MESSAGE FROM THE PRESIDENT
Pierre MacKay

There is much to celebrate. \TeX \textit{“came of age”} in December, and the \TeXbook is out. Which leads to the first and most urgent of several messages, addressed to those members of TUG who may still be using P\TeX, \TeX80 or one of their offspring. The message is, “STOP!” \TeX80 is now an interesting piece of technological archaeology; it was a necessary step along the way, but it does not offer anything like the power of genuine \TeX, and it can never improve. Change now, and you will face a slightly painful but rather brief effort of macro conversion, rather like getting a tooth fixed. Be brave. Get it over with. You will be glad you did.

This leads to a second message. In the next year or so, we are likely to see the appearance of \TeX offspring. Some will be the enhancements that have deliberately been allowed for in the final modules of the \TeX \texttt{WEB} file, and some may be more like Halfa\TeX, Parta\TeX, Ratha\TeX and Hardli\TeX. There may be good arguments for some of them, but there should be no arguments about the legitimacy of genuine versions of \TeX. The test of the real thing lies in a file called \texttt{TRIP.TEX}. When you run \texttt{TRIP} through your newly compiled \TeX, you get a very alarming set of diagnostic messages on the log file, and if that log file agrees with a master copy, then what you have is pretty sure to be \TeX. If the log files don’t agree, watch out.

Similarly, all DVI interpreters ought to produce the same basic results at the same output resolution. The \texttt{DVIType} program which is included in any distribution of \TeX sets the standard. If anything seems odd, it should be possible to try out various sizes of rule and space and see whether the results produced by \texttt{DVIType} match the results you see on your laser-printer. The operation of high-resolution typesetters is rather less easy to check, but here it ought to be possible to check against the ideal measurements in the \TeX source file. When you ask for a one-pica rule from a phototypesetter, you ought to get exactly that. When you try to do that on a low resolution printer, you can expect some fairly gross adjustments owing to rounding.

There is a fair amount of work still to be done with fonts, and perhaps the most significant news at this time is that \texttt{METAFONT} is being converted from a SAIL program running in a very limited environment to a \texttt{Pascal} program which ought to run wherever \TeX can run. For the present, we are still dependent on the old \texttt{METAFONT} and some very interesting problems have surfaced from the need to generate low-resolution fonts in several closely related pixel densities. The general lesson is that in font design you have to take a great many factors into account, not the least of which is the interaction of ink and paper on the specific device you are designing for. It will never be enough just to take a high-resolution design and cut it down mechanically to low-resolution densities.

At the end of February, there was a lively exchange over the mail networks about the possibility of establishing some standards for the inclusion of graphics in \TeX. Several sites have already worked out protocols using the \TeX \texttt{special} and there was a widespread feeling that before we go too far in separate directions it would be a good idea to arrange for a department in \TUGboat where the systematic use of special sequences could be worked out. We can probably wait to set this up until August, but meanwhile, if you are doing anything interesting with graphics and \TeX, send it on through one of the networks, or to Barbara Beeton at the AMS, or to me. And remember that we will need a volunteer to coordinate the new department, so, if you are feeling public-spirited, we need you.

Unfortunately, we are losing one of the most active and public-spirited members of TUG for now, though we hope very much that it is only for a short time. Lynne Price, who has been one of our chief guides through the early years of TUG, has written that she is moving to a place where, for the moment, she has no access to \TeX. The whole organization will miss her, and the Steering Committee will miss her especially. We will need someone else to take up her position as macro coordinator for \TUGboat. Once again, do we have a volunteer?

To Lynne, for the present, we say “The very best of luck, and hurry back.”
away. The following list is confined to works that were actually published, although my files also include dozens of concert programs, church programs, newsletters, and such things that my wife and I have been putting together ever since \TeX\ began to be operational.

The first edition of the \TeX\ manual is already quite rare, although I believe several hundred copies were printed. It was called “Tau Epsilon Chi, a system for technical text,” Stanford Computer Science Report STAN-CS-78-675 = Artificial Intelligence Laboratory Memo AIM-317 (September, 1978), 198 pp. The American Mathematical Society published a corrected version of this manual in June, 1979; my wife Jill designed the cover of this edition, of which I believe approximately 1000 copies were sold. If you have a “clean” copy you will be able to distinguish a subtle \TeX\ texture on the cover (quite similar to the example on page 225 of The \TeX\ book).

Most people learned about the prototype version of \TeX\ by reading the third edition of the manual, which appeared as part 2 of \TeX\ and METAFONT, co-published by AMS and Digital Press in the latter part of 1979. Approximately 15,000 copies of this book were printed.

The type for all three editions was produced on experimental low-resolution equipment that was not available commercially. The first edition used a Xerox Graphics Printer (XGP) that had been donated to Stanford’s Artificial Intelligence Laboratory; the second used a one-of-a-kind “Colorado” printer at Xerox Electro-Optical Systems in Pasadena, California; and the third used a “Penguin” printer at Xerox’s Advanced Systems Department in Palo Alto. These machines had variable resolution, which was set to 200 pixels/inch on the XGP and 384 pixels/inch on the others. Dale Green and Leo Guibas were instrumental in getting the latter two editions printed.

The METAFONT manual had a similar printing history: It first came out on the XGP as “METAFONT, a system for alphabet design,” Stanford Computer Science Report STAN-CS-79-762 = Artificial Intelligence Laboratory Memo AIM-332, 105 pp.; then it was reprinted on a Penguin, with minor corrections, in the Digital Press book.

Of course, user manuals don’t count as real milestones in publishing. I like to think that the first real book to be printed with \TeX\ was a 28-page keepsake that was made for my wife’s relatives at Christmastime, 1978. This book included eighteen original linoleum block illustrations, into which we pasted XGP-produced text set in a special 14-point extended variant of the prototype Computer Modern font. In order to compensate for the XGP’s limited resolution, we prepared magnified copy and the printer reduced it to 70%; the effective resolution was therefore about 286 pixels/inch. The title, opening pages, and colophon are illustrated here (reduced another 65% from the published size). About 100 copies were printed, of which roughly 25 were sold and the remaining 75 were given as gifts. A complete library citation for this book would read as follows: “Lena Bernice: Her Christmas in Wood County, 1895. By Elizabeth Ann James, with illustrations by Jill Carter Knuth. Columbus, Ohio: Rainshine Press, 1978.”

David W. Wall made an unusual application of \TeX\ and METAFONT in his Ph.D. thesis, “Mechanisms for broadcast and selective broadcast,” Stanford Computer Science Report STAN-CS-82-919 = Stanford Computer Systems Laboratory Technical Report No. 190 (June 1980), 120 pp. He considered each illustration to be a “character” in a new “typeface,” and he drew these large characters with METAFONT; then he superimposed textual labels using \TeX\. This approach would defeat our current METAFONT software if the figures were to be drawn at high resolution, but he got away with it because he was using the XGP. (See the samples attached, which have been reduced to 65% of their original size.) In David’s words, “I fear I’ve opened a Pandora’s box; this isn’t exactly what METAFONT was designed for. But ain’t it purty?”

All this time we didn’t have access to a high-resolution phototypesetter, but after several months of work David Fuchs and I successfully built an interface to an Alphatype CRS machine in the winter and spring of 1980. (Most of this effort was directed to complete revision of the microcode inside the CRS, because of the machine’s limited font storage.) My notes show that we produced the first decent sample pages on April 1, 1980; and the first page of output that was eventually published was my one-page poem entitled “Disappearances” that appeared on page 264 of The Mathematical Gardner, edited by David Klanner (Belmont, California: Wadsworth, 1981). In May I sent off a longer paper, “The Letter S,” that was published in The Mathematical Intelligencer 2 (Heidelberg: Springer-Verlag, 1980), 114–122.

Most of my time during April, May, June, and July of 1980 was spent making the final revisions to a big book that had been the original impetus for all of my work on \TeX\ and METAFONT: The volume had already been typeset during 1976 at The Universities Press, Belfast, using Monophoto systems called Cora and Maths, but the results were not
LEN A BERNICE

Her Christmas in Wood County, 1895

Lena Bernice was our grandmother. She told us about her first Christmas tree. She told us many things while the snow fell.

Elizabeth Ann and Jill
Christmas 1978

Figure 1. Title page and colophon of TeX's first book.
The snow began around three o'clock. Aunt Sally had the little ones turn to the window and recite their lesson.

"See the snow softly fall
over barns and churches tall."

Gussie was trying to teach Horace at home, so she copied it down. She wanted Horace to be a member of the state legislature, like Ben James who was her uncle and the greatest orator in Wood County.

Lena Bernice thought about little Jimmy Reed in the lesson book and how he wondered if the snow tasted of sugar. She thought about the brave dog, Cæsar, who had protected his mistress during the blizzard in Old Kentucky. She thought about the layer of ice on Rock Pond.

Aunt Sally took up the Illustrated Geography and showed The Entire Class a picture of the Alps and of the dear Saint Bernards who saved many a folk from certain death.

Figure 2. The opening pages of Lena Bernice.
When a vertex enters FULFILL-OBLIGATION, it looks at its fragment state and picks out the smallest outgoing edge. From here we must consider three cases.

If that edge selected is incident to v, then v sends a message—which includes its fragment state—to the other endpoint, which is not in v's fragment; when the other endpoint receives it, it merges fragment states, with the result that it now has a larger fragment state than v did.

If the edge is not incident to v but rather to some other vertex w, then v transfers the obligation to w along with its fragment state. If w agrees that this edge is the appropriate one to make into a branch, it sends a message with its fragment state to the other endpoint, which is not in v's fragment state with that of v it had a larger fragment state present. Thus as soon as the fragment of v and w that v did not know was included the state for some other vertex w, then v transfers the obligation state and finds a better edge than the one u selected, then w must know about a vertex in v's neighbors, it must wait until it has received one "yes" message or (n-1) "no" messages before it knows anything useful. It can acknowledge any "no" it receives, but can do nothing more. If it receives (n-1) "no" messages, it knows that the only subtree containing original nodes is the one from which it has not received a message, and so it can send "no" to that subtree, wait for acknowledgment, and then leave.

We observe that z precedes y on this path p. For if z = y then this single vertex is on both path q1 and path q2, which are represented by edges without a common endpoint. This violates Lemma 4. Similarly, if z follows y then y is on the portion of path p from m to z and so by Lemma 2 it must also be on the portion of path q1 from m to z. Thus y is on both q1 and q2, which again contradicts Lemma 4. So z precedes y.

Thus we can divide the path p into three pieces: p1 from m to z, p2 from z to y, and p3 from y to n. We have defined x and y in such a manner that the vertices on p1 only appear on paths incident to m, the vertices on p3 only appear on paths incident to n, and the vertices on p2 do not appear either place and hence have not yet appeared at all.

We are trying to show that the graph G5 has no cycles. There is one easy way we might produce a cycle: if a pair of vertices appears on the paths for two of the edges in the tree, and if there are two routes of equal cost between these two vertices, we could pick a different route in each case. The first two lemmas show that nothing this simple will produce a cycle as long as we are using a consistent tie-breaking rule, because we would have to pick the same route both times. As a result, we can only form a cycle from bits and pieces of several paths.

The idea behind this alternate approach is that instead of letting a branch partition the tree into two subtrees, we will let a node partition the tree into n subtrees, where n is the number of neighbors it has. A node sends "yes" across a branch as soon as it knows that there is an original node on this side of the branch, or a "no" as soon as it knows there isn't. We see that the case of an original node is trivial; since it is an original node, it can send "yes" out along all incident branches immediately. Then it can simply wait for answers, keeping or deleting branches according to the messages received across them.

An added node, in contrast, has a more complicated algorithm than before. If it has n neighbors, it must wait until it has received one "yes" message or (n-1) "no" messages before it knows anything useful. It can acknowledge any "no" it receives, but can do nothing more. If it receives (n-1) "no" messages, it knows that the only subtree containing original nodes is the one from which it has not received a message, and so it can send "no" to that subtree, wait for acknowledgment, and then leave.

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Figure 3. Excerpts from David Wall's thesis.
satisfactory. I received the paper tapes from Belfast and converted them to pseudo-\TeX{} so that the re-keyboarding would be easier. (It isn't clear that I actually saved any time by this maneuver!) All 700 pages of the book finally fell into place; and the camera-ready copy for *Seminumerical Algorithms: The Art of Computer Programming*, Volume 2, second edition (Reading, Massachusetts: Addison-Wesley, 1981) was completed at 2 am on the morning of Monday, July 29, 1980. On October 22 I had to remake page iv (so that it contained Library of Congress information). A bound copy of the book actually appeared in my hands on January 4, 1981. It seems most appropriate to regard the appearance of this book as the actual birth of \TeX{} in the world of publishing. My publishers prepared a limited edition of 256 copies, hand bound in leather, to commemorate the occasion. (I believe that only a few people ever purchased these special copies, because computer scientists didn’t want to pay for leather binding, while lovers of fine printing didn’t cherish the invasion of computers. However, about 10,000 copies of *Seminumerical Algorithms* were sold in its regular binding during 1981.)

Meanwhile other people at Stanford had been getting books ready for publication, using \TeX{} and the Alphatype in our lab. The first of these to be finished was *KAREL the ROBOT: A Gentle Introduction to the Art of Programming* by Richard E. Pattis (New York: Wiley, 1981), 120 pp. Many of the illustrations in this book were typeset using special symbols \texttt{METAFONT}ed for the occasion with David Wall’s help. The next book of this kind was *Practical Optimization* by Philip E. Gill, Walter Murray, and Margaret H. Wright (New York: Academic Press, 1981), 417 pp. Speaking of optimization, a paper by Bengt Aspvall and Yossi Shiloach, “A polynomial time algorithm for solving systems of linear inequalities with two variables per inequality,” *SIAM J. Computing* 9 (1980), 827–845, was also produced on the Alphatype in our lab that year.

Scott Kim was the first to use our Alphatype together with \TeX{} to produce copy with non-\texttt{METAFONT} typefaces, in *Inversions: A Catalog of Calligraphic Cartwheels* (Peterborough, New Hampshire: Byte Books, 1981), 124 pp. He later \texttt{METAFONT}ed some special symbols that are featured in Arthur Keller’s *A First Course in Computer Programming using PASCAL* (New York: McGraw-Hill, 1982), 319 pp. (It’s interesting to note that the Italian translation of this text, *Programmare in PASCAL* (Bologna: Zanichelli, 1983), 303 pp., was one of the first books to be published from \TeX{} output in Italy. The Italian translators worked independently of the American author, and produced the camera-ready copy on a Versatec machine in Milano—unfortunately without Scott’s symbols.)

Terry Winograd was one of the first \TeX{} users and (therefore) one of the first to complain about its original limitations; for example, I added \texttt{\xdef} at his request, on November 28, 1978. He had begun writing a book with a system called PUB [Larry Tesler, “PUB. The Document Compiler,” Stanford Artificial Intelligence Project Operating Note 70 (March, 1973), 84 pp.], then had converted all the files to BRAVO [Butler W. Lampson, “Bravo Manual,” in *Alto User’s Handbook*, Xerox Palo Alto Research Center (1978), 32–62], before converting again to \TeX{}. Winograd contributed macros for indexing to the first issue of TUGboat, and his struggles with the early \TeX{} finally led to the completed book *Language as a Cognitive Process*, Vol. 1: *Syntax* (Reading, Massachusetts: Addison-Wesley, 1983), 654 pp. He used Computer Modern fonts, but substituted Optima for the (awful) sans serifs that I had been using at the time.

Gio Wiederhold modified \texttt{ACME} files that he had used to prepare the first edition of his database book so that he could typeset the second edition with \TeX{}. He says that it took about six months to do the final formatting (e.g., writing extra copy so that page breaks would occur in desirable places). The resulting volume holds the current record for the longest book to be produced in our lab: *Database Design*, second edition (New York: McGraw-Hill, 1983), 767 pp.

Another faculty colleague, Jeffrey D. Ullman, converted first-edition Troff files to \TeX{} files, for his book *Principles of Database Systems*, second edition (Rockville, Maryland: Computer Science Press, 1982), 491 pp. Then he used \TeX{} directly to write *Computational Aspects of VLSI* (Rockville, Maryland: Computer Science Press, 1984), 505 pp. Jeff’s 13-year-old son, Peter, helped by using \texttt{METAFONT} to create special fonts for the typesetting of VLSI stipple patterns.

My co-author Daniel H. Greene \TeX{}ed our book *Mathematics for the Analysis of Algorithms* (Boston: Birkhäuser, 1981), 107 pp. It’s interesting to compare the first edition to the second (1982, 123 pp.), because the fonts were significantly tuned up during the year that intervened between editions.

The books and articles mentioned so far were all typeset by their authors; this is to be expected in a computer science department. But a few experiments were also undertaken in a more traditional way, where the \TeX{} composition was done by people who were skilled at keyboard entry but not in-

It may be of interest to note that the first volume of the *Handbook of Artificial Intelligence* (1981) was done with early Computer Modern fonts on our Alphatype, but the typesetting was by PUB rather than \TeX. In particular, all hyphenation in that book was done by hand.


The software we used to interface between \TeX and the Alphatype CRS was used at three other sites: The American Mathematical Society (Providence, Rhode Island), Kunglig Tekniska Högskolan (Stockholm, Sweden), and Bell Northern Research (Mountain View, California). I have only sketchy information about what books were produced with \TeX at other installations, but I’ll give a partial list so that people at those sites might be moved to provide a more correct history.

The first AMS use of \TeX and the Alphatype in my collection is an article entitled “1980 Wiener & Steele Prizes Awarded,” *Math. Notices* 27 (1980), 528–533. (Since then an ever-growing percentage of the Notices has been \TeXed.) The SIAM-AMS-MAA Combined Membership List for 1981–1982 was another early production, as was the AMS Catalog of Publications for 1981–1982.


Before AMS began using the Alphatype, they published several things from photo-reduced Varian output. The indexes to individual issues of *Mathematical Reviews* have been done with \TeX since November 1979 (Volume 58, #5); the Combined Membership List for 1980–1981 also came off the Varian.

Several books composed elsewhere have also been typeset with the facilities at AMS headquarters, notably Oregon Software’s *PASCAL-2: Version 2.0 for RSX-11* (1981), 186 pp.; *Turtle Geometry* by Harold

At Bell Northern, I think \TeX\ was used mostly (or entirely?) for company-confidential reports. But I have seen several excellent publications from the Swedish Royal Institute of Technology, notably a 46-page monograph on Non-linear Inverse Problems by Gerd Ericksson, Report TR17A-NA-8209 (1983), and I would like to know more about their independent experiences with \TeX.

The University of Wisconsin Press sent me a copy of their 1981 Fall Catalog, which they told me was typeset by \TeX. I don't know if \TeX\ actually helped to produce any of the books listed in the catalog.

When Computer Modern fonts are not used, it isn't so easy to tell that \TeX\ was behind the formatting. But I have been assured that the book Guide to International Commerce Law by Paul H. Vishny (Colorado Springs, Colorado: Shepard's/McGraw-Hill, 1981), 782 pp., was entirely typeset by \TeX, using an IBM 370/3081 coupled to an APS 5 phototypesetter.

Some books have been published directly from Xerox Dover output (384 dots/inch resolution) that was printed at Stanford. In particular, the original hardcover edition of Joseph Deken's The Electronic Cottage (New York: William Morrow, 1982), 334 pp., was produced in this way, because of tight publication deadlines, and so were the books Arithmetic and Geometry: Papers Dedicated to I. R. Shafarevich on the Occasion of His Sixtieth Birthday, edited by Michael Artin and John Tate (Boston: Birkhäuser, 1983); vol. 1, 359 pp., vol. 2, 481 pp.

Max Díaz was instrumental in setting up a \TeX\ installation at the Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas of the Universidad Nacional Autónoma de México (i.e., at IIMAS-UNAM). The first \TeX\-produced book to be done entirely in Mexico was Nonlinear Phenomena, ed. by Kurt Bernardo Wolf, Lecture Notes in Physics 189 (1983), 464 pp. Max's \texttt{Fácil} \TeX\ macros were, of course, the basis of this production, which was photoreduced from low-resolution output.

The \textit{AI Magazine} (an official publication of the American Association for Artificial Intelligence) has been typeset with \TeX\ in our laboratory since volume 3, number 2 (Spring 1982). Actually nobody told me anything about this until June 16, 1983, when I received the following unsolicited letter from the managing editor, Claudia C. Mazzetti: "The production time of the magazine has decreased almost in half because of \TeX. We just want to express our thanks for creating such a marvelous system!"

Well, by 1983 I was unable to understand why anybody would think the old version of \TeX\ was easy to use, since I had just spent two years removing hundreds of deficiencies. (All of the work reported above was produced by the old proto-\TeX\ system.) Furthermore, I'm still not entirely happy with the Computer Modern fonts, although the "Almost Computer Modern" version of July 1983 is much better than the fonts that we were using in 1980. I expect to make further improvements during the next two years, as I complete my research on typography. My goal is to have a new \texttt{META-FONT} in 1984 and a new Computer Modern in 1985. Meanwhile, we do have a new, permanent \TeX\ in 1983, and I'll conclude this list by mentioning the first three publications that have flowed from the new \TeX\ together with our new APS Micro-5 phototypesetter: The \TeX\book (Reading, Massachusetts: Addison-Wesley, 1984), 496 pp., was the first; it was sent to the publisher on October 12. Coordinated Computing: Tools and Techniques for Distributed Software by Robert E. Filman and Daniel P. Friedman (New York: McGraw-Hill, 1984), 390 pp., was the second. And my paper "Literate Programming" (15 pp.) was the third; this paper—which discusses \texttt{WEB}—combines Times Roman and Univers type with Computer Modern, and it will be published in volume 27 of The Computer Journal.

I like to think that the use of \TeX\ has not only produced books that are well formatted; it also seems to have helped produce books whose content is significantly better than books that were written in the old way. Part of this change is due simply to the advantages of word processing and computer editing, since changes are so much easier; but part of it is due to the fact that authors are able to choose the notations and formatting that they want, once they are free from the worries of communicating through several levels of other people to whom such notations might be unfamiliar. I believe that a large number of the books listed above show such improvements in scientific exposition; in particular, my own books have been greatly improved because I've been able to control the typesetting. I still rely heavily on the advice of professional editors and book designers, but I can be much more sure of the final quality than ever before, because there now is comparatively little chance that misunderstandings will introduce any errors. This, to me, is the "bottom line" that has made all of my work on \TeX\ seem worth while.