Footnotes in a multi-column layout*

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1 Preface to version 1.1

The new release is a basically unchanged version of the original. I upgraded the macros so that they work with LaTeX 2_ε and used some of the additional flexibility introduced therein. For example, the command `\preparefootins` is now automatically called at `\begin{document}`, thus allowing the user to adjust the `\textheight` in the preamble.

It is not surprisingly that I was forced to change some of the macros because they dig deep into LaTeX's output routines. Fortunately this is something normally not necessary when upgrading other LaTeX 2.09 styles to LaTeX 2_ε packages.

I also upgraded the documentation to conform to the LaTeX 2_ε terminology, e.g., this is a package since document classes will not know about it. However it is very likely that i have missed some necessary corrections.

2 Introduction

The placement of footnotes in a multi-column layout always bothered me. The approach taken by LaTeX (i.e., placing the footnotes separately under each column) might be all right if nearly no footnotes are present. But it looks clumsy when both columns contain footnotes, especially when they occupy different amounts of space.

In the multi-column package [5], I used page-wide footnotes at the bottom of the page, but again the result doesn't look very pleasant since short footnotes produce undesired gaps of white space. Of course, the main goal of this package was a balancing algorithm for columns which would allow switching between different numbers of columns on the same page. With this feature, the natural place for footnotes seems to be the bottom of the page[1] but looking at some of the results it seems best to avoid footnotes in such a layout entirely.

Another possibility is to turn footnotes into endnotes, i.e., printing them at the end of every chapter or the end of the entire document. But I assume everyone who has ever read a book using such a layout will agree with me, that it is a pain to search back and forth, so that the reader is tempted to ignore the endnotes entirely.

When I wrote the article about "Future extensions of TeX" [6] I was again dissatisfied with the outcome of the footnotes, and since this article should show certain aspects of high quality typesetting, I decided to give the footnote problem a try and modified the LaTeX output routine for this purpose. The layout I used was inspired by the yearbook of the Gutenberg Gesellschaft Mainz [2]. Later on, I found that it is also recommended by Jan White [9]. On the layout of footnotes I also consulted books by Jan Tschichold [8] and Manfred Simoneit [7], books, I would recommend to everyone being able to read German texts.

*The LaTeX package **ftnright** which is described in this article has the version number v1.1b dated 1994/02/28. The documentation was last revised on 1994/02/28.

1. You can not use column footnotes at the bottom, since the number of columns can differ on one page.

2.1 Description of the new layout

The result of this effort is presented in this paper and the reader can judge for himself whether it was successful or not.[2] The main idea for this layout is to assemble the footnotes of all columns on a page and place them all together at the bottom of the right column. Allowing for enough space between footnotes and text, and in addition, setting the footnotes in smaller type[3] I decided that one could omit the footnote separator rule which is used in most publications prepared with TeX.[4] Furthermore, I decided to place the footnote markers[5] at the baseline instead of raising them as superscripts.[6]

All in all, I think this generates a neat layout, and surprisingly enough, the necessary changes to the LaTeX output routine are nevertheless astonishingly simple.

2.2 The use of the package

This package might be used together with any other package for LaTeX which does not change the three internals changed by `ftnright.sty`.[7] In most cases, it is best to use this package as the very last package in the preamble to make sure that its settings are not overwritten by other packages.

It is unfortunate that the current LaTeX has nearly no provisions to make such changes without overwriting the internal routines. In the LaTeX3 implementation, we will certainly add some hooks that will make such changes more easy.

3 The documentation driver

The first bit of code contains the documentation driver file for TeX, i.e., the file that will produce the documentation you are currently reading. It will be extracted from this file by the `docstrip` program. If you don't want to make any changes to the presentation you can alternatively process the `.dtx` file directly with LaTeX 2_ε to obtain the documentation.

```
⟨*driver⟩
\documentclass[twocolumn]{ltxdoc}


\newcommand{\TUB}{{\sl TUGboat\/}}
\renewcommand\DescribeMacro[1]{\fbox
          {\PrintDescribeMacro{#1}}}
\renewcommand\DescribeEnv[1]{\fbox
          {\PrintDescribeEnv{#1}}}
\renewcommand\PrintMacroName[1]{}

\setlength{\parindent}{1em}
\setlength{\parskip}
          {2pt plus1pt minus1pt}
\setlength{\headsep}{20pt}
\setlength{\columnsep}{1.5pc}
\renewcommand{\bottomfraction}{.4}


\setlength{\textwidth}{\paperwidth}
\addtolength{\textwidth}{-2in}
\setlength{\oddsidemargin}{0pt}
\setlength{\evensidemargin}{0pt}

\usepackage{ftnright}


\flushbottom
\CodelineIndex
\RecordChanges      % produce history
\EnableCrossrefs

\setcounter{IndexColumns}{2}
\IndexPrologue{\section{Index}
 All numbers denote code lines where
```

2. Please note, that this option only changed the placement of footnotes. Since this article also makes use of the `doc` package [1], that assigns tiny numbers to code lines sprincled throughout the text, the resulting design is not perfect. This package is now a standard part of LaTeX 2_ε.

3. The standard layout in *TUGboat* uses the same size for footnotes and text, giving the footnotes, in my opinion, much too much prominence.

4. People who prefer the rule can add it by redefining the command `\footnoterule` [3, p. 156]. Please, note, that this command should occupy no space, so that a negative space should be used to compensate for the width of the rule used.

5. The tiny numbers or symbols, e.g., the '5' in front of this footnote.

6. Of course, this is only done for the mark preceeding the footnote text and not the one used within the main text where a raised number or symbol set in smaller type will help to keep the flow of thoughts, uninterrupted.

7. These are the macros `\@startcolumn`, `\@makecol` and `\@outputdblcol` as we will see below. Of course, the package will take only effect with a document class using a twocolumn layout (like `ltugboat`) or when the user additionally specifies `twocolumn` as a document class option in the `\documentclass` command.

```
the corresponding entry is used,
underlined entries point to the
definition.}

\begin{document}
  \DocInput{ftnright.dtx}
\end{document}
⟨/driver⟩
```

4 The Implementation

As usual, we start by identifying the current version of this package file in the transcript file.[8]

```
⟨*package⟩
\wlog{Package: `\filename'
  \fileversion\space <\filedate> (FMi)}
\wlog{English Documentation
              \@spaces <\docdate> (FMi)}
```

We also announce the file to LaTeX 2_ε, so that it shows up in `\listfiles` etc.

```
\ProvidesPackage{ftnright}[\filedate\space
              LaTeX2e package \fileversion]
```

To implement the layout described, above we have to distinguish between the left and the right column on a page. For this purpose LaTeX maintains the switch `\if@firstcolumn`. When assembling material for the left (i.e., the first) column, footnotes should take up no space, since they are held over for the second column. In the second column these footnotes are combined with the ones found there and placed a suitable distance from the main text at the bottom of this column.

This means that we have to change certain parameters for the insertion `\footins` when we construct the second column. The right place to do this is in the LaTeX macro `\@outputdblcol` which we are going to change later on. What settings for the insertion parameters are appropriate? For setting the first column `\count\footins` and `\skip\footins` should both be zero since footnotes are held over while for the second column `\count\footins` should be 1000 and the `\skip \footins` has to be set to the desired separation between main text and footnotes.[9]

We will allow one column of footnotes (i.e., the right column) at most, so that `\dimen\footins` has to equal `\textheight`. In principle, it would be possible to allow for even more footnotes, but this would complicate matters enormously.[10]

Since a document usually starts with a left column, we have to set `\count` and `\skip\footins` on top-level to zero. For this purpose, we define a macro `\preparefootins` which will first save the current value of `\skip\footins` in a safe place. This saved value will be used later for the second column. In this way, it is possible for the user or a designer of a document class to adjust this parameter without fiddling with the code of this package file.

```
\def\preparefootins{%
  \global\rcol@footinsskip\skip\footins
  \global\skip\footins\z@
  \global\count\footins\z@
```

We will also assign `\textheight` to `\dimen\footins` to allow the user to change this parameter in the preamble.

```
  \global\dimen\footins\textheight}
```

It is necessary to make the assignments above `\global` because we are going to use this macro in the output routine which has an implicit grouping level to keep the changes made by it local.

Of course, we have to allocate the skip register that we used above:

```
\newskip\rcol@footinsskip
```

Now we have all the necessary tools available to tackle `\@outputdblcol`. We have to remember that when `\if@firstcolumn` equals `\iftrue`, we are currently starting to build the second column, i.e., that the first column is already assembled.

8. Nico Poppelier suggested omitting the `\typeout` statements in the production version of the files to avoid showing all that unnecessary information to the user. While I accept his criticism as valid, I decided that this information should at least be placed into the transcript file to make it easier to detect problems arising from the use of older versions. The command `\wlog` is a Plain TeX command that will write its argument to the transcript file.

9. A value of 1000 means that there is a one-to-one relationship between the real size of the footnote and the size finally occupied by the footnote on the current page.

10. It is not possible to make `\dimen\footins` larger than `\textheight` directly, because this would result in a full left column (with text) and more than one column of footnotes. Instead, one has to make footnotes visible to the page generation algorithm again at the moment when a full column of footnotes is assembled, but we still have some space left in the first column. It is a nice enhancement, and, I suppose, it is of some value for preparing publications in certain disciplines, so here is the challenge ...

Therefore, the macro will start with the following code:

```
\def\@outputdblcol{\if@firstcolumn
  \global\@firstcolumnfalse
```

After changing the switch, we save the first column (which was placed by preceeding macros in `\@outputbox`) in the box register `\@leftcolumn`. Since we are inside the output routine, all those assignments have to be `\global` to take any effect.

```
  \global\setbox\@leftcolumn\box\@outputbox
```

Then, we make the footnotes visible to the page generation algorithm by setting `\count\footins` to 1000 (`\@m` is an abbreviation for this number) and `\skip\footins` to its saved value (i.e., `\rcol@footinsskip`).

```
  \global\count\footins\@m
  \global\skip\footins\rcol@footinsskip
```

We also have to reinsert all footnotes left over from the first column to make sure that they are reconsidered by the page generation algorithm of TeX using the new values for `\count` and `\skip` `\footins`. But this will be done later in the macro `\@startcolumn`.

If we have just finished the right column, i.e., when `\if@firstcolumn` equals `\iffalse`, we will reset the `\footins` parameters as explained above using the utitlity macro `\preparefootins`.

```
 \else \preparefootins
```

Then, we compose both columns in `\@outputbox`, combine them with all page-wide floats for this page (`\@combinedblfloats`), attach header and footer, and ship out the result (`\@outputpage`). Finally we look to see whether it is possible to generate following pages consisting only of page-wide floats.[11]

```
  \global\@firstcolumntrue
  \setbox\@outputbox\vbox{\hbox to\textwidth
    {\hbox to\columnwidth
                  {\box\@leftcolumn\hss}%
     \hfil\vrule\@width\columnseprule\hfil
     \hbox to\columnwidth
                  {\box\@outputbox\hss}}}%
  \@combinedblfloats\@outputpage
  \begingroup
   \@dblfloatplacement\@startdblcolumn
   \@whilesw\if@fcolmade\fi
    {\@outputpage\@startdblcolumn}%
  \endgroup
 \fi}
```

There is a fundamental flaw in LaTeX's output routine for float columns and float pages: split footnotes, i.e., footnotes which are only partly typeset on the preceding page are not resolved. They are held over until LaTeX starts a page (or column) containing text besides floats again. For our current layout, this would mean, that if LaTeX decided to make the right column of a page a float column, footnotes from the left column would appear on a later page. A real cure for this problem would be to rewrite two-thirds of LaTeX's output routine, so I am leaving this open for the interested reader.

But the problem shows up even if only one float is contributed to the right column since LaTeX assumes that the whole column is usable, whereas some of it might actually be already devoted to footnotes from the left column. So we have to change the output routine at least in the part that contributes floats to the next column. The macro involved is called `\@startcolumn`. The first thing we do is to check and see whether any deferred floats exists.

```
\def\@startcolumn{%
 \ifx\@deferlist\@empty
```

11. This part is copied directly from the original LaTeX macro. Details about the used macros, their interfaces and meanings can be found in the LaTeX 2_ε source code [4].

Puzzle:

Given a simple TeX document containing only straight text, is it possible for the editor, after deleting one sentence, to end up with a document producing an extra page? We assume that the deleted text contains no TeX macros and that the document was prepared with a standard macro package like the one used for *TUGboat* production.

The answer will be given in the next issue.

If not, we set the switch `\if@fcolmade` to `false` which says that we did not succeed in making a float column. Then, we set `\@colroom` to `\@colht`. The register `\@colht` holds the amount of space that is available for floats, text, and footnotes in one column, i.e., it equals `\textheight` minus the space devoted to page-wide floats. `\@colroom` is a similar register which holds the value `\@colht` minus space for column floats that are already contributed to the current column. Of course, both values should be equal when we start a new column.

```
    \global\@fcolmadefalse
    \global\@colroom\@colht
  \else
```

If there are floats waiting for a change to be processed, the situation is more difficult. In this case, we have to reduce both `\@colht` and `\@colroom` by the amount of space that will be needed for the footnotes from the left column. So we must check whether such footnotes are present. As we have not reinserted them in `\@outputdblcol`, we can check the `\footins` box.

```
    \ifvoid\footins\else
```

If there are some, we measure the space that will be occupied by them. This measurement is not really exact. If we have a full column of footnotes, it will be too high, but this does matter since we need it only for an upper bound on the free space available for floats.

```
      \ftn@amount\ht\footins
      \advance\ftn@amount\dp\footins
      \advance\ftn@amount\skip\footins
    \fi
```

We then reduce the `\@colht` by this amount and again assign `\@colroom` the value of `\@colht`. If no footnotes are present, we substract zero, so there is no harm in doing this operation all the time.

```
    \global\advance\@colht-\ftn@amount
    \global\@colroom\@colht
```

Now, we call another internal LaTeX macro that will try to contribute floats to the next column. It will use the register `\@colht` when trying to build up a float column, which is the reason for reducing this register. If it succeeds, it will set the switch `\if@fcolmade` to `true`, otherwise, to `false`. If no float column is possible, it will try to place some or all of the deferred floats to the top or the bottom of the next column, thereby, using and reducing the value of the register `\@colroom`.

```
    \@xstartcol
```

Afterwards, we have to restore the correct values for `\@colht` and `\@colroom` again, but this time, they may differ, so that we have to `\advance` both registers separately by `\ftn@amount`.

```
    \global\advance\@colht\ftn@amount
    \global\advance\@colroom\ftn@amount
  \fi
```

Now, after doing the things depending on the status of the `\@deferlist`, we have to incorporate the left over footnotes in the new column. First we check whether a float column was produced by `\@xstartcol` or not.

```
  \if@fcolmade
```

If so, we do something awful. To make use of the `\@makecol` macro, which attaches footnotes to `\box 255` and places the result in the box register `\@outputbox`, we have to assign `\@outputbox` (i.e., the result of `\@xstartcol`) to `\box 255`.[12]

```
   \setbox\@cclv\box\@outputbox
   \@makecol
  \else
```

If no float column was produced, we reinsert the held over footnotes so that they can be reconsidered by the page generation algorithm of TeX. But it is necessary to ensure that this operation is done only when footnotes are actually present.[13]

```
    \ifvoid\footins\else
      \insert\footins{\unvbox\footins}\fi
  \fi}
```

Of course, we also have to allocate the dimen register. It will be automatically initialized to zero.

```
\newdimen\ftn@amount
```

The macro `\@xtsartcol` was removed in LaTeX 2_ε but we introduce it here again for the moment.

12. In German, we call this “from the back through the chest into the eyes”.

13. Otherwise, we might get an undesired extra vertical space coming from `\skip\footins`, even if there are no footnotes on the page.

```
\def\@xstartcol{%
  \@tryfcolumn \@deferlist
  \if@fcolmade
  \else
    \begingroup
      \let \@tempb \@deferlist
      \global \let \@deferlist \@empty
      \let \@elt \@scolelt
      \@tempb
    \endgroup
  \fi
}
```

The other internal macro that we have to change is `\@makecol`, a macro that is called whenever one column of material is assembled and column floats and footnotes have to be added. Again, we have to distinguish between actions for the first and the second column.

```
\def\@makecol{\if@firstcolumn
```

For the first column, we leave the footnotes in their box and simply save the contents of box 255 in the `\box` register `\@outputbox`.

```
  \setbox\@outputbox\box\@cclv
```

But if the user errously forgot to specify a twocolumn layout, we will always typeset the first column, so that the footnotes are never printed. Therefore we better check for this special case and output the footnotes on a separate page in an emergency.[14]

```
  \if@twocolumn \else
    \ifvoid\footins \else
      \@latexerr{ftnright package
                 used in one-column mode}%
   {The ftnright package was designed to
    work with LaTeX's standard^^Jtwocolumn
    option. It does *not* work with the
    multicol package.^^JSo please specify
    'twocolum' in the
    \noexpand\documentclass command.}%
      \shipout\box\footins \fi\fi
  \else
```

When we construct the second column, we must first check whether footnotes are actually present. If not, we perform the same actions as before.

```
  \ifvoid\footins
    \setbox\@outputbox\box\@cclv
  \else
```

But, if footnotes are present, it may be possible that the whole column consists of footnotes, i.e., `\box 255` is empty. In this case, there is no use in placing any glue (`\skip\footins`) in front,[15] so we have to check for this possibility.

```
    \setbox\@outputbox\vbox
      {\ifvoid\@cclv \else
          \unvbox\@cclv
          \vskip\skip\footins\fi
```

But in any case, we place the `\footnoterule` in front of the footnotes even if this macro is not used by this package.[16] This ends the if-statement testing whether footnotes are present or not. It also ends the code which differs depending on the column number.

```
          \footnoterule\unvbox\footins}\fi
  \fi
```

Now the column floats are added at the top and the bottom, and the `\@outputbox` is adjusted to the full column height so that the glue inside will stretch in certain situations.[17] Again, this code is copied verbatim from the original source, so I

14. Otherwise, the footnotes are held over for ever, preventing TEX from finishing the document successfully. Instead, TEX will produce infinity many empty pages at the end of the document, trying in vain to output the held over footnotes. This problem was found by Rainer Schöpf when we prepared the paper for the Cork conference.

15. In fact, it would be a mistake since this glue was not taken into account when the footnotes where assembled, so it would produce an overfull box.

16. This decision if certainly open to criticism, since there is nothing to separate. On the other hand, a rule or some other ornament in front of the footnotes is part of the design which should be used concistently throughout a document. As a last argument in favor of the rule, consider the situation where LATEX decided to place only floats and footnotes into the right hand column. In this case a separator again seems adequate. In this situation one can even argue that it is necessary to put in the `\skip\footins`.

17. It is an interesting question as to whether the current layout works well with bottom floats or not. Actually, I would prefer to place the footnotes below the bottom floats instead of above, as it is done here. At least when the floats are part of the document and not puzzles thrown in. But I was too lazy to implement it because I seldom use floats. If somebody implements this layout (some parts of this macro have to be changed) I would be interested in seeing the code and some sample results.

won't dwell on details.[18][19]

```
  \xdef\@freelist{\@freelist\@midlist}%
  \global \let \@midlist \@empty
  \@combinefloats
  \ifvbox\@kludgeins
    \@makespecialcolbox
  \else
   \setbox\@outputbox\vbox to\@colht
     {\boxmaxdepth\maxdepth
      \@texttop
      \@tempdima\dp\@outputbox
      \unvbox\@outputbox
      \vskip-\@tempdima
      \@textbottom}%
  \fi
  \global\maxdepth\@maxdepth}
```

Now we can tackle the remaining small changes to the standard layout. I decided to use a smaller size for footnotes but with a slightly larger leading than usual. This means that we have to redefine the `\footnotesize` macro which depends on options like `11pt` etc. Fortunately, there is a simple way to find out the main size of the document: the macro `\@ptsize` contains 0, 1, or 2 standing for 10, 11, or 12 points document text size.[20]

```
\ifcase \@ptsize
\renewcommand\footnotesize{%
 \@setfontsize\footnotesize\@viiipt{9.9}%
 \abovedisplayskip 6\p@\@plus2\p@\@minus4\p@
 \abovedisplayshortskip \z@ \@plus\p@
 \belowdisplayshortskip
                         3\p@\@plus\p@\@minus2\p@
 \def\@listi{\leftmargin\leftmargini
             \topsep 3\p@ \@plus\p@ \@minus\p@
             \parsep 2\p@ \@plus\p@ \@minus\p@
             \itemsep \parsep}%
 \belowdisplayskip \abovedisplayskip
}
\or
\renewcommand\footnotesize{%
 \@setfontsize\footnotesize\@ixpt{11.1}%
 \abovedisplayskip 8\p@\@plus2\p@\@minus4\p@
 \abovedisplayshortskip \z@ \@plus\p@
 \belowdisplayshortskip
                      4\p@ \@plus2\p@ \@minus2\p@
 \def\@listi{\leftmargin\leftmargini
            \topsep 4\p@ \@plus2\p@\@minus2\p@
            \parsep 2\p@ \@plus\p@ \@minus\p@
            \itemsep \parsep}%
 \belowdisplayskip \abovedisplayskip
}
\or
\renewcommand\footnotesize{%
 \@setfontsize\footnotesize\@xpt{12.3}%
 \abovedisplayskip10\p@\@plus2\p@\@minus5\p@
 \abovedisplayshortskip \z@ \@plus3\p@
 \belowdisplayshortskip
                   6\p@ \@plus3\p@ \@minus3\p@
 \def\@listi{\leftmargin\leftmargini
          \topsep 6\p@ \@plus2\p@ \@minus2\p@
          \parsep 3\p@ \@plus2\p@ \@minus\p@
          \itemsep \parsep}%
 \belowdisplayskip \abovedisplayskip
}
\fi
```

Setting footnotes in smaller type and separating them with sufficiant space from the main text allow us to omit the `\footnoterule` normally used.

```
\let\footnoterule\@empty
```

Individual footnotes are separated from each other by a more or less baseline skip of the text size. This can be specified with the following code:

```
\AtBeginDocument
  {\global\footnotesep\ht\strutbox}
```

The use of the LaTeX 2_ε hook `\AtBeginDocument` is a big help since it allows us to defer everything that might depend on user setting inside the preamble to the `\begin{document}` environment start.

And finally, a small but nice change, to the mark at the beginning of the footnote text. We will place it at the baseline instead of raising it as a superscript. Additionally, it will get a dot as punctuation.

```
\long\def\@makefntext#1{\parindent 1em
  \noindent\hbox to 2em{}%
  \llap{$\@thefnmark.\;\;$}#1}
```

18. I only changed `\dimen128` into `\@tempdima` which is, besides being faster and shorter, only a cosmetic change. The use of this hardwired `dimen` register seems to indicate that this part of LaTeX was written very early and left unchanged since then: an interesting fact for software archeologists.

19. For the LaTeX 2_ε upgrade I had to add the support for the `\enlargethispage` command—let's hope I did it in the correct way.

20. In the new release I used the definitions from the class option files `size1?.clo` and modified them slightly. In the previous release there was no correction for the list parameters etc., thus giving you incorrect spacing if somebody used display lists in footnotes.

5 Initialisation

We defined the macro `\preparefootins` above, but we also have to use it to prepare typesetting the first column. As a default for the separation of footnotes and text on the second column, we use the following:

```
\setlength{\skip\footins}
          {10pt plus 5pt minus 3pt}
\AtBeginDocument{\preparefootins}
⟨/package⟩
```

Of course, this value can be changed, on by the user as described in the introduction.

References

[1] M. Goossens, F. Mittelbach and A. Samarin. The LaTeX Companion. Addison-Wesley, Reading, Massachusetts, 1994.

[2] Hans-Joachim Koppitz, editor. *Gutenberg Jahrbuch.* Gutenberg-Gesellschaft, Mainz.

[3] Leslie Lamport. *LaTeX: A Document Preparation System.* Addison-Wesley, Reading, Massachusetts, 1986.

[4] LaTeX3 project. LaTeX 2εdistribution, 1994. Souces for LaTeX 2ε the successor to LaTeX 2.09.

[5] Frank Mittelbach An environment for multicolumn output. *TUGboat*, 10(3):407–415, November 1989.

[6] Frank Mittelbach E-TeX: Guidelines to future TeX extensions. In Lincoln K. Durst, editor, *TUGboat*, 11(3): *1990 TUG Annual Meeting Proceedings*, pages 337–345, September 1990.

[7] Manfred Siemoneit. *Typographisches Gestalten.* Polygraph Verlag, Frankfurt am Main, second edition, 1989.

[8] Jan Tschichold. *Ausgewählte Aufsätze über Fragen der Gestalt des Buches.* Birkhäuser Verlag, Basel, 1987. Second printing.

[9] Jan White. *Graphic Design for the Electronic Age.* Watson Guptill, Xerox Press, New York, 1988.

6 Index

All numbers denote code lines where the corresponding entry is used, underlined entries point to the definition.

Change History