmingly in capital-only forms.

In typeface design terms, this implies that the typographic forms of the script did not undergo the pressure to adapt to much heavier strokes at reading sizes. For example, the problem of maintaining a clear separation of overlapping strokes as in the gamma, epsilon, kappa, mu, xi, and omega with an increased stroke thickness was not resolved adequately for text sizes. This can be seen most clearly in styles that maintain a clear connection to the cursive form of the letters, such as Monotype's Series 90. The upside of this lack of typographic development has been the survival of the script's core characteristic, the fluid movement of a stroke around looped counters, with an implied ductus of successive looped movements. By attempting a wide range of weights, and including heavy variants at caption sizes, Minion Pro provided a base point for subsequent Adobe typefaces, as well as a model for work by other international publishers and local Greek designers (Parachute n.d.).

The capacity of the OpenType format to accommodate a large character set allowed Minion Pro to include letterforms with both monotonic and polytonic diacritics in the same typeface. Although this was not the absolute first

Greek typeface accommodating both systems in parallel,[9] the range of intended uses represented an opportunity to and a new design problem. For texts incorporating both versions of written Greek, such as textbooks, texts with quoted passages, and scholarly texts, it is important to distinguish between monotonic words with a tonos, and polytonic ones with an oxia, especially in cases where the spelling may be identical: both marks are similar to an acute. Reference books on Greek grammar state that the tonos takes the same form as the oxia, without specifying the form of the mark (Triandafyllidis 1991). The assumption is that the acute-like inclination to the right will be sufficient to distinguish the oxia from the varia in a polytonic text, whereas in a monotonic context the angle is not critical. Minion Pro was the first typeface to offer a linguistically and typographically correct solution, by employing different angles of inclination for the two diacritics: similar enough to indicate a right-leaning mark, but with enough difference to enable unambiguous reading in mixed texts.

Another area where Minion Pro broke new ground was the definition of rules for correct case conversion in an OpenType environment, in an attempt to integrate into the font itself grammatically correct behaviour during automatic text transformations. Greek has considerably complex rules for the case conversion of letters with diacritics, especially in a polytonic text. Some letters with capital forms only occur in the context of a lower-case setting, necessitating a logical model with three cases to allows the transformations to function smoothly. However, the substitutions model integrated in OpenType only allows two cases, necessitating considerable font engineering effort to make case conversion in Minion Pro function correctly. Quite apart from demonstrating the limits and potential of the technology, the solutions implemented in Minion Pro formed the basis for more complex behaviours in subsequent typefaces.

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9 Victor Gaultney's Gentium, published in 2002, is the first new digital Greek typeface to include both monotonic and polytonic diacritics. However, it follows a more conventional approach, with the tonos being identical to the oxia. (SIL 2016) Gentium is widely used for scholarly texts outside Greece.

4. Extension and exploration

The case of Minion Pro, discussed in the previous section, exemplifies how the tensions between convention and the desire to innovate find a focus on the more immediately visible aspects of a design: in Minion Pro's case the overall approach to typographic texture, the definition of a character set, the handling of multiple diacritics, and fundamental functionality. Considering the typographic environment in 1998, Minion Pro could be seen as ground-breaking in its totality, and innovative for offering a new interpretation for a modulated Greek text typeface without any significant imported features. However, in terms of letterform design it is relatively conservative, and keeps probably a bit too close to the counter shapes of the original Latin letterforms. Regardless, it provided a reference point for further explorations of the relationship between Latin and Greek styles, which Adobe embarked on with two progressively larger type families, Garamond Premier Pro (Adobe 2005), henceforth GPP, and Arno Pro (Adobe 2007). With each of these two families Adobe extended the design envelope for a Greek text typeface, exploring both the design of the letters themselves, and the definition of what a reference typeface for Greek texts would consist of in terms of character set and behaviours.

It is safe to say that, from a design point of view, GPP represented the most challenging Greek typeface design of the post-1985 digital period. Like Minion Pro, GPP shipped with four weights and four optical sizes (although no narrow widths). The challenge of developing a modulated Greek text typeface for an extensive family in a range of weights was compounded by GPP utilising a ductus that was much closer to the cursive forms of Greek. This made counters considerably more variable in size, and often much smaller than in Minion Pro (Figure 10). However, whereas the sources for GPP's Latin were obvious, the connected style of Garamond's Greek types rendered them entirely unsuitable for a 21st century Greek. Furthermore, a cursive but typographically homogeneous Greek style has problematic equivalents in the historical record, not just in the sixteenth century. (See also section 2.) Neither the typefaces used without ligatures in the Low Countries (Lane 1996), nor typefaces like

Wilson's (Aristotle 1745) and Baskerville's Greek (Leonidas 2017) were suitable for continuous text setting fur current readerships. Slimbach's devising of an unconnected Greek typeface that is typographically competent, while avoiding the Didot style, represents a genuine innovation. GPP gave concrete form to a new genre, demonstrating that the design space for Greek modulated typefaces is much wider than existing typefaces would suggest. Arno Pro exists in the same design space, employing a variation in the shapes of counters that is reminiscent of cursive forms, but strengthening the influence of Slimbach's pen-made forms. GPP employs a horizontal stress, which is closer to the historical modulation of Greek, whereas Arno Pro modulates the two scripts with a relatively consistent angle. Neither resorts to any copying of forms across the scripts, even for letters like the omicron and o: the letters in each typeface stem from their written forms, and produce a consistent texture by maintaining a rhythm derived from confident, continuous writing (Adobe 2007).

The same approach was taken by other designers of new Greek typefaces at the time, most notably John Hudson of Tiro Typeworks. His typefaces for the Society of Biblical Literature (2007) and Brill (2012) reference similar explorations of modulation and (in the Brill) style relationships within the family. Although the SBL and Brill typefaces have limited distribution compared to Adobe's fonts, their use in reference publications with long shelf lives reinforces a texture that references written forms, but is updated for contemporary typographic environments.[10]

A lecture on polytonic Greek (Leonidas 2003) and a series of discussions with key Adobe personnel proved decisive for including small caps in the default character sets for Greek. These considerations drew on evidence for the use of artificially-scaled small caps in a range of documents within Greece, and the complete lack of any originally designed small caps for Greek. However, whereas the decision to include original small caps for the Greek characters

[10] SBL Greek is available in one style only, echoing the typographic repertoire of Greek typefaces used in Europe until the 19th century. https://www.sbl-site.org/educational/BiblicalFonts_SBLGreek.aspx The Brill typeface (https://brill.com/page/BrillFont/brill-typeface) offers upright and italic styles in two weights, and is used in editions such as Montanari (2015).

may make sense from the point of view of providing better resources to users, it represented a unique and entirely novel challenge: both Garamond Premier Pro and Arno Pro have polytonic character sets. The behaviour for automatic conversion of lowercase strings to small caps is identical to the conversion to all capital setting, assuming that diacritics are dropped during the conversion, according to the dominant practice.[11]

However, research in early Greek printing revealed a practice of typesetting a main text in smaller capitals with full polytonic diacritics, surrounded by a gloss in a conventional lowercase typeface. (Works by Lorenzo de Alopa, 1495 and 1496, were reviewed; as well as Aristophanes' *Comoediae Novem*, by Aldus Manutius, 1498.) Whereas GPP provided a full polytonic character set and small caps with subscript support, Arno Pro extended this provision to full polytonic small caps (Figure 11). This necessitated a new expression of the logic for case conversion when the diacritics were present, in addition to the default, unaccented case conversion (Leonidas 2005). Significantly, the behaviour of fully accented small caps in case conversions is considerably more complex than that of simple capitals, greatly increasing the complexity of the implementation. The result, the first typeface with fully functioning polytonic diacritics over both lowercase and small cap letters, defined a new reference point for the typographic elaboration of scholarly texts, and demonstrated further both the potential and limitations of the format.

The presence of diacritics over capitals and small caps in Greek may appear at first like a futile anachronism. However, beyond the technical challenge, it serves an important function on a number of levels. As the environments for authoring and publishing become more vertically integrated, typographic resources determine the range of expression though documents (Leonidas 2015). Projects like Arno Pro that draw on the full range of typographic expression from previous typesetting environments to define their briefs may

[11] The subscript iota is an exception to the omission of diacritics, and survives in all-capital setting. There are, however, seven possible configurations of its position and form in an all-capital setting (Haralambous 1999). Opinions vary on the preferred behaviour, with arguments seemingly depending on the selection of primary sources.

seem excessive, since some of their potential will only apply to very small communities or niche uses. However, by enabling these marginal typesetting scenarios, projects like Arno Pro support the preservation of typographic practice, and enable experimentation and research into new approaches to document design.

This argument has been supported by recent evidence in publications within Greece, in ephemera, and publications design: accented capitals are increasingly being used in the commercial environment in words with a classical root, where readers may not be trusted to stress the correct syllable. This instance of typographic practice responding to a perceived user need is an example of a typesetting technology enabling developments beyond the parameters that prescribed its original development. At the same time, it is an excellent indication of typographic language adapting and evolving in response to the changing audience.

5. Conclusion

The generous time and resources allocated to the development of the typefaces discussed above allowed these projects to become exemplars for the integration of typographic research into practice. They are notable because they place advances in the utilisation of font technology at the service of typographic expression, and integrate the lessons of scholarship in a manner that, with the exception of Gentium, had not been accomplished for the Greek script. Furthermore, by developing families with weights and styles for which no precedent existed, they provide a reference point for other practitioners to position their work, and other researchers to enrich further — as indeed the three typefaces demonstrate themselves, through progressive enhancement of their typographic capabilities. It is not an overstatement to say that the three Adobe Greek typefaces have transformed the typesetting and appearance of Greek printed matter, both directly (through the volume of material typeset with them) and indirectly (because they are seen as models for the development of new typefaces). In this context it is worth noting the forthcoming *Ancient Greek-English Lexicon* by Cambridge University Press, which will be published in 2019[12], as well as recent typefaces that expand the typographic repertoire for Greek, while referencing the explorations of modulation and stroke terminations seen in the Adobe fonts (Figure 12).

The specific, letter- and paragraph-level design solutions developed for the three typefaces constitute key moments in the dialogue between tradition and modernity in the Greek script. However, the observations made for Greek can be arguably made for other scripts undergoing a process of enrichment of their typographic palettes. In this respect, these projects represent a response to pressure on a script to develop a wider typographic palette. Integrating re-

[12] See "Cambridge Greek Lexicon" on https://www.classics.cam.ac.uk/research/projects/glp . A sample of the typeset volume is available, and reproduced in figure 9.

search in to the design process allows the identification of a balance point between traditional modes of document articulation, and an informed exploration of the potential and limitations of new technology.

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Figure 1
The three Adobe typefaces discussed in this paper: Minion Pro (2000), Garamond Prremier Pro (2005) and Arno Pro (2007).

Η ΤΥΠΟΓΡΑΦΙΑ είναι ένα πεδίο που αντλεί γνώσεις και μεθόδους από θετικές και ανθρωπιστικές επιστήμες, αλλά και τις εφαρμοσμένες τέχνες. Ιστορία, τεχνολογία, κοινωνία, και κουλτούρα αλλά και *οι μηχανισμοί της αγοράς και η επιχειρηματικότητα*: όλα αυτά έχουν θέση στα γνωστικά εφόδια των τυπογράφων.

Η ΤΥΠΟΓΡΑΦΙΑ είναι ένα πεδίο που αντλεί γνώσεις και μεθόδους από θετικές και ανθρωπιστικές επιστήμες, και τις εφαρμοσμένες τέχνες. Ιστορία, τεχνολογία, κοινωνία, και κουλτούρα αλλά και *οι μηχανισμοί της αγοράς και η επιχειρηματικότητα*: όλα αυτά έχουν θέση στα γνωστικά εφόδια των τυπογράφων.

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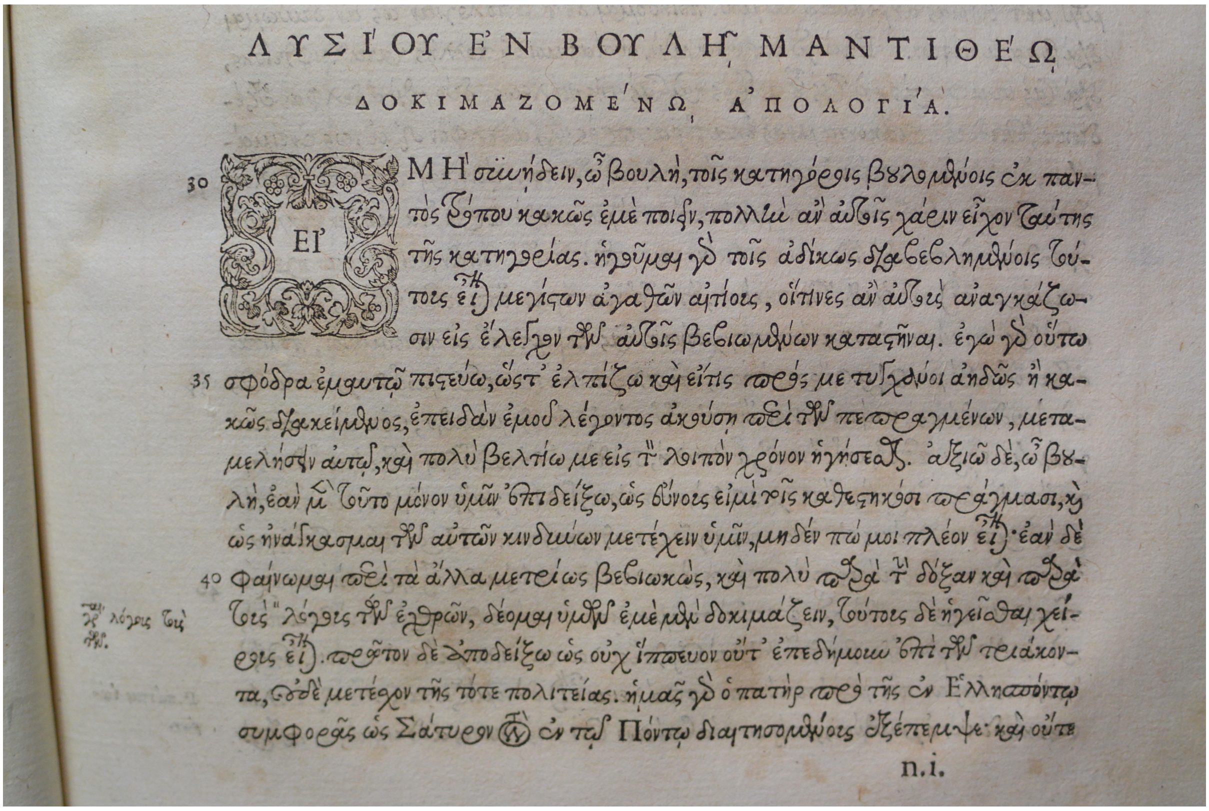
Figure 2

A detail from Henri Estienne’s *Oratorvm Vetervm Orationes*, 1575, which demonstrates the formal complexity of Greek when typeset for a scholarly text. Author’s collection.



ΛΥΣΙΟΥ ΕΝ ΒΟΥΛΗ͂ ΜΑΝΤΙΘΕΩ͂

ΔΟΚΙΜΑΖΟΜΕΝΩ͂ ΑΠΟΛΟΓΙΑ.

ΕΙ ΜΗ συνῄδειν, ὦ βουλή, τοῖς κατηγόροις βουλομένοις ἐκ παντὸς τρόπου κακῶς ἐμὲ ποιεῖν, πολλὴν ἂν αὐτοῖς χάριν εἶχον ταύτης τῆς κατηγορίας. ἡγοῦμαι γὰρ τοῖς ἀδίκως διαβεβλημένοις τούτους εἶναι μεγίστων ἀγαθῶν αἰτίους, οἵτινες ἂν αὐτοὺς ἀναγκάζωσιν εἰς ἔλεγχον τῶν αὐτοῖς βεβιωμένων καταστῆναι. ἐγὼ γὰρ οὕτω σφόδρα ἐμαυτῷ πιστεύω, ὥστ᾽ ἐλπίζω καὶ εἴ τις πρός με τυγχάνει ἀηδῶς ἢ κακῶς διακείμενος, ἐπειδὰν ἐμοῦ λέγοντος ἀκούσῃ περὶ τῶν πεπραγμένων, μεταμελήσειν αὐτῷ, καὶ πολὺ βελτίω με εἰς τὸν λοιπὸν χρόνον ἡγήσεσθαι. ἀξιῶ δέ, ὦ βουλή, ἐὰν μὲν τοῦτο μόνον ὑμῖν ἐπιδείξω, ὡς εὔνους εἰμὶ τοῖς καθεστηκόσι πράγμασι, καὶ ὡς ἠνάγκασμαι τῶν αὐτῶν κινδύνων μετέχειν ὑμῖν, μηδέν πώ μοι πλέον εἶναι· ἐὰν δὲ φαίνωμαι περὶ τὰ ἄλλα μετρίως βεβιωκώς, καὶ πολὺ παρὰ τὴν δόξαν καὶ παρὰ τοὺς λόγους τῶν ἐχθρῶν, δέομαι ὑμῶν ἐμὲ μὲν δοκιμάζειν, τούτους δὲ ἡγεῖσθαι χείρους εἶναι. πρῶτον δὲ ἀποδείξω ὡς οὐχ ἵππευον οὔτ᾽ ἐπεδήμουν ἐπὶ τῶν τριάκοντα, οὐδὲ μετέσχον τῆς τότε πολιτείας. ἡμᾶς γὰρ ὁ πατὴρ πρὸ τῆς ἐν Ἑλλησπόντῳ συμφορᾶς ὡς Σάτυρον τὸν ἐν τῷ Πόντῳ διαιτησομένους ἐξέπεμψε· καὶ οὔτε

n.i.

Figure 3

A plate from the *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des metiers,* ed. by Denis Diderot and Jean le Rond d'Alembert (1751 onwards) showing three of the six cases required to typeset Greek with the full range of ligatures and abbreviations of the formal style represented in fig. 2. Author's collection.

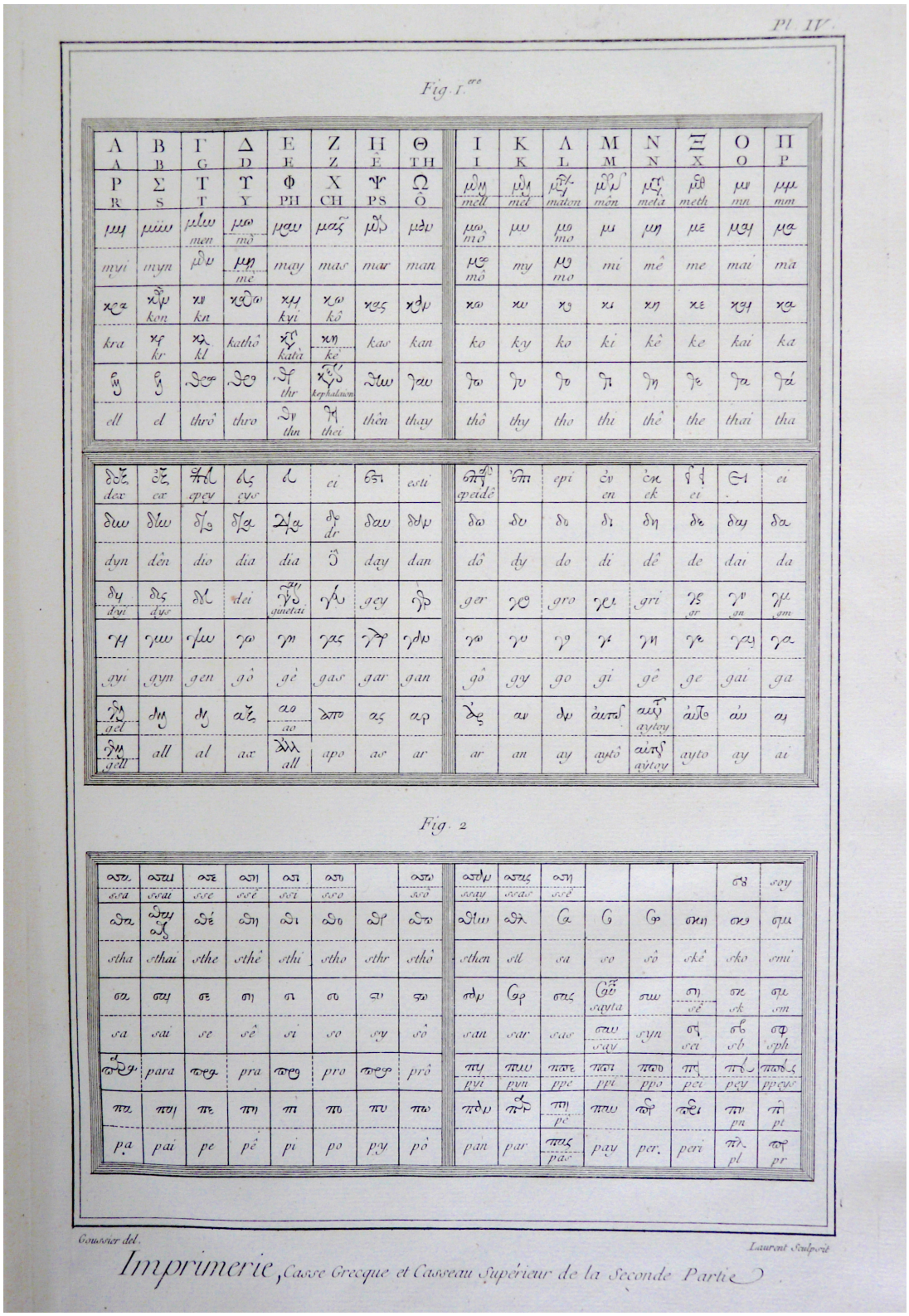
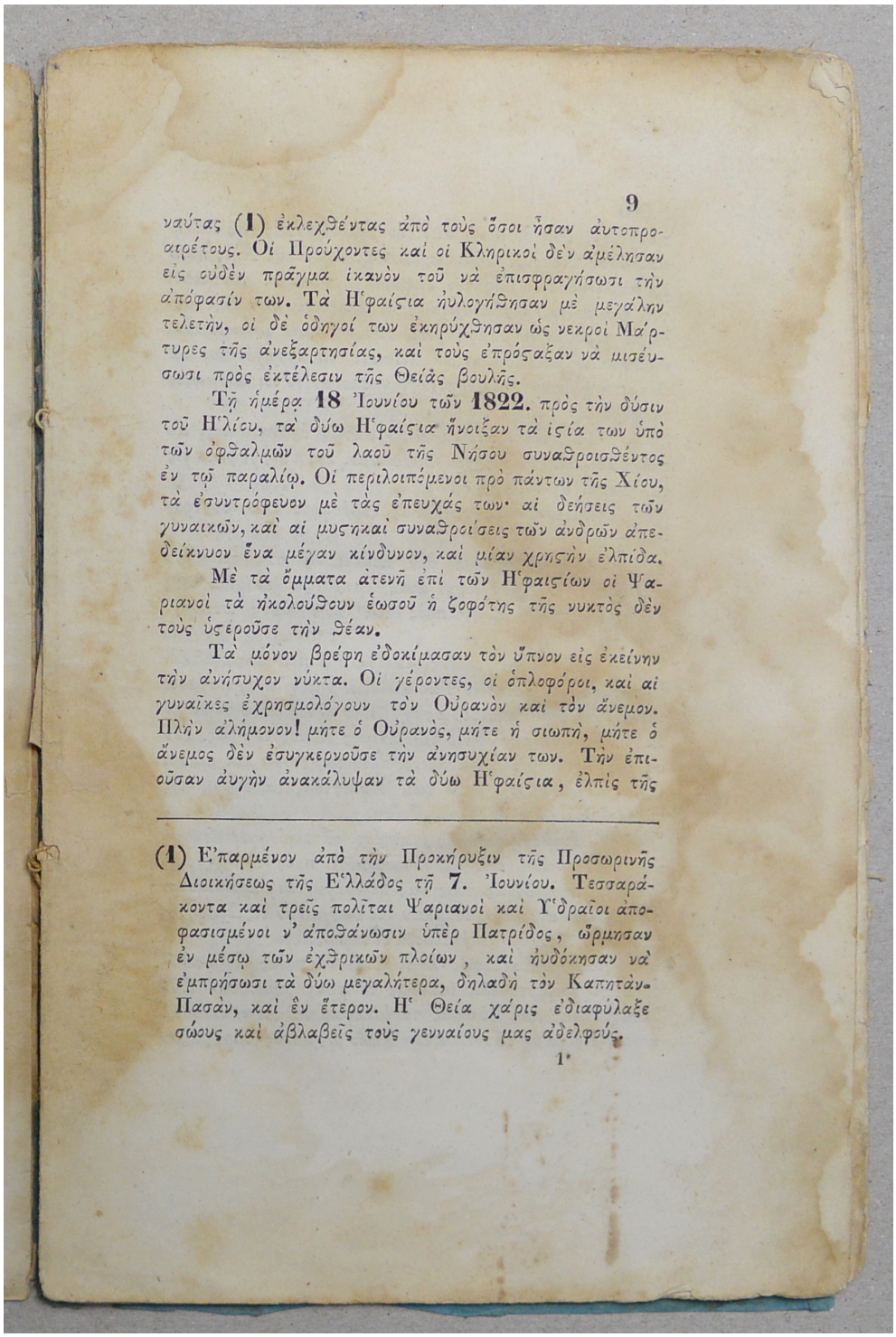


Figure 4

Γεώργιος Κουτούφας Αθηναίος, Ιστορία Κωνσταντίνου Κανάριου Ψαριανού: πυρπολιστού. Livorno, 1840. An edition of a historical topic printed outside Greece for importation, in a typically simple typographic structure. Author's collection.



9

ναύτας (1) ἐκλεχθέντας ἀπὸ τοὺς ὅσοι ἦσαν αὐτοπροαιρέτους. Οἱ Προύχοντες καὶ οἱ Κληρικοὶ δὲν ἀμέλησαν εἰς οὐδὲν πρᾶγμα ἱκανὸν τοῦ νὰ ἐπισφραγήσωσι τὴν ἀπόφασίν των. Τὰ Ἡφαίσια ἠυλογήθησαν μὲ μεγάλην τελετὴν, οἱ δὲ ὁδηγοί των ἐκηρύχθησαν ὡς νεκροὶ Μάρτυρες τῆς ἀνεξαρτησίας, καὶ τοὺς ἐπρόσαξαν νὰ μισεύσωσι πρὸς ἐκτέλεσιν τῆς Θείας βουλῆς.

Τῇ ἡμέρᾳ **18** Ἰουνίου τῶν **1822.** πρὸς τὴν δύσιν τοῦ Ἡλίου, τὰ δύω Ἡφαίσια ἤνοιξαν τὰ ἱσία των ὑπὸ τῶν ὀφθαλμῶν τοῦ λαοῦ τῆς Νήσου συναθροισθέντος ἐν τῷ παραλίῳ. Οἱ περιλοιπόμενοι πρὸ πάντων τῆς Χίου, τὰ ἐσυντρόφευον μὲ τὰς ἐπευχάς των· αἱ δεήσεις τῶν γυναικῶν, καὶ αἱ μυσηκαὶ συναθροίσεις τῶν ἀνδρῶν ἀπεδείκνυον ἕνα μέγαν κίνδυνον, καὶ μίαν χρηστὴν ἐλπίδα.

Μὲ τὰ ὄμματα ἀτενῆ ἐπὶ τῶν Ἡφαισίων οἱ Ψαριανοὶ τὰ ἠκολούθουν ἑωσοῦ ἡ ζοφότης τῆς νυκτὸς δὲν τοὺς ὑσέροῦσε τὴν Θέαν.

Τὰ μόνον βρέφη ἐδοκίμασαν τὸν ὕπνον εἰς ἐκείνην τὴν ἀνήσυχον νύκτα. Οἱ γέροντες, οἱ ὁπλοφόροι, καὶ αἱ γυναῖκες ἐχρησμολόγουν τὸν Οὐρανὸν καὶ τὸν ἄνεμον. Πλὴν ἀλήμονον! μήτε ὁ Οὐρανὸς, μήτε ἡ σιωπὴ, μήτε ὁ ἄνεμος δὲν ἐσυγκερνοῦσε τὴν ἀνησυχίαν των. Τὴν ἐπιοῦσαν αὐγὴν ἀνακάλυψαν τὰ δύω Ἡφαίσια, ἐλπὶς τῆς

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(1) Ἐπαρμένον ἀπὸ τὴν Προκήρυξιν τῆς Προσωρινῆς Διοικήσεως τῆς Ἑλλάδος τῇ **7.** Ἰουνίου. Τεσσαράκοντα καὶ τρεῖς πολῖται Ψαριανοὶ καὶ Ὑδραῖοι ἀποφασισμένοι ν' ἀποθάνωσιν ὑπὲρ Πατρίδος, ὥρμησαν ἐν μέσῳ τῶν ἐχθρικῶν πλοίων, καὶ ἠυδόκησαν νὰ ἐμπρήσωσι τὰ δύω μεγαλήτερα, δηλαδὴ τὸν Καπετὰν-Πασὰν, καὶ ἓν ἕτερον. Ἡ Θεία χάρις ἐδιαφύλαξε σώους καὶ ἀβλαβεῖς τοὺς γενναίους μας ἀδελφούς.

Figure 5
Detail from *LinoType Collection*, 1988, showing one of the key Greek typefaces for proprietary typesetting systems. Of note is the inclusion of some alternate letters, which were dropped in PostScript Type 1 versions. Author's collection.

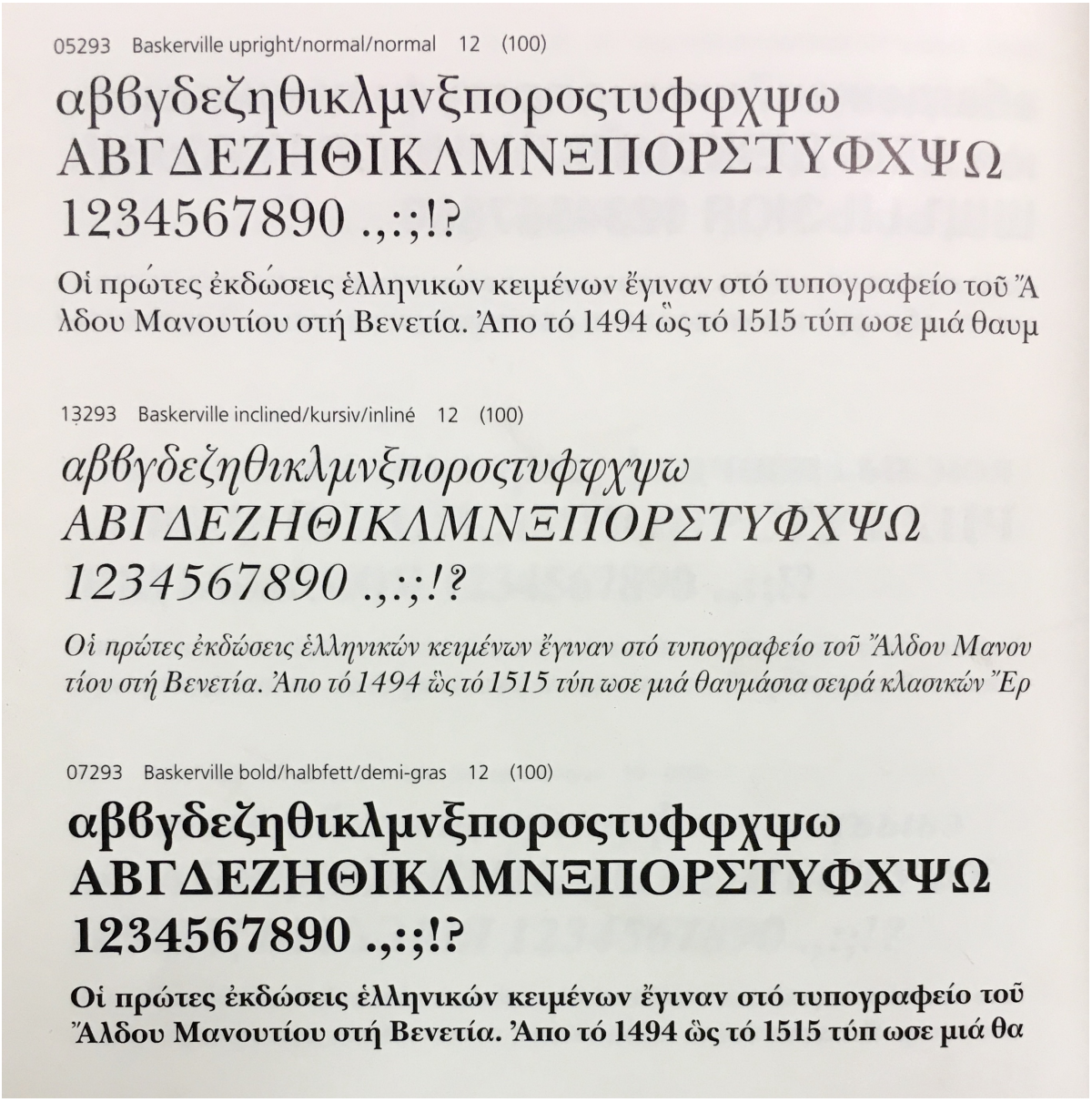
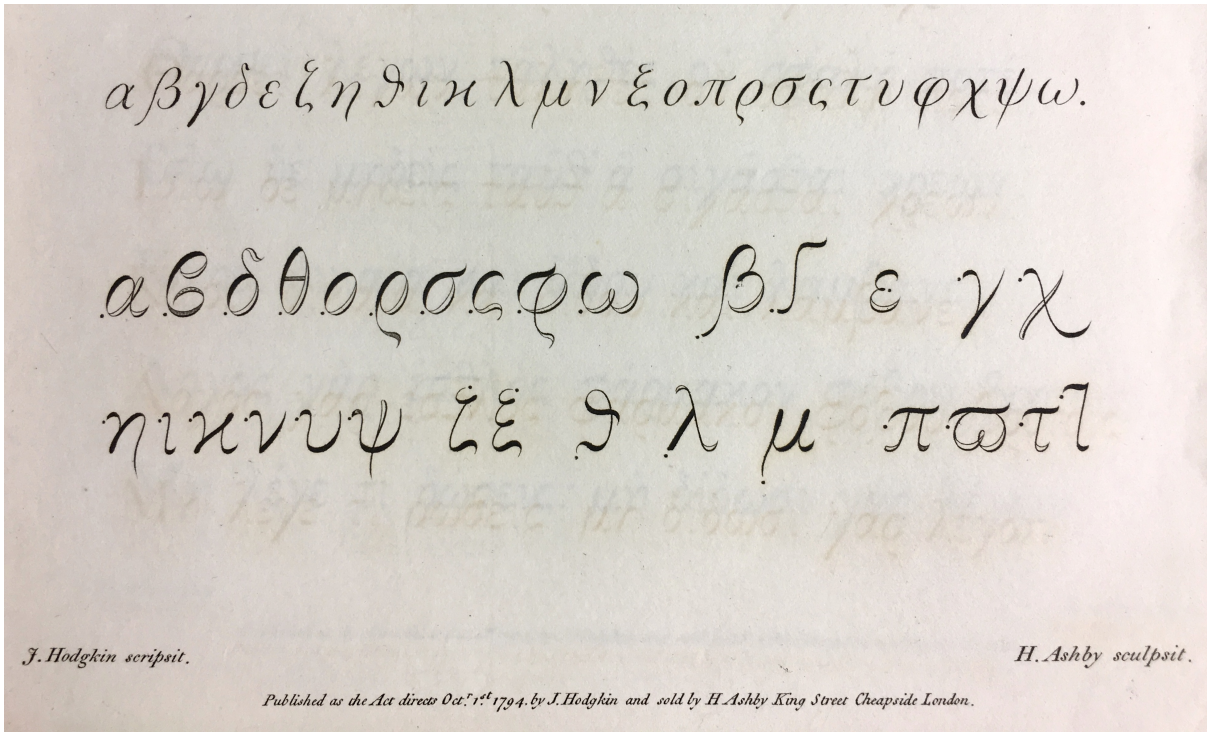


Figure 6

A page from a Greek digital foundry aimed at the local market (Kosmopolis, 1999) showing typefaces developed with significant loan elements from original Latin typefaces. Author's collection.

Figure 7

Details from studies on the written form of the Greek script; top: from Hodgkin's *Specimens of Greek penmanship*, based on the work of Porson and Young; below: a table from Amariotou's *Writing and education*, comparing formal features of the Greek, Latin, and "German" lowercase characters (the German includes ß and alternate forms of writing). Both author's collection.



Το ελληνικο μικρο αλφάβητο του τύπου, με 25 γράμματα, έχει:
4 υπέρστιχα, 6 υπόστιχα και 3-4 αμφίστιχα (β). Το χειρόγραφο έχει:
3-4 υπέρστιχα (τ), 6-7 υπόστιχα (λ) και 3 αμφίστιχα.
Το κεφαλαίομας αλφάβητο, έντυπο και χειρόγραφο, έχει μόνο υπέρστιχα, αν και γράφομε κάποτε αμφίστιχο το Ψ.
Βλέπομε λοιπον πως το ελληνικο αλφάβητο δεν υστερει καθόλου απο τ' άλλα όσο για τα μακρια γράμματα και ξεπερνα μάλιστα το λατινικο, όπως φαίνεται καλύτερα απο τον πίνακα τούτον:

Αλφάβητα:	Λατινικο 25 γράμματα				Γερμανικο 28 γράμματα				Ελληνικο 25 γράμματα			
Γράμματα:	Μικρο		Κεφαλαίο		Μικρο		Κεφαλαίο		Μικρο		Κεφαλαίο	
	έντυπο.	χειρ.	έντυπο.	χειρ.	έντυπο.	χειρ.	έντυπο.	χειρ.	έντυπο.	χειρ.	έντυπο.	χειρ.
Υπέρστιχα	6	6	25	23	4-5	6	20	18	4	3-4	24	24-23
Υπόστιχα	5	5-6	—	—	6	7	—	—	6	6-7	—	—
Αμφίστιχα	—	1		2	4	4	6	8	3-4	3	—	0-1
Επίστιχα	14	13-12	—	—	14-13	11	—	—	12-11	13-11	—	—

Figure 8

Detail from proofs during the design process of Minion Pro, 1998, which show the substitution of serif-like elements with integrated instrokes. Author's collection.

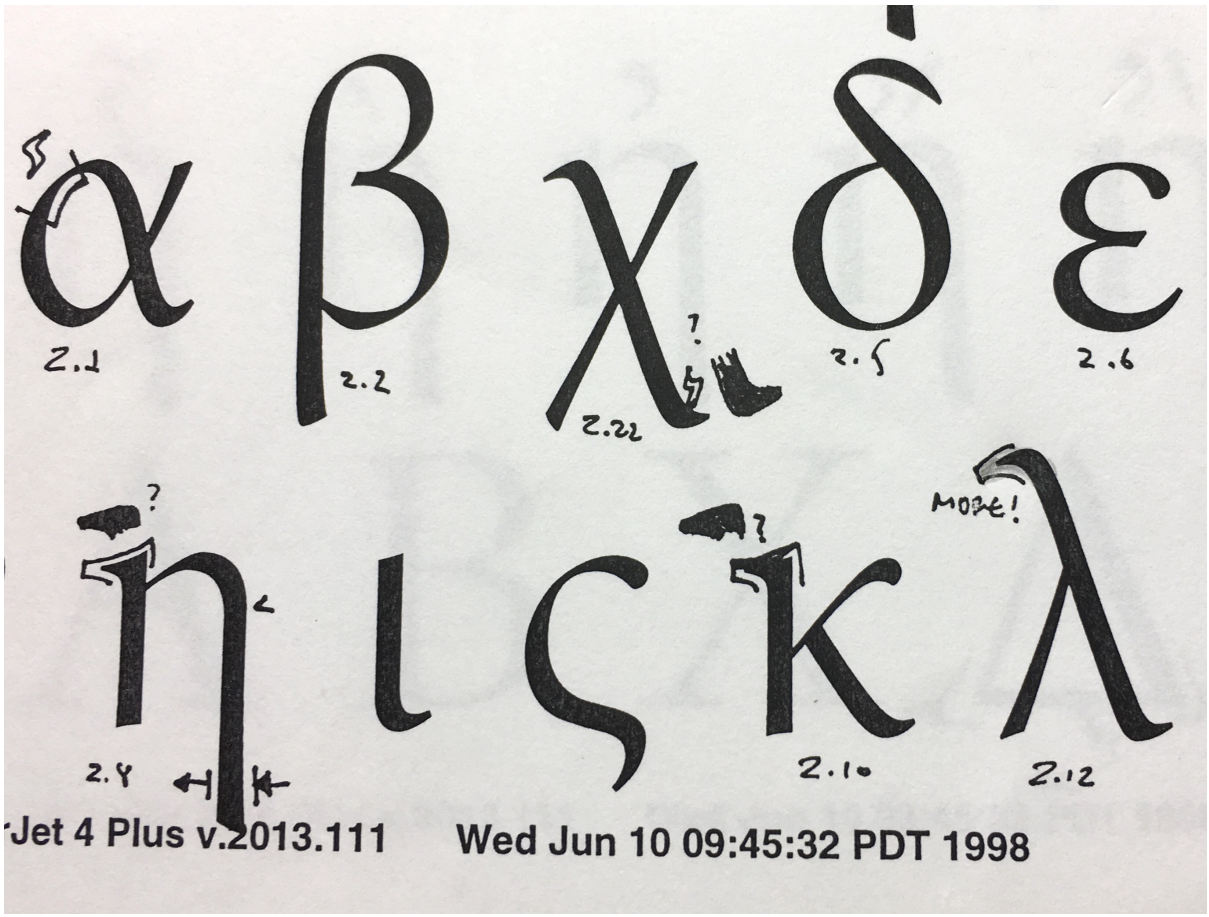
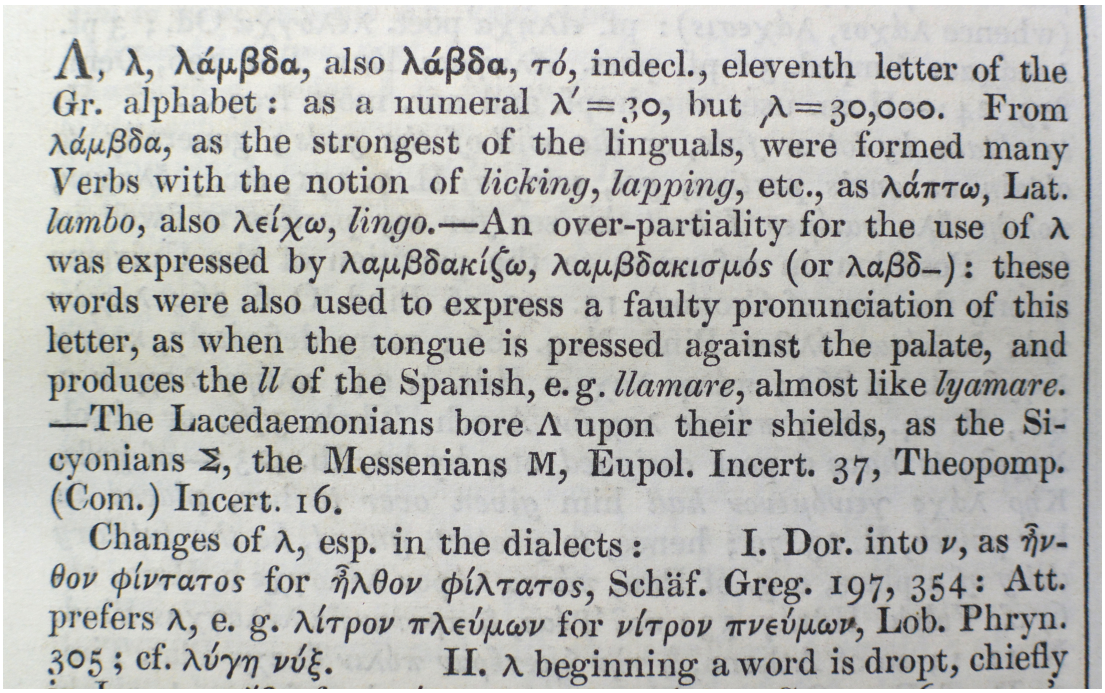


Figure 9

Detail from Liddell & Scott's *Greek-English Lexicon*, 1845, which exemplifies complex typographic settings with uncoordinated typefaces. Author's collection. Below, detail from a sample page of the *Ancient Greek-English Lexicon,* Cambridge University Press, 2019, which uses several styles of Arno Pro with modified diacritics to ensure clarity at small text sizes. Available at: https://www.classics.cam.ac.uk/research/projects/glp/lambda30



Λ, λ, λάμβδα, also λάβδα, τό, indecl., eleventh letter of the Gr. alphabet: as a numeral λ′ = 30, but ,λ = 30,000. From λάμβδα, as the strongest of the linguals, were formed many Verbs with the notion of *licking*, *lapping*, etc., as λάπτω, Lat. *lambo*, also λείχω, *lingo*.—An over-partiality for the use of λ was expressed by λαμβδακίζω, λαμβδακισμός (or λαβδ–): these words were also used to express a faulty pronunciation of this letter, as when the tongue is pressed against the palate, and produces the *ll* of the Spanish, e. g. *llamare*, almost like *lyamare*. —The Lacedaemonians bore Λ upon their shields, as the Sicyonians Σ, the Messenians M, Eupol. Incert. 37, Theopomp. (Com.) Incert. 16.

Changes of λ, esp. in the dialects: I. Dor. into ν, as ἦνθον φίντατος for ἦλθον φίλτατος, Schäf. Greg. 197, 354: Att. prefers λ, e. g. λίτρον πλεύμων for νίτρον πνεύμων, Lob. Phryn. 305; cf. λύγη νύξ. II. λ beginning a word is dropt, chiefly

λυσσάς άδος *fem.adj.* **1** (of Spirits of Vengeance) **frenzied, raging mad** E.; (of a woman or goddess) Tim.
2 (of a fate allotted to Herakles) **of frenzied madness** E.

λυσσάω, also Att. **λυττάω** *contr.vb.* | dial.inf. λυσσῆν (Theoc.) |
1 (of persons, their minds or feelings, a lover's soul) **be in a mad frenzy, be frantic** S. Pl. Plb.; (of a soldier, in battle) **go berserk** Hdt. || PTCPL.ADJ. (of desires) frenzied, frantic Pl.
2 (of dogs, wolves) **be rabid** Ar. Theoc.

λύσσημα ατος *n.* **fit of frenzy** (sent by the Erinyes) E.

λυσσητήρ ῆρος *m.* one who rages madly; (pejor., appos.w. κύων) *mad dog* (*fig.ref. to an enemy warrior*) Il.

λυσσώδης ες *adj.* (of persons) **frenzied, maddened, frantic** Il. E.; (of an affliction sent by a deity) **of frenzied madness** S.

λυτέος ᾱ ον *vbl.adj.* [λύω] (of a law) **to be annulled** D.

λυτήρ ῆρος *m.* [λῦω] **1 deliverer, rescuer** (W.GEN. fr. troubles) E.; (fr. marriage, ref. to a path of escape) A.
2 resolver, ender (W.GEN. of conflicts, ref. to personif. Iron) A.

λυτήριον ου *n.* **1** (sg. and pl.) **means of release** or **deliverance** E.*fr.*; (W.GEN. fr. one's fate, troubles) Stesich. S.
2 means of absolution or **expiation** (W.GEN. for a murder) S. AR.
3 (ref. to a victory song) means of providing payment (in return), **recompense** (W.GEN. for one's expenses) Pi.

—**λυτήριος** ον *adj.* (of deities, prayers, remedies, stratagems) **bringing release** or **deliverance** (sts. W.GEN. or ἐκ + GEN. fr. sthg.) Trag.

λυχνοφορίω *Lacon.vb.* [λυχνοφόρος] **carry a lamp** Ar.

λυχνο-φόρος ου *m.* [φέρω] **lamp-bearer** (ref. to a person) Plu.

λῡ́ω *vb.* | ep.pres. usu. λῡ́ω | impf. ἔλῡον, ep. λῦον | fut. λῡ́σω | aor. ἔλῡσα | pf. λέλῡκα || MID.: impf. ἐλῡόμην, ep. λῡόμην | aor. ἐλῡσάμην | ep.athem.aor. (w.pass.sens.) λύμην, 3sg. λύτο, also λῦτο, 3pl. λύντο || PASS.: fut. λῡθήσομαι | aor. ἐλύθην, ep.3pl. λύθεν | pf. λέλῡμαι, ep.3sg.opt. λελῦτο | fut.pf. λελῡ́σομαι || neut.impers.vbl.adj. λῡτέον || The sections are grouped as follows: (1–8) set loose (fr. another's control, a physical constraint or unwelcome condition), (9–18) loosen a fastening or sthg. fastened, (19) make loose or slack, (20–24) disintegrate, dissolve, break up, or weaken, (25–29) bring to an end, (30–35) discharge, fulfil or pay off. |
1 set loose (a person, fr. restraint or captivity); **release, free** —*a person, their hands* (*sts.* W.GEN. or PREP.PHR. *fr. bonds or sim.*) Hom. Hes. Alc. Pi. Hdt. Trag. + || MID. **free oneself** Od. || PASS. be freed Od. Hes.*fr.* A. Pi.*fr.* Hdt. E. +; (of a people) be given liberty —W.INF. *to speak freely* A.
2 set loose (an animal); **unyoke** —*horses, mules* (*freq.* W.PREP.PHR. *fr. a chariot or wagon, or fr. beneath the yoke*) Hom.(sts.mid.) —*oxen* Hes.; **untether** —*horses* Il.; **unleash** —*a dog* X. —*a sow* Ar.
3 set free (fr. sthg. unwelcome); **set free, release** —*a person* (W.GEN. or PREP.PHR. *fr. troubles, pain, fear, ruin, or sim.*) Od. Sapph. Pi. B. Trag. +; (mid.) Hes. A. || PASS. be freed —W.GEN. *fr. pain* Pi.*fr.*
4 (of a pillaging warrior) app. **free, strip** —*houses* (W.GEN. *of*

Figure 10

Demonstrating modulation across the Greek omicron, in Minion Pro, Garamond Premier Pro, and Arno Pro respectively. The Latin counterparts are in outline. Whereas Minion Pro remains close to the Latin ductus, GPP follows a traditional angle, and Arno Pro follows a hybrid construction, with softer modulation but heavily modified proportions. The text examples demonstrate the impact of the change in Minion Pro, GPP, And Arno Pro: the top line contains the Greek omicron, while the bottom line substitutes it with the Latin o.

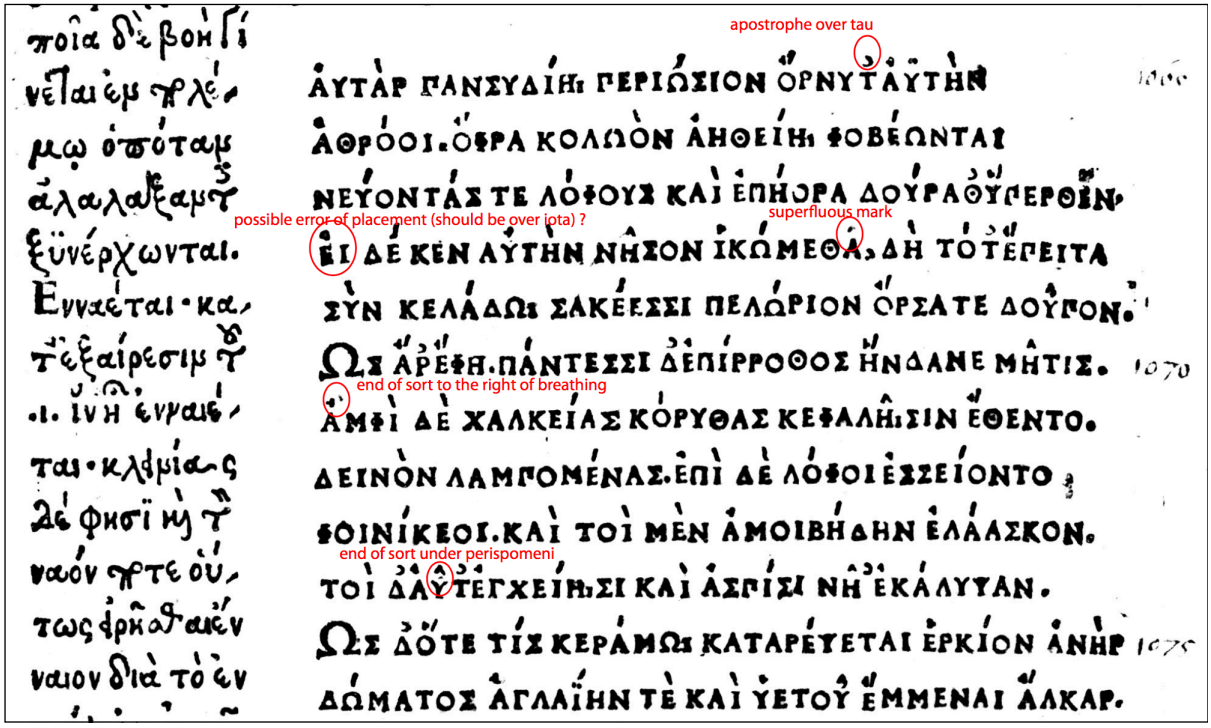
Ο τυπογράφος υπερβαίνει το εφαρμοσμένο πεδίο.
Ο τυπογράφος υπερβαίνει το εφαρμοσμένο πεδίο.

Ο τυπογράφος υπερβαίνει το εφαρμοσμένο πεδίο.
Ο τυπογράφος υπερβαίνει το εφαρμοσμένο πεδίο.

Ο τυπογράφος υπερβαίνει το εφαρμοσμένο πεδίο.
Ο τυπογράφος υπερβαίνει το εφαρμοσμένο πεδίο.

Figure 11

A marked up photocopy of a page of early printing by Lorenzo de Alopa with Greek diacritics over small capital letters that served as a reference for Arno Pro's expanded Greek character set and case conversion features. Author's collection. Below, a passage in polytonic in lower-case and accented small caps, in imitation of de Alopa's setting.



ἄνδρα μοι ἔννεπε, μοῦσα, πολύτροπον, ὃς μάλα πολλὰ
πλάγχθη, ἐπεὶ Τροίης ἱερὸν πτολίεθρον ἔπερσεν:
πολλῶν δ᾽ ἀνθρώπων ἴδεν ἄστεα καὶ νόον ἔγνω,
πολλὰ δ᾽ ὅ γ᾽ ἐν πόντῳ πάθεν ἄλγεα ὃν κατὰ θυμόν,
ἀρνύμενος ἥν τε ψυχὴν καὶ νόστον ἑταίρων.

ἌΝΔΡΑ ΜΟΙ ἜΝΝΕΠΕ, ΜΟΥ̃ΣΑ, ΠΟΛΎΤΡΟΠΟΝ, ὍΣ ΜΆΛΑ ΠΟΛΛᾺ ΠΛΆΓΧΘΗ, ἘΠΕῚ ΤΡΟΊΗΣ ἹΕΡῸΝ ΠΤΟΛΊΕΘΡΟΝ ἜΠΕΡΣΕΝ: ΠΟΛΛΩ̃Ν Δ᾽ ἈΝΘΡΏΠΩΝ ἼΔΕΝ ἌΣΤΕΑ ΚΑῚ ΝΌΟΝ ἜΓΝΩ, ΠΟΛΛᾺ Δ᾽ Ὅ Γ᾽ ἘΝ ΠΌΝΤΩΙ ΠΆΘΕΝ ἌΛΓΕΑ ὍΝ ΚΑΤᾺ ΘΥΜΌΝ, ἈΡΝΎΜΕΝΟΣ ἮΝ ΤΕ ΨΥΧῊΝ ΚΑῚ ΝΌΣΤΟΝ ἙΤΑΊΡΩΝ.

Figure 12

Recent typefaces that explore modulation and stroke terminations: Garamond Premier Pro, Brill, and Arno Pro in the top three rows demonstrate a closer connection to written forms; Literata (Type-Together, 2015), Skolar PE (Rosetta Type, 2011) and Colvert (Typographies, 2012) introduce a more constructed texture, while maintaining a variation in the counter shapes and richness of entry- and exit strokes. Below, an example of GPP in use in an edition of the *Iliad* by Carocci Editore, Italy.

αβγδεζηθϑίκλμνξοπρστῦφφχψως

αβϐγδεζηθϑίκλμνξοπρστῦφϕχψως

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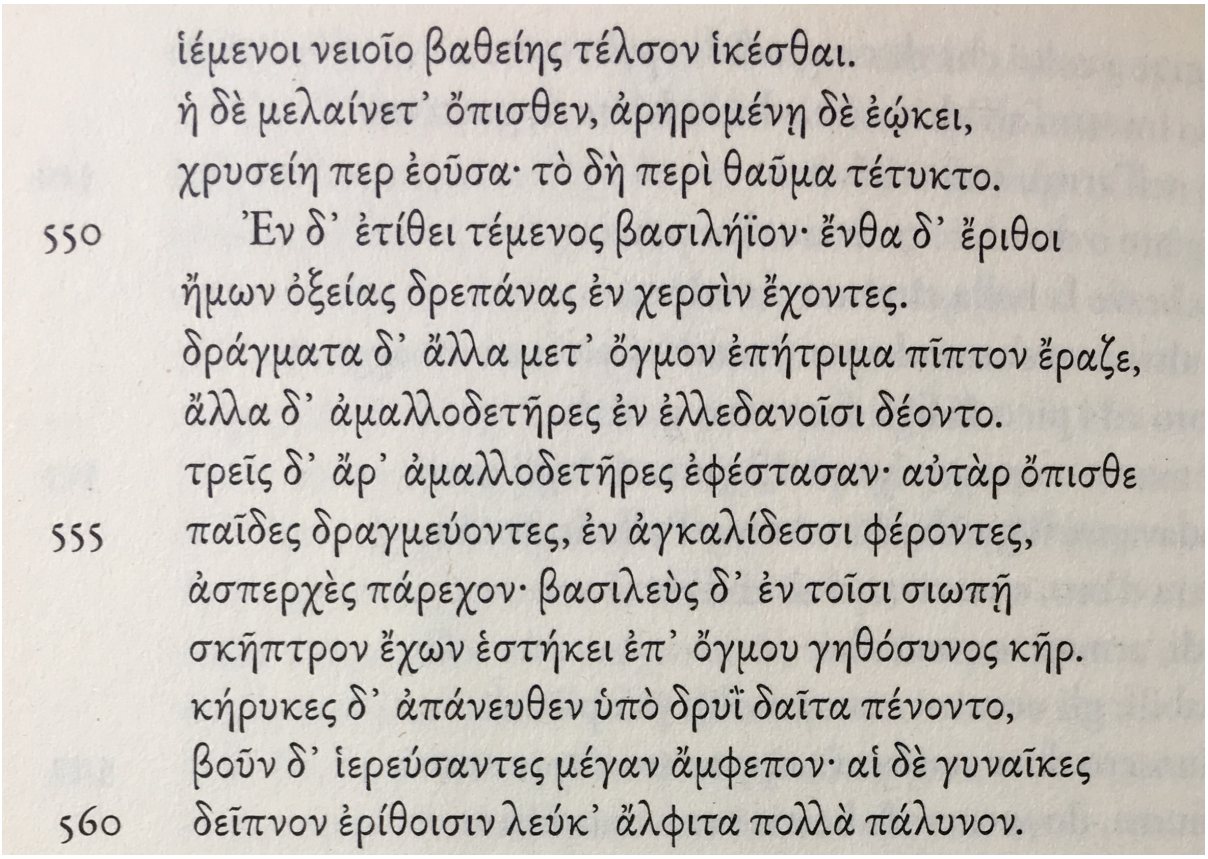
αβγδεζηθίκλμνξοπρστῦφχψως

αβγδεζηθϑίκλμνξοπρστῦφφχψως

αβγδεζηθίκλμνξοπρστῦφχψως



ἰέμενοι νειοῖο βαθείης τέλσον ἱκέσθαι.
ἡ δὲ μελαίνετ᾽ ὄπισθεν, ἀρηρομένη δὲ ἐώκει,
χρυσείη περ ἐοῦσα· τὸ δὴ περὶ θαῦμα τέτυκτο.
Ἐν δ᾽ ἐτίθει τέμενος βασιλήϊον· ἔνθα δ᾽ ἔριθοι
ἤμων ὀξείας δρεπάνας ἐν χερσὶν ἔχοντες.
δράγματα δ᾽ ἄλλα μετ᾽ ὄγμον ἐπήτριμα πῖπτον ἔραζε,
ἄλλα δ᾽ ἀμαλλοδετῆρες ἐν ἑλλεδανοῖσι δέοντο.
τρεῖς δ᾽ ἄρ᾽ ἀμαλλοδετῆρες ἐφέστασαν· αὐτὰρ ὄπισθε
παῖδες δραγμεύοντες, ἐν ἀγκαλίδεσσι φέροντες,
ἀσπερχὲς πάρεχον· βασιλεὺς δ᾽ ἐν τοῖσι σιωπῇ
σκῆπτρον ἔχων ἑστήκει ἐπ᾽ ὄγμου γηθόσυνος κῆρ.
κήρυκες δ᾽ ἀπάνευθεν ὑπὸ δρυΐ δαῖτα πένοντο,
βοῦν δ᾽ ἱερεύσαντες μέγαν ἄμφεπον· αἱ δὲ γυναῖκες
δεῖπνον ἐρίθοισιν λεύκ᾽ ἄλφιτα πολλὰ πάλυνον.