

The font table shows the Ethiopic alphabet, which was designed with METAFONT, and its phonetic representation. The Computer Modern family of fonts served as a raw model almost in every aspect. Fortunately, with slight modification, the CM parameter and driver files (of course under different names) filled a gap that would have required intensive work in defining and generating the font. The font has distinctive characteristics compared with the 'traditional' one. The height of all characters, except the families of "ሸ, ቸ, ሸ, ቸ", is the same. Full calligraphic effects are not added because the 'usual types' don't feature identical calligraphic patterns.

Typesetting Ethiopic Alphabet

One of the serious challenges remaining in this project is that of incorporating the Ethiopic alphabet with the T_EX typesetting system. Now, the testing process is underway, but some problems remain unsolved.

- a. Overall, there are more than 256 characters in the Ethiopic alphabet. Both METAFONT and T_EX can handle 256 characters without problem, but hardware restrictions and the methods of usage require that the number of characters must be adjusted with the keyboard[3].
- b. Let's assume that problem (a) is solved using "ligtable" and "control sequences". Now, for a person who cannot speak and write English, but who wants to use the Ethiopic alphabet to typeset documents, there has to be an "Ethiopic editor". Thus, an interface between the T_EX system and the Ethiopian language must be devised for non-English speaking users.

These are the main problems that require extensive effort in order to make the E^IH_TE_X project fruitful. Hopefully, in the near future, these problems will be solved.

In the Fall of 1987, we were talking 'how we should start the project', but now we are talking 'how we should solve the remaining task', so that the project would be fruitful. The E^IH_TE_X project was done partially as senior project at University of Houston-Downtown. Above all, it wouldn't have been possible to come this far without a profound commitment and genuine participation of Dr. Brian Bourgeois and Dr. Victor Espino, the faculty members of Department of Applied Mathematical Sciences at University of Houston-Downtown.

Bibliography

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- [2] E. Ullendorff, THE ETHIOPIANS, Oxford University Press, 1973, page 126-130.
- [3] Donald E. Knuth, The T_EXbook, Addison-Wesley, 1986 page 43-49.
- [4] Donald E. Knuth, The METAFONTbook, Addison-Wesley, 1986.

Typesetting Modern Greek with 128 Character Codes

Yannis Haralambous and Klaus Thull

*"Ved dette været,
når det regner
så snør det"*

— Frøydís Frósk

In european scripts where diacritical marks are common, there are (at least) two reasons to avoid T_EX's accent mechanism in favor of many accented characters.

One is the possible misplacement of accents by dvitype's rounding algorithm; the second is lack or invalidity of hyphenation. For example, large portions of german text may be unhyphenatable, and, given the german inclination to long words, may not be in shape to be typeset at all. Thus, in Europe, the obvious thing to do is: let METAFONT put the accents onto the letters, then access these characters via T_EX's ligature mechanism.

Accordingly, the greek fonts created by Silvio Levy¹ have 256 characters each, and are a fine tool to typeset greek texts, ancient as well as modern, except those containing the most recent unique accent "·" (see below). But alas, there is the commercial world, whose device drivers just cannot do 256-code fonts (even .px1-fonts were seen on the "Big-Tech" sales exhibition in West Berlin last winter). The free drivers are in better shape generally, but often the commercial ones cannot be disposed of in a hurry. So we decided to reduce these fonts to 128 characters. We kept only the ones strictly necessary for writing modern greek without misusing the \accent primitive. At the same time, we constructed some new fonts, which we describe below.

doesn't have any accents at all, and so may be used in any accent system.

These new fonts are designed to work with the same input as the old accent system. The printed text will follow the current grammar² (at least concerning the accent), with one exception: monosyllables (like articles, prepositions and other auxiliary words) don't take any accent at all. To solve this problem we are working at a Pascal word processor program, based on Fred M. Liang's packed trie device, which will, once given the list of the accented monosyllables, recognize them, and replace them by non-accented words. According to the dictionary of H. Mihiotis³, there are 284 such words, to which we must add many new and foreign words.

Of course, you can write your text in one-accent greek right away (unfortunately there is no "magic" macro to transform it back into multi-accent greek ...). With these new fonts you will get a nice symmetric "universal" accent instead of an acute or a circumflex.

To write in one-accent greek you get into "Greek one-accent mode", by typing `\beginmgreek`. If you are in greek multi-accent mode already, you must use the macro `\monotoniko`. There is also the converse macro `\polutoniko`. So if you want to obtain

Ο Ηράκλειτος ἔλεγε «τὰ πάντα ρεῖ»
καὶ εἶχε δίκιο! ...

you type

```
\beginmgreek Ο Ηr'akleitoc 'elege
\polutoniko
((t\grave{a} p'anta \rhorough e~i))
\monotoniko
kai e'iqe d'ikio!...\endgreek
```

The Greek Numeral Symbols

The so-called Ionian⁴ system of numeration (~fifth century BC) consisted of the following numerals:

A	B	Γ	Δ	E	F	Z	H	Θ
1	2	3	4	5	6	7	8	9
I	K	Λ	M	N	Ξ	O	Π	Ϛ
10	20	30	40	50	60	70	80	90
P	Σ	T	Υ	Φ	X	Ψ	Ω	Δ
100	200	300	400	500	600	700	800	900

The letters F, Ϛ, Δ are called digamma, qoppa, sanpi. They belong to an older alphabet. Later on, as lowercase letters were introduced and as the need for higher numbers grew, the numerals became:

α'	β'	γ'	δ'	ε'	Ϛ'	ζ'	η'	θ'
1	2	3	4	5	6	7	8	9

ι'	κ'	λ'	μ'	ν'	ξ'	ο'	π'	ρ'
10	20	30	40	50	60	70	80	90
ρ'	σ'	τ'	υ'	φ'	χ'	ψ'	ω'	Ϡ'
100	200	300	400	500	600	700	800	900
α	β	γ	δ	ε	Ϛ	ζ		
1000	2000	3000	4000	5000	6000	7000		
		η	θ	M				
		8000	9000	10000				

So, for example, the date *February 16th, 1989* would be written Ϛ' Φεβρουαρίου ,αλπθ and the following equality holds:

$$\sigma\zeta' + \psi\pi\theta' = \rho\delta\varphi'$$

Notice that there is no zero. Zero is, and has always been, the cardinal of the empty set which in Ancient Greece was not considered an entity in its own right.

To express numbers greater than 10,000 there were many ways. One of them was to use 10,000 as a base: thus, for example, 67,536,753 (= 6753 · 10,000 + 6753) was written M,Ϛψνγ·Ϛψνγ.

EXERCISE: If -γωνο means "gon", which of the following polygons can be constructed by rule and compasses?

ιζ'-γωνο, λϚ'-γωνο, δτξθ-γωνο,
ακδ-γωνο, Με'·εφλζ-γωνο, ϠϚϚ'-γωνο.

Let's return now to TEX: you can obtain these symbols by the following macros: `\digamma` for Ϛ, `\vardigamma` for Ϛ, `\Digamma` for F, `\qoppa` for Ϛ, `\Qoppa` for Ϛ, `\sanpi` for Δ, and `\Sanpi` for Δ. To get the tick marks which distinguish units and thousands, you can use `\overstroke` after the numeral, or `\understroke` in front of the numeral.

Symbols for cypriotic greek

The official language of Cyprus is greek. It is also the language used in the mass-media and at school. But the language actually spoken is a dialect, derived from byzantine greek (and as it seems, far more faithful to ancient greek than the one spoken in Greece). Some literature has been written in the dialect, and since there are phonemes not available in the greek alphabet, cypriotic writers use several conventions of new symbols to express them.

In the convention we followed,⁵ the symbols ϣ, Ϥ stand for the sound "sh" (like "shower" in english, or "шашка" in russian), ϥ, Ϧ stand for "j" (like "jazz" in english or "джунгли" in russian), ϧ, Ϩ stand for a ψ followed by a ϣ (like "пшеницза")

in russian) and ξ, Ξ stand for a κ followed by a σ (like in hindi “kṣetriya”).

You can get these symbols by the macros \ssh, \SSH, \dz, \DZ, \psh, \PSH, \ksh, \KSH. Here is an example of a small text using these symbols:

Δικιάλεξες τούς ξερόροτσους, δεντρών μου, νά ριζώσεις,
νά φάεις τήν ζωούλλαν σου, ποττέ σὸν θά στερκώσεις.
Τζι ἐν κανεί πὸν'ξεροκαγιαίς τζι ἐν ἔσει στάξην χῶμα
νά ὄσιεπαστοῦν οἱ ρίξες σου, πλαστήχαν τζι ἄλλ'ἀκόμα.
Οἱ σπαλαθκιές τζαί οἱ βατιές πᾶσιν νά σέ τυλίξουν,
ἐπκιάσαν σε πού τόν λαμόν, σφίγγουν σε νά σέ πνίξουν.
Τζι ἂν πέσει μιά σταξιά νερόν, ἐνά τήν πίνουν ἄλλοι
τζι ἐνά σκεντζέρες τζειαχαμαί, ἕναν ξεροδρομπάλιν.
Ἐθθα ζορτώσεις νά ὄσιαστείς ποττέ τοῦ ἡλιου ἀμμάτι,
γιατ'ἐνά σέ χασκιάζουσιν οἱ σπαλαθκιές τζι οἱ βάτοι.
Τζι ἐσούνη, καχορίζικον, ἐνά δουλεύεις γρόνους
τζαί νά γυρεύεις ἴποσπασιάν πού τούς κακούς γειτόνους.
Τζι οἱ κόποι εἰς τ'ἀνάθεμαν. Μάγκουμου μὲν προκάμεις. . .
τζι ἐσούνη τό χατριν μου, φτωχόν μου, ἕνα κάμεις.

From Ilias Georgiou's "Geloklaman"

On hyphenation

There is still no greek hyphenation list, so one has to use hyphenation from other languages. We have compared on an ordinary text, the standard english (Liang), the german (Schwarz) and portuguese (Rezende)⁶ hyphenation patterns. The results were surprising: on 267 possible hypens, these three patterns missed 199 (!!), 141 and 149 resp, found 46, 115, 111 correct ones and 22, 11, 7 bad ones (the portuguese mistakes were less embarrassing than the german ones). So, for a temporary substitute, we would choose either the german or the portuguese patterns.

And since you will be forced to make corrections by hand, here are the complete actual rules of greek hyphenation:

Let c_1, c_2, \dots, c_n be consonants ($n \geq 2$) and v_1, v_2, v_3, v_4 vowels. Then we have

RULE 1. The combination $v_1c_1v_2$ is separated as $v_1 - c_1v_2$ (ex. πα-ρα-κα-λῶ)

RULE 2. The combination $v_1c_1 \dots c_nv_2$ is separated as $v_1 - c_1 \dots c_nv_2$ if there is a greek word starting with c_1c_2 (λά-σπη, κο-φτε-ρός), else $v_1c_1 - c_2 \dots c_nv_2$ (θάρ-ρος, ἐχ-θρός)

RULE 3. The combinations of vowels $v_1v_2, v_1v_2v_3$ or $v_1v_2v_3v_4$ are not to be separated if they are pronounced as one phoneme (ἄη-δό-νι but ἄ-ήτ-τη-τος, πῖο but πύ-ο).

S. Levy made in his fonts separate characters of all possible accented letters, to prevent problems

of hyphenation (TEX doesn't yet hyphenate words with accents). The only exceptions he made, were the two combinations $\acute{\alpha}$, $\acute{\alpha}$ which occur only on monosyllables.

In our case, to be able to reduce the fonts, we were forced to make accents also of τ , τ , τ , τ , τ (and macros of $\acute{\alpha}$, $\acute{\alpha}$ as already mentioned). This of course adds problems to hyphenation. Nevertheless, τ , τ occur on one- and 2-syllable words only, τ , τ occur rarely and depends on the kind of language one is writing (to find it, you have to go back to older versions of καθαρεύουσα as for example in the following lovely text:

Ἐνῶ ἐσπέραν τινὰ ἐξαντλήσας τὰ μυρολόγια του ἐκοιμάτο ὁ Φρουμέντιος ἐπὶ τῆς ἄμμου τῆς παραλίας, καταβάς ἐξ οὐρανῶν ὁ ἀπόστολος ἐκεῖνος τῶν Σαξόνων ἤνοιξε διὰ μαχαίρας τὰ στήθη τοῦ κοιωμένου, εἰσήγαγε τοὺς ἱεροὺς δακτύλους του εἰς τὴν ὀπὴν καὶ ἐξαγῶν τὴν καρδίαν ἐβύθισεν αὐτὴν εἰς λάκκον πλήρη ὕδατος, ὅπερ ἠγίασεν προηγουμένως. Ἡ φλέγουσα ἐκεῖνη καρδία ἔφριζεν εἰς τὸ ὕδωρ ὡς σμαρὶς ἐντὸς τοῦ τηγανίου, ἀφοῦ δὲ ἐκρύωσεν, ἔθεσε πάλιν αὐτὴν ὁ ἅγιος εἰς τὸν τόπον τῆς καὶ κλείσας τὴν πληγὴν ἐπέστρεψεν εἰς τὸν ἰδικόν του.

Ἐτυχε ποτε, ἀναγνώστὰ μου, νὰ ἀποκοιμηθῆς μὲ ἀνυπόφορον βῆχα, κοιμώμενος νὰ ιδρώσης καὶ ἐξυπνήσας νὰ εὐρεθῆς ἰατρευμένος; Ἄγνοῶν ὅτι εἶσαι καλὰ ἀνοίγεις μηχανικῶς τὸ στόμα, ἵνα πληρώσης εἰς τὸν ἐπικατάρατον βῆχα τὸν συνήθη φόρον. Ἀλλὰ πόσην αἰσθάνεσαι χαράν, μὴ εὐρίσκων εἰς τὸν λάρυγγα τὸ ὄχληρόν θηρίον! Οὕτω ἅμα ἤνοιξε καὶ ὁ Φρουμέντιος τοὺς ὀφθαλμούς, ἠτοιμάσθη νὰ προσφέρῃ εἰς τὴν ἀχάριστον Ἰωάνναν τὴν συνήθη δακρύων σπονδὴν, ἀλλὰ παρὰ πᾶσαν προσδοκίαν οἱ ὀφθαλμοὶ του εὐρέθησαν ξηροὶ καὶ νὰ προγευματίσῃ μᾶλλον ἢ νὰ κλαύσῃ ἤσθάνετο ὄρεξιν μετὰ πολυήμερον νηστείας ὁ καλὸς Βενεδεκτινός.

From Emmanouil Roidis' "The Popess Johanna (1866)"

Note that in one-accent greek, all accented letters are represented by separate characters in the code table, so that no hyphenation problem arises.

Samples, Tables, and Remarks

The font rgrrg10

Καθόταν μπροστά της καὶ τὴν κύτταζε. Νοιώθοντας μιὰ ἀπέραντη εὐχαρίστηση νὰ τὴν βλέπει ἔτσι μπροστά του καὶ ἕνα ἀπέραντο ἀνικανοποίητο πού δὲν μπορούσε νὰ τὴν τραβῆξει στὴν ἀγκαλιά του καὶ νὰ τὴν φιλήσει ἐκεῖ στὸν λαμό πού τὴν εἶχε φιλήσει τὴν μιὰ καὶ μοναδική φορά καὶ εἶχε νοιώσει μέσα του τὴν πῖο

Layout for fonts rgrrg, rgrbf, rgrsl

	'0	'1	'2	'3	'4	'5	'6	'7	
'00x	-	á	â	ã	ä	å	ä	ä	"0x
'01x	ή	ή	ή	ή	ή	ώ	ώ	ώ	
'02x	ώ	ώ	ώ	ι	ι	ι	ι	ι	"1x
'03x	ι	υ	υ	ύ	ϋ	'	υ	ε	
'04x	ε	!	"	"	έ	%	ξ	'	"2x
'05x	()	*	+	,	-	.	/	
'06x	0	1	2	3	4	5	6	7	"3x
'07x	8	9	:	.	'	=	'	;	
'10x	·	A	B	ó	Δ	E	Φ	Γ	"4x
'11x	H	I	Θ	K	Λ	M	N	O	
'12x	Π	X	P	Σ	T	Υ	·	Ω	"5x
'13x	Ξ	Ψ	Z	ó	·	ó	·	ó	
'14x	ó	α	β	ς	δ	ε	φ	γ	"6x
'15x	η	ι	θ	κ	λ	μ	ν	ο	
'16x	π	χ	ρ	σ	τ	υ	ϋ	ω	"7x
'17x	ξ	ψ	ζ	«	.	»	·	ξ	
	"8	"9	"A	"B	"C	"D	"E	"F	

ὁμορφὴ στιγμὴ τοῦ καλοκαιριοῦ κι ὅτι τό καλοκαίρι αὐτό, φτάνοντας στό ἀποκορύφωμά του, εἶχε κιόλας περάσει. Ἄλλὰ δέν εἶχε ἀκόμα περάσει τελείως, γιατί ἐκεῖνη βρισκόταν τώρα μπροστά του. Καί δέν μποροῦσε νά κάνει τίποτα.

The font rgrbf10

Καθόταν μπροστά της καί τήν κύτταζε. Νοιώθοντας μιὰ ἀπέραντη εὐχαρίστηση νά τήν βλέπει ἔτσι μπροστά του καί ἕνα ἀπέραντο ἀνικανοποίητο πού δέν μποροῦσε νά τήν τραβήξει στήν ἀγκαλιά του καί νά τήν φιλήσει ἐκεῖ στόν λαιμό πού τήν εἶχε φιλήσει τήν μία καί μοναδική φορά καί εἶχε νοιώσει μέσα του τήν πιό ὁμορφὴ στιγμὴ τοῦ καλοκαιριοῦ κι ὅτι τό καλοκαίρι αὐτό, φτάνοντας στό ἀποκορύφωμά του, εἶχε κιόλας περάσει. Ἄλλὰ δέν εἶχε ἀκόμα περάσει τελείως, γιατί ἐκεῖνη βρισκόταν τώρα μπροστά του. Καί δέν μποροῦσε νά κάνει τίποτα.

The font rgrsl10

Καθόταν μπροστά της καί τήν κύτταζε. Νοιώθοντας μιὰ ἀπέραντη εὐχαρίστηση νά τήν βλέπει ἔτσι μπροστά του καί ἕνα ἀπέραντο ἀνικανοποίητο πού δέν μποροῦσε νά τήν τραβήξει στήν ἀγκαλιά του καί νά τήν φιλήσει ἐκεῖ στόν λαιμό πού τήν εἶχε φιλήσει τήν μία καί μοναδική φορά καί εἶχε νοιώσει μέσα του τήν πιό

ὁμορφὴ στιγμὴ τοῦ καλοκαιριοῦ κι ὅτι τό καλοκαίρι αὐτό, φτάνοντας στό ἀποκορύφωμά του, εἶχε κιόλας περάσει. Ἄλλὰ δέν εἶχε ἀκόμα περάσει τελείως, γιατί ἐκεῖνη βρισκόταν τώρα μπροστά του. Καί δέν μποροῦσε νά κάνει τίποτα.

The font mrgrrg10

Καθόταν μπροστά της καί τήν κύτταζε. Νοιώθοντας μιὰ ἀπέραντη εὐχαρίστηση νά τήν βλέπει ἔτσι μπροστά του καί ἕνα ἀπέραντο ἀνικανοποίητο πού δέν μποροῦσε νά τήν τραβήξει στήν ἀγκαλιά του καί νά τήν φιλήσει ἐκεῖ στόν λαιμό πού τήν εἶχε φιλήσει τήν μία καί μοναδική φορά καί εἶχε νοιώσει μέσα του τήν πιό ὁμορφὴ στιγμὴ τοῦ καλοκαιριοῦ κι ὅτι τό καλοκαίρι αὐτό, φτάνοντας στό ἀποκορύφωμά του, εἶχε κιόλας περάσει. Ἄλλὰ δέν εἶχε ἀκόμα περάσει τελείως, γιατί ἐκεῖνη βρισκόταν τώρα μπροστά του. Καί δέν μποροῦσε νά κάνει τίποτα.

The font mrgrbf10

Καθόταν μπροστά της καί τήν κύτταζε. Νοιώθοντας μιὰ ἀπέραντη εὐχαρίστηση νά τήν βλέπει ἔτσι μπροστά του καί ἕνα ἀπέραντο ἀνικανοποίητο πού δέν μποροῦσε νά τήν τραβήξει στήν ἀγκαλιά του καί νά τήν φιλήσει ἐκεῖ στόν λαιμό πού τήν εἶχε φιλήσει τήν μία καί μοναδική φορά καί εἶχε νοιώσει μέσα του τήν πιό ὁμορφὴ στιγμὴ

Layout for fonts mrgrrg, mrgrbf, mrgrsl

	'0	'1	'2	'3	'4	'5	'6	'7	
'00x	-	α	α	α	α	α	α	η	"0x
'01x	η	ή	ή	ή	ή	ω	ω	ώ	
'02x	ώ	ώ	ώ	ι	ι	ι	ι	ι	"1x
'03x	ι	υ	υ	ύ	ϋ	'	υ	ε	
'04x	ε	!	"	"	έ	%	έ	'	"2x
'05x	()	*	+	,	-	.	/	
'06x	0	1	2	3	4	5	6	7	"3x
'07x	8	9	:	.	'	=	'	;	
'10x	·	A	B	ó	Δ	E	Φ	Γ	"4x
'11x	H	I	Θ	K	Λ	M	N	O	
'12x	Π	X	P	Σ	T	Υ	·	Ω	"5x
'13x	Ξ	Ψ	Z	ó	·	ó	·	ó	
'14x	ó	α	β	ς	δ	ε	φ	γ	"6x
'15x	η	ι	θ	κ	λ	μ	ν	ο	
'16x	π	χ	ρ	σ	τ	υ	ϋ	ω	"7x
'17x	ξ	ψ	ζ	«	.	»	·	ξ	
	"8	"9	"A	"B	"C	"D	"E	"F	

Layout for font rgrsc

	'0	'1	'2	'3	'4	'5	'6	'7	
'00x	-	`	^	~	ˆ	˜	˘	-	"0x
'01x	ρ	ρ	ϕ	ϕ	ϕ	,	∞	Δ	"1x
'02x	φ	ϕ							"2x
'03x									"3x
'04x		!	"	"		%			"4x
'05x	()	*	+	,	-	.	/	"5x
'06x	0	1	2	3	4	5	6	7	"6x
'07x	8	9	:	.		=		;	"7x
'10x		A	B		Δ	E	Φ	Γ	"8x
'11x	H	I	Θ	K	Λ	M	N	O	"9x
'12x	Π	X	P	Σ	T	Υ		Ω	"10x
'13x	Ξ	Ψ	Z						"11x
'14x		A	B	Σ	Δ	E	Φ	Γ	"12x
'15x	H	I	Θ	K	Λ	M	N	O	"13x
'16x	Π	X	P	Σ	T	Υ		Ω	"14x
'17x	Ξ	Ψ	Z	«	,	»		☉	"15x
	"8	"9	"A	"B	"C	"D	"E	"F	

του καλοκαιριού κι ότι το καλοκαίρι αυτό, φτάνοντας στο αποκορύφωμά του, είχε κιόλας περάσει. Αλλά δεν είχε ακόμα περάσει τελείως, γιατί εκείνη βρισκόταν τώρα μπροστά του. Και δεν μπορούσε να κάνει τίποτα.

The font mgrs110

Καθόταν μπροστά της και την κτύπαζε. Νοιώθοντας μια απέραντη ευχαρίστηση να την βλέπει έτσι μπροστά του και ένα απέραντο ανικανοποίητο που δεν μπορούσε να την τραβήξει στην αγκαλιά του και να την φιλήσει εκεί στον λαιμό που την είχε φιλήσει την μία και μοναδική φορά και είχε νοιώσει μέσα του την πιο όμορφη στιγμή του καλοκαιριού κι ότι το καλοκαίρι αυτό, φτάνοντας στο αποκορύφωμά του, είχε κιόλας περάσει. Αλλά δεν είχε ακόμα περάσει τελείως, γιατί εκείνη βρισκόταν τώρα μπροστά του. Και δεν μπορούσε να κάνει τίποτα.

We conclude with the following remark: people writing french, czech, turkish or other languages with many diacritical marks complain that there is no space left in Computer Modern to incorporate already-accented letters. The solution (in the case of French) that Désarménien⁷ proposed, was to replace greek uppercase letters by the french é, è, ê, ô, î, â, û, à, ù. But then the question is: where to put the greek uppercase letters, which are necessary for mathematical formulas. We answer: if

you have the greek rgr family of fonts, you already have all kinds of greek uppercase letters. Just take them from there! Of course, math families must be restructured in that case since math family 7 cannot be used for those letters anymore. As Gariépy⁸ pointed out already, the inconvenience with this solution is that for every language with accents you will need another cm family of fonts. That's why we still believe that the best once and for all solution would be to be able to work with fonts of 256 characters.

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Erratum:

Chess Printing via METAFONT and T_EX
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Editor's note: Within the METAFONT code for the pawn on p. 171, {dir 135} should be replaced by {dir 315}.