

## The Many Faces of $\TeX$ A Survey of Digital METAFonts

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### 1 Introduction

This article seeks to give a reasonably complete survey of the fonts and METAFonts that are currently available for use with  $\TeX$ . Although I have been primarily interested in cataloguing fonts designed with METAFONT, I also wanted to include information about any other fonts that have been successfully used with  $\TeX$ , i.e., fonts with  $\TeX$  Font Metric files, and a mechanism for the creation of the appropriate ligatures and kerning pairs, be it within the TFM file, or by means of a preprocessor.

I first started compiling this article late in 1987, as a note to myself and my immediate Indological colleagues. But it seemed little extra work to include more information in it about other fonts that I had heard of, and doing this greatly widened its usefulness to  $\TeX$  users in general. But you may still detect a slight Indic leaning.

For those with access to the academic computer networks, I post information about revisions of this article to  $\TeX$ hax from time to time, and send the

latest version of the article to `score.stanford.edu`, where it ends up as `WUJASTYK.TXH` in the directory `TEX.TEXHAX`. This way, people will know from  $\TeX$ hax whether there is enough new stuff for it to be worth downloading the whole article afresh.

I would be grateful for any relevant information that is not already mentioned and, of course, for any corrections. While keeping the memo reasonably concise, I have given all the useful information that I currently have. I have also given everything I know about how to get more information about each font, so follow those leads rather than contacting me directly, in the first instance.

This article is made up of information given to me by others, both in person and through general publication in *TUGboat*,  $\TeX$ hax and the net. My sincere thanks to all the contributors.

### 2 Computer Modern

It may seem odd to start with Computer Modern (CM), the typeface family that most  $\TeX$  users use most of the time, since it was created side by side with  $\TeX$ , and is included in all distributions of  $\TeX$ . Nevertheless, I feel that there is an important point to be made about CM.

When Knuth developed METAFONT, one of the central ideas of the whole project was that of producing *parametrized* typefaces. In Douglas Hofstadter's memorable phrase, METAFONT is a 'knobbed category machine'<sup>1</sup>, and when Knuth announced the capabilities of METAFONT to the world in *Visible Language* it was precisely this parametrization that he emphasized and demonstrated so brilliantly.<sup>2</sup> Later on, Knuth explained that the whole inspiration for METAFONT had arisen from the three ideas of *pens*, *parameters* and *programs*.<sup>3</sup> Hofstadter argued, wrongly I think, that this idea contained basic flaws, and that some of Knuth's implications about using METAFONT to generate different typefaces by twiddling the 'knobs' of a single underlying typeface

<sup>1</sup>Douglas R. Hofstadter, 'Metafont, Metamathematics and Metaphysics: comments on Donald Knuth's Article "The Concept of a Meta-Font"', *Visible Language* **16** (1982), 309-338. This article, and selections from the discussion which it engendered in the pages of *Visible Language* (henceforth *VL*), were republished as chapter 13 of Hofstadter's *Metamagical Themas* (New York, 1986<sup>2</sup>).

<sup>2</sup>'The Concept of a Meta-Font', *VL* **16** (1982), 3-27.

<sup>3</sup>Donald E. Knuth, 'Lessons Learned from Metafont', *VL* **19** (1985), 35-53.

description were misleading.<sup>4</sup> Knuth made it clear that he had never meant to imply that all typefaces could usefully be combined into one single METAFONT (although he did not actually deny the feasibility of such an endeavor), and again emphasized the desirability of trying to incorporate variability into a design.<sup>5</sup>

In view of the vigor with which Knuth has maintained the idea of parametrization, both in discussion and in the actual implementation of Computer Modern, I am very surprised that the following survey of T<sub>E</sub>X fonts does not include a single example of a new typeface created from CM by changing its parameters. In Knuth's own hands, CM is utterly plastic, as was demonstrated so startlingly in his article 'The Concept of a Meta-Font' referred to above, and by the inclusion of such fonts as Computer Modern Funny Roman (CMFF), Unslanted Text Italic (CMU), and the delightful CMFIB (which uses the Fibonacci series for the ratios of several of the CM parameters) in the standard distributions of CM. But none of us has taken up the challenge, implicit in the 62 parameters of CM, to produce a new face for general distribution. It would be very nice, for example, to produce a full set of CMFIB, with bold, slanted, italic, typewriter and other versions. And someone should pick up the gauntlet thrown down by Hofstadter, and try to produce a Times Roman, or a Baskerville or some other familiar face from the CM programs. Knuth has said that we should not blindly copy the old masters, without trying to understand why they produced what they did.<sup>6</sup> How interesting it might be, then, to try to manipulate the parameters of CM to produce a different, but recognizable family of faces. And if the experiment failed, the reasons why it did so would themselves be of great interest. The first sentences of the Introduction to *Computer Modern Typefaces* are:

Infinitely many alphabets can be generated by the programs in this book. All you have to do is assign values to 62 parameters and fire up the METAFONT system; then presto — out comes a new font of type.

Let's do it, but of course in the best possible taste!

<sup>4</sup>I agree with the refutation by Geoffrey Sampson, 'Is Roman Type an Open-Ended System: A Response to Douglas Hofstadter' *VL* 17 (1983), 410–412, in spite of Hofstadter's reply in pages 413–416 of the same issue.

<sup>5</sup>*VL* 17 (1983), 417.

<sup>6</sup>*VL* 17 (1983), 417.

### 3 Devanāgarī

Devanāgarī is the alphabet used for writing and printing Sanskrit, Hindi and several other languages of South Asia, both ancient and modern.

#### 3.1 Knuth

As far as I know, Donald Knuth coded the first Devanāgarī character to be created with METAFONT. This was the single syllable *la*, which Matthew Carter gave to Knuth in 1980 as a challenge to test the capabilities of the then nascent METAFONT. The smoke proof of the character, and several interesting remarks about the experience, were published as 'My First Experience with Indian Scripts', in *CALTIS-84: Special Issue on Calligraphy, Lettering & Typography of Indian Scripts*, (Proceedings of a Delhi 1984 conference).

#### 3.2 Ghosh

An early Devanāgarī font was designed with old METAFONT (MF-in-SAIL) by P. K. Ghosh during a visit to Stanford in 1982–83. Ghosh published what he had done as Stanford Computer Science Report 965: *An Approach to Type Design and Text Composition in Indian Scripts* (Stanford, 1984). One of the valuable aspects of this work was that Ghosh worked from Devanāgarī characters designed and drawn for him by the famous Bombay calligrapher R. K. Joshi. Drawings of these, on a grid, are published in the *Report*. Unfortunately, Ghosh's work was done in a now superseded version of METAFONT, and was not fully worked out at the keyboard level. It also lacked a number of the conjunct consonant clusters necessary for fine Indian typography. The report, however, remains of considerable interest for general background. The source code is available at the University of Washington, through Pierre MacKay (address below), and presumably at Stanford (try Emma Pease). Ghosh has said explicitly that he has no objection to others doing further work on it.

#### Contact

If you wish to contact Ghosh he can be reached at the following address:

National Centre for Software Technology,  
Gulmohar Cross Road 9,  
Juhu, Bombay 400 049,  
India.

#### 3.3 Velthuis

The only fully worked out version of Devanāgarī presently available is that of Frans Velthuis.

### The Font

In November 1987, Frans Velthuis completed version 1.0 of a Devanāgarī METAFONT for T<sub>E</sub>X. He has written METAFONT code for all the *akṣaras* (syllabic characters) necessary for Hindi, and most of those for Sanskrit too, although in the latter case some *virāmas* are used. Frans intends to produce a special Sanskrit version of his font in the future. Also included are the Devanāgarī numerals, *anusvāra*, *virāma*, *daṇḍa*, *candrabindu*, *visarga*, *avagraha*, full stop, and the superscript abbreviation circle.

### Usage

You prepare your T<sub>E</sub>X or L<sup>A</sup>T<sub>E</sub>X file normally, and mark any Hindi portions, typed in a simple Roman transliteration, with a font marker, thus: `{\dn ...}`. At the top of the T<sub>E</sub>X file you `\input` a file called `DNMACS`; in L<sup>A</sup>T<sub>E</sub>X, a `DEV.STY` file is provided which inputs the necessary macros, and automatically makes appropriate font size changes. Frans provides a preprocessor, `DEVNAG`, available compiled for several systems, or in Pascal or C, which reads your file and converts the Hindi transliteration into the appropriate codes for Frans's font. The converted file is then processed by T<sub>E</sub>X or L<sup>A</sup>T<sub>E</sub>X in the normal way, and the resulting DVI file can be printed using a standard DVI output program. The portions of Hindi text originally in Roman transliteration will be printed in Devanāgarī, with full use of conjunct consonants (*sandhyakṣaras*), etc.

### Quality

The quality of the typeface is excellent, with full calligraphic molding of the curves and loops, like some of the best handwriting of manuscript scribes using a broad nib.

### Terms of Availability

Frans will sell a set of four or five sizes of the Devanāgarī fonts, at the printer resolution you specify (Epson-type 9 pin matrix, 24 pin matrix (180 × 180, 360 × 360, 180 × 360), write-white laser, or write-black laser), together with the compiled code (specify VAX/VMS, SUN, Cyber, IBM/PC, Atari ST) of the text preprocessor `DEVNAG`, for \$119. The METAFONT source programs are not at present being made generally available.

### Contact

Frans J. Velthuis,  
Nyensteinheerd 267,  
9736 TV Groningen,

The Netherlands.

Bitnet: `velthuis@hgrrug5`

### Further information

A note about Velthuis's Devanāgarī font appeared in T<sub>E</sub>Xhax, 1987, issue 93. Velthuis intends to publish a full account of his font in a future issue of *TUGboat*.

## 4 Tamil

### 4.1 Arthanari

According to Emma Pease (network response on 10 November 1987 to my query in T<sub>E</sub>Xhax 1987, issue 93) a basic set of Tamil characters for T<sub>E</sub>X was designed and created by T. S. Arthanari when he was at Stanford from May to July, 1985. Emma has the source code but does not want to distribute it further without his knowledge.

### The Font

There are approximately 160 characters in several styles written in a pre-release version of the current METAFONT. Emma has only tried producing characters for one style but had little difficulty in doing so (a few commands had changed). They are rough but look fairly good.

### Contact

T. S. Arthanari's last known address was:  
Quality Informatics Labs, Ltd.,  
312, P. M. G. Complex,  
57, South Usman Road,  
Madras, 600 017, India.

I wrote to Mr. Arthanari in December 1987 to ascertain his intentions concerning his work, and especially to learn whether he is willing and able to allow the source code of his Tamil font to be distributed as public domain software. There has been, as yet, no reply. A colleague is visiting Madras in a few weeks, and will try to make contact with him.

### 4.2 Ramanujan

#### The Font

According to information received by e-mail from Pierre MacKay (Fri Jan 22, 1988), Ramanujan, a graduate student who worked at Washington two years ago, designed a Tamil font in METAFONT84 (I think). According to Pierre, the problem with this, as with Ghosh's Devanāgarī, is that it was arbitrarily developed in a framework that bears no relation to the monotype-based character grid used for Computer Modern, i.e., the characters do not sit in a box or on a baseline that relates in an appro-

priate manner to CM; this is unfortunate, since it makes it almost unusable in an environment with CM. Moreover, it does not make much use of the macro capabilities of METAFONT.

### 4.3 Ridgeway and Schiffman

After a thorough evaluation of the Ramanujan characters, the Humanities and Arts Computing Center at the University of Washington decided that it was better to begin again. Dr. Thomas Ridgeway, director of the Center, in consultation with Prof. Harold Schiffman of the Department of Asian Languages, has almost completed a fully vowelised METAFONT for Tamil. It will be tested during the summer, and should be ready for release in early fall 1988, together with some sort of macro package to make it usable from a Latin-letter keyboard.

Characters are arranged in the font in rough alphabetical order, starting from position zero. We have not found any other coding system which seems definite enough to use as a model. The Tamil phonetic subset of ISCII does not provide nearly enough character positions. It is expected that with this as with many other non-Latin fonts some sort of input preprocessor will be used to mediate between the code used for text-editing and the  $\TeX$  font coding.

#### Contact

Dr. Thomas Ridgeway, Director  
Humanities and Arts Computing Center  
Mail Stop DW-10  
University of Washington  
Seattle, WA 98195, USA  
Phone: (206) 543-6259  
Net: mackay@june.cs.washington.edu

### 4.4 Other Developments

T. K. Rengarajan, a software engineer (Database Systems, Digital Equipment Corporation), e-mailed me on Fri 5 Feb, 1988, and mentioned that he may do a METAFONT Tamil. He can be contacted at:  
Net: ranga%debit.DEC@decwrl.dec.com

## 5 Telugu

### 5.1 Mukkavilli

#### The Font

Recent mail from Lakshmi Mukkavilli indicates her intention, together with her husband Lakshman Kumar Mukkavilli, to implement a Telugu script font in METAFONT. Their work on this font will intensify during the summer of 1988. Incidentally, they are looking for a good Telugu calligrapher and would welcome suggestions. In their opinion, existing Tel-

ugu typefaces are not good, tending to be very heavy along the baseline, which is hard on eyes. So they are not keen on imitating existing typefaces, and will probably create their own.

A note from Lakshmi in May 1988 said that she and her husband have now started working full time on the Telugu fonts using METAFONT, and they expect to start coding METAFONT programs in the second week of June. They are at present deciding on parameters, and the characters for which METAFONT programs are to be written. They are also concerned about how to incorporate context analysis logic in the form of  $\TeX$  macros. Entering text in Roman transliteration and preprocessing the text for input to  $\TeX$  does not seem very attractive to them, although, in the absence of widely available customizable terminals that could cope with Telugu, they may be forced down this path.

Another point of concern is their desire to use the ISCII standard (a version of ASCII for Indian languages). This is the only really widely published standard for the arrangement of the characters of Indian languages in a font grid, and I suspect that all creators of Indic fonts should be using it as far as possible.

#### Contact

Lakshman Kumar Mukkavilli or  
Lakshmi Mukkavilli,  
226 Computer Science,  
Iowa State University,  
Ames IA 50011, USA.  
Phone: (515) 296-7808  
CSnet: lakshmi@atanasoff.cs.iastate.edu  
Uucp: lakshmi!atanasoff

### 5.2 Other Developments

E-Mail from K. Sankara Rao in March 1988 indicates his similar intention to implement a Telugu font in METAFONT. He can be contacted at:  
Department of Electrical Engineering  
North Dakota State University  
Fargo, ND 58105, USA.  
Bitnet: nu043109@ndsuvml

## 6 Perso-Arabic

### 6.1 MacKay

Pierre A. MacKay (TUG Site Coordinator for Unix-flavored  $\TeX$ ) and the Washington team have been working on an Arabic implementation of  $\TeX$  for some years. Their plans are ambitious, and include building a customized version of  $\TeX$ , called  $\TeX$ - $\text{XET}$ , which has a built-in capability for handling

bidirectional text. Details of this change to  $\TeX$  were published by Don Knuth and Pierre MacKay in *TUGboat* 8, issue 1. This is an active project, but MacKay says wistfully that Arabic remains a long-term dream.

### Terms of Availability

$\TeX$ - $\XeT$  can be compiled with the C compiler using `WEB-to-C` and the change file `Cxet.ch`, both of which are part of the Unix  $\TeX$  distribution. Several sites have actually made use of the reflection primitives, and Larry Denenberg of BBN has rewritten the `dvi2ps` device driver to do the correct things with right-to-left text. The Denenberg `dvi2ps` is vastly superior to the old `dvi2ps` in many other ways, and it will become a part of the distribution very shortly. (The driver is available as an FTP file from the pub directory on `june.cs.washington.edu`. Look for `ld_dvi2ps.tar.Z`.) `WEB-to-C` is also available as the file `web2c.tar.Z`, along with `Cxet.ch.Z`.

### Contact

Pierre MacKay,  
Department of Computer Science, FR-35,  
University of Washington,  
Seattle, WA 98195, USA.  
Phone: (206) 545-2386/543-6259.  
Net: `MacKay@June.cs.Washington.edu`

### 6.2 Goldberg

On Monday, 18 Jan 1988, and again on 15 Feb 1988, Jacques J. Goldberg wrote to  $\TeX$ hax (1988, issues 7 and 15), giving details of a package giving the capability of printing Hebrew. He said that an article is currently being written about the package, for submission to *TUGboat* (see under **Hebrew**). At the same time he included a brief note referring to a nearly completed Arabic font.

### The Font

Goldberg said,

An Arabic font is three characters away from completion, but the MetaFounders are near midyear exams and unpaid, so the Arabic font *might* show up around mid March [1988]. (To be precise, their font is Parsi, and some limited work is needed to extend it to full Arabic). ... This needs *no* change either in  $\TeX$  or in DVI drivers: a simple preprocessing of the  $\TeX$  input file and a small additional macro package do it.

### Terms of Availability

It is likely that the Arabic fonts and macros may be distributed on similar terms to the Hebrew; see the **Hebrew** section.

### Contact

For Prof. Goldberg's address see under **Hebrew**.

### 6.3 Other Developments

See also the bitmap Arabic (?) fonts distributed by the **Austin Code Works**.

## 7 Hebrew

### 7.1 Goldberg

On Monday, 18 Jan 1988, and again on 15 Feb 1988, Jacques J. Goldberg wrote to  $\TeX$ hax (1988, issues 7 and 15), giving details of a package giving the capability of printing Hebrew. He said that an article is currently being written about the package, for submission to *TUGboat*.

### The Font

Goldberg says that the package comprises:

- a set of fonts at 8, 9, 10, 12, 17 points in regular type, 10 points slanted and bold, and any magnification on request (1000 off the shelf).
- a 100% portable preprocessor written in C (MSDOS users who do not have a compiler can get the `.COM` file).
- a small set of  $\TeX$  macros.
- a sample file.

### Usage

Hebrew words in Roman transliteration are inserted either by typing first-typed-last-read with the font invoked, which is a pain but 'displays' in natural reading order, or by typing first typed first read as argument of the `\reflect` macro given by D. Knuth and P. MacKay, *TUGboat* 8 (1987), p. 14. Long Hebrew sequences are typed, in first-typed-first-read order, within delimiters. The preprocessor copies non Hebrew sequences to an auxiliary file. Hebrew sequences are parsed into words, and written to the auxiliary file one word at a time after each word has been reflected.  $\TeX$  is then invoked on the file containing the macro package, which itself `\inputs` the auxiliary files, feeding  $\TeX$  with either normal English input or `\lines{ }` adjusted by the macro to the optimal number of Hebrew words.

### Quality

Goldberg is—I suspect unnecessarily—diffident about the quality of the fonts. He calls them 'ugly

fonts not good for anything else than Office documents (drafts, reports, ...)'.

### Future development

Goldberg is looking for a convenient table representing the 22 Hebrew letters by Roman letters. Then the preprocessor could translate to standard ASCII the character codes used in Israel with their special Hebrew terminals, so that anybody with an English-only terminal could write in Hebrew.

### Terms of Availability

Goldberg says,

I do not expect any fee from individuals, but I would be happy if *institutions* that may use this package would later voluntarily contribute \$25 to \$50 [payable to the Treasurer of the University] to help my Department ... pay students employed on font development.

He later added,

All that project is stored and freely available on a Bitnet server. To get the whole package, send an interactive message GET IVRITEX PACKAGE to LISTSERV@TAUNIVM. Arpanet or other nets not interactively connected to Bitnet, just send a MAIL file to that address, with the request GET IVRITEX PACKAGE in the first line (*not* Subject) of the message. Other useful commands to that server are:

GET IVRITEX FILELIST to get a directory of the project, and  
INFO FILES to get instructions how to sign up for automatic updates.

### Contact

Prof. Jacques J. Goldberg,  
Department of Physics,  
Technion-City,  
32000 Haifa, Israel.  
Bitnet: phr00jg@technion  
If you are not on Bitnet, try:  
phr00jg%technion.bitnet at  
forsythe.stanford.edu

### 7.2 Other Developments

See also the experimental Hebrew font described under the heading **Georgia Tobin**, and the bitmaps distributed by the **Austin Code Works**.

## 8 Greek

### 8.1 Levy

#### The Font

Regular, bold, and typewriter versions of the Greek alphabet have been coded in METAFONT84 by Silvio Levy of Princeton, starting from the Greek character set created by Don Knuth as part of the CM family, but with all accents, breathings, correct spacing, ligatures, and macros to implement a convenient Roman transliteration for input. The font is suitable for both classical and modern Greek.

Full details and illustrations of the use of the fonts have been given by Silvio Levy in his two publications:

'Typesetting Greek', in *T<sub>E</sub>X Users Group Eighth Annual Meeting: Conference Proceedings*, edited by Dean Guenther (Providence: TUG, 1988), 27-33.

'Using Greek Fonts with T<sub>E</sub>X', *TUGboat* 9 (1988), 20-24.

#### Terms of Availability

Silvio Levy has released his Greek fonts freely, without charge (and without any warranty). He maintains an electronic mailing list of interested parties, and the METAFONT source is available to Arpanet users by anonymous FTP from `princeton.edu`.

#### Contact

Silvio Levy,  
Math Department, Fine Hall,  
Princeton University,  
Washington Road,  
Princeton, NJ 08544, USA.  
Phone: (609) 452-5790  
Net: `levy@princeton.edu`

### 8.2 Kelly

Issue 14 of UKT<sub>E</sub>X 1988 (Fri, May 20), the UK's answer to T<sub>E</sub>Xhax, put out from Aston by Peter Abbott (`abbottp@aston.ac.uk.bitnet`), carried a notice by Christopher P. Andrasic (of Cranfield) reporting some Greek fonts.

#### The Fonts

Brian Hamilton Kelly (also at Cranfield) created these Greek fonts using METAFONT84. The METAFONT sources of the non-Math Greek fonts are contained in the files `CMGI10.MF`, `CMGTT10.MF`, `CMG10.MF`, `CMG810.MF`, and `GRKTXM.MF`. As far as I know, there are no macros or preprocessor offered for implementing the font at the keyboard level.

**Terms of Availability**

These fonts are being offered for general, free release. They are available for FTP within the UK, from the directory `public.mffiles` of the UK $\TeX$  archive at Aston.

**Contact**

Christopher P. Andrasic  
Net: `rm001a@uk.ac.cranfield.cdvc`

**9 Cyrillic****9.1 MacKay**

Pierre MacKay reports that the Washington team is working on Old Russian (more or less Old Church Slavonic, but specifically designed for the Slovo).

**Contact**

For Prof. MacKay's address, see under **Arabic**.

**9.2 MF Slavic Family**

This family of Cyrillic fonts is described under **Georgia Tobin**.

**9.3 AMS**

The American Mathematical Society has developed a post revolution Cyrillic font, in old METAFONT79, and a set of macros to implement it comfortably. Details of the font, with examples of its use, and grids of the character set were published in *TUGboat* **6** (1985), 124 ff.

**Terms of Availability**

Same terms and contact addresses as described under **AMSFonTS**.

**9.4 Other Developments**

See also the Cyrillic bitmap fonts distributed by the **Austin Code Works**.

**10 Turkish****10.1 Washington****The Font**

Pierre MacKay informs me (Jan 22 1988) that work on properly accented Roman-letter Turkish fonts in METAFONT has been undertaken at the University of Washington by himself and Walter Andrews. The accented characters are developed from Computer Modern descriptions, so as to maintain the maximum possible compatibility with the Computer Modern faces. Andrews and MacKay have published a description of their work as:

'The Ottoman Texts Project' in *TeX Users Group Eighth Annual Meeting: Conference Proceedings*, edited by Dean Guenther (Providence: TUG, 1988), 35-52.

Pierre also wrote on 'Turkish Hyphenations for  $\TeX$ ' in *TUGboat* **9** (1988), 12-14. See also the note in *TUGboat* **8** (1987), 260.

**Contact**

For Prof. MacKay's address, see under **Arabic**.

**11 Japanese**

In order to typeset Japanese text it is insufficient merely to have a Japanese font. There are several problems, including the very large size of the Japanese character set, which mean that a modified implementation of the  $\TeX$  system as a whole is necessary.

Some of the issues concerned in using  $\TeX$  for typesetting Japanese were surveyed by Nobuo Saito and Kazuhiro Kitagawa of Keio University, Yokohama:

'What Should We Do for Japanese  $\TeX$ ', in *TeX Users Group Eighth Annual Meeting: Conference Proceedings*, edited by Dean Guenther (Providence: TUG, 1988), 53-56.

Saito and Kitagawa have taken Pat Monardo's Common  $\TeX$  as the starting point for a series of modifications to  $\TeX$  itself that have some features in common with the ASCII Corporation's work, described below.

I recently received a comprehensive message from Edgar M. Cooke about the current state of  $\TeX$  in Japan. Most what follows is reproduced verbatim from this message.

At present, two publicly available versions of  $\TeX$  are being distributed that support Japanese, and one further version is supposed to become available shortly. These are not entirely mutually compatible, and each has its strong and weak points.

**11.1 ASCII Corporation**

The ASCII Corporation is a microcomputer oriented publishing and software house that has taken a strong interest in  $\TeX$  for their own publishing work, and whose UNIX support section has produced and distributes the Japanized version of  $\TeX$ .

ASCII's version was implemented without concern for 100% internal compatibility with Knuth's  $\TeX$ , and cannot pass the TRIP test (N.B.: it is closer to passing as of version 1.0). However, the output of an identical English  $\TeX$  input file is, to the best of my knowledge, identical with that of

standard  $\text{T}_{\text{E}}\text{X}$ . They have added a few primitives (concerned with spacing between the ideographs and letters, etc.) useful in handling Japanese or Japanese with Romanized languages, and have created a variant of TFM which they call JFM (but which still has the TFM extension, although it is internally identifiable by a coded ID byte). The purpose of this is to allow one font to hold the more than 6000 characters of a typical Japanese font. It also differs in other ways, notably that the ligature table (unnecessary in Japanese) has been replaced by a 'glue table', which handles much of the information necessary concerning spacing between the characters (which usually appear without distinction between inter-character and inter-word spaces, unlike in modern Western languages).

### Terms of Availability

At present, the ASCII Corporation is freely distributing this implementation in the form of sources including change files for  $\text{I}\text{N}\text{I}\text{T}_{\text{E}}\text{X}$ ,  $\text{V}\text{I}\text{R}\text{T}_{\text{E}}\text{X}$ , and  $\text{B}\text{i}\text{B}\text{T}_{\text{E}}\text{X}$ , and Japanized macro files for plain  $\text{T}_{\text{E}}\text{X}$ ,  $\text{L}\text{A}\text{T}_{\text{E}}\text{X}$ , and  $\text{S}\text{L}\text{T}_{\text{E}}\text{X}$  (with the  $\text{L}\text{A}\text{T}_{\text{E}}\text{X}$  style files), and they include the source for a (just adequate) printer driver for the Canon LBP-8 that uses its internal Japanese character set, and JFM files for point sizes 5 through 10 of a standard ('Mincho' = Ming Dynasty style) typeface and of an emboldened ('Gothic') typeface which can probably be used with a number of different pixel font sets, e.g., the internal Canon LBP-8 set, (but which in ver. 1.0 is based on the Dai Nippon Printing Co. [DNP] fonts). A printer driver and X-windows previewer handling the DNP fonts is now available.

### Contact

ASCII Corporation,  
Sumitomo Minamiaoyama Building,  
5-1-5 Minamiaoyama Minato-ku,  
Tokyo 107, Japan.

### 11.2 $\text{J}\text{T}_{\text{E}}\text{X}$

The following articles on  $\text{J}\text{T}_{\text{E}}\text{X}$  and its fonts, by Yasuki Saito, have appeared:

'Japanese  $\text{T}_{\text{E}}\text{X}$ ', *TUGboat* 8 (1987), 103-116.

' $\text{T}_{\text{E}}\text{X}$ :  $\text{J}\text{T}_{\text{E}}\text{X}$ ', in  *$\text{T}_{\text{E}}\text{X}$  Users Group Eighth Annual Meeting: Conference Proceedings*, edited by Dean Guenther (Providence: TUG, 1988), 57-68.

$\text{J}\text{T}_{\text{E}}\text{X}$  was developed by Yasuki Saito of Nippon Telephone & Telegraph (NTT). Saito's policy has been to attempt to avoid radical changes to standard  $\text{T}_{\text{E}}\text{X}$  as much as possible, but this increased compatibil-

ity has led to problems: since a font can have only 256 characters, the number of fonts one needs even to support a single real Japanese font set (33) tends to be quite large, even if one only declares the fonts corresponding to the various sections of the original font that include characters that have actually been input into the document.

A standard (but ugly) set of Japanese characters that is in the public domain (known as the JIS fonts, for the Japanese Industrial Standards Institute, which is responsible for the (abjectly arbitrary) standard coding of Japanese characters and for making the font set available) is included with  $\text{J}\text{T}_{\text{E}}\text{X}$ . This originally consisted of only 1 size, namely characters described in a 24-dot square matrix, but Saito mechanically generated 36-, 48-, and 72-dot fonts to imitate other point sizes or  $\backslash\text{magsteps}$ . This set is not very high quality by any standard, but it is the only public domain font known to me [Cooke].

Yasuki Saito has also collaborated with Dai Nippon Printing Co. to make their industry standard fonts available—but for a price: 95,000 Japanese yen.<sup>7</sup>

Saito's 1988 article, cited above, includes a section describing the JIS and DNP Japanese fonts, with illustrations.

$\text{J}\text{T}_{\text{E}}\text{X}$  has 240, 300, 400, and 480 dpi fonts available currently. Please note that 6000+ characters makes for a largish distribution tape—the rudimentary set of JIS fonts in an adapted GF format with TFM's takes up about 10 M of disk space, while the PXL, GF, and TFM files for the DNP Mincho and Gothic fonts very nearly fill an entire 2400 ft mag-tape at 6250 bpi! I had a chance to measure these more carefully:

DNP fonts		JIS fonts	
GF Mincho	49,312,713	PXL	11,321,384
GF Gothic	43,401,652	GF	7,729,124
TFMs	559,152	TFMs	137,417
<b>Total bytes</b>	<b>93,273,517</b>		<b>19,187,925</b>

In other words, non-trivial.

### Terms of Availability

$\text{J}\text{T}_{\text{E}}\text{X}$  is in the public domain, and comes free with the JIS fonts. In Japan, the Japan Society for Software Science and Technology distributes it.

<sup>7</sup>ASCII and SONY are also negotiating with Dai Nippon to allow similar font sets to become available for different resolutions of printers, and, if we are lucky, a vector stroke typeface of high quality that is applicable to various sizes and resolutions may become available next year.



J<sub>T</sub>E<sub>X</sub> is available in the US by anonymous FTP from `turing.stanford.edu`. The Tops-20 version is installed on Turing in directory `PS:<JTEX>`.

The UNIX version is being distributed for the time being by Yasuki Saito, with source files for pretty much what ASCII has, but with an Imagen printer driver that handles external Japanese font data and an X-windows previewer for J<sub>T</sub>E<sub>X</sub>, as well as a version of DVI2PS supporting Japanese, but no support for Bi<sub>T</sub>E<sub>X</sub> or Sli<sub>T</sub>E<sub>X</sub> is offered.

But in a note to T<sub>E</sub>Xhax 1987, issue 106 (Fri 25 Dec), Hideki Isozaki announced that he has prepared L<sub>A</sub>T<sub>E</sub>X and Sli<sub>T</sub>E<sub>X</sub> files to work with J<sub>T</sub>E<sub>X</sub>.

### Contacts

Yasuki Saito,  
NTT Electrical Communications Laboratories,  
NTT Corp., 3-9-11  
Midori-cho Musashina-shi,  
Tokyo 180, Japan.  
Phone: +81 (422) 59-2537  
Net: `yaski%ntt-20@sumex-aim.stanford.edu`

Hideki Isozaki,  
NTT Software Laboratories,  
JUNet: `isozaki@ntt-20.ntt.junet`  
CSNet: `isozaki@ntt-20.ntt.jp`  
Arpa: `isozaki%ntt-20@sumex-aim.stanford.edu`

### 11.3 Other Developments

There is a version of Japanese T<sub>E</sub>X that is likely to become available from Canon which resembles J<sub>T</sub>E<sub>X</sub>, but it may take a *long* time for the management at Canon to make anything available to the public domain, so it may not be available until some time next year.

Similarly, IBM Japan has a Japanese version based on the Canon algorithm (which was also the stimulus for the Saito's J<sub>T</sub>E<sub>X</sub>).

The Bitstream Kanji fonts could almost certainly be integrated into the above Japanese T<sub>E</sub>X implementations (see **Bitstream**).

### 11.4 Conclusion

There has been a meeting of the leaders and interested parties of J-TUG about whether it is possible to merge these three versions, and a number of suggestions and guidelines have been set forth. But lacking a central authority figure along the lines of a Donald Knuth has limited this from going beyond recommendations.

All three parties are working on improving the inherent quality and mutual compatibility of their versions, and I expect that they will be working on

this throughout the next year (all this being more or less volunteer work). Except for the fact that just about none of the other utilities (DVITYPE, etc.) seem to work with the ASCII version (except T<sub>F</sub>to<sub>P</sub>L and <sub>P</sub>Lto<sub>T</sub>F to preen J<sub>F</sub>M's), I suspect that it is a leading contender, because

- they are promoting it through prompt and widespread distribution of the sources advertised in their own and others' publications, and
- because they have obviously lavished a good deal of care in attending to details of Japanese printing practice that make it at least as good as either of the others — in addition, of course, to removing the burden of having to deal with a plethora of fonts each comprising a tiny fragment of a whole Japanese font set.

### Contact for all Japanese T<sub>E</sub>X

Edgar M. Cooke is prepared to act as a clearing house for T<sub>E</sub>X going into and coming out of Japan. He can be contacted at:

Software Research Association Inc.,  
1-1-1 Hirakawa-cho,  
Chiyoda-ku,  
Tokyo 102, Japan.  
Net: `cooke%srava.sra.junet@uunet.uu.NET`<sup>8</sup>

Edgar Cooke is in close touch with Pierre MacKay, and has sent Pierre the two versions of Japanese T<sub>E</sub>X (ASCII Corp. and J<sub>T</sub>E<sub>X</sub>) mentioned above.

## 12 Chinese

Work done on a Chinese MET<sub>A</sub>font by Gu Guoan and John D. Hobby is available by anonymous FTP from `june.cs.washington.edu`, in the directory `/pub`, as the (large) file `CHINESE.TAR.Z`. This was written up in *TUGboat* 5 (1984), pp.119-136. (This is a reprint of the Stanford Computer Science Report 974 by Gu Guoan and J. D. Hobby: *A Chinese Meta-font* (Stanford, 1983).)

## 13 International Phonetic Alphabet

### 13.1 Washington State University

Dean Guenther informs me (June 22, 1988) that Washington State University has an IPA font available. It contains 128 popular IPA characters and diacritics as specified in the *Phonetic Symbol Guide*

<sup>8</sup>N.B. It is possible to reply to any mail he will send you by 'R' or 'r' from the Unix `mail(1)` program, but then it will come via CSnet, which (although days faster) is prohibited to non-member, non-academic institutions such as his.

by Geoffrey K. Pullum and William A. Ladusaw (Chicago, London, 1986). Janene Winter did the METAFONT work on this font. The character positions were coordinated with help from Helmut Feldweg at the Max-Planck-Institut für Psycholinguistik in the Netherlands, Christina Thiele at Carleton University and some ideas from Brian MacWhinney at Carnegie Mellon and Karen Mullen at the University of Kentucky at Louisville.

The font also comes with a set of macros to access the characters easily. For example, `\schwa` prints what you would expect.

### Terms of Availability

The Washington State University IPA is available for \$100. The package includes GF, PXL or PK fonts at 9, 10, 11 and 12 point (together) in the Roman bold and slanted faces (together). The typeface is designed to match the CM Roman face. The METAFONT source is not included.

### Contact

Send a note to Dean Guenther at `guenther@wsuvm1` on Bitnet, or write to:

TEX<sub>1</sub> Distribution,  
Computing Service Center,  
Washington State University,  
Pullman, WA 99164-1220, USA.

### 13.2 Other Developments

Georgia Tobin (q. v.) has an IPA font, created in old METAFONT79.

A bitmap IPA font, `ph10`, was created by Jean Pierre Paillet for use with T<sub>E</sub>X for typesetting the *Canadian Journal of Linguistics*. This font is described, with a printout of the character grid, by Christina Thiele in

'T<sub>E</sub>X, Linguistics, and Journal Production' in *TEX Users Group Eighth Annual Meeting: Conference Proceedings*, edited by Dean Guenther (Providence: TUG, 1988), 5-26.

`ph10` is now superseded by the Washington State University font.

According to a note from G. Toal in UKT<sub>E</sub>X 1988, issue 2, Tibor Tscheke's company, Stürtz AG, also has an IPA font for sale. Toal does not state whether this font was created with METAFONT, but the implication is that it is usable with T<sub>E</sub>X. Contact:

Tibor Tscheke,  
Head, Computer Science Department,  
Universitätsdruckerei,  
H. Stürtz AG,

Beethovenstraße 5,  
D-8700 Würzburg,  
West Germany.

Kris Holmes and Chuck Bigelow also report that they have a bitmap IPA font. See **Lucida**.

### 13.3 Ridgeway

A phonetic alphabet has been developed by Thomas Ridgeway for a large subrange of American Indian languages. The first active projects using this are in Salish and Navajo. This font is presently being tested and will be available from the Humanities and Arts Computing Center at the University of Washington in early fall 1988.

### Contact

See under **Tamil** above.

### 14 Elvish

Elvish, or more properly, Tengwar, is the script used by the elves of Middle Earth. It was described by J. R. R. Tolkien.

#### 14.1 Urban

On 4 Dec 1986 (*sic*) Mike Urban released the METAFONT code for the Tengwar script through the Usenet newsgroup `comp.text`.

### The Font

Mike said the following:

[Here are the] METAFONT sources for a digitized version of the Tengwar (Elvish script) created by J. R. R. Tolkien. They have only been tested on a 300dpi laser printer. No guarantee of the quality of either the code or the output is offered. I'm not particularly satisfied with the quality of the code (my first non-trivial attempt to use METAFONT), but the results look OK to me.

### Contact

Michael Urban,  
TRW Inc., R2/2009  
One Space Park,  
Redondo Beach, CA 90278, USA.  
Phone: (213) 812-0632  
Net: `urban@spp2.UUCP`

### 14.2 Other Developments

See also the Elvish bitmap fonts available from the **Austin Code Works**.

## 15 Georgia Tobin

Georgia Tobin is well known to readers of *TUGboat* as the editor of, and chief contributor to, the 'Font Forum' section of the journal. She has been working with METAFONT since 1982, and between 1982 and 1987 she created several complete families of fonts for use with T<sub>E</sub>X. (Georgia's husband Rick works with her on the fonts.) Because much of her earlier work was done using METAFONT79, which is now superseded, only the bitmaps of these early fonts are available but not the METAFONT source code.

The bitmap fonts are mostly at 300dpi, and are optimized for write-black imaging machines (i.e., Apple, Canon, HP, and certain other laser printers). The fonts are available at a wide range of sizes ranging from 5 to 72 points (some of the less common fonts are available in a narrower range of sizes, say from 5 to 36 point). One particular subset of these fonts, marketed by Personal T<sub>E</sub>X Inc. as a package called MF Medley, consists of the Chel fonts at 5, 7, 10 and 12 point sizes, with Copperplate and Schoolbook at 36 and 48 point, and Black Letter at 36 point. The MF Medley is available at 180, 240 and 300dpi, with some fonts available at 118dpi too, and costs \$100.

An important point to notice is that the Roman, Chel and Schoolbook families described below include math symbol and extensible fonts, like Knuth's CM, so that these fonts can be used for the full range of mathematical and technical typesetting as defined in the PLAIN format and L<sup>A</sup>T<sub>E</sub>X.

Georgia's newer work on Schoolbook, Hebrew, ALA and Special Effects typefaces, described below, is all done in METAFONT84, the current and stabilized version of METAFONT, and is therefore much more flexible. Fonts of these faces can be generated at any reasonable resolution, and for any marking engine with a defined mode. One hopes that Georgia will find some way of making her METAFONT source code available to bona fide users of her newer typefaces, without of course jeopardizing her livelihood.

### 15.1 MF Chel Family

The Chel ('Computer Helvetica') family of sans-serif fonts was initially created by Thom Hickey in a Tandem TAL translation of METAFONT79 (later recoded into Apollo Pascal using the MAP preprocessor). He began work on the font in the winter of 1980, and continued to work on the font until 1982.<sup>9</sup> Chel was later completed and extensively

<sup>9</sup>Reference to Hickey's work on Chel, with an illustration of the MF code for the letters 'B' and 'b',

reworked by Georgia Tobin. In its finished form, Chel has been described as 'lighter and more compact' than the Computer Modern sans-serif (CMSS) which was designed by Richard Southall and is included in all CM distributions. Chel comprises fifteen fonts including Chel Book, Slant, Medium Bold, Slanted Medium Bold, Bold, Slanted Bold, Extra Bold, Slanted Extra Bold, Math Symbols, Bold Math Symbols, Math Italic, Bold Math Italic, Math Extensible, Elite, Bold Elite, Pica and Bold Pica.

### 15.2 MF Roman Family

This family comprises more than nineteen Times Roman style seriffed fonts, including Roman Text, Slanted Text, Italic, Unslanted Italic, Medium Bold, Medium Bold Italic, Bold, Bold Italic, Extra Bold, Extra Bold Italic, Titling (Small Caps), Slanted Titling, Math Symbol, Bold Math Symbols, Math Italic, Bold Math Italic, Math Extensible, Elite and Pica. The last two fonts are 12 cpi and 10 cpi typewriter style fonts respectively, and include slanted and emboldened versions.

### 15.3 MF Slavic Family

The Slavic Family of fonts includes all the fonts necessary for sophisticated typesetting in Russian. The family includes Chel-compatible and Roman-compatible versions of Cyrillic in Book, Slant, Bold and Bold Slant versions, and also an Italic version of the Roman-compatible face. There are further 'additional' fonts corresponding to each of these categories which contain extra accents and characters used in typesetting other Slavic languages.

### 15.4 MF Decorative Family

Also offered is a decorative package of fonts which includes six typefaces, including Black Letter, a Copperplate Script, Hodge Podge (including assorted dingbats, pharmacy and planetary symbols, a turtle and a frog), an Outline Helvetica (upper case), and a Slanted Outline Helvetica (also upper case), and an Uncial Majuscule which emulates a medieval manuscript script.

### 15.5 Century Schoolbook

Georgia is close to finalizing a first release version of a Century Schoolbook typeface. This is the first fruits of her work with the new METAFONT84. Her goal has been to create a complete Century Schoolbook style typeface that is clean and legible from

is made in Knuth's 'Lessons Learned from Metafont' (1985), 37-38.

very low resolutions (about 72dpi is the lowest so far) to very high, and in point sizes from 5 to 96 or so.

### 15.6 MF ALA

Another project has been the creation of METAFONT fonts which include the special character set defined as a standard by the American Library Association (ALA) and used by the Library of Congress and other bodies influential in the library automation world, such as OCLC. This set of characters and accents was designed to make possible the representation, if necessary in a standard Roman transliteration, of virtually all the world's languages. The characters include items like upper and lower case thorn, Polish dark *el* (with a cross bar), eth, and several other unusual signs and accents. There is even a *candrabindu* for Sanskritists! Georgia did this work for the Library of Congress. The font is available in Text, Bold, Italic, and Bold Italic.

The ALA fonts contain 256 character positions, and therefore require a robust DVI driver program such as the members of Nelson Beebe's DVI driver family or the latest release of the Arbortext drivers.

### 15.7 Hebrew

Georgia is developing a Hebrew typeface, which is still at an experimental stage. At the present time it consists of 27 characters, with more calligraphic molding of the strokes than is shown in Goldberg's font. However, Georgia has not developed any macros or preprocessors for inputting Hebrew text in quantities, as Goldberg has. It would be advantageous if Georgia and Goldberg were to standardize on a common font layout, so that any macro/input system would be able to access either of their fonts.

### 15.8 Special Effects

Georgia published 'The ABC's of Special Effects' in *TUGboat* 9 (1988), 15-18, in which are demonstrated several fascinating typographical effects that are relatively simple to produce with clever use of METAFONT84 macros. The article includes the METAFONT code illustrating how the effects were produced.

### Terms of Availability

The Chel, Roman, Slavic, Decorative and Century Schoolbook font families are available on a commercial basis from the following sources:

ASCII Corporation,  
Sumitomo Minami Aoyama Bldg.,  
5-11-5 Minami Aoyama,

Minato-ku,  
Tokyo 107, Japan.

DocuSoft Publishing Technologies,  
Suite 300,  
1120 Hamilton Street,  
Vancouver, B. C. VV6B 2S2,  
Canada.

Interbase,  
Dantes Plads 1,  
DK-1556 Copenhagen V,  
Denmark.

Personal T<sub>E</sub>X, Inc.,  
12 Madrona Avenue,  
Mill Valley, CA 94941,  
USA.

T<sub>E</sub>Xpert Systems Ltd.,  
5 Northernhay Square,  
Exeter EX4 3ES,  
Devon, UK.

Georgia has some fine catalogues illustrating the Roman, Chel and Decorative families: send a cheque for \$6 (\$15 outside USA or Canada) to:

Georgia Tobin,  
1888 Barnard Drive,  
Powell, Ohio 43065.  
Phone: (614) 764-9863.

## 16 Blackboard Bold

### 16.1 Robert Messer

Robert Messer published an article 'Blackboard Bold' in *TUGboat* 9 (1988), 19-20, in which he generalized a method used by Knuth in *The T<sub>E</sub>Xbook* to produce such characters. This is a series of Plain T<sub>E</sub>X macros which jiggle the characters of CM around, using small kerns and the capital I and small rules, to produce a 'poor person's blackboard bold'.

### 16.2 Other Developments

See also **Custom fonts & Pandora**, and the **AMSFonTS package**.

## 17 APL

The APL programming language requires many unusual symbol characters, which often baffle normal typesetting and word processing systems.

### 17.1 Hohti and Kanerva

Aarno Hohti and Okko Kanerva of the University of Helsinki have developed an APL font for use with T<sub>E</sub>X. They have 'raided' the CM character set to this

end, so the characters should be similar in weight and style with CM.

The font is described in the article 'Generating an APL Font' in *TUGboat* 8 (1987), 275-278.

### Terms of Availability

The authors can be contacted at:  
University of Helsinki,  
Department of Mathematics,  
Hallituskatu 15,  
SF-00100 Helsinki,  
Finland.

I assume that the fonts are being freely distributed, since the METAFONT code for them is available for anonymous FTP as file CMAPL10 from `score.stanford.edu`, in directory <TEX.TUGBOAT>.

## 18 AMSFonts Package

The American Mathematical Society (AMS) has developed several fonts of symbols and alphabets intended for use in mathematical notation.

### 18.1 The Fonts

Three alphabets, collectively known as Euler, were designed by Hermann Zapf and implemented in METAFONT at Stanford as part of the T<sub>E</sub>X project. They come in both medium and bold weights, and include Fraktur, script and an upright cursive alphabet, which was intended to minimize problems with the placement of accents and indices. The Euler fonts are considered proprietary, and sources are available only under lease.

Two fonts of symbols, including a Blackboard Bold alphabet, are also available. Details of these fonts, including character grids, were published in *TUGboat* 6 (1985), 124 ff. These fonts are still rendered in METAFONT79, which is totally incompatible with the current METAFONT, so distribution of the sources is pointless; arrangements are being made for their re-implementation in new METAFONT, but the schedule is uncertain.

### 18.2 Terms of Availability

Together with Cyrillic (see under **Cyrillic**) fonts, this collection is called AMSFonts. A set of TFM and 300GF files (`magstep0` only) is available:

- by anonymous FTP from directory <TEX.AMSFONTS> at `score.stanford.edu`;
- as part of the standard distribution from Maria Code;
- as part of other major T<sub>E</sub>X distributions.

The AMSFonts are available from the AMS in a full range of magnifications and in additional resolutions

on IBM PC-compatible and Macintosh diskettes and on mag tape in VAX/VMS format. For information, contact:

AMS T<sub>E</sub>X Library,  
American Mathematical Society,  
P. O. Box 6248,  
Providence, RI 02940, USA.  
Phone: (401) 272-9500 or (800) 556-7774  
Internet: `sse@math.AMS.com`

Contact for technical inquiries:

Barbara Beeton,  
(same address)  
Phone: (401) 272-9500  
Internet: `bnb@seed.AMS.com` or  
`bnb@xx.lcs.MIT.edu`

## 19 Custom Fonts & Pandora

### 19.1 Custom Fonts

If you are desperate for a T<sub>E</sub>X font that does not yet exist, why not commission a METAFONT programmer to create it?

Neenie N. Billawala advertises her services as a METAFONT consultant in *TUGboat*. She is responsible for creating the fine calligraphic capitals that are part of the Computer Modern typeface family (in the CMSY fonts).

### 19.2 Pandora

Neenie, a designer, has also created a new typeface called Pandora, which is part of a larger research project concerning the possibility of breaking the elements of typeface design down into general reusable components such as serifs (and terminal endings), bowls, circular shapes, arms and so on. Pandora is the result of setting the parameters for these components to one particular set of values, but many others could be chosen. In this sense, Pandora explores further the 'parametrization' which is at the heart of Knuth's endeavor with METAFONT. Neenie has nearly finished writing a Stanford Computer Science Report about this, called *Meta-Marks: Preliminary Studies for a Pandora's Box of shapes* (to appear). Knuth describes this study as 'lavishly illustrated studies in parameter variation, leading to the design of a new typeface called Pandora'.<sup>10</sup>

The Pandora typeface is intended to be a 'bread and butter' text face and has been generated in serifed, sans-serif and fixed width versions. The character set of Pandora coincides with CMR and CMTT,

<sup>10</sup> *Computer Modern Typefaces* (Reading etc., 1986), xiii.

etc., and thus it does not include the math symbol characters and extensibles.

### Terms of Availability

Neenie hopes, in the longer run, to donate Pandora to the T<sub>E</sub>X community, perhaps submitting it for inclusion in the standard distributions.

### 19.3 Blackboard Bold & Outline

Neenie is also working on a Blackboard Bold, to be compatible with Times Roman, for the AMS, and an outline font.

### Contact

Neenie Billawala,  
841 Stendhal Lane,  
Cupertino, CA 95104, USA.  
Phone: (408) 253-4833  
Uucp: (ihnp4, seismo, decwrl,  
ucbvax, ... )!sun!metamarks!nb

## 20 Bitstream Font Family

### 20.1 The Fonts

In my view, one of the most exciting developments in the area of Roman alphabet typeface availability for T<sub>E</sub>X has been the recent announcement by Personal T<sub>E</sub>X Inc., of the PTI Font Interface Package (FIP). This is an MS DOS program that converts the outline typefaces of the Bitstream typeface library into PXL (and then PK) fonts, with associated TFM files, for use with T<sub>E</sub>X in a manner analogous to the use of the use of the Computer Modern fonts.

Since the Bitstream typeface outline files for any given font contain more than the 128 characters usual in a T<sub>E</sub>X font, the extra Bitstream characters can be generated in a second, complement font. The Bitstream fonts generated by the FIP contain the same characters as CMR10. However, equivalents of the math italic, math symbol and extensible fonts of the CM family are not provided, so the Bitstream fonts are for use in typesetting predominantly textual matter. (One could, of course, mix the fonts, using Bitstream for the text and CM for the mathematics.)

The method of producing the font bitmaps is exactly the same, in principle, as using METAFONT, except that one has no access to the underlying character descriptions. The FIP reads the typeface outline data and generates bitmap fonts at any desired point size between 6 and 72 points and above, and at any resolution, from below 100dpi for IBM PC screens, to over 1000dpi for typesetters.

The Bitstream typeface library advertised by Personal T<sub>E</sub>X at present includes the following typefaces, each consisting of a regular, an italic, a bold and a bold italic face: Baskerville, Bitstream Charter, Bitstream Cooper Light, Century Schoolbook, Courier, Dutch (i.e., Times Roman), Futura Book, Futura Light, Futura Medium, Goudy Old Style, ITC Avant Garde Gothic, ITC Bookman Light, ITC Galliard, ITC Garamond Condensed, ITC Garamond, ITC Korinna, ITC Souvenir Light, Letter Gothic, News Gothic, Prestige, Serifa, Swiss (i.e., Helvetica), Swiss Condensed, Swiss Light, Zapf Calligraphic (i.e., Palatino), Zapf Humanist (i.e., Optima), and a selection of Headline faces including Bitstream Cloister Black, Broadway, Cooper Black, and University Roman.

New Fontware outline typefaces are regularly released by Bitstream: their catalogue currently has 40 faces.

Users of operating systems other than MS DOS can presumably use the Bitstream PXL or PK fonts (with TFMs) once generated on a PC/AT, just by uploading them with, say, Kermit.

### 20.2 Quality

The creation of the font bitmaps is done by the FIP using what Bitstream calls 'smart outlines'. Typographic rules are stored with the typeface outlines and are applied at the time of bitmap generation, using artificial intelligence algorithms (originally implemented on Symbolics 3600 Lisp workstations) to tailor significant features of the font to its point size, and the resolution and marking characteristics of the printing device. Some typographically significant features that are so treated are the stem weight, x-height, cap height, side bearings, and baseline alignment. So a 6 point Bitstream font is not a mere linear reduction of some larger design size, just as CMR6 is not simply a small CMR10. This is very significant for the high quality of the fonts at small or large sizes, and goes some of the way towards meeting the argument made by Knuth in *The T<sub>E</sub>Xbook* (p.16), against scaling fonts much beyond their design size.

Optional software switches set when running the FIP permit the adjustment of accents and letter spacing. The newest release of the Fontware software also includes the choice of producing bitmaps appropriate to write-white as well as write-black marking engines. In the former case, the software will add a half-pixel layer all the way around a character to compensate for the erosion that occurs on white writers.

A recent discussion of fonts in *PC Magazine* (March 15, 1988, issue 7(5), p. 238) noted that:

Bitstream fonts are the same ones you get in already-generated form from H[ewlett] P[ackard], are widely (though not exclusively) used in the printing industry, and are used in our Tegra galley-generating machine.

A useful article comparing Bitstream fonts with Adobe PostScript fonts was published in the magazine *Publish!* (March 1988, issue 3(3), pp.46 ff.). It included valuable illustrations of both manufacturers' fonts at several different resolutions.

I myself have only experimented with the Dutch and Swiss fonts at 10pt, and then only on a 640×400 pixel screen, and at 240dpi on a 9-pin matrix printer. On both these devices the Bitstream fonts appear *much* superior to the nearest CM equivalents, (CMR10 and CMSS10). The characters are somewhat broader, with relatively rounder bowls and shorter ascenders, and give a more even, regular appearance across the page. They make the CM fonts look very uneven by comparison (and I am a great fan of CM). I suspect that the CM fonts would compare more favorably at higher resolutions, since they were not designed for such poor output devices.

The Bitstream Font Interface Package offers T<sub>E</sub>X users (without access to PostScript printers) access for the first time to a proper typeface catalogue, and a highly professional one at that.

### 20.3 Other Developments

Although Bitstream has released 40 Fontware outline typefaces, it actually has a library of over 1000 digital typefaces waiting in the wings. This collection includes traditional designs, original designs, pi-fonts, and non-Latin fonts such as Arabic, Cyrillic, Greek, Gujarati, Hebrew, Laotian, and Tai Dan. However, all these exist in plain digital outline format only, which means that the outlines have not had the AI scaling optimization rules added to them, and are thus not 'smart outlines' such as can be used with the Fontware Installation packages. They are are thus not at present marketed widely.

Intelligent font scaling for Kanji fonts (Nippon Information Science Ltd. Iwata Gothic, with other faces to follow) was announced in March 1988, and is offered to OEMs.

### 20.4 Terms of Availability

The Fontware Installation Kit costs \$195, and normally comes with the Swiss font family (one can

make a special request to have the Dutch family instead).

### 20.5 Contacts

Personal T<sub>E</sub>X Inc.,  
12 Madrona Avenue,  
Mill Valley, CA 94941.  
Phone: (415) 388-8853  
Telex: 51060 10672 PCTEX  
Fax: (415) 388-8865

Bitstream,  
Athenaeum House,  
215 First Street,  
Cambridge, MA 02142.  
Phone: (617) 497-6222  
Telex: 467237  
Fax: (617) 868-4632

## 21 Times Roman in METAFONT

### 21.1 Kemmish

#### The Font

The creator of the font, Ian Kemmish, writes:

I have a Times font in METAFONT which I have been tinkering with over the past six or seven months. It is modelled on Monotype Times New Roman (visually — no calipers in sight!) The standard of rasterization is about comparable to a Laser-Writer, but the typography is of necessity a lot more amateurish. The regular font is largely OK, the italic is a few weeks behind and probably needs some tweaking. There is a rather lumpy semibold which needs parameter tweaking. I suspect a genuine bold needs a new set of minuscule routines. I also have a typewriter font generated from it, and am working on a Nebiolo Eurostyle sans-serif font. (I needed something easy after the Times! I want to do Helvetica sometime soon.)

#### Terms of Availability

Ian Kemmish writes:

I'd be happy to distribute what I have, though I suspect my employers would want to charge something for it. Ideally, I'd like to send out some GF files first to people who are interested in test-driving them and can make constructive comments about how to improve them. The METAFONT code is still in a state of flux. I'd hate to distribute it

and have a lot of unco-ordinated changes being made to it all!

### Contact

Ian Kemmish can be contacted at:  
Whitechapel Workstations,  
75 Whitechapel Road,  
London E1 1DU, England.  
Phone: (+44) 01 377 8680  
Telex: (UK) 885300 WCW G  
Fax: (+44) 01 247 4589  
Uucp: ian@wcw.co.uk  
OldUucp: ...!mcvax!ukc!wcwvax!ian

### 21.2 Other Developments

See also the MF Roman Family by **Georgia Tobin**, and the Dutch typeface by **Bitstream**.

## 22 Lucida

Lucida is the name of one of the typefaces designed by Kris Holmes and Chuck Bigelow. Its main design aim is that it be legible and beautiful at low as well as high resolutions, and it is probably the first original typeface family produced for digital printers and displays.<sup>11</sup> By low resolution, Holmes and Bigelow mean laser printers and computer screens. The font has been discussed in the following publications:

Jonathan A. Epstein, 'Best Font Forward', *Digital Review* (July 1986), 82-87.

C. Bigelow and K. Holmes, 'The Design of Lucida: an Integrated Family of Types for Electronic Literacy', in *Text Processing and Document Manipulation* edited by J. C. van Vliet (Cambridge, 1986), 1-17.

'Alumna Designs First LaserWriter Typeface', *Harvard Extension Newsletter* 8(2) (Spring 1988).

The second of these articles is itself printed in the Lucida typeface. It goes into detail about the design concepts of Lucida, with illustrations.

### 22.1 The Fonts

The Lucida family includes the following eight fonts: Roman, Italic, Bold, and Bold Italic, in both serifed and sans-serif styles. Lucida has been called a 'super family' because of the wide range of characters and fonts it provides, including compatibility with the full CM character set. Unusual features of Lucida fonts include the fact that the italic sans-serif is a true cursive style, rather than a slanted Roman, and that there are alternate sets of capitals,

<sup>11</sup>Another font with some similar design goals is Matthew Carter's Bitstream Charter.

one heavier in weight, for English and French typographers, and one lighter, for Germanic texts which use extensive capitalization, and therefore need de-emphasized capitals.

The screen 'versions' of Lucida are at such low resolution (75-100dpi) that they cannot be regarded as straight reproductions of their higher resolution counterparts. They are therefore called Pellucida, to suggest that the designs are related to Lucida, but optimized for 'pel' based screen displays.

### Adobe

Chuck Bigelow informed me in April 1988 that Adobe Systems is dealing with the release of several Lucida typefaces for use with T<sub>E</sub>X. Dan Mills, Manager of Typography at Adobe informed me later in the same month that:

Knowing people would want these fonts for use with T<sub>E</sub>X (because of the Math versions, ...), we purposely extended our normal character set for these fonts (by about 16 characters) to cover the 'T<sub>E</sub>X text' set (Figure 1 in Appendix F of *The T<sub>E</sub>Xbook*). What I mean is, these fonts have a union of our standard character set and the T<sub>E</sub>X text set.

The following faces have already been released by Adobe as downloadable PostScript fonts on both Mac and PC disks: Lucida Roman (serifed), Lucida Italic, Lucida Bold, Lucida Bold Italic, Lucida Sans Roman (sans-serif), Lucida Sans Italic, Lucida Sans Bold, and Lucida Sans Bold Italic.

The following will be released soon: Lucida T<sub>E</sub>X Math Italic, Lucida T<sub>E</sub>X Math Symbol, Lucida T<sub>E</sub>X Math Extension, and Lucida Sans Typewriter. Dan notes that the Math fonts have the same character sets as shown in appendix F of *The T<sub>E</sub>Xbook*. The Lucida Sans Typewriter has another union of Adobe's standard set, this time with the T<sub>E</sub>X text typewriter set, shown in figure 3 in the same appendix.

Bigelow suggested that for dates of release and information on TFM files, etc., one should contact Adobe. Once again, Dan Mills was most helpful. He said:

As for TFM's, we've been getting a lot of help from Barry Smith of Kellerman & Smith ... to produce these. We aren't finished. If you are a T<sub>E</sub>Xtures user, they will certainly be willing to help you out. If not, we plan to make these metrics available to the general T<sub>E</sub>X community 'somehow' in



the near future. Exactly how they will be distributed remains to be decided.

### Imagen

Chuck Bigelow also noted that the Imagen Corporation currently offers various Lucida typefaces, and an upgrade to the full  $\TeX$  character set will be released in July 1988. These will include the Lucida seriffed family, the Lucida Sans family, and the Lucida Sans Typewriter family. Imagen will produce the  $\TeX$  Math fonts if there is demand from their users. Imagen Lucida will be available in outline format for their UltraScript (PostScript clone) and DDL language printers, and for their imPRESS printers. The Imagen fonts should be metrically compatible with the Adobe fonts. They are made from exactly the same outline data.

### Compugraphic

A last minute update from Chuck indicates that Lucida will soon be available for Compugraphic typesetters:

Compugraphic Corporation has licensed the Lucida seriffed family (roman, italic, bold, bold italic) and the three basic  $\TeX$  math fonts (math italic, math symbol, math extension) for their 8600 and 9600 typesetters, and perhaps the 8400 as well. Contact Cynthia Marsh or Norbert Florendo at CG for estimate of availability, price, etc.

Compugraphic Corporation, Type Division, Wilmington, MA, (617) 658-5600.

### Other Developments

A maker of inexpensive personal computers and printers will announce Lucida availability very shortly. The fonts will be metrically compatible with Adobe and Imagen.

Chuck and Kris are also working on outline versions of several of the additional fonts shown in Knuth's Volume E of *Computers and Typesetting*, and fonts analogous to the Euler family, including Bold Greek, Bold Script, Bold Symbol font, Small Capitals, as well as a Chancery, lower-case Script, Fraktur, Hebrew, and others. Light and Demibold versions of both seriffed and sans-serif families are also in progress, as well as the 'Bright' versions used in Scientific American. However, these must await a distributor like Adobe or Imagen to reach the market.

Chuck also reports that in their studio, Bigelow & Holmes, he and Kris have produced bitmap fonts

in the  $\TeX$  character set (as well as PostScript character set) in PXL format for the Lucida seriffed and Lucida Sans families in the following point sizes, at 300dpi: 6, 8, 10, 12, 14, 18, 24, and the same sizes, excepting 6 point, for 75 dpi and 100 dpi screens. Currently there is no distributor for these. These are hand-tuned bitmaps that are slightly different for each size, and therefore have their own (simple) TFM files that are not fully compatible with those for the Adobe PostScript outlines. However, they feel that the quality of the hand-tuned fonts is usually higher than that of the algorithmically produced bitmaps from outlines. They haven't finished bitmap versions of the math fonts or the typewriter fonts yet, but they do have an International Phonetic Alphabet and some other oddities in bitmap.

### 22.2 Contacts

Chuck Bigelow can be reached at the Dept. of Computer Science at Stanford:

Phone: (415) 723 3827

Arpa: `cab@sail.stanford.edu`,

or at his Menlo Park studio, Bigelow & Holmes:

Phone: (415) 326-8973.

Dan Mills can be reached at:

Adobe Systems Inc.,

1585 Charleston Road, P. O. Box 7900,  
Mountain View, CA 94039-7900, USA.

Phone: (415) 962-2100

Net: `adobe!mills@decwrl`, (and possibly  
`mills@ucbvax.berkeley.edu`)

## 23 Icelandic

### 23.1 Pind

#### The Font

On March 10, 1988, Jorgen Pind reported in  $\TeX$ hax 1988, issue 22, that he is running an unmodified  $\TeX$  with new fonts and formats (including hyphenation) which cater for Icelandic.

#### Contact

Jorgen Pind,

Institute of Lexicography,

University of Iceland,

Reykjavik 101, Iceland.

Internet: `jorgen@lexis.hi.is`

Uucp: `...mcvax!hafro!rhi!lexis!jorgen`

## 24 OCR-A

### 24.1 Lillqvist

In  $\TeX$ hax 1987, issue 106, information was given about an OCR-A font coded in METAFONT84 by

Tor Lillqvist, VTT/ATK (Technical Research Centre of Finland, Computing Services).

### The Font

Lillqvist's OCR-A is based on ISO Recommendation R1073, 1st ed., May 1969 (which he thinks is probably obsolete by now).

### Terms of Availability

The font is distributed free of charge. On 1 June 1987, Brandon S. Allbery ([allbery@ncoast.UUCP](mailto:allbery@ncoast.UUCP)) and Michael Lichter posted the METAFONT sources for the OCR-A on Usenet, in `comp.sources.misc`.

### Contact

Tor Lillqvist,  
VTT/ATK,  
Lehtisaarentie 2,  
SF-00340 Helsinki, Finland.  
Net: [tml@fingate.bitnet](mailto:tml@fingate.bitnet), or  
[tml@santra.UUCP](mailto:tml@santra.UUCP), or  
[mcvax!santra!tml](mailto:mcvax!santra!tml)

## 25 Miscellaneous

### 25.1 Austin Code Works

The Austin Code Works has a large collection of bitmap fonts that work with T<sub>E</sub>X, and which were originally created at SAIL (Stanford Artificial Intelligence Lab) in the late 60s or early 70s (I think). Because these fonts are not coded in up-to-date METAFONT, what you get is what you get, i.e., you cannot change the size or resolution of the fonts. I believe they are all (or most) 200dpi fonts. Bear in mind that although you might get, say, a Hebrew font, there are no accompanying macros to implement it at the keyboard level.

### The Fonts

The 'KST Fonts by Les Earnest' are described thus in the ACW handout:

Originally developed for the Xerox XGP printer, the 137 KST fonts include Hebrew, Greek, Old English, Old German, Cyrillic, hand [sign alphabet], and Tengwar alphabets in addition to the Roman alphabet in a large number of eclectic styles. Specify T<sub>E</sub>X or bitmap format. Both come with an extraction and display program.

The fonts include such essentials as single character fonts for the Stanford and MIT logos (separate fonts for each, naturally), two views of Snoopy, two views of Starship Enterprise, three fonts of chess pieces,

several sans-serif fonts, and what looks as if it might be a very tiny Arabic font.

### Terms of Availability

The collection of fonts costs \$30.

### Contact

The Austin Code Works,  
11100 Leafwood Lane,  
Austin, Texas 78750-3409, USA.  
Phone: (512) 258-0785  
BBS: (512) 258-8831  
FidoNet: 1:382/12  
Net: [acw!info@uunet.uu.net](mailto:acw!info@uunet.uu.net)

### 25.2 SPRITE.STY

If you use L<sup>A</sup>T<sub>E</sub>X, and you only need one or two extra characters, an ingenious and very easy way to generate them has been devised by Martin Costabel. It is a L<sup>A</sup>T<sub>E</sub>X style called SPRITE, and the code and documentation were published on 14 November 1987 in issue 1.8 of T<sub>E</sub>XMag, an online T<sub>E</sub>X magazine put out by Don Hosek ([dhosek@hmcvax.Bitnet](mailto:dhosek@hmcvax.Bitnet)). Here is an extract from Martin's documentation:

SPRITE.STY is a L<sup>A</sup>T<sub>E</sub>X macro that allows you to define in a quick and dirty way your own symbols. You just have to define the character as a dot pattern on your screen and enclose it by `\sprite` and `\endsprite` commands. Of course, I know, T<sub>E</sub>X is awfully professional and this primitive technique will not provide results as good as a METAFONT-designed character or even one drawn using device-dependent `\special` commands, but if you just need one special character or some cute little symbol and you don't have the time/brains/Macintosh/superuser-privilege/money-for-AMS-fonts/or whatever-is-necessary for a professional solution, this might produce acceptable results.

Using SPRITE.STY one 'draws' the character to be defined as a pattern of characters on a grid. Figure 1 shows how *schwa* is done. To use this character in your L<sup>A</sup>T<sub>E</sub>X document, all you have to do is use the command `\schwa`. This method uses a lot of T<sub>E</sub>X's memory, and is only suitable for characters which are used rarely, say a few times on a page.

### Contact

Martin Costabel.  
Net: [xbr1da29@ddathd21.bitnet](mailto:xbr1da29@ddathd21.bitnet)

---

```

\def\schwa{\FormOfSchwa\kern 1 pt}
% Only necessary if \kern... is wanted
\sprite{\FormOfSchwa}(16,24)[0.4 em, 1 ex]
% Resolution ca. 200x340 dpi.
:.....BBBBBBBBBB..... |
:....BBBB.....BBBB.... |
:..BBB.....BBBB.. |
:..BB.....BBB. |
:.B.....BBB |
:.....BBB |
:.....BBB |
:.....BBB |
:BBBBBBBBBBBBBBBBBBBB |
:BBB.....BBB |
:BBB.....BBB |
:BBB.....BBB. |
:..BBB.....BBB.. |
:..BBBB.....BBBB.. |
:....BBBBB.....BBBB.... |
:.....BBBBBBBB..... |
\endsprite

```

Figure 1: SPRITE.STY commands for *schwa*.

---

### 25.3 HP2TEX (HP Font Conversion)

#### The Program

In February 1988, the uuencoded ARC file HP2TEX appeared on Usenet, in `comp.text`. It included the Turbo Pascal 3.0 source code and a compiled DOS version of HP2TEX, a program to read a Hewlett Packard soft font and generate two files useful to T<sub>E</sub>X users, a PL and a PXL file.

Since the HP soft fonts are bitmap fonts generated from the Bitstream outline typefaces (see the **Bitstream** section), this is another way to produce the latter family of fonts. However, the TFM file produced by HP2TEX does not contain the information required to make ligatures, etc. (see below), so in practice, if real quality is sought, it would be better to buy the FIP from Personal T<sub>E</sub>X Inc.

#### Usage

The HP2TEX program prompts the user for the names of the font files for input and output, and also for the original design size of the HP font, and its magnification (so that a 12pt HP font can make a 12pt PXL font, or a 10pt PXL font magnified `\magstep1`). Names can be supplied on the command line, and will be given appropriate extensions if necessary. The output is a PXL font with its associated prop-

erty list (PL) file. The PL file can be converted to a TFM file (with or without editing: see below) by the T<sub>E</sub>Xware program PLtoTF (compiled DOS version available on the PCT<sub>E</sub>X Bulletin board: (415) 388-1708). The PXL file can be left as it is, or converted to a smaller PK file by PXtoPK (also on the same BBS).

The PL file generated by this program contains several parameters that determine the appearance of the T<sub>E</sub>X output. These parameters control the inter-word glue, the space after a period, the size of a quad and em space, and the parameters determining accent placement. The 'correct' values for these parameters are NOT contained in the HP soft fonts. They are estimated by HP2TEX, and might not be very good estimates. If your output is visually bad, read about `fontdimen` parameters in the back of the *T<sub>E</sub>Xbook* (or *METAFONTbook*) and adjust their values in the PL file. Then generate a new TFM file. The authors have not attempted to deal with kerns, although you could add those to the PL file as well. Ligatures require the same action, assuming the ligature glyph is in the font at all.

The authors note that certain fonts generated by GLYPHIX appear to convert with a bad underscore character that is far too low. This is in fact how the underscore is encoded in the font, not an artifact of the conversion.

#### Terms of Availability

HP2TEX was written by David Strip, with help from Dimitri Vulis. The program is copyrighted, and in keeping with the spirit of the T<sub>E</sub>X community, you are granted permission to copy and redistribute it so long as you provide the source and the README file along with any executable. In addition, you may not charge any fee in excess of the actual cost of the media and reasonable labor charges. This charge may not exceed \$3.00 per disk plus shipping costs.

HP2TEX is available on SIMTEL20 (FTP or Listserve access) and GENIE, as well as some BBSs.

#### Contact

David Strip,  
431 Camino de la Sierra NE,  
Albuquerque, NM 87123, USA.  
Arpa: `drstrip@sandia-2.arpa`  
Uucp: `...(ucbvax, cmu!rice, ihnp4!lanl, gatech)!unmvax!intvax!drstrip`

Dimitri L. Vulis,  
529 W. 111 Street, #61  
New York, NY 10025-1943, USA.  
Bitnet: `d1v@cunyvms1`

## 25.4 Bar Codes

Issue 94 of  $\TeX$ hax 1987 carried the following note from Dimitri Vulis:

I was amazed to find out that business people pay enormous money for the ability to produce bar codes. This ought to be *trivial* with  $\TeX$ . So, I got hold of a public domain BASIC program that supposedly does that and lifted the codes and put them into METAFONT (it was *easy*). Caveat(s): I have never tested these codes with an OCR. The BASIC program said it used '3 of 9' encoding. I presume it's not the same as UPC. The sizes may be off—I took them from the BASIC program that used HP LJ's 100dpi graphics mode.

Remarks:

- White space is a displayable character.
- There are 9 significant strips, bwbbw-bwbbw; 3 of them are wide.
- The `white_naro` at the end of each code is the inter-code spacing.

The original BASIC program was written by 'Bill Wood Mil., WI' and later re-written by 'Bill Baines, Enfield, CT.'

Dimitri notes that he has not tested the bar codes.

### Terms of Availability

The METAFONT code for the bar codes is available for anonymous FTP from `score.stanford.edu` as file `<TEX.TEXHAX>VULIS.TXH`. A copy has also been forwarded to  $\TeX$ -L for BITNETers.

### Contact

For Vulis's address see under **HP2TEX**.

## 25.5 Old English

### Henderson

Doug Henderson has implemented METAFONT on the PC/AT family of personal computers, and is also responsible for generating the high resolution bitmaps of several of the non-standard fonts illustrated in recent issues of *TUGboat*, such as the APL and Greek fonts.

On Tuesday May 3, 1988, Doug wrote to me with several useful corrections to the present article, and included the following information:

I have recently created a few characters for an associate at the International Christian University by the name of William Schipper. He requested that the Old English characters thorn (upper/lower case) and

eth (upper/lower case) be created for him. As he was referred to me by Knuth, I decided to take this challenge and create the characters. Mainly, they are variations of characters found in Computer Modern already, with some polishing up.

This will probably be the first in a series of ad-hoc characters I create for various folks in need, and I will keep them in a sort-of miscellaneous font category. For now, they are compatible with CMR10.

Doug is willing to distribute the Old English characters free of charge. He says that the final versions should be done in time for this year's TUG conference in Montréal. Contact him at:

Division of Library Automation,  
Univ. of California, Berkeley,  
186 University Hall,  
Berkeley, CA 94720, USA.  
Bitnet: `dlatex@ucbcmsa`  
Arpa: `dlatex%ucbcmsa.cc@berkeley`

### Curran

Charles Curran of the Oxford University Computing Service notes that he is 'generating odd squiggles for a user's medieval English', but he feels that the quality isn't adequate for wider dissemination at present. Contact Charles at:

OUCS,  
13 Banbury Road,  
Oxford, OX2 6NN, England.  
Phone: (UK) 0865 56721  
Net: `charles@vax.oxford.ac.uk`

### Bradfield

In a note to  $\TeX$ hax 1987, issue 73 (sent on Fri, 04 Sep 1987), Julian Bradfield reported that he has preliminary versions of the letters eth, thorn and yogh for Computer Modern. He said:

They are rather hastily cobbled together from bits of real CM letters, so are not very robust at present; in particular my yogh is not yet very happy on lowres devices, though I hope to fix that soon. They look OK (to me!) in roman, italic, bold and sans-serif at 300 dpi, which is the highest resolution available to me.

If you want to use these characters, mail Julian at:  
% Christ's College,  
Cambridge, CB2 3BU, England.  
Janet: `jcb7@uk.ac.cam.phx`  
Earn/Bitnet: `jcb7@phx.cam.ac.uk`

### Ridgeway and Barnett

A font to supplement the basic Latin alphabet of Computer Modern with Old English characters will be released in Autumn of this year by the University of Washington Humanities and Arts Computing Center. Macros for direct input and translators from various Personal Computer editor files will accompany the release.

For the contact address, see under **Tamil** above.

### 25.6 Vietnamese

A note from Trung Dung at the end of March 1988 signalled his intention of using METAFONT to create a Vietnamese font. This uses a Roman character set, with a wide range of diacritical marks. Trung hopes to finish some time this summer. He can be contacted at `trung@umb.edu`.

### 26 The PostScript Question

This article does not deal with the availability of PostScript fonts, because it would double its length to do so, and because the author has never used a PS device, and really wouldn't know what he was talking about. Suffice it to say that instead of sending a bitmap to the printer, a PostScript output file sends the printer instructions on how to construct character bitmaps at the time of printing. These PostScript bitmaps are created in a manner analogous to running METAFONT, in that the characters are encoded in a high level language, which gives the outline, filling or stroke routines for creating glyphs. Like T<sub>E</sub>X TFM files, PostScript fonts have their own font metric files, called AFM files. A utility program called AFtoTF exists to convert AFM files to TFM ones. A copy of AFtoTF, compiled and ready to run under DOS, is available on the Personal T<sub>E</sub>X BBS. Another route is to use AFtoPL, a program that converts the AFM file to the intermediate PL format, which can then be converted to a TFM file (see HP2TEX above). The C source for the latest version of AFtoPL (version 2.0, 25 April 1988) by Clayton M. Elwell is available via anonymous FTP from `tut.cis.ohio-state.edu` as `pub/aftopl.c`, and also from `june.cs.washington.edu`. Since all the font information T<sub>E</sub>X needs to create a DVI file is in the TFM file, T<sub>E</sub>X can thus create DVI files ready to be printed using PostScript fonts. All that is needed is a DVI driver that knows how to call for a PostScript font in the right way, and such drivers are available. Thus, with a bit of tinkering, it is perfectly feasible to use PostScript fonts in a T<sub>E</sub>X document, and there is a large and growing cata-

logue of such fonts. Adobe themselves have a catalogue of fonts which they market directly, which currently includes 230 individual fonts (several for most typefaces). There are also several other companies and individuals producing PostScript fonts in various styles and for a wide range of languages, using such font creation tools as Fontographer on the Mac, or Publisher's Type Foundry on the PC.

## Output Devices

### Index to Sample Output from Various Devices

Camera copy for this issue of TUGboat was prepared on the devices indicated, and can be taken as representative of the output produced by those devices. The bulk of this issue was at the American Mathematical Society on a VAX 8600 (VMS) and output on an APS- $\mu$ 5 using resident CM fonts and additional downloadable fonts for special purposes. The items listed below were received as camera copy; they were prepared on the devices indicated. The output devices used to prepare the advertisements were not usually identified; anyone interested in determining the device used for a particular ad should inquire of the advertiser.

- Unidentified: all advertisements. Some of the ads were received in a size larger than permitted; these were reduced photographically using the PMT process.
- Autologic APS- $\mu$ 5 (1440 dpi): Donald E. Knuth, *A punk Meta-Font*, p. 152, DEC 10; the drawings and proof fonts on pp. 154-156 and the photograph on p. 155 were pasted in.
- Canon CX (300 dpi): Georgia Tobin, *Designing for low-res devices*, p. 126.