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General Delivery

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MESSAGE FROM THE PRESIDENT

Pierre MacKay

There is much to celebrate. TEX "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 PTEX, 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 WEB file, and some may be more like HalfaTEX, PartaTEX, RathaTEX and HardliTEX. 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 TRIP.TEX. When you run 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 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 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 METAFONT is being converted from a SAIL program running in a very limited environment to a Pascal program which ought to run wherever TEX can run. For the present, we are still dependent on the old 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 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."

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TEX INCUNABULA

by Donald E. Knuth

Several people have asked me for a list of the "first" books ever typeset by TEX. Bibliophiles might some day enjoy tracing the early history of this particular method of book production; I have therefore tried to record the publications known to me, before my memory of those exciting moments fades 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 TEXture on the cover (quite similar to the example on page 225 of *The TEXbook*).

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 Klarner (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

LENA 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

Elizabeth Ann wrote the story for this book, and Jill designed the pages and drew the pictures. The book was typeset by Don Knuth using the TEX system, and printed by Homer Weathers at THE RAINSHINE PRESS.

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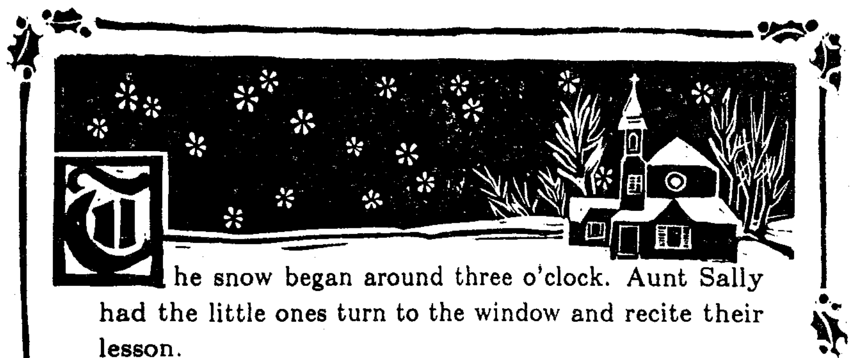
Figure 1. Title page and colophon of TEX's first book.



he 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.

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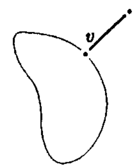
Figure 2. The opening pages of *Lena Bernice*.

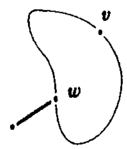
When a vertex enters FULFILL-OBLIGATION, it looks at its fragment state and picks out the smallest outgoing edge. From here we must consider three cases.

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.



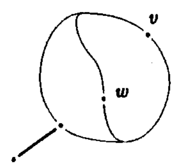
Edge Leaves at v

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; since that fragment state includes the state for v, the result is the same as in the previous case—the far endpoint will have a fragment state larger than that of v.



Endpoint Agrees with v

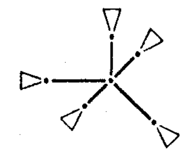
On the other hand, if w looks at its own fragment state and finds a *better* edge than the one v selected, then w must know about a vertex in the fragment of v and w that v did not know was present. Thus as soon as w merged its fragment state with that of v it had a larger fragment state than v. Its fragment state may even have been larger than v's beforehand.



Endpoint Disagrees with v

4.4. A Distributed Heuristic Algorithm for Low-Cost Steiner Trees □

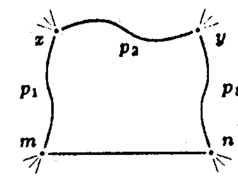
The idea behind this alternate approach is that instead of letting a branch partition the tree into two subtrees, we will let a node partition the tree into n subtrees, where n is the number of neighbors it has. A node sends "yes" across a branch as soon as it knows that there is an original node on 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.



A Node and Its n Subtrees

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.

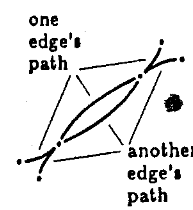
We observe that x precedes y on this path p. For if $x = y$ then this single vertex is on both path q_1 and path q_2, which are represented by edges without a common endpoint. This violates Lemma 4. Similarly, if x follows y then y is on the portion of path p from m to x and so by Lemma 2 it must also be on the portion of path q_1 from m to x. Thus y is on both q_1 and q_2, which again contradicts Lemma 4. So x precedes y.



Replacing $\{m, n\}$ with p

Thus we can divide the path p into three pieces: p_1 from m to x, p_2 from x to y, and p_3 from y to n. We have defined x and y in such a manner that the vertices on p_1 only appear on paths incident to m, the vertices on p_3 only appear on paths incident to n, and the vertices on p_2 do not appear either place and hence have not yet appeared at all.

We are trying to show that the graph G_S 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.



One Way to Make a Cycle

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 **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-**METAFONT** typefaces, in *Inversions: A Catalog of Calligraphic Cartwheels* (Peterborough, New Hampshire: Byte Books, 1981), 124 pp. He later **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 `\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 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 **METAFONT** to create special fonts for the typesetting of VLSI stipple patterns.

My co-author Daniel H. Greene TEXed 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 intimately familiar with the subject matter. I think the first such books to be done in our lab were the *Handbook of Artificial Intelligence*, vol. 2, edited by Avron Barr and Edward A. Feigenbaum (Los Altos, California: William Kaufman, 1982), 441 pp.; *Handbook of Artificial Intelligence*, vol. 3, edited by Paul R. Cohen and Edward A. Feigenbaum (Los Altos, California: William Kaufman, 1982), 652 pp.; *Introduction to Arithmetic for Digital Systems Designers* by Shlomo Waser and Michael J. Flynn (New York: Holt, Rinehart and Winston, 1982), 326 pp.; *Introduction to Stochastic Integration* by Kai Lai Chung and Ruth J. Williams (Boston: Birkhäuser, 1983), 204 pp.; *Hands-on Basic: For the IBM Personal Computer*, by Herbert Peckham (New York: McGraw-Hill, 1983), 320 pp.; *Hands-on Basic: For the Apple II*, by Herbert Peckham with Wade Ellis, Jr., and Ed Lodi (New York: McGraw-Hill, 1983), 332 pp.; *Hands-on Basic: For the TRS-80 Color Computer*, by Herbert Peckham with Wade Ellis, Jr., and Ed Lodi (New York: McGraw-Hill, 1983), 354 pp.; *Hands-on Basic: For the Atari 400/800/1200XL*, by Herbert Peckham with Wade Ellis, Jr., and Ed Lodi (New York: McGraw-Hill, 1983), 319 pp.; and *Probability in Social Science* by Samuel Goldberg (Boston: Birkhäuser, 1983), 131 pp. Incidentally, the typesetting of this last book was done by my son John during the summer of 1982, before he had learned anything about computer programming. I helped him with a few `\halign` constructions, but otherwise he worked essentially without supervision. At that time he was about to be a senior in high school; I know of at least three other children in his high school who were typesetting books with TEX. (These other books have not come out yet.)

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.

Members of Stanford's Space, Telecommunications and Radioscience Laboratory began to use TEX for articles that were typeset on our Alphatype and published in journals and conference proceedings. I believe the first of these were "Photographic observations of earth's airglow from space," by S. B. Mende, P. M. Banks, R. Nobles, O. K. Garriott, and J. Hoffman, *Geophysical Research Letters* **10** (1983), 1108–1111; "Solar wind control of the low-latitude asymmetric magnetic disturbance field," by C. Robert Clauer, Robert L. McPherron, and Craig Searls, *Journal of Geophysical Research* **88** (1983), 2123–2130; "VLF wave injections from the ground," by Robert A. Helliwell, in *Active Experiments in Space* (Paris: European Space Agency, 1983), 3–9; "Electron beam experiments aboard the space shuttle," by P. M. Banks, P. R. Williamson, W. J. Raitt, S. D. Shawhan, and G. Murphy, *ibid.*, 171–175. Dozens more are currently in press.

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.

The Society first put TEX's mathematical abilities to the test in the pre-preliminary edition of Michael Spivak's *The Joy of TEX*, 134 pp., which was distributed at the AMS meeting in San Francisco (January 1981). There are many instances of TEX usage in the subsequent *Proceedings* [Volume 85 (1982), pp. 141–488, 567–595, 643–665, 673–674; Volume 86 (1982), pp. 12–14, 19–86, 103–125, 133–142, 148–150, 153–183, 186–188, 253–274, 305–306, 321–327, 363–374, 391, 459–490, 511–524, 574–598, 609–624, 632–637, 641–648, 679–684]. David J. Eck's thesis, "Gauge-natural bundles and generalized gauge theories," was published in *Memoirs of the American Mathematical Society* **33**, number 247 (September 1981), 54 pp.; this memoir includes an interesting preface by Richard Palais, pointing out that David was pleased to be the first guinea pig for AMS-TEX when he typeset the thesis.

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

Abelson and Andrea A. diSessa (Cambridge, Massachusetts: MIT Press, 1981), 497 pp.; and *History of Ophthalmology* by George Gorin (Wilmington, Delaware: Publish or Perish, 1982), 646 pp.

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 *Fácil TEX* macros were, of course, the basis of this production, which was photoreduced from low-resolution output.

The *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 **METAFONT** 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 TEXbook* (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 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.