1. Double Column Output

Typesetting text in more than one column on a single page is more involved than typesetting text in a single page-wide column, but this extra effort can be rewarded with a document which looks much more professional and which can be easier to read (provided that the resolution of your printer is up to it). Many publishers of "camera-ready" conference proceedings require double column typesetting, and the *Physical Review* and other APS and AIP journals are typeset in double columns. In order to make it easy for authors to prepare manuscripts either for such camera-ready conference proceedings or for submission to *Physical Review*, we have included some powerful double column typesetting macros in TEXsis. These macros can automatically balance columns which do not fill an entire page, and there are also provisions for equations which must be extended across both columns because they are too wide for a single column. Figures and tables (or other such "floating" insertions) can be put either in a single column or across both columns. The same is true for footnotes. By changing a single instruction in the manuscript file it is also possible to take a document which has been prepared for double columns and to print it in single column mode. The converse is not true — typesetting text in double columns with automatic column balancing is a nontrivial task. While the macros generally behave as intended, more attention to the layout of the document is required, and even then the macros will sometimes fail without some extra guidance. It is not possible to divide three lines into two balanced columns! In such cases you must rearrange text or the placement of figures and tables, or explicitly select column or page breaks elsewhere in the document, in order to give TEXsis some extra guidance on how best to format the page.

In order to use the double column formatting macros you must first specify the size of the columns with the command `\SetDoubleColumns{`⟨c-width⟩`}`. The width and height of the full page are taken from the current settings of `\hsize` and `\vsize`, while the width of each column is ⟨c-width⟩. This re-defines TEX's `\output` routine, so it should be called shortly after you say `\texsis`, before any output is actually produced, and it should only be called if double column output is to be produced.

`\SetDoubleColumns` only sets the column dimensions and prepares the `\output` routine for double column output at some point in the future — it does not actually put you in double column mode. Text will still be set in a single page-wide column until you say `\doublecolumns`. After you say `\doublecolumns` text will be set in double columns until you say `\enddoublecolumns`. This will cause the text collected so far to be put into two "balanced" columns of the same height. You can, if you desire, return to double column mode at any later time by saying `\doublecolumns` again, and you can switch back and forth as much as you like. However, keep in mind that frequently switching between single and double columns will make it very difficult for TEXsis to choose good points to break columns and pages, and you may get an error message warning you that a column cannot be balanced.

A simple example of the use of these double column commands is the following:

```
\SetDoubleColumns{0.47\hsize}
\doublecolumns\tenpoint
{\bf BISMUTH} (Ger.\ {\it Weisse Masse}, white mass; later
{\it Wismuth} and {\it Bisemutum}, Bi; at.~wt. 308.981;
```

```
at.~no. 83; m.p.  271.3$^\circ$C; b.p. 1560 $\pm$ 5$^\circ$C;
sp.~gr. 9.747 (20$^\circ$); valence 3 or~5.  In early times
bismuth was confused with tin and lead.  Claude Geoffroy the
Younger showed it to be distinct from lead . . .
     . . . . . . .
. . .   High purity bismuth metal costs about \$4/lb.
\enddoublecolumns
```

Here the column size is chosen to be slightly less than half of the `\hsize` (0.47 times the `\hsize`) to allow some space (called the "gutter") between the two columns. The result is the following:[1]

BISMUTH (Ger. *Weisse Masse*, white mass; later *Wismuth* and *Bisemutum*, Bi; at. wt. 308.981; at. no. 83; m.p. 271.3°C; b.p. 1560 ± 5°C; sp. gr. 9.747 (20°); valence 3 or 5. In early times bismuth was confused with tin and lead. Claude Geoffroy the Younger showed it to be distinct from lead in 1753. It is a white, crystalline, brittle metal with a pinkish tinge. It occurs native. The most important ores are *bismuthinite* or *bismuth glance* (Bi_2S_3) and *bismite* (Bi_2O_3). Peru, Japan, Mexico, Bolivia, and Canada are major bismuth producers. Much of the bismuth produced in the U.S. is obtained as a by-product in refining lead, copper, tin, silver, and gold ores. Bismuth is the most diamagnetic of all metals, and the thermal conductivity is lower than any metal, except mercury. It has a high electrical resistance, and has the highest Hall effect of any metal (i.e., greatest increase in electrical resistance when placed in a magnetic field). "Bismanol" is a permanent magnet of high coercive force, made of MnBi, by the U.S. Naval Ordnance Laboratory. Bismuth expands 3.32% on solidification. This property makes bismuth alloys particularly suited to the making of sharp castings of objects subject to damage by high temperatures. With other metals, such as tin, cadmium, etc., bismuth forms low-melting alloys which are extensively used for safety devices used in fire detection and extinguishing systems. Bismuth is used in producing malleable irons and is finding use as a catalyst for making acrylic fibers. When bismuth is heated in air it burns with a blue flame forming yellow fumes of the oxide. The metal is also used as a thermocouple material (has highest negativity known), and has found application as a carrier for U^{235} or U^{238} fuel in atomic reactors. Its soluble salts are characterized by forming insoluble basic salts on the addition of water, a property sometimes used in detection work. Bismuth oxychloride is used extensively in cosmetics. Bismuth subnitrate and subcarbonate are used in medicine. High purity bismuth metal costs about $4/lb.

The `\IEEE`, `\PhysRev`, and `\NorthHollandTwo` document formats described in Section 9 also use these double column macros.

Any document prepared for double column output using the macros just described can also be printed in the simpler single column mode very easily, simply by leaving out the `\SetDoubleColumns`. Without the initialization provided by `\SetDoubleColumns` the `\doublecolumns` and `\enddoublecolumns` commands do nothing (they are, in fact, the same as saying `\relax`). However, if you restore the `\SetDoubleColumns` command, or invoke one of the specialized document styles which use double column output (like `\PhysRev`) they will come back to life and perform as required.

In double column mode displayed equations that fit within a single column are typed within the usual `$$ ... $$`. If an equation is too long then it may have to be printed across both columns. This is easily done by saying `\longequation` before the `$$` which begins the equation and `\endlongequation` after the `$$` which ends the equation, like so:

```
\longequation
$$
\psi_{nlm}(r,\theta,\phi)
        = [({2Z \over n a_0})^3 {(n-l-1)! \over 2n(n+l)!} ]^{1 \over 2}
           \, (\rho)^l \, e^{-\rho / 2} \, \,
        L_{n-l-1}^{2l+1} (\rho)  \,\,  Y_l^m(\theta,\phi)
$$
\endlongequation
```

The command `\longequation` invokes `\enddoublecolumns` to end double column mode and balance the partial double columns, and it will also draw a ruled line across the bottom of the left column. After the equation has been completed `\endlongequation` invokes `\doublecolumns` to go back to double column mode, and it also draws a rule across the top of the right column.

The purpose of these ruled lines is to guide the reader's eye from the incomplete left column to the right column above the equation, and to the top of the incomplete right column from the left column below the long equation. The default style of these rules is the same as is used by *Physical Review*. The rules are drawn by macros called `\leftcolrule` and `\rightcolrule`, and these can be changed either by you or by a style file. For example, if you don't want these rules you can turn them off simply by redefining these macros to be `\relax`:

```
\def\leftcolrule{\relax}
\def\rightcolrule{\relax}
```

As with the other double column macros, `\longequation` and `\endlongequation` do nothing if they are invoked when double column mode has not been initialized with `\SetDoubleColumns`, to make it easy to print the document in single column mode.

Keep in mind that when dealing with long equations which span both columns, switching frequently between single and double columns will almost certainly cause trouble in balancing the double columns. Also note that each separate piece of double-column material forms its own group, so any definitions made inside that group will be forgotten outside it. To avoid this problem put all definitions at the beginning of the paper, before double column mode is begun. Alternatively, make your definitions global by using `\gdef` rather than `\def`.

Figures, tables, or other floating insertions can be inserted within a single column using the usual insertion commands of TeX and TeXsis: `\topinsert`, `\midinsert`, `\pageinsert`, `\bottominsert`, or `\heavyinsert`, all of which are terminated as usual by `\endinsert`. A `\midinsert` or `\heavyinsert` will appear in the column where it is called for, unless it won't fit, in which case it migrates to the next *column* (rather than all the way to the next page). You can force an insertion into a particular column by placing *within* the insertion either `\forceleft` or `\forceright`. Since insertions which have been forced into the left or right columns are handled separately, an insertion which fails to fit on a page is moved to the same column of the next page and not just to the next column. This means that if there are several figures per page, then the figures can easily appear in the wrong order. Also, a `\topinsert` which follows a wide equation on a page will be placed after the equation, not at the top of the page. Such problems can easily be corrected by moving the insertion to a better place in the manuscript file.

Besides putting insertions in one column or the other, it is also sometimes desirable to be able to put an insertion across the full width of the page. These "wide" insertions can be made with "wide" versions of some of the the insertions already mentioned: `\widetopinsert`, `\widepageinsert` and `\widebottominsert` (there is no such thing as `\widemidinsert` or `\wideheavyinsert`). These wide insertions behave just like their more conventional counterparts when in single column mode.

The standard TEXsis macros for table and figure insertions described in Section 7.3 use `\topinsert` and cousins, and so make insertions within a single column in double column format. There are also macros to make two-column wide tables and figures:

`\widetable{`⟨label⟩`}`
: Insert a two-column wide table, with the tag ⟨label⟩, at the top of the current page.

`\widefigure{`⟨label⟩`}`
: Insert a two-column wide figure, with the tag ⟨label⟩, at the top of the current page.

`\widetopfigure{`⟨label⟩`}`
: A synonym for `\widefigure`.

`\widefulltable{`⟨label⟩`}`
: Insert a two-column wide, full-page table, with the tag ⟨label⟩.

`\widefullfigure{`⟨label⟩`}`
: Insert a two-column wide, full-page figure, with the tag ⟨label⟩.

These also behave correctly in single column document formats.

Here is a summary of the commands which can be used to set-up and control double column mode:

`\SetDoubleColumns{`⟨c-width⟩`}`
: Set up the double column format, using the current `\hsize` and `\vsize` for the total size of the page and ⟨c-width⟩ for the column width.

`\doublecolumns`
: Begin double column mode.

`\newcolumn`
: Force a column break, much like `\newpage` forces a page break.

`\enddoublecolumns`
: End double column mode, making balanced double columns,

`\longequation` Begins a "long" equation which cannot fit within one column and therefore must stretch across both columns. This balances the columns, putting a `\leftcolrule` below the left column, and then enters single column mode.

`\endlongequation`
Ends a long equation, returning to double column mode and putting a `\rightcolrule` above the right column of the text following.