Keeping Greek Typography Alive

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Abstract

This paper presents methods and tools for typesseting Greek books developed jointly by the École Nationale Supérieure des Télécommunications de Bretagne and Atelier Fluxus Virus. In particular, the «*digital monotype*» method aims to emulate—and hence, revive—hot lead typography on Monotype machines, by the use of the latest electronic document technologies (such as XML and Omega) and a careful study of the characteristics of Monotype typeset material and Greek typographical conventions.

1 Introduction

In the past few centuries, Greek typographers have produced works of art and won many prizes at international book exhibitions. But, due to various economic and social factors, the Greek printing industry has evolved in a slightly different way than in other European countries. The most important difference was the fact that in Greece the three main printing methods of the twentieth century—hot lead typography, phototypesetting, computer typesetting—still co-exist, while in other countries hot lead typography has completely vanished (except for some rare bibliophile collector's items) and phototypesetting is underway to be completely replaced by the computer.

Unfortunately, although the co-existence of the three methods—often in the same company—would be the ideal condition for preserving tradition, this doesn't seem to be the case. The majority of computer typeset books—and here we are refering only to books in *regular* Greek[1]—are clearly typographically inferior than

1. Throughout this paper we call *regular* Greek the Greek language written *with accents and breathings*, which is the natural way of writing it. We do not call it «polytonic»»—as is done in standards like Unicode—because consider this name redundant, just as it would be redundant to a Frenchman to call his language «accented French», since accents are an integral part of French language. Needless to say that the author considers the «monotonic» spelling reform as a crime against Greek language, a crime commited by populistic politicians and negationist pseudo-linguists.

those produced by traditional methods (see Fig. 1 to 2 for some examples, taken from books by notorious publishers, printed in the last decade).

The reasons for this loss of quality are manifold. First of all, purely technical ones: the «monotonic» spelling reform of 1982, besides all other evil consequences, has also obstructed the development of computer tools for processing regular Greek. The situation is a bit better nowadays, since more and more people are returning to the real way of writing the language, but at the early days of computer typesetting in Greece it was quite hard to find decent resources for typesetting regular Greek. Creating or modifying existing software to adapt them to regular Greek had never been an easy task, and demands specific skills in computing.

Also there seems to have been a resistance to the use of the computer for regular Greek, since in the seventies and eighties hot lead printers (and phototypesetters) were still keeping the monopoly of regular Greek books. When hot lead printing started to diminuish, because of the usury of equipment and the fact of craftsmen growing older and being retired, it was often too late to transfer their knowledge and experience to the generation of computer users.

Thirdly, and this is a general problem not confined to Greece only, computer operating systems and commercial DTP programs never offered a decent operating model of the book. Software products like Quark XPress or PageMaker, which are considered to be—or to have been—the best DTP systems, have not been designed to handle books, but rather magazines and newspapers. They suffer both on the micro-typographical level, since they are not sufficiently precise or customizable, and on the macro-typographical level, since they do not offer an automatic treatment of the most basic visual constructions of a book, like footnotes, headers, etc.

2 Digital monotype

It is generally admitted that the typographically finest Greek books have been typeset on Monotype machines; furthermore there are still monotypists in Greece perpetuating that tradition[2]. This is the reason why, to keep high quality Greek typography alive, the author has started a research and development project called «*digital monotype*» (in Greek: ψηφιακὴ μονοτυπία). In this context, the word «monotype» is lowercased, since we are refering to the technique of using Monotype machines, rather than on the machines themselves; in French, the author translates this term «monotypie numérique».

Digital monotype is the *method of computer emulation of the printed output of Monotype machines*[3] (see Fig. 3 and 4 to compare an original hot lead typeset page

2. Like Christos Manousaridis (Manoutios) and Christos Darras (Ideogramma).

3. Often the question is asked weither emulation alone is sufficient, or weither one must seek improvement of the technique that is emulated. The answer is not clear, since it involves evaluation and

"Αλλωστε αὐτὸ τὸ ὄνειρο τῶν μουσουλμάνων εἶχε ἀρχίσει νὰ γίνεται πραγματικότητα μὲ τὸν σταθερὸ ἐξισλαμισμὸ τῶν χριστιανῶν τῆς M. 'Ασίας καὶ τῶν Βαλκανίων[64].

Gennadios Scholarios gegeüber dem Islam», στὸν συλλογικὸ τόμο *Philoxenia* (Münster 1980), σσ. 159-172.

62. A. Βακαλόπουλου, *'Ιστορία τοῦ Νέου 'Ελληνισμοῦ*, τ. 1, Θεσσαλονίκη (1974²), σ. 197.

63. Δούκα, *Βυζαντινὴ 'Ιστορία*, ἐκδ. Βόννης, σ. 145.

64. S. Vryonis, *The decline of Medieval Hellenism in Asia Minor and the Process of islamization from the eleventh through the fifteenth century*, Berkeley-Los Angeles-Londres 1971.

Athens 1994. Both Latin and Greek: artificially slanted instead of italic; lines 1, 3 and 6: breathings too far from capital letters; line 3: footnote number too small; lines 4-5: umlaut on u not centered; line -3: S. too far from V; lines 4 and -1: spelling errors (gegeüber instead of gegenüber, Londres instead of London).

'Α. "Ιων εἶ, ξένε, ἢ πόθεν;

Φ. Φοῖνιξ, ἀμπελουργέ, τῶν περὶ Σιδῶνα καὶ Τύρον. τὸ δὲ 'Ιωνικὸν τῆς στολῆς ἐπιχώριον ἤδη καὶ ἡμῖν τοῖς ἐκ Φοινίκης.

Athens 1995. Lines 1-3: breathings too close to capital letters, lines 2-3: circumflex on letter ι too wide (same size as circumflex on omega); lines 1-2: no alignment of letters 'A and Φ, no alignment of words "Ιων and Φοῖνιξ (in both cases, diacritics should be hanging).

Proseedings of the Glagow Oriental Society 14 (1950-2), σσ. 1-10.

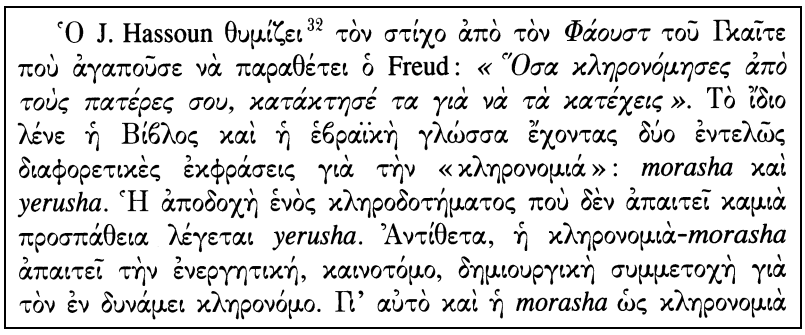
E. R. Dodds, *Pagan and Christian in an Age of Anxiety*, Cambridge, 1968.

S. Eitrem, «Philostratos Heroikos», *Symbolae Osloenses* 8 (1929), σσ. 1-56.

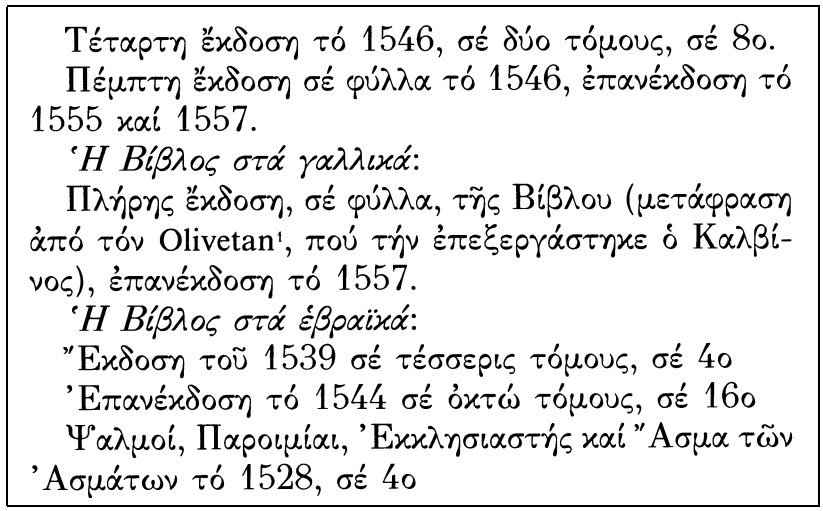
K. Friedrichs, *Die Philostratischen Bildern. Ein Beitrag zur Charakteristik der alten Kunst*, Erlangen, 1860.

Athens 1995 (same book as previously). Roman Latin font: badly kerned, lowercase letters too small; Italic Latin font: letters typeset too tightly, touching each other; line 1: spelling error (Proseedings instead of Proceedings).

Figure 1: Some examples of low quality computer typesetting.



Athens 1999. Latin and Greek fonts badly calibrated: Latin capital letters smaller than Greek ones; non-optimal choice of Latin and Greek font combination: Latin font is Times and Greek is close to plain (άπλά); line 1: footnote number too thin; lines 2-3: Greek font slanted instead of italic; lines 5 and 7: word *morasha* seems wider on line 7 than on line 5; lines 4, 5 and 7: too loose, probably because of uncapacity to hyphenate word *morusha*.



Athens 1995. No grave accents; no alignment of capital letters with and without diacritics (in such a case, diacritics should be hanging); lines 4 and 8: slanted instead of italic font; lines 4, 6, 8: initial β in the middle of the word; lines -1 and -2: breathing too far away from A (on line -2, the breathing is exactly in the middle between words καί and Ασμα).

Figure 2: Some more examples of low quality computer typesetting.

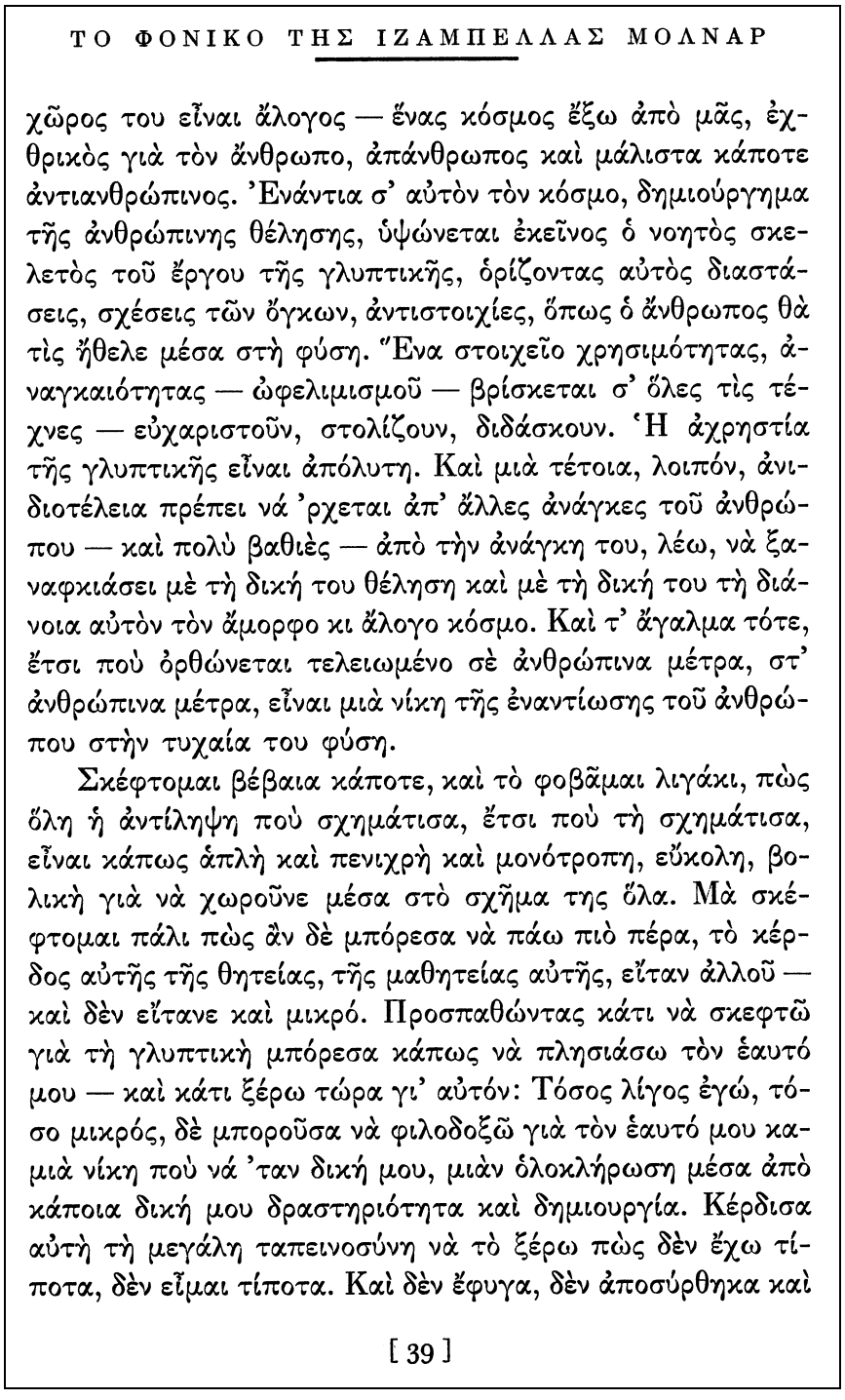
with a digitally monotyped one). To achieve this goal, the latest technologies in electronic document engineering are used. In fact, the process of production of a digitally monotyped book is completely different than the one involving DTP software like Quark XPress or PageMaker.

Instead, we are processing data in a multi-step process with feedback:

1. the original data—textual contents and structural mark up—are stored in XML, encoded in Unicode;
2. using stylesheets describing specific configurations (according to the publishers preferences and conventions), the XML data are typeset and produce a static binary file (in a device-independent file format called DVI) containing an extremely precise description of printed page plus additional textual information;
3. this DVI file is parsed to extract textual information (which is now linked to the geography of the page) and to gauge the printed result; the results of this parsing process are stored into auxiliary files;
4. using information stored in these auxiliary files, step 2 is repeated, to produce a slightly different—and, in principle, better—printed result;
5. once again the typeset pages are parsed and the results are stored in auxiliary files;
6. steps 4 and 5 are repeated until either the result meets qualitative criteria (which means that modified versions have converged to an «ideal» version), or we enter into a vicious circle and the same versions re-occur periodically (which means that there has been no convergence). In the latter case, manual intervention is necessary;
7. once the «ideal» result has been achieved, it is stored in a commonly used rigid presentation file format; nowadays the best such format is PDF, since it is sufficiently device-independent and autonomous to produce good results on a variety of output devices, and at the same time can be used for online use of documents.

Clearly, the feedback used in this iterative process to enhance the subsequent versions of typeset material is contradicting the WYSIWYG («what you see is what

classification of properties of the emulated technique into positive ones and negative ones—«bugs» and «features» are the terms commonly used in the computing world. For example, we will see later on in this paper that Greek Monotype typeset books use a fixed grid of lines on the page. Is this due to a conscious creative choice, or to material incapacity to do otherwise? And even if the latter is the case, has it become integral part of that tradition, or is it still just a technical constraint which one would be please to abandon whenever possible? We have only very rarely «improved» our *digital monotype* output, in comparison with the original Monotype output, and this only in cases where this has been asked by people knowledgeable of the original techniques and their limitations.


ΤΟ ΦΟΝΙΚΟ ΤΗΣ ΙΖΑΜΠΕΛΑΑΣ ΜΟΛΝΑΡ

χῶρος του εἶναι ἄλογος — ἕνας κόσμος ἔξω ἀπὸ μᾶς, ἐχθρικὸς γιὰ τὸν ἄνθρωπο, ἀπάνθρωπος καὶ μάλιστα κάποτε ἀντιανθρώπινος. Ἐνάντια σ' αὐτὸν τὸν κόσμο, δημιούργημα τῆς ἀνθρώπινης θέλησης, ὑψώνεται ἐκεῖνος ὁ νοητὸς σκελετὸς τοῦ ἔργου τῆς γλυπτικῆς, ὁρίζοντας αὐτὸς διαστάσεις, σχέσεις τῶν ὄγκων, ἀντιστοιχίες, ὅπως ὁ ἄνθρωπος θὰ τὶς ἤθελε μέσα στὴ φύση. Ἕνα στοιχεῖο χρησιμότητας, ἀναγκαιότητας — ὠφελιμισμοῦ — βρίσκεται σ' ὅλες τὶς τέχνες — εὐχαριστοῦν, στολίζουν, διδάσκουν. Ἡ ἀχρηστία τῆς γλυπτικῆς εἶναι ἀπόλυτη. Καὶ μιὰ τέτοια, λοιπόν, ἀνιδιοτέλεια πρέπει νά 'ρχεται ἀπ' ἄλλες ἀνάγκες τοῦ ἀνθρώπου — καὶ πολὺ βαθιὲς — ἀπὸ τὴν ἀνάγκη του, λέω, νὰ ξαναφκιάσει μὲ τὴ δική του θέληση καὶ μὲ τὴ δική του τὴ διάνοια αὐτὸν τὸν ἄμορφο κι ἄλογο κόσμο. Καὶ τ' ἄγαλμα τότε, ἔτσι ποὺ ὀρθώνεται τελειωμένο σὲ ἀνθρώπινα μέτρα, στ' ἀνθρώπινα μέτρα, εἶναι μιὰ νίκη τῆς ἐναντίωσης τοῦ ἀνθρώπου στὴν τυχαία του φύση.

Σκέφτομαι βέβαια κάποτε, καὶ τὸ φοβᾶμαι λιγάκι, πὼς ὅλη ἡ ἀντίληψη ποὺ σχημάτισα, ἔτσι ποὺ τὴ σχημάτισα, εἶναι κάπως ἁπλὴ καὶ πενιχρὴ καὶ μονότροπη, εὔκολη, βολικὴ γιὰ νὰ χωροῦνε μέσα στὸ σχῆμα της ὅλα. Μὰ σκέφτομαι πάλι πὼς ἂν δὲ μπόρεσα νὰ πάω πιὸ πέρα, τὸ κέρδος αὐτῆς τῆς θητείας, τῆς μαθητείας αὐτῆς, εἴταν ἀλλοῦ — καὶ δὲν εἴτανε καὶ μικρό. Προσπαθώντας κάτι νὰ σκεφτῶ γιὰ τὴ γλυπτικὴ μπόρεσα κάπως νὰ πλησιάσω τὸν ἑαυτό μου — καὶ κάτι ξέρω τώρα γι' αὐτόν: Τόσος λίγος ἐγώ, τόσο μικρός, δὲ μποροῦσα νὰ φιλοδοξῶ γιὰ τὸν ἑαυτό μου καμιὰ νίκη ποὺ νά 'ταν δική μου, μιὰν ὁλοκλήρωση μέσα ἀπὸ κάποια δική μου δραστηριότητα καὶ δημιουργία. Κέρδισα αὐτὴ τὴ μεγάλη ταπεινοσύνη νὰ τὸ ξέρω πὼς δὲν ἔχω τίποτα, δὲν εἶμαι τίποτα. Καὶ δὲν ἔφυγα, δὲν ἀποσύρθηκα καὶ

[39]

Figure 3: A page from Δημήτρης Χατζῆς, *Σπουδές*, Τὸ Ροδακιό, Athens 2000, typeset on Monotype machines by Palivogiannis Broths.

πὼς οἱ διαπραγματεύσεις μὲ τοὺς ὑπεύθυνους τῆς μονῆς, καὶ ἰδιαίτερα μὲ τὸν ἴδιο τὸν ἡγούμενο, ἦταν ἀπὸ τὶς δυσκολότερες στὸ ἐπάγγελμά τους, κι αὐτὸ ὄχι μόνο γιατὶ οἱ ἀπαιτήσεις τοῦ μοναστηριοῦ ἦταν πάντα ὑψηλές, ἀλλὰ καὶ γιατὶ ὁ μεταφυσικὸς φόρτος τοῦ χώρου ὅπου γίνονταν οἱ συζητήσεις αὐτές, τὰ διαπεραστικὰ βλέμματα τόσο τῶν μοναχῶν ὅσο καὶ τῶν ζωγραφισμένων μορφῶν, ἀσκοῦσαν πάνω τους ψυχολογικὴ πίεση ποὺ ἔκαμπτε σχεδὸν πάντοτε τὶς ἀντιρρήσεις τους.

Ψιθυριζόταν ἀκόμη ὅτι, ἐκτὸς ἀπὸ τὶς φανερές, τὸ μοναστήρι διατηροῦσε κι ἄλλες, μυστικὲς ἐμπορικὲς συναλλαγές. Μὲ μιὰ ἐμπορικὴ συναλλαγὴ καὶ ὁ Π. Ροδακὴς κατὰ νοῦ ἔφτανε στοὺς πρόποδες τοῦ λόφου τοῦ Χτιστοῦ. Ἔχοντας ἀπὸ καιρὸ καταλήξει στὴν ἀπόφαση νὰ διαθέτει μὲ τὴν ὀνομασία Ἀγγελικὸ μόνο τὸ ἀνοιξιάτικο μέλι τῆς ἐποχῆς τῆς ταυτόχρονης ἀνθοφορίας τῶν εἰδῶν, καθὼς μόνο τότε γινόταν ἡ ὀρθὴ ἐκτέλεση τοῦ τύπου (κάτι ποὺ τοῦ ἐξασφάλιζε ἔρεισμα γιὰ ὑψηλὲς τιμὲς ἀλλὰ ποὺ ταυτόχρονα μείωνε τὴν παραγόμενη ποσότητα), ἦρθε ἀντιμέτωπος μὲ τὸ ἐρώτημα πῶς θὰ μποροῦσε νὰ αὐξηθεῖ ἡ παραγωγὴ στὸ περιορισμένο πάντα αὐτὸ χρονικὸ διάστημα. Λύση ὑπῆρχε μόνο μία. Νὰ αὐξηθεῖ ὁ ἀριθμὸς τῶν κυψελῶν. Αὐτὸ προυπέθετε ἀνάλογη ἐπέκταση σὲ χῶρο, τόσο γιὰ τὴν ἐγκατάσταση τῶν πρόσθετων κυψελῶν ὅσο καὶ γιὰ τὴ φύτευση περισσότερων φυτῶν.

Ὁ Π. Ροδακὴς εἶχε βέβαια τὴ δυνατότητα νὰ ἀγοράσει ὁποιαδήποτε ἔκταση, σ' ὁποιοδήποτε μέρος ἐπιθυμοῦσε. Ὑπῆρχαν, ὅμως, λόγοι γιὰ τοὺς ὁποίους θὰ προτιμοῦσε νὰ ἀποκτήσει τὰ γειτονικὰ μὲ αὐτὸ τὸ δικό του ποὺ εἶχε ὅλα τὰ χρόνια χρησιμοποιήσει. Ὁ ἕνας λόγος ἦταν ὅτι φοβόταν πὼς ἂν ἄλλαζε τοποθεσία μπορεῖ νὰ ἔδυε τὸ τυχερό του ἄστρο. Ὁ ἄλλος λόγος ἦταν πρακτικὸς καὶ εἶχε νὰ κάνει μὲ τὸ γεγονὸς πὼς οἱ ἐκτάσεις αὐτὲς βρίσκονταν στὴν πε-

Figure 4: A page from Βαγγέλης Χατζηγιαννίδης, *Οἱ Τέσσερις Τοῖχοι*, Τὸ Ροδακιό, Athens 2000, typeset by Atelier Fluxus Virus, using *digital monotype* method.

you get») principle of DTP software. Also the precision obtained by *digital monotype* is far beyond the precision obtained by even the best computer operator when moving text blocks around with a mouse. In fact, in *digital monotype* every step is a part of data processing, accomplished by various software modules.

As this paper is intended for a Typography Conference, we will omit the technical computer engineering details and present the methods from a typographical point of view. In fact, we will cover the most important problems we encountered, going from local to global level. Some of the methods presented here are not new: for example, the TEX typesetting system has been developed in the seventies, and the Omega system has started in the early nineties—and a big part of our model is based on the latter. Nevertheless we will present them for the sake of completeness and to give the reader a global view of *digital monotype* methods.

3 Building paragraphs

Theoretically speaking, a *paragraph* is a structural unit of text, and this has no relation whatsoever with presentation. Our first visual approach to the concept of paragraph is a long line containing all words, separated by equal blank spaces. To fit this into our page, we have to break this line several times, either between words or inside them. To obtain justification on both sides, one must choose the best breakpoints and slightly modify the widths of blank spaces.

How do we calculate the optimal breakpoints? There is a standard value for the blank space, it is the blank space we would have if there were no justification constraints. This standard blank space depends on the font used, and should be a decision of the font designer and of the book designer. Let us call the standard blank space w. Suppose now that we break a paragraph into lines, so that the following conditions are satisfied: (a) on a given line all blank spaces are equal (with some exceptions which we will consider later on), (b) lines are justified, (c) all blank spaces have values between a given minimum and a given maximum. For that given paragraph presentation, which we call P, let w_i, $1 \leq i \leq N$ be the widths of blank spaces. Then, following Don Knuth's paradigm, we call «badness» of the paragraph the sum

$$b_P = \sum_{i=1}^{N} |w_i - w|^2.$$

Suppose now that, as an optimal paragraph presentation P_{opt} we take the one

which is the «least bad[4]»:

$$b_{P_{\text{opt}}} = \min_P b_P$$

and, of course, this means that one has to make a big number of calculations, in order to compare the different combinations of breakpoints. The bigger a paragraph is, the more potential breakpoints it contains.

This is a mathematical model of an optimal paragraph presentation introduced by Knuth ([1], [2]) in the seventies. It has been extensively used in the last decades and has shown both its efficience and its limits. It has the advantage that all lines of the paragraph participate in the regulation of blank spaces, so that the result is rather homogeneous, and also that—thanks to the quadratic factor—deviations from the standard blank space very quickly increase badness and hence reduce the chances of a given paragraph presentation fo being the optimal one[5].

The situation we just described is rather abstract and simplified; a real-life situation, and especially if we are typesetting Greek text, is even more complex, since additional constraints are applied. Here are some of them:

3.1 Unequal interword spaces

It is common Anglosaxon tradition to leave more blank space after a full point, or after double punctuation. Blank spaces following abreviation points have the same width as ordinary blank spaces, except of course if, at the same time, they are also full points: by this technique, the eye detects more easily the beginning of a sentence. This convention has also been applied in Greek typography, at least whenever typesetters followed Anglosaxon conventions—and not at all when they followed French ones. In our model, if $w_j, \ldots, w_{j+k}$ are the blank spaces of a given line, this means that instead of having $w_j = \cdots = w_{j+k}$, some of the blank spaces (for example, those following full points) will be different, but still equal to each other, if there are more than one of them on the same line. But how do we calculate the width of these «extended» spaces? This width has to depend on the tightness or looseness of each line, but it still has to be unique on a given line. This means that if w'_L is the width of an extended blank space on line L,

4. In fact, this is a simplified version of Knuth's method implemented in TEX, since Knuth also introduces «hyphenation penalties» and «line penalties», and goes one step further, in calculating «demerits» out of these two quantities and badness. The paragraph chosen is the one with the least demerits. See [2, p. 98] for more details.

5. On the other hand, this model may become inefficient in some rare cases where a single line may be «sacrified» to save the paragraph; also it has the disadvantage of treating spaces wider than standard, and spaces narrower than standard, the same way: this means that the difference between the narrowest and the widest space can be quite big, even for the optimal solution, since it will be twice the difference between one of those two and the standard space. This may result into a mixture of lines which are tighter and others which are looser than normal. In our experimental platform (which is part of the Omega project) we are testing other models of optimal paragraph presentation, which may lead to a new generic algorithm of line breaking.

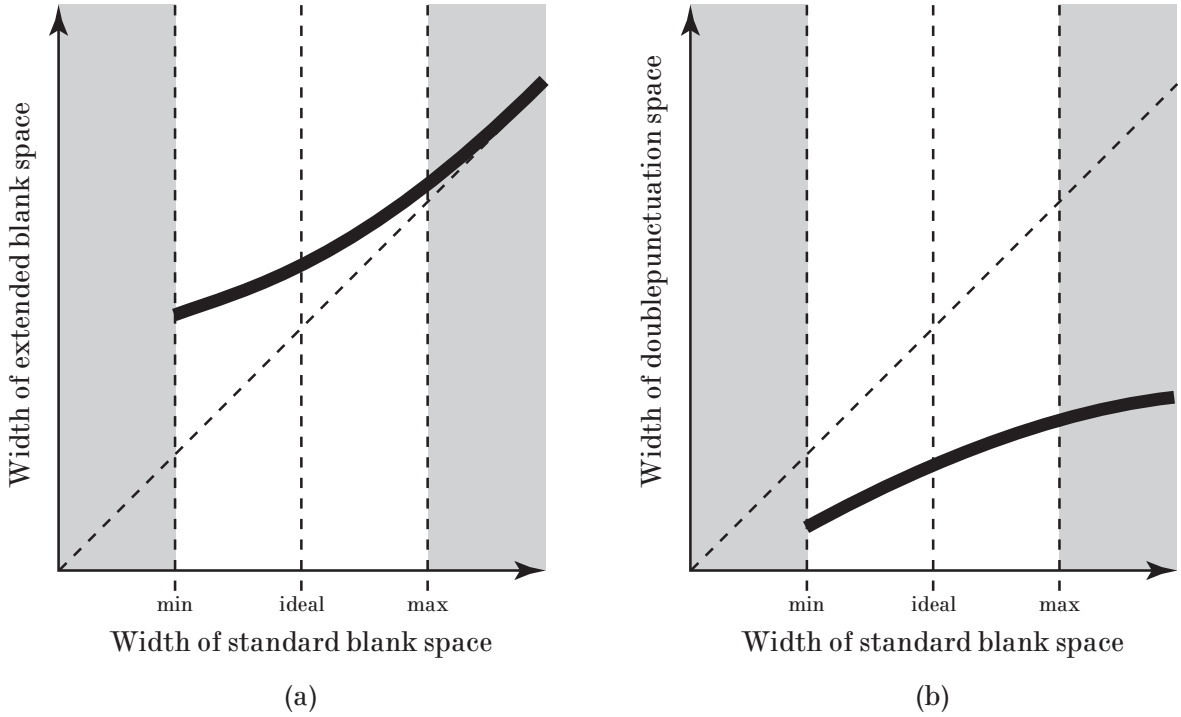


Figure 5: The width of expanded/double punctuation spaces and standard blank spaces, for a given line

then it is a function

$$w'_L = f(w_L)$$

of the width of the standard blank space of that line w_L. Knuth has chosen this function to be simply a multiplication by a fixed factor (for example, if we chose 1.3 as factor, then all spaces after full points will be 30% wider than standard blank spaces on the same line). This factor being the same for all lines, it is usually chosen so that it gives good results for optimal lines. But what happens for less optimal lines? For tight lines, the fixed factor is still the only natural solution: after all, if standard spaces become smaller and smaller, there is no reason why extended spaces should behave differently. On the other hand, the fixed factor function is not well suited for loosely spaced lines: if standard blank spaces have a tendency of becoming too big, then multiplying them by a fixed factor only makes things even worse. This is why we rather use a function f, as represented on diagram 5 (a). By this function, extended spaces get more and more closer to standard spaces when these are becoming wide, but behave more-or-less like in Knuth's paradigm when in optimal or tight lines.

3.2 Double punctuation and spacing

As in French, Greek punctuation needs spacing. But the rules are slightly different: while in French there is the notion of *espace fine* (French thin space), a

standard width used for all double punctuation except the colon, in Greek, thin spaces are different for each double punctuation mark. We have estimated that the space before an exclamation mark is bigger than the space before a semicolon (Greek question mark) which is bigger than the space before a colon. Contrarily to French, Greek guillemets are not spaced[6]. In most current typesetting software, thin spaces, weither for French or for Greek, are of fixed width. This looks nice when standard spaces are of natural width or tend to become wide, but causes a serious problem when standard spaces become narrow: in fact, it may happen that a regular space becomes narrower than the thin space of double punctuation. This is an absurd situation and we resolve it once again in our model by defining these spaces as a function f of regular spaces, represented on diagram 5 (b).

3.3 Letterspacing

A similar micro-typographical problem is the one of letterspacing. Using letterspacing in Greek typography—as in German and in Russian—is integral part of tradition and has no relation whatsoever with the typesetter's potential tendency of steeling sheep. Letterspacing in a method for emphasizing, like using italics. In Greek tradition, italics are rather used for quoted titles, guillemets are used for words or sentences spoken or narrated and letterspacing is used for emphasizing. Here is an example: Ὁ Γιάννης εἶπε: «ἡ *Καζαμπλάνκα* εἶναι φοβερὴ ταινία» [John said: «*Casablanca* is a f a b u l o u s movie»].

Using letterspacing to improve line justification is certainly as bad as steeling sheep, and this is the case also in Greek typography. But, on the other hand, spaces used between letters can not be completely indifferent to what happens between words. In the contrary, if interword spaces become too narrow, then interletter spaces can hardly be distinguished from them and the individual letters look like words. On the other hand, contrarily to «extended spaces» after full points, and to double punctuation spaces, one wouldn't like a letterspaced word to look different on two different lines of the same text[7]. This means that we don't have the possibility of defining letterspacing as a function of standard interword spaces on the same line. The only solution is to change the line breaking algorithm so that it chooses a different set of breakpoints whenever a line containing a letterspaced word is getting too tight[8].

Finally, an issue that has to be taken into consideration is the one of blank spaces between letterspaced words and at the boundary between letterspaced and non-letterspaced ones. It is clear that these blank spaces should be wider than the

6. With a single exception: books published by Agra indeed space guillemets, but also all other delimiters: parentheses, brackets, braces, etc.

7. In fact, if this would happen, that is if one could have to copies of the same word, with one of them more letterspaced than the other, one would—conciously or unconciously—imagine that the former carries more emphasis than the latter...

8. This means, increasing significantly the badness of tight lines containing letterspaced material.

standard blank spaces on the line, since otherwise the distinction between them and spaces between letters would be more difficult.

3.4 Optical kerning

In current mathematical models of typesetting, kerning is a technique that is applied inside words. But in some cases, kerning is needed even *between* words: this depends both on the shapes of the (visually) last letter of the first word and the (visually) first letter of the second one, and on the width of regular blank space of that line. If the line is very loosely spaced, then the shapes of these letters are less influential than when the line is tightly spaced. Technically it is impossible to predict all possible combinations of letters and blank space inbetween, especially since these letters can be in different fonts or in different sizes. Imagine, for example, in the Latin alphabet, a Roman capital A followed by a blank space and an italic f : 'A *f*,' or, two Roman W letters with a blank space inbetween: 'W W.' These blank spaces, although being theoretically of the same width, at least according to our basic mathematical model, appear to be quite unequal visually.

Optical kerning needs to be applied to obtain better visual results. For this, different methods are tested (calculation of the blank area between the letters or between simplified versions of the letters, comparison of horizontal extrema on both sides, comparison of the letters with basic forms for which we have kerning rules) and combined. Practically, the most difficult problem is not calculate optical kerning, but to detect when this is really necessary, since it is a calculation too heavy to be applied to all pairs of words of the paragraph.

3.5 Alignment of capital letters

Greek diacritics (breathings and eventually accents) in front of capital letters have a very special behaviour: whenever they are encountered inside a paragraph, they are spacing diacritics; but whenever the capital letters have to aligned, then diacritics become hanging diacritics. This is the case for the first words of: items in lists, verses in poetry, paragraphs, etc. It is interesting to note that this alignment occurs also for the first word of a paragraph when it is preceded by an em-dash (as in dialogs). Examples:

Ὁ κανόνας λέει ὅτι	—Ὅπως εἴπαμε
Στοιχειοθετοῦμε λέξεις ποὺ	— Νὰ μὴ ξεχάσεις
Ἀρχίζουν ἀπὸ φωνῆεν	—Ἀφοῦ σοῦ λέω
Μὲ περασιὰ στὸ γράμμα καὶ	— Πάψε πιά !
Ὄχι στὸ πνεῦμα.	—Ἔτσι μ' ἀρέσει

3.6 Overlapping ascenders/descenders, rivers, typographical gray

Until now, the micro-typographical problems we have discussed have always been «horizontal» ones, that is problems of placing words on a line so that the sum of badnesses of individual lines is minimal. The problem with this mathematical model is that it doesn't take vertical properties of lines into consideration. Two main problems may occur: if leading is too small, descenders of one line may overlap with ascenders from the line beneath. This can be avoided by choosing a slightly different presentation of the paragraph, but, again, the problem is to detect this problem.

Even more difficult to detect is the phenomenon of «rivers», which are groups of more-or-less horizontally aligned blank spaces on subsequent lines of text, given the impression that a river is flowing in the middle of the text (and give the impression that the paragraph is broken into two columns). We have defined a mathematical model of rivers and are working on modifying the general line breaking algorithm so that these are taken into account in the calculation of badness, so that they may be avoided.

The problem of rivers can be generalized into a problem of typographical gray density variations. Typographical gray is the visual image perceived when a page of printed text is viewed from a distance such that individual letters are not distinguished anymore. Well typeset pages have a very uniformly dense typographical gray. We are collaborating with medical imagery specialists to develop efficient methods of measuring typographical gray and its variations. Once this is accurately measured, we will search ways of including its calculation into the general line breaking algorithm so as to be able to predict the typographical gray of a page before even typesetting it.

3.7 Hyphenation and re-occuring words

Last but not least, there also linguistic problems involved, like hyphenation: there are several sets of rules for hyphenating Greek, differing mainly in the amount of etymological vs. phonetic hyphenations (one publisher will hyphenate ἀνέντιμος etymologically as ἀν-έν-τι-μος[9] while some other will hyphenate phonetically ἀ-νέν-τι-μος and, nowadays, one may even encounter the terrifying ἀ-νέ-ντι-μος). This problem has been solved, by using sets of hyphenation rules and exceptions. Up to now, in our model, all potential breakpoints in a word are considered as being of equal priority and only the badness of the paragraph as a whole decides which breakpoint in a word (or between words) is to be used.

Greek words happen to be sometimes very long and typesetters seem to have no scruples of breaking them in parts of quite unequal width (the author often encounters extreme cases of hyphenations like ἀ-εροπλανοφόρο). Therefore it would be useful to give different levels of priority to breakpoints, allowing more easily

9. Where we indicate by a hyphen the potential breakpoints of the word.

hyphenation towards the middle of the word than close to its extremities. One could even go a step farther, and apply methods similar to German typography, where compound words are more easily hyphenated between components, and then between syllables towards the center of the words, and finally at the extremities. This would give, for example, a scheme such as ἀ4ε3ρο1πλα2νο1φό3ρο, where 1 is first priority, 2 second priority, and so on.

A problem similar to hyphenation (and to rivers, examined in the previous section) is the one of the same words occuring at the beginning of two or more subsequent lines. Once again here the paragraph presentation should be slightly modified to avoid this phenomenon (which is irritating to the eye since there is uncertainty on which line has been read and which is the next line to read).

We have discussed seven factors involved in building optimally presented paragraphs by breaking lines. Each of these factors should ideally influence the choice of paragraph presentation. The question is: what are their mutual priorities and how do they compare? Our study of the mathematical model of typesetting is by no means sufficient to answer that question, as it is not yet a global model but rather a collection of models for the various facets of typeset text. We hope that in the future we will have a clearer idea of the interaction of these facets and maybe an attempt of their integration into a single abstract model, which will result into a globally more efficient line-breaking algorithm.

4 Building pages

Up to now we have discussed the micro-typographical aspects, that is those whose scope is limited to the level of the paragraph. In this section we will discuss macro-typographical aspects of the book, and mainly the process of building pages out of paragraphs, eventually broken between lines.

This process can theoretically be considered as a generalization of the line-breaking process, if we echange the triplet of concepts (*word*, *line*, *paragraph*) by the triplet (*paragraph*, *page*, *book*). Indeed, the sentence «a book is broken into pages by distributing (eventually breaking) paragraphs» is the counterpart of «a paragraph is broken into lines by distributing (eventually breaking) words». This implies that it would be quite natural to apply the same algorithm as in the previous section for breaking a book into pages. For example, one could define and calculate a *badness measure* of each page, take the sum of all such page badnesses as the badness of the given presentation of the book, and choose as optimal book the one with the least badness.

Unfortunately it is hard to implement such a method[10]. All we are able to

10. And a student of Knuth has even proven in his Ph.D. thesis [3] that the general problem is NP-complete, that is: impossible to solve by computer.

do, up to now, is to apply a best-fit method corrected by an iterative process as described in the Introduction. We fill pages in a linear way so that each one of them is filled in the best possible way, independently of all preceding and following pages. Once this process has terminated, we examine the result, make measures and extract information which is injected into the data and stylesheets so that the next times pages are built, some problems in the results are corrected. This process is iterated until either the results have converged to a stable version, which, by definition, is the optimal one, or we have entered a vicious circle of corrections producing two or more alternating versions: in the latter case, human intervention is necessary to escape the vicious circle.

Here are some cases where this iterative process of building pages is of crucial importance.

4.1 Widow lines

Widow lines (κουτσὲς ἀράδες = limping lines) occur whenever the last line of a paragraph is not a full line and happens to be the first line of the page. This problem is solved in modern typesetting and DTP software by adding additional white space between paragraphs, so that an additional line is sent to the page, so that the partial line is not the first line of the page anymore.

This approach, which seems so very natural nowadays, is out of question in *digital monotype*. As a matter of fact, *digital monotype* books have to be typeset on a fixed grid so that there is absolutely no variation in leading. Even explicit vertical blank spaces between paragraphs (to show textual unities of higher order than paragraphs), have to be exact multiples of the leading of printed lines; the same constraint applied when decorative elements or figures are placed between paragraphs. These rules are very strict and the slightest deviation is immediately visible.

This means that there is no trivial solution for widow lines. The non-trivial solution we apply is based on methods used by hot lead typographers. In fact there are three possibilities:

1. if the conditions allow it, one can typeset the paragraph to which the widow line belongs a bit more loosely, so that the widow line fills the whole line width (see Fig. 6). A «filled widow» line is not only admissible, but even sometimes quite nice for connoisseurs, since it shows the efforts of the typesetter to avoid widows;

2. otherwise, one has to typeset the paragraph containing the line, or some previous paragraph, one line tighter so that the widow line is absorbed by the previous page (see Fig. 7). Of course one must not climb up too many paragraphs in the book, because otherwise new widow lines may occur inbetween.

3. if step 2 is not possible, one can instead typeset some previous paragraph

τὰ παραδοσιακὰ σπίτια τοῦ νησιοῦ. Ὁ Ἰταλός, μετὰ ἀπὸ μερικὲς μέρες, τοῦ παρέδωσε τὸ σχέδιο καὶ ἀναχώρησε. Ὁ Σ. Ροδακὴς ἀνέθεσε τὴν ἐκτέλεση στοὺς ντόπιους μάστορες ποὺ ἀπὸ τότε βλαστημοῦσαν καθημερινὰ τὴν Ἰταλία, τὶς ἀρχαιότητες καὶ τὸ μέλι. Πάντως καταφέρανε νὰ ἀποτελειώσουν τὸ ἔργο. Τὸ ἀποτέλεσμα ἦταν πράγματι ἀσυνήθιστο, ὅπως εἶχε παραγγείλει ὁ Σ. Ροδακής· ὅσο γιὰ τὴν αἰσθητική του ὑπῆρξαν γνῶμες πολλές.

199

Μετὰ τὴν ἀποπεράτωση τοῦ χτισίματος, ὁ Σ. Ροδακὴς διαπίστωσε πὼς εἶχε ἀνάγκη ἑνὸς παραπάνω χώρου ὅπου θὰ μποροῦσε νὰ ἀποθηκεύει τὰ ἐργαλεῖα τοῦ κήπου μὲ δική του ἀνεξάρτητη εἴσοδο ὥστε νὰ εἶναι ἀκόμα πιὸ εὔχρηστος. Ἔτσι, πρόσθεσε μιὰ ἀκόμη προεξοχὴ στὸν κορμὸ τοῦ κτιρίου χτίζοντας μόνος του ἕνα εὐρύχωρο μακρουλὸ δωμάτιο (μὲ ἀποτέλεσμα, βέβαια, νὰ καταστραφεῖ ἐντελῶς ἡ ἰσορροπία τοῦ σχεδίου). Αὐτὴ ἦταν ἡ λεγόμενη «πίσω ἀποθήκη», ποὺ ὁ Π. Ροδακὴς παραχώρησε στὴ Βάγια γιὰ τὰ μπαοῦλα

200

της, ἕνας χῶρος ποὺ τελικὰ ἔμεινε μᾶλλον ἀχρησιμοποίητος παρὰ τὴν ἀρχικὴ ἀνάγκη προσθήκης του.

Τὰ βήματά του τὸν εἶχαν φέρει πιὰ κοντὰ στὸ σπίτι ὅταν τὸ μάτι του ἔπεσε πάνω στὴν προεξοχὴ τῆς πίσω ἀποθήκης. Ἔνιωσε τὴν περιέργεια, γιὰ πρώτη φορὰ ἀπὸ τότε ποὺ ἡ Βάγια εἶχε ἐγκαταστήσει ἐκεῖ τὰ ὑπάρχοντά της, νὰ ρίξει μιὰ ματιὰ στὰ δύο ἐκεῖνα μπαοῦλα, ὄχι ἴσως νὰ τὰ ἀνοίξει καὶ νὰ τὰ ψάξει, ἁπλὰ καὶ μόνο νὰ ρίξει μιὰ ματιά. Παραξενεύτηκε καθὼς διαπίστωσε ὅτι ἡ πόρτα, ποὺ ἦταν πάντοτε ξεκλείδωτη (γιὰ τὴν ἀκρίβεια, δὲν εἶχε κὰν κλειδί γιὰ νὰ κλειδώνει), ἦταν ἀδύνατο νὰ ἀνοίξει. Πῆγε ἀπὸ τὴν ἄλλη πλευρὰ ὅπου ὑπῆρχε ἕνα μικρὸ παράθυρο. Ἀντίθετα, αὐτὸ ποὺ ἦταν πάντοτε κλειστό, εἶχε τὰ παραθυρόφυλλά του κουφωτά. Τοῦ φάνηκε μάλιστα ὅτι ἀπὸ μέσα διέρρεε κάποιο ἀδύναμο φῶς ἀλλὰ τὸ φεγγοβόλημα τὸν δυσκόλευε νὰ καταλάβει ἂν ἦταν ἔτσι. Θὰ ἔπρεπε νὰ πλησιάσει πε-

201

ρισσότερο καὶ νὰ κοιτάξει μέσα.

Ἔφερε τὸ πρόσωπό του στὸ κενὸ ἀνάμεσα στὰ δυὸ γερτὰ φύλλα. Πραγματικά, τὸ δωμάτιο ἦταν φωτισμένο. Ἀπέναντί του ἀντίκρισε παλιές, ξεχαρβαλιασμένες καρέκλες, κομμάτια ἀπὸ σκουριασμένες λαμαρίνες, ξερὰ κλαδιὰ ἀπὸ παλιὰ κλαδέματα, κουβάδες μὲ ξεραμένες μπογιὲς καὶ οἰκοδομικὰ ὑλικά. Ἔστριψε τὸ κεφάλι του πρὸς τὰ ἀριστερὰ καί, ὅσο τοῦ ἐπέτρεπε τὸ στενὸ ἄνοιγμα, διέκρινε τὰ δυὸ μπαοῦλα. Τὸ ἕνα ἦταν ἀνοιχτὸ καὶ ἀπὸ πάνω του βρισκόταν σκυμμένη ἡ Βάγια, μὲ τὴν πλάτη της πρὸς τὴ μεριά του, ἀσχολούμενη μὲ κάτι ποὺ ἐκεῖνος δὲν μποροῦσε νὰ διακρίνει ἀπὸ τὴ θέση ποὺ βρισκόταν. Τὸ μόνο ποὺ ἔβλεπε

202

ἦταν οἱ κινήσεις τῶν χεριῶν της ποὺ δούλευαν ἐντατικὰ σὰ νὰ ζύμωνε, ἢ νὰ δίπλωνε ροῦχα, ἢ νὰ τύλιγε μαλλί.

203

«Μὰ τέτοια ὥρα», ἀναρωτήθηκε, «τί μπορεῖ νὰ κάνει τέτοια ὥρα ἐδῶ;»

Διαισθάνθηκε πὼς ὁτιδήποτε ἦταν αὐτὸ ποὺ ἔκανε ἦταν κάτι ποὺ τὸ ἔκανε στὰ κρυφά. Καὶ δὲν μποροῦσε νὰ ἐξηγήσει γιατί, ἅμα ἤθελε νὰ κάνει κάτι στὰ κρυφά, δὲν τό 'κανε ὅλη μέρα ποὺ ἦταν ὁλομόναχη.

204

Ἡ σκέψη του διακόπηκε ἀπὸ μιὰ κίνηση τῆς Βάγιας. Μὲ τὰ δυό της χέρια ἔπιασε αὐτὸ ποὺ ὑπῆρχε μπροστά της μέσα στὸ μπαοῦλο καὶ τὸ σήκωσε ψηλὰ στὸν ἀέρα πάνω

205

ἀπ' τὸ κεφάλι της, ὅπως μιὰ μάνα σηκώνει τὸ μωρό της στὸν ἀέρα.

Τόλμησε νὰ τραβήξει τὸ ἕνα φύλλο καὶ νὰ βάλει τὸ κε-

206

φάλι του λίγο πιὸ μέσα. Πράγματι. Στὰ χέρια της κρατοῦσε ἕνα μικρὸ ἀδύνατο μωρό.

«Καὶ τί ἤθελες νὰ ἔκανα παιδί μου», εἶπε ἀπολογητικὰ ὁ πατὴρ Χρύσανθος ἐνῶ ἔξυνε μιὰ ξεραμένη σταγόνα κερὶ

τὰ παραδοσιακὰ σπίτια τοῦ νησιοῦ. Ὁ Ἰταλός, μετὰ ἀπὸ μερικὲς μέρες, τοῦ παρέδωσε τὸ σχέδιο καὶ ἀναχώρησε. Ὁ Σ. Ροδακὴς ἀνέθεσε τὴν ἐκτέλεση στοὺς ντόπιους μάστορες ποὺ ἀπὸ τότε βλαστημοῦσαν καθημερινὰ τὴν Ἰταλία, τὶς ἀρχαιότητες καὶ τὸ μέλι. Πάντως καταφέρανε νὰ ἀποτελειώσουν τὸ ἔργο. Τὸ ἀποτέλεσμα ἦταν πράγματι ἀσυνήθιστο, ὅπως εἶχε παραγγείλει ὁ Σ. Ροδακής· ὅσο γιὰ τὴν αἰσθητική του ὑπῆρξαν γνῶμες πολλές.

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[47]

201

Θὰ ἔπρεπε νὰ πλησιάσει περισσότερο καὶ νὰ κοιτάξει μέσα.

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Τόλμησε νὰ τραβήξει τὸ ἕνα φύλλο καὶ νὰ βάλει τὸ κε-

206

φάλι του λίγο πιὸ μέσα. Πράγματι. Στὰ χέρια της κρατοῦσε ἕνα μικρὸ ἀδύνατο μωρό.

«Καὶ τί ἤθελες νὰ ἔκανα παιδί μου», εἶπε ἀπολογητικὰ ὁ πατὴρ Χρύσανθος ἐνῶ ἔξυνε μιὰ ξεραμένη σταγόνα κερὶ

[48]

Figure 6: Examples of pages with widow line before and after correction: paragraph 201 is loosened so that the widow line becomes a full line.

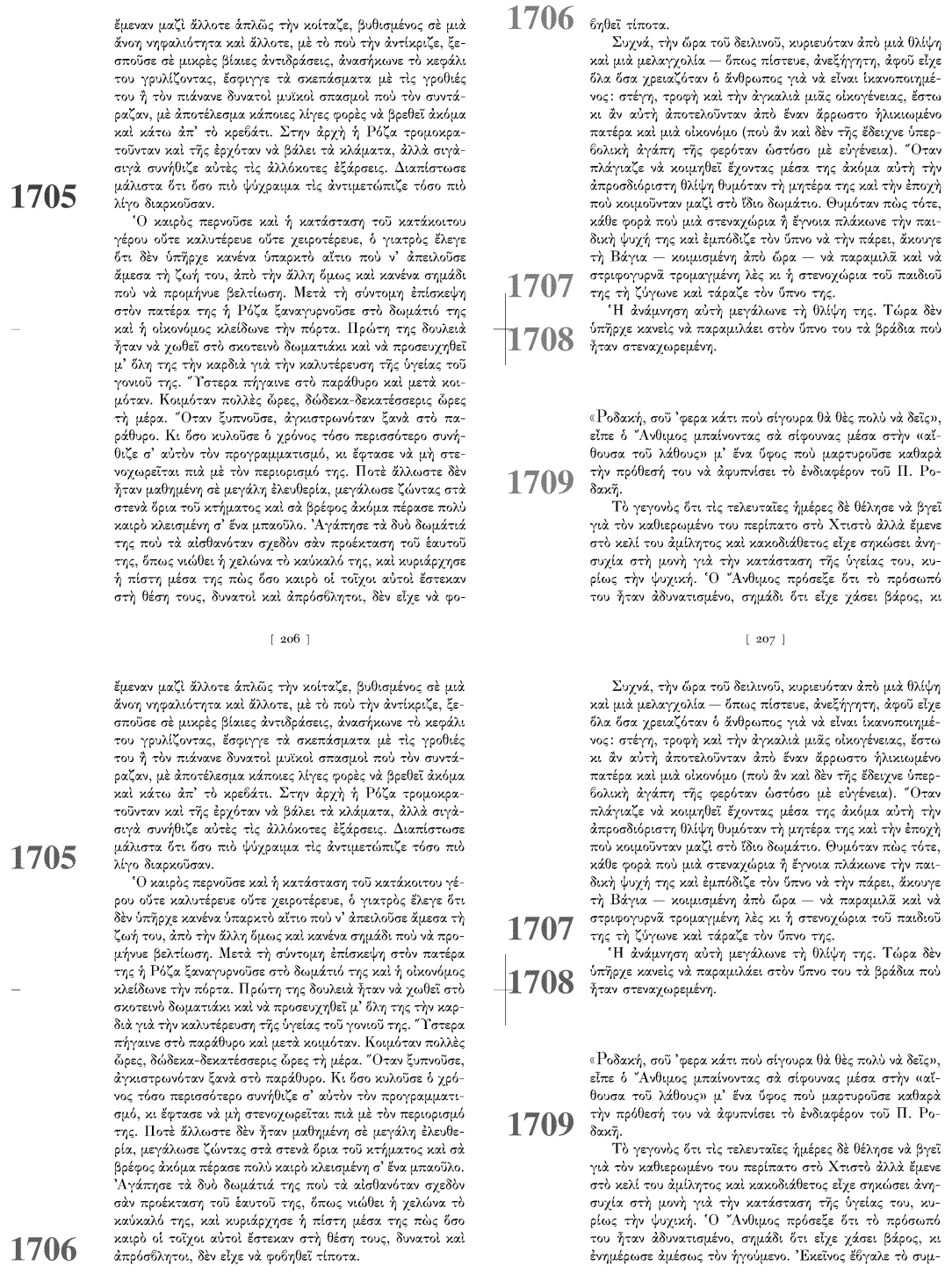

Figure 7: Examples of pages with widow line before and after correction: paragraph 1706 is tightened so that it absorves the widow line.

one line looser, so that the widow line becomes the second line of the page. Once again it is unsafe to climb up too many paragraphs in the book, because otherwise new widow lines may occur inbetween.

All three solutions depend on the flexibility of paragraphs located before the widow line. They are based on the assumption that we know how a paragraph will react if we increase or decrease the standard interword space (which in turn will modify non-standard interword spaces, as we have seen in the previous sections). Obviously a 50-line paragraph will more easily «swallow» a partially filled widow line than a 3-line one, but if we take two arbitrary regular size paragraphs there is no trivial way to predict how they will react when the standard interword space is slightly modified, and which one will more easily absorb a line.

The only way to find out is to actually try it and so our system makes various tests on paragraphs preceding the widow line before deciding if the widow line should be filled, or absorbed, and in the latter case which paragraph must be tighted so that a line is won.

The results are not only unpredictable but also quite surprising, since by its nature our line breaking algorithm mixes tightly and loosely typeset lines so that one can hardly say if a given paragraph is rather loosely or tightly typeset. Often the fact of making standard interword space a bit narrower will, as contradictory as it may seem, make some lines more loosely spaced: this may happen because of the way words are hyphenated, or because of other factors we have discussed previously. We are experimenting with other line breaking methods which may produce more homogeneous results and may make paragraph behaviour more predictable and easier controlable.

Nevertheless it should be noted that widow lines are the most difficult problem we had to solve in order to do *digital monotype*.

4.2 Parallel texts

To produce parallel texts, as on Fig. 8, we first introduce identifiers into the XML elements which correspond to paragraphs. These identifiers are the same in paragraphs of both files (original text and translation). When these texts are typeset, the identifiers are included as invisible spots in the DVI files. The DVI parsing process counts lines between these spots and decides how many blank lines have to be included into either the original text or the translation so that parallelism is optimal.

4.3 Critical editions

A critical edition, as on Fig. 9, is a real typesetter's challenge. There are two parallel texts, which generate further text flows (the critical apparatus, and several footnote apparati). These additional text flows can be placed on separate sides, or can be floating, in the sense that they will—all together—fill the empty space

Figure 8: Parallel texts

ΗΡΟΔΟΤΟΥ ΙΣΤΟΡΙΑΙ Ι 29-33

29 Κατεστραμμένων δὲ τούτων καὶ προσεπικτωμένου Κροίσου Λυδοῖσι, ἀπικνέονται ἐς Σάρδις ἀκμαζούσας πλούτῳ ἄλλοι τε οἱ πάντες ἐκ τῆς Ἑλλάδος σοφισταί, οἳ τοῦτον τὸν χρόνον ἐτύγχανον ἐόντες, ὡς ἕκαστος αὐτῶν ἀπικνέοιτο, καὶ δὴ καὶ Σόλων ἀνὴρ Ἀθηναῖος, ὃς Ἀθηναίοισι νόμους κελεύσασι ποιήσας ἀπεδήμησε ἔτεα δέκα, κατὰ θεωρίης πρόφασιν ἐκπλώσας, ἵνα δὴ μή τινα τῶν νόμων ἀναγκασθῇ λῦσαι τῶν ἔθετο. Αὐτοὶ γὰρ οὐκ οἷοί τε ἦσαν αὐτὸ ποιῆσαι Ἀθηναῖοι· ὁρκίοισι γὰρ μεγάλοισι κατείχοντο δέκα ἔτεα χρήσεσθαι νόμοισι τοὺς ἄν σφι Σόλων θῆται.

30 Αὐτῶν δὴ ὧν τούτων καὶ τῆς θεωρίης ἐκδημήσας ὁ Σόλων εἵνεκεν ἐς Αἴγυπτον ἀπίκετο παρὰ Ἄμασιν καὶ δὴ καὶ ἐς Σάρδις παρὰ Κροῖσον. Ἀπικόμενος δὲ ἐξεινίζετο ἐν τοι-

ΟΛΒΙΟΣ ΒΙΟΣ:

ΔΙΑΛΟΓΟΣ ΚΡΟΙΣΟΥ ΚΑΙ ΣΟΛΩΝΑ

Εἶχαν λοιπὸν ὅλοι αὐτοὶ ὑποταχθεῖ (ὁ Κροῖσος τοὺς εἶχε προσαρτήσει στὸ λυδικὸ βασίλειο), ὅταν φτάνουν στὴν πλούσια τότε καὶ ἀκμάζουσα πόλη τῶν Σάρδεων καὶ ἄλλοι (ὅλοι οἱ σοφοὶ τῆς Ἑλλάδος ποὺ ζοῦσαν τὰ χρόνια ἐκεῖνα, ὅπως καθένας τους ἔφτανε), καὶ ἀνάμεσά τους ὁ Σόλων ὁ Ἀθηναῖος, μετὰ τοὺς νόμους ποὺ ἔβαλε στοὺς Ἀθηναίους — τοῦ τὸ εἶχαν ζητήσει οἱ Ἀθηναῖοι. Ἀμέσως μετὰ ἀποδήμησε ὁ Σόλων γιὰ δέκα χρόνια, μὲ τὴν πρόθεση νὰ δεῖ καὶ νὰ γνωρίσει τὸν κόσμο, ἀλλὰ καὶ ἐπειδὴ ἤθελε νὰ μὴ βρεθεῖ στὴν ἀνάγκη νὰ λύσει κάποιον ἀπὸ τοὺς νόμους ποὺ θέσπισε. Μόνοι τους δὲν εἶχαν δικαίωμα νὰ τὸ κάνουν αὐτὸ οἱ Ἀθηναῖοι, ἐπειδὴ ἦταν δεμένοι μὲ μεγάλο ὅρκο, δέκα χρόνια νὰ κρατήσουν τοὺς νόμους ποὺ θὰ τοὺς ἔβαζε ὁ Σόλων.

Γι' αὐτὸν λοιπὸν τὸν λόγο καὶ ἐπειδὴ ἤθελε νὰ γνωρίσει τὸν κόσμο, ὁ Σόλων ἀποδήμησε καὶ ἔφτασε στὴν Αἴγυπτο, στὴν αὐλὴ τοῦ Ἄμαση, ὕστερα καὶ στὶς Σάρδεις, στὴν αὐλὴ τοῦ Κροίσου.

Διὸ παραινῶ φεύγειν αὐτῶν τὴν μανίαν· μανίαν γὰρ ἔγωγέ φημι εἶναι ἐσχάτην τὸ φιλονεικεῖν εἰδέναι τί τὴν οὐσίαν ἐστὶν ὁ Θεός. Καὶ ἵνα μάθῃς ὅτι μανίας ἐσχάτης τοῦτο, ἀπὸ τῶν προφητῶν ὑμῖν τοῦτο ποιήσω φανερόν· οἱ γὰρ προφῆται οὐ μόνον τί τὴν οὐσίαν ἐστὶν ἀγνοοῦντες φαίνονται, ἀλλὰ καὶ περὶ τῆς σοφίας αὐτοῦ πόση τίς ἐστιν ἀποροῦσι· καίτοι γε οὐχ ἡ οὐσία ἀπὸ τῆς σοφίας, ἀλλ' ἡ σοφία ἐκ τῆς οὐσίας. Ὅταν δὲ μηδὲ ταύτην δύνωνται καταλαμβάνειν οἱ προφῆται μετὰ ἀκριβείας, πόσης ἂν εἴη μανίας τὸ τὴν οὐσίαν αὐτὴν νομίζειν δύνασθαι τοῖς οἰκείοις ὑποβάλλειν λογισμοῖς; Ἀκούσωμεν τοίνυν τί φησιν ὁ προφήτης περὶ αὐτῆς· «Ἐθαυμαστώθη ἡ γνῶσίς σου ἐξ ἐμοῦ.» Μᾶλλον δὲ ἀνωτέρω τὸν λόγον ἀγάγωμεν· «Ἐξομολογήσομαί σοι, ὅτι φοβερῶς ἐθαυμαστώθης.» Τί ἐστι «φοβερῶς»; Πολλὰ θαυμάζομεν μόνον, ἀλλ' οὐ μετὰ φόβου, οἷον κιόνων κάλλος, τοίχων ζωγραφίαν, ἄνθη σωμάτων· θαυμάζομεν πάλιν τῆς θαλάσσης τὸ

1 μανίαν[2] : μανίας EL DG OVX || ἔγωγε om. DG || 2 φημι B : transp. post. ἐσχάτης E O om. cett. || εἶναι : οἶμαι VX om. DG || ἐσχάτης EL DG OVX om. B || τὸ om. DG || 3 μανίας ἐσχάτης : μανίαν ἐσχάτην AC om. B || 8 μετ' corr. Duc || 14 μόνον : νῦν E om. CL G VX || 14-15 κάλλη τύπων ζωγραφίας Duc e cod. Paris. 777.

a. Ps. 138, 6.
b. Ps. 138, 14.

1. Le mot προφήτης a des nuances diverses dans l'Ancien et le Nouveau Testament et à l'intérieur de chacun d'eux, mais ces sens divers ont un caractère commun : le prophète est l'homme qui parle sous l'inspiration de l'Esprit. Cf. *hom.*, III, li. 150 s. C'est ainsi que Jean va citer successivement des textes du Psalmiste, d'Isaïe et de Paul.

2. On remarquera que Jean utilise très fréquemment la tournure οὐ μόνον... ἀλλὰ καί. C'est sans doute une habitude de style enseignée par la rhétorique mais elle correspond chez lui, croyons-nous, à une tendance profonde. Son dynamisme naturel ne se contente pas d'une constatation pure et simple ; il la renforce soit dans un sens positif, soit dans un sens négatif. Ici, la tournure marque un nouveau point gagné sur l'adversaire, grâce au témoi-

Je vous exhorte donc à éviter leur folie, car c'est le comble de la folie que s'acharner à connaître Dieu dans son essence. Et pour que vous compreniez que c'est bien en effet le comble de la folie, je vous le montrerai à l'évidence par le témoignage des écrivains sacrés[1] : non seulement ceux-ci ignorent manifestement ce qu'il est dans son essence, mais encore ils ne savent que dire de l'étendue de sa sagesse[2] ; or ce n'est pas l'essence qui dérive de la sagesse, mais la sagesse de l'essence. Quand donc les écrivains sacrés ne peuvent pas même délimiter celle-là avec exactitude, quelle est la folie de ceux qui croient pouvoir soumettre son essence elle-même à leurs propres raisonnements[3] ? Écoutons donc ce que dit l'écrivain sacré à ce sujet : « La connaissance que tu as de moi m'a été un objet d'admiration[a]. » Mais suivons plus loin son propos : « Je te bénirai, parce qu'on t'admire avec crainte[b]. » Que signifient ces mots : « avec crainte » ? Nombreuses sont les choses que nous nous contentons d'admirer[4], mais non pas avec crainte, par exemple la beauté des colonnes, ou des chefs-d'œuvres de la peinture, ou des corps dans leur

gnage d'hommes inspirés. Loin de prétendre connaître l'essence de Dieu, ils ont un mouvement de recul, de confusion, même lorsqu'il s'agit de parler des manifestations de la sagesse.

3. Jean oppose ici la saisie claire du mystère de Dieu, dont se prévalent les Anoméens, καταλαμβάνειν μετὰ ἀκριβείας, à la connaissance conjecturale, forcément imparfaite lorsqu'elle ne s'appuie que sur des raisonnements humains. En fait, Eunome affirme qu'il ne s'appuie pas uniquement sur « ses propres raisonnements », mais grâce à une théorie du langage qu'il tire de l'Écriture (*Gen.* 1, 3), il attribue à Dieu l'origine du nom qui le désigne exactement. Voir *Apologia*, chap. 7, *PG* 30, 841.

4. Ici encore, le choix des textes permet à Jean de faire progresser son argumentation. L'usage du verbe θαυμάζειν dans le premier texte suggère l'admiration dans plus. Mais dans le second, l'adjonction de φοβερῶς montre l'homme saisi d'une crainte révérentielle en présence de Dieu, devant l'océan infini de sa sagesse : τὸ ἄπειρον... πέλαγος τῆς τοῦ Θεοῦ σοφίας.

Figure 9: Critical edition

underneath the original text and translation. This is the ideal page setup for critical editions, since the two main texts can be of unequal length: the additional text flows will adapt to fill the space underneath.

The critical apparatus is especially difficult to typeset, because its entries are preceded by the line number where the entry is encountered in the original text above. This line number, of course, depends on typesetting, and may change completely if euther the context or the original text changes even slightly. Furthermore the following rules apply: if two entries are on the same line, then the line number is not written twice; if the entry spans on several lines (or even several pages) then the whole span is indicated in the apparatus; if the same entry occurs twice or more times on the same line, then a superset number indicates which occurence one is refering to.

Information included in the critical apparatus depends so much on the original text, that a small change in the latter can heavily change the former. Which, in turn, may change again the critical apparatus. In other words, the original text and the critical apparatus significantly influence each other.

The method we have chosen to produce critical editions is to fill the pair of even and odd page by the original text and its translation, typeset line by line. Every line of the original text will call for a certain number of lines (or simply, words) of the translation. At the same time, both the original text and the translation will produce parts of the critical apparatus and footnotes, which will fill the lower parts of the pages. At some time the insertion of a line in the original text will cause an overflow of our pages. If this overflow is caused by the translation or by the last footnote, then we can keep that line of original text and try to place the overflowed text in the next pair of pages. If the overflow is caused by the critical apparatus, then we stop just before the line that caused the overflow and attempt to balance vertical spaces on both pages.

This method of typesetting critical editions is very time- and CPU-consuming, since for every line of original text, a new typesetting process is started. But it is the only method that ensures the same high quality of the result, as in ordinary *digital monotype* books. At the same time, this method is relatively failproof, since at every step of the process the (partial) critical edition is optimally typeset, and the iterative process' role is not to enhance typesetting but to provide data in small chunks.

5 Typefaces

Many people in Greece, even between the so-called professionals of the book, believe that all that is necessary to produce high quality books, is to have the right typefaces. We hope to have shown, in the previous two sections of this paper, that this is untrue and that there is a lot of development and research involved and

still to be done in the areas of micro- and macro-typography, weither the problem is building words, paragraphs or pages.

Nevertheless it is obvious that when the goal is to reproduce as faithfully as possible a technique that has existed—and still exists—like Monotype typesetting, the typefaces used are crucial for producing a convincing result.

This is why a tremendous effort has been spent on designing or adapting fonts identical to the ones used in Greek hot lead typography, weither for regular text or for special purposes.

5.1 Regular text

In the West, printers have the privilege of calling typefaces they use by illustrious names: Garamont, Bodoni, Baskerville... In Greece the most commonly used typeface—before the disaster caused to Greek typography by the computer and the «monotonic» spelling reform—is anonymous: people involved in book production simply call it «plain»: ἁπλά. Monotype craftsmen have a better name for it, namely its Monotype denomination, which is «Greek 90» («Greek 91» for italics and «Greek 92» for bold). Our working model is based on three basic sizes with specially adapted shapes for each size: 9, 10 and 12 Didot points [Greek craftsmen still work with Didot points = 0,376 mm, which are slightly bigger than PostScript points = 0,353 mm used by computers]. We have inspected them on a practically miscroscopical level to insure that shapes, accent position and kerning pairs are faithful to the original ones.

Plain straight 12 points.

> Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ 'Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ

Plain italic 12 points.

> *Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ 'Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρόμους τοὺς ὀνειρικοὺς τοῦ*

Plain straight 10 points.

″Οσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ 'Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρόμους τοὺς ὀνειρικοὺς τοῦ σκοτεινοῦ Λονδί-

Plain straight 9 points.

″Οσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ 'Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρόμους τοὺς ὀνειρικοὺς τοῦ σκοτεινοῦ Λονδίνου, στοὺς ἄλλους τοὺς πλατεῖς ἢ τοὺς στενοὺς ποὺ ἐκτείνον-

A bold italic version of the plain typeface is under preparation.

Apart from the basic sizes there are two extremes: 6 points digits used for footnote numbers,

Plain straight 6 points.

0123456789

and a 16 points typeface.

Plain straight 16 points.

″Οσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ 'Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί,

The latter is a very interesting case, since it originates from a hot lead type that has always been set by hand. Even its name (known only by craftsmen) is «16 points out of the case» δεκαεξάρια τῆς κάσας. It is amazing how often this typeface is encountered in Greek books of the middle of the 20th century: sometimes it is just a title, or just a word on the cover, but it is always invariably the same plain 16 points typeface.

This typeface is an excellent example of the positive impact of random or apparently random variation of its components. The same accent on different vowels has quite different shapes and sometimes is placed on surprising positions. A given glyph from this font, taken separately, may seem badly designed or with an

unfortunate position of the accent. But seen as a whole, glyphs from this font produce a very vivid and lively impression, and make reading very enjoyable.

A few books have been printed entirely in the 16 points typeface[11] and reading them is a very special experience.

The problem with plain 16 points is that there is no adequate italics version. In the last decades, craftsmen have used, as a substitute, the italics version of the 16 points Elselvier typeface (see section 5.2 below). This typeface, besides being quite different in style than plain 16 points, has also the disadvantage of being significantly bigger. We have designed this typeface and reduced it slightly so that, at least by its size, it fits with plain 16 points. This is one of the few cases where we have conciously transgressed the principle of visual identity with Monotype output, and this has only been done after concertation with experts of Monotype typesetting[12].

5.2 A variant style: Elsevier

Current computer fonts «Times Greek» (Monotype) and «Times Ten Greek» (Linotype) belong to a different style, which Greek craftsmen call «Elsevier». Elsevier typefaces have been used less frequently than «plain» typefaces described in the previous section. They are mostly used together with «plain» typefaces whenever a block of text has to be distinguished as playing a different role. Books typeset entirely in Elsevier are either technical or general purpose books, and are not considered to be typographically state-of-the-art books. In particular, Elsevier bold or bold italic is sometimes used in conjunction with plain because it is less heavy than plain bold, and because plain bold italic is most of the time unavailable.

Elsevier straight 10 points.

> Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ Ἐπιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαι-

Once again, the situation is slightly different for 16 points types. As mentioned in the previous section, the 16 points Elsevier italics typeface has traditionally been used in conjunction with plain 16 points.

11. For example, *Agra* publisher has a longstanding series of short booklets called «The turbulent rabbit» *Ὁ ἄτακτος λαγός*. Other books, including a text by the great icon painter Kontoglou, are under preparation.

12. We would like to grab the opportunity to thank Mss Georgia Papageorgiou for help in this matter.

Elsevier italic 16 points.

Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ᾽ στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ ᾽Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο,

The straight 16 points Elsevier typeface has also been used occasionally, and we are now preparing its digital counterpart. In a world dominated by texts typeset in «Times» fonts, it is incredible how refreshing a text typeset in a typeface like this can be: while being stylistically quite close to «Times», it keeps the same amount of small imperfections/variations as plain 16 points, giving it that particular artisanal taste.

Elsevier straight 16 points (taken from Γιάννης Ζιώτης, *Μὲ τὸ βλέμμα τῆς νιότης μου*, Διάττων, Athens 2000).

᾽Εκεῖνο τὸ μεσημέρι ὁ ᾽Οδυσσέας δὲν ἦταν στὰ κέφια του. Ὁ πατέρας ἀμέσως τὸ κατάλαβε. «Τί συμβαίνει, ἀγόρι μου; Ἔγινε κάτι στὸ σχολεῖο ποὺ πρέπει νὰ γνωρίζω;» Τὸ παιδὶ προσπάθησε νὰ τὸ κρύψει, ἀλλὰ τὸ πάθος του νὰ μάθει τοῦ ἔλυσε τὴ γλώσ-

5.3 Typefaces for ancient Greek

When it comes to ancient Greek, craftsmen in Greece follow Western paradigms, and more precisely the English one. The two typefaces used in Greece for ancient Greek text—and sometimes also for modern text as stylistic variants—are New Hellenic (called «Attic» ᾽Αττικὰ in Greece) and Porson (called «Pelasgic» Πελασγικά). The latter is most commonly used for text (probably because of the notorious *Oxford Classical Texts*) and the former for inscriptions (probably because of the ultimate collection of inscriptions *Inscriptiones Graecae*).

New Hellenic 12 points.

Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ᾽ στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ ᾽Επιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες

ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρό-

Porson 12 points.

Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ Ἐπιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρόμους τοὺς

Ancient Greek, and especially the transcription of epigraphical material, are a typesetter's challenge since additional symbols are needed (for example, underdotted versions of all letters). Especially the New Hellenic typeface is very well suited for representing ancient Greek engravings on stone, with all possible variations of letters.

But Greek typography is not restricted to Greece: abroad there are still houses publishing ancient Greek texts, and we consider that studying and respecting their traditions is also part of the goal of *digital monotype*. We have done so for one very important case, namely the *Collection Budé*, published by the French house *Belles Lettres*. Historically, this collection has used two typefaces: the first one was designed especially for them in the twenties by a German foundry, and the second one is the Monotype typeface Greek Sans 486 which they started to use in the fifties.

We have studied both cases and have elaborated models for them. The former typeface, which we call «Belles Lettres» since it has been used exclusively by this publisher during the 20th century, has a quite irritating look. In particular, uppercase letters are significantly fatter than lowercase ones. Nevertheless many people—and especially in France—are sentimentaly attached to this typeface because of the importance of the *Budé* collection to Greek studies in France.

Belles Lettres 10 points.

Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ' στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ Ἐπιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρόμους τοὺς ὀνειρικοὺς τοῦ σκοτεινοῦ Λονδίνου, στοὺς ἄλλους τοὺς

Greek Sans 486, 10 points.

Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ᾽ στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ Ἐπιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς δρόμους τοὺς ὀνειρικοὺς τοῦ σκοτεινοῦ Λονδίνου, στοὺς ἄλλους τοὺς

For the sake of completness we have also included in our arsenal the typeface Monotype Greek 472, which is very close to the typefaces used by Harvard's *Loeb* collection.

Greek 472, 12 points.

Ὅσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ᾽ στοὺς δρόμους, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τοῦ Ἐπιταφίου Θρήνου, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρούμενες ποὺ ὁδηγοῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν ποὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκουσθοῦν οἱ ἀναστάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τοῦ καλοκαιριοῦ στοὺς

5.4 Revival of a 19th century typeface

In the West it is quite common to use typefaces which are 2, 3 or even 4 centuries old. Although Garamont has lived in the 16th century, his typefaces (in some cases simplified or slightly modernized) are still used today. This is not the case in Greece: typefaces older than 150 years already seem oldish or even «fac-similish», and their use severely obstructs access to the text contents.

A good friend and colleague of ours at ENST de Bretagne, Prof. Ioannis Kanellos, has started an initiative against this trend, by giving us the opportunity to modelize the typesetting of a very important collection of books: the *Aristotelian Collected Works* by the German scholar Bekker of the Academy of Leipzig. The typeface used in these books, and especially in the earlier volumes, is a pure masterpiece of 18th-19th century Greek typefaces. It has practically no ligatures (besides omicron-upsilon and sigma-tau) but keeps the manuscipt style of earlier Greek typefaces. The placement of accents is amazingly dynamic: in some cases, an accented letter seen out of context seems to be completely wrong. The same letter seems completely natural in the context of a word.

We hope that this typeface, called «Bekkeriana» in honour of Bekker, will contribute to the revival of older Greek typefaces and bring the Greek audience closer to part of the (typographical) history of its language.

Bekkeriana, 11.5 points.

᾽Οσοι ἀπὸ σᾶς γυρίζετε τὴν νύκτα μέσ᾽ στὺς δρόμυς, ἀμέριμνοι ἢ σκεπτικοί, τὴν ἄνοιξι, κατὰ τὴν ἐποχὴ τῦ ᾽Επιταφίυ Θρήνυ, ἢ ἐκεῖ κοντὰ στὶς ὧρες τὶς χαρύμενες πὺ ὁδηγῦν στὴν θριαμβευτικὴν τὴν ἄνωσιν πὺ πάει νὰ γίνῃ Πάσχα, πρὶν ἀκυσθῦν οἱ ἀναςάσιμες καμπάνες, καί, ἀκόμη περισσότερο, τὶς νύκτες τῦ καλοκαιριῦ στὺς δρόμυς τὺς ὀνειρικὺς τῦ σκοτεινῦ Λονδίνυ, στὺς ἄλλυς τὺς πλατεῖς ἢ τὺς στενὺς πὺ ἐκτείνονται γύρω ἀπὸ τὸν Μόσχοβα στὴ Μόσχα, ἢ στὰς ὁδὺς τῆς κάτασπρης ᾽Αθήνας, σὲ δορυάλωτες στιγμὲς τῆς θλίψεως, ἢ σὲ ἀφρόεσσες στιγμὲς εὐδαιμονίας, ὅταν παράθυρα καὶ ἐξώφυλλα χαίνυν διάπλατα ἀνοικτὰ γιὰ νὰ δεχθῦν δροσιὰ καὶ μῦρα, ὅσοι ἀπὸ σᾶς νύκτωρ γυρίζετε στὺς δρόμυς πανευτυχεῖς πὺ ἐκσπερματίσατε, ἢ δυςυχεῖς πὺ κάποια γυναίκα δὲν ἔςερξε νὰ σᾶς δεχθῇ καὶ δὲν ἐςάθη, λίγο ἂν προσέξετε, θὰ ἀκύσετε πολλά, ὅσα στὴν τύρβη τῆς ἡμέρας δύσκολον εἶναι νὰ ἀκυσθῦν.

5.5 Titles

In the *digital monotype* model we also had to consider typefaces specialized into titling. We have modelized an uppercase-only Greek and Latin typeface designed by the Italian factory *Nebiolo*, called «Garaldus» (after Vox's name for the Garamont/Aldus Manutius family of typefaces).

Nebiolo Garaldus 18 points letterspaced.

Α Β Γ Δ Ε Ζ Η Θ Ι Κ Λ Μ Ν Ξ Ο Π Ρ Σ Τ Υ Φ Χ Ψ Ω
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

5.6 Non-Greek typefaces

Travelling and seeing books around the world has convinced us that there is an universal truth about typography: however brillantly typeset a book may be when the text is in the printers writing system, it will have flaws when it comes to other writing systems: we have seen magnificent books in Japan, with akward French excerpts, impressive books in Egypt with completely obvious problems in English text blocks, beautifully typeset French books with horrible Greek words... Greece is unfortunately not an exception to this rule. Indeed, one of the most common problems in current Greek books, is the clumsiness of Latin alphabet insertions, weither it is the choice of typefaces or ignorance of simple typographical rules. For example, as in Greek an apostrophe is always followed by a blank space, it is a common flaw in Greek books to find such blank spaces after apostrophes also in French or English text: «c' est pourtant monstrueux...».

Let us note that we distinguish between obvious errors (like the one mentioned) and the conventions of «nested typography», that is the conventions of one language applied to nested blocks of text in other languages. For example, the text the reader is currently reading is in English, but punctuation follows Greek conventions, and in particular *Agra* conventions, since parentheses and other delimiters are spaced.

But let us return to Latin alphabet insertions. When working on our model of Monotype output, it has become obvious, already at a very early state, that there could be no *digital monotype* without the adequate Latin alphabet typefaces. Strange as it may seem, these typefaces are not at all common outside Greece, at least not anymore. There are, in fact, a derivative of the *Monotype Modern* typeface (with special shapes for italic letters *v* and *w*, probably to distinguish them more easily from Greek upsilon).

When calibrating sizes and weights of this special Latin Monotype Modern font with Greek plain, we came to the conclusion that a very important decision had to be taken. Indeed, the ratio between size of upper and lowercase letters (without ascenders and descenders), is much bigger in the Greek typeface than in the Latin one. As one is forced to keep uppercase letters at the same size (after all, more of the half Greek uppercase letters are completely identical to Latin alphabet letters), inevitably Greek lowercase letters are significantly higher than Latin ones.

Some of the craftsmen we met described this fact as one of the biggest flaws of Greek Monotype typesetting and strongly encouraged us to modify Latin letters so that the ratios become, if not equal, at least much closer. Attempts to do this, have shown that it would break the visual identity with Monotype output. Therefore we have kept this «flaw», which seems quite surprising to colleagues unfamiliar with Greek printing tradition. It would be interesting to conduct a psychological study on the perceptive impact of this difference of size between Greek and Latin letters for the reader. It also would be interesting to know if there have been attempts to escape this tradition and use a different combination of Greek + Latin typefaces.

6 Conclusion

The purpose of many sciences, be it physics, mechanics, chemistry, etc. is to give a theoretical and mathematical model of the world surrounding us. The model of the book, which is the ultimate goal of our research and developments, has to go a step further: it has to include the tools and methods to actually produce its subject, namely the book. In this paper we have shown facets of this model, which have been achieved by actually making books and trying to make them as faithful as possible to tradition.

The book is now entering a new stage of its history: from tablets to papyrus, to manuscripts, to the printed book, now we are entering the era of the *electronic book*.

We know that is going to happen, but we don't know yet what the electronic book will be. And how could we know how it will be, since we don't even really know what the «real» book is. Technological evolutions in the book production process and the ability for anyone of making books using personal computers, have caused an abyss between our generation and the multicentennial tradition of bookmaking.

Before we move to the «electronic» book we must first study what the real book was. The latter is the goal of our research project and the former its first application.

In the case of Greek typography the issue is of crucial importance since Greece is one of the few places in the world where high quality typography is still alive and accessible to the large public. The goal of the *digital monotype* project is to keep it alive.

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