A use case for `\valign`

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The TEX primitive command `\halign` is the backbone of traditional macros for predominantly horizontal tabular material. Its companion primitive `\valign` can be used for predominantly vertical material, but column-based tabular material is rare so there is no built-in support for it in ConTEXt. Since I was required to typeset a table using vertical alignment, I wrote a small set of higher-level macros to allow use of `\valign` in a ConTEXt-friendly manner.

1. Introduction

From the TEXbook comes this quote by D.E. Knuth (p. 249, *emphasis* mine):

> "The control sequence `\valign` is analogous to `\halign`, but rows and columns change rôles. In this case `\cr` marks the bottom of a column, and the aligned columns are vboxes that are put together in horizontal mode. The individual entries of each column are vboxed with depth zero (i.e., as if `\boxmaxdepth` were zero, as explained in Chapter 12); the entry heights for each row of a `\valign` are maximized in the same fashion as the entry widths for each column of an `\halign` are maximized. The `\noalign` operation can now be used to insert horizontal mode material between columns; the `\span` operation now spans rows. *People usually work with TEX at least a year before they find their first application for* `\valign`; and then it's usually a one-row '`\valign{\vfil#\vfil\cr...}`'. But the general mechanism is there if you need it."

Well, it took me a lot longer than that: nearly three decades, in fact. But then I realized that what I needed to score the `\valign` achievement of an experienced TEX user is to find data that requires row spanning instead of column spanning.

Armed with that knowledge, I browbeat some of the DocWolves clients into having commission meetings in parallel, on the same day. Then, I convinced them that all items on the separate agendas should have a fixed duration. Finally, some fast talking made sure that they wanted an aggregated overview on a single page. They could not even imagine my motive!

2. The input data

In our pdf creation workflow, data is exported to a ConTEXt source file, to be processed. The data export code massages the core data a bit to make it easier to process. This could also be done in Lua, but since the export code has to do various parsing jobs anyway, it makes sense to make the ConTEXt processing as straightforward as possible. In particular, the export code calculates the total

number of needed rows and the required spans based on the duration of the various items.

In the example ConTEXt file that follows, I removed lots of information that is not relevant for this article and changed the text to snippets of poems. The structure remained the same, though.

```
\startmeetings
  [Aanvang={17:00},
   Datum={2 juli 2018},
   Titel={Romantic poets evening}]

\startmeeting
  [TimeStamps={17:00,17:10,17:30,17:45,},
   NumberOfMeetings=3,
   Class=timetable]

\startmeetingagenda
  [Titel=When I am dead, my dearest]

\meetingagendapunt
  [Span=2,
   Name={When I am dead, my dearest,\crlf
         Sing no sad songs for me;\crlf
         Plant thou no roses at my head,\crlf
         Nor shady cypress tree:\crlf
         Be the green grass above me\crlf
         With showers and dewdrops wet;\crlf
         And if thou wilt, remember,\crlf
         And if thou wilt, forget.}]
\meetingagendapunt
  [Span=3,
   Voorzitter={Christina Rossetti},
   Name={I shall not see the shadows,\crlf
         I shall not feel the rain;\crlf
         I shall not hear the nightingale\crlf
         Sing on, as if in pain:\crlf
         And dreaming through the twilight\crlf
         That doth not rise nor set,\crlf
         Haply I may remember,\crlf
         And haply may forget.}]

\stopmeetingagenda

\startmeetingagenda
  [Titel=To My Mother]

\meetingagendapunt
  [Span=5,
   Voorzitter={Edgar Allan Poe},
   Name={Because I feel that, in the Heavens above,\crlf
   The angels, whispering to one another,\crlf
   Can find, among their burning terms of love,\crlf
```

```
          None so devotional as that of "Mother,"\crlf
          Therefore by that dear name I long have called you—\crlf
          You who are more than mother unto me,\crlf
          And fill my heart of hearts, where Death installed you\crlf
          In setting my Virginia's spirit free.\crlf
          My mother—my own mother, who died early,\crlf
          Was but the mother of myself; but you\crlf
          Are mother to the one I loved so dearly,\crlf
          And thus are dearer than the mother I knew\crlf
          By that infinity with which my wife\crlf
          Was dearer to my soul than its soul-life.}]

\stopmeetingagenda

\startmeetingagenda
  [Titel=Proud Maisie]

\meetingagendapunt
  [Span=1,
   Name={Proud Maisie is in the wood,\crlf
         Walking so early;\crlf
         Sweet Robin sits on the bush,\crlf
         Singing so rarely. }]
\meetingagendapunt
  [Span=2,
   Name={"Tell me, thou bonny bird,\crlf
         When shall I marry me?"—\crlf
         "When six braw gentlemen\crlf
         Kirkward shall carry ye.\par
         \blank
         "Who makes the bridal bed,\crlf
         Birdie, say truly?"—\crlf
         "The gray-headed sexton\crlf
         That delves the grave duly. }]
\meetingagendapunt
  [Span=2,
     Voorzitter={Sir Walter Scott},
   Name={"The glowworm o'er grave and stone\crlf
         Shall light thee steady;\crlf
         The owl from the steeple sing,\crlf
         'Welcome, proud lady.'"}]

\stopmeetingagenda
\stopmeeting

\stopmeetings
```

Note:
In the TₑX input examples below, I will abbreviate the actual poems so that the listings do not become overly large. All important parts of the input are kept, just the actual content is abbreviated.

3. Using `\valign`

As a start, here is the 'plain T_EX style' `\valign`-based code that my processing
software could generate (both more and smarter macro definitions would make the
input look nicer, but for the purpose of this paper that would just distract from the
main topic):

```
\def\h#1#2{\vbox{\hsize=#2  \bf    \kern 6pt #1\par\kern 6pt}}
\def\t  #1{\vbox{\hsize=1cm \hrule \kern 6pt #1\par\kern 6pt}}
\def\c  #1{\vbox{\hsize=7cm \hrule \kern 6pt #1\par\kern 9pt}}
\valign{#&#&#&#&#&#\cr
\h{Tijd}{1cm}&
\t{17:00}&
\t{17:15}&
\t{17:30}&
\t{17:45}\cr
\noalign{\kern 6pt}
\h{When I am dead}{7cm}%
&\span
\c{<<When I am dead (1)>>}%
&\span
\c{<<When I am dead (2)>>
    \kern 6pt
    \hbox to 7cm{\hss Christina Rossetti}}%
\cr
\noalign{\kern 6pt}
\h{To My Mother}{7cm}%
&\span\span\span\span
\c{<<To My Mother>>
    \kern 6pt
    \hbox to 7cm{\hss Edgar Allan Poe}}%
\cr
\noalign{\kern 6pt}
\h{Proud Maisie}{7cm}%
&
\c{<<Proud Maisie (1)>>}%
&\span
\c{<<Proud Maisie (2,3)>>}%
&
\c{<<Proud Maisie (4)>>
    \kern 6pt
    \hbox to 7cm{\hss Sir Walter Scott}}%
\cr
}% \valign
```

and of course this input produces a 'perfect' result, as can be seen in figure 1.

Tijd	When I am dead	To My Mother	Proud Maisie
17:00	When I am dead, my dearest, Sing no sad songs for me; Plant thou no roses at my head, Nor shady cypress tree: Be the green grass above me	Because I feel that, in the Heavens above, The angels, whispering to one another, Can find, among their burning terms of love, None so devotional as that of "Mother," Therefore by that dear name I long have called you—	Proud Maisie is in the wood, Walking so early; Sweet Robin sits on the bush, Singing so rarely.
17:15	With showers and dewdrops wet; And if thou wilt, remember, And if thou wilt, forget.	You who are more than mother unto me, And fill my heart of hearts, where Death installed you In setting my Virginia's spirit free. My mother—my own mother, who died early,	"Tell me, thou bonny bird, When shall I marry me?"— "When six braw gentlemen Kirkward shall carry ye."
17:30	I shall not see the shadows, I shall not feel the rain; I shall not hear the nightingale Sing on, as if in pain: And dreaming through the twilight	Was but the mother of myself; but you Are mother to the one I loved so dearly, And thus are dearer than the mother I knew By that infinity with which my wife Was dearer to my soul than its soul-life.	"Who makes the bridal bed, Birdie, say truly?"— "The gray-headed sexton That delves the grave duly.
17:45	That doth not rise nor set, Haply I may remember, And haply may forget.	*Edgar Allan Poe*	"The glowworm o'er grave and stone Shall light thee steady; The owl from the steeple sing, 'Welcome, proud lady.'"
	Christina Rossetti		*Sir Walter Scott*

Figure 1. The `\valign` output

4. Using `\starttable` macros

Trying to build a table like this with conventional `\halign`-based table macros is quite a challenge, because quite a lot of data needs to be shuffled around. But there is an even bigger problem…

```
\starttable[|p(1cm)|p(7cm)|p(7cm)|p(7cm)|]
\NC \bold Tijd
\NC \bold When I am dead
\NC \bold To My Mother
\NC \bold Proud Maisie
\NC \NR
\noalign{\medskip}
\NC \hrule \smallskip 17:00
\NC \hrule \smallskip
\vbox to 50pt
  {<<When I am dead (1)>>}
\NC \hrule \smallskip
\vbox to 10pt
  {<<To My Mother>>
    \blank \rightline{Edgar Allan Poe}}
\NC \hrule \smallskip
\vbox to 40pt
  {<<Proud Maisie (1)>>}
\NC \NR
\NC \hrule \smallskip 17:10
\NC
\NC
\NC \hrule \smallskip
\vbox to 40pt
  {<<Proud Maisie (2,3)>>}
\NC \NR
```

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Tijd	When I am dead	To My Mother	Proud Maisie
17:00	When I am dead, my dearest,	Because I feel that, in the Heavens above,	Proud Maisie is in the wood,
	Sing no sad songs for me;	The angels, whispering to one another,	Walking so early;
	Plant thou no roses at my head,	Can find, among their burning terms of love,	Sweet Robin sits on the bush,
	Nor shady cypress tree:	None so devotional as that of "Mother,"	Singing so rarely.
	Be the green grass above me	Therefore by that dear name I long have called you—	
17:10	With showers and dewdrops wet;	You who are more than mother unto me,	"Tell me, thou bonny bird,
	And if thou wilt, remember,	And fill my heart of hearts, where Death installed you	When shall I marry me?"—
	And if thou wilt, forget.	In setting my Virginia's spirit free.	"When six braw gentlemen
		My mother—my own mother, who died early,	Kirkward shall carry ye."
		Was but the mother of myself; but you	
17:30	I shall not see the shadows,	Are mother to the one I loved so dearly,	"Who makes the bridal bed,
	I shall not feel the rain;	And thus are dearer than the mother I knew	Birdie, say truly?"—
	I shall not hear the nightingale	By that infinity with which my wife	"The gray-headed sexton
	Sing on, as if in pain:	Was dearer to my soul than its soul-life.	That delves the grave duly.
	And dreaming through the twilight		
17:45	That doth not rise nor set,	*Edgar Allan Poe*	"The glowworm o'er grave and stone
	Haply I may remember,		Shall light thee steady;
	And haply may forget.		The owl from the steeple sing,
			'Welcome, proud lady.'"
	Christina Rossetti		
			Sir Walter Scott

Figure 2. The `\starttable` attempt

```
\NC \hrule \smallskip 17:30
\NC \hrule \smallskip
\vbox to 50pt
  {<<When I am dead (2)>>
   \blank \rightline{Christina Rossetti}}
\NC
\NC
\NC
\NR
\NC \hrule \smallskip 17:45
\NC
\NC
\NC \hrule \smallskip
<<Proud Maisie (4)>>
\blank \rightline{Sir Walter Scott}
\NC \NR
\stoptable
```

This input produces an *okay* result (see figure 2).

But take another look at that source code. Not only is all the data pushed around in an odd order, but also a fair number of `\vbox` commands are needed to make sure the row heights are correct. These `\vbox`es are needed because of row spanning, of course.

Now, using the example text it is simple to predict the correct heights, but with normal running text, it would be impossible to know how much space is needed before the actual typesetting is done. That height information would need to be saved to be used in a subsequent run to fix the row heights. As the actual running text in our production environment can also contain references, another run would be needed to correct for that too. Of course, after that run the table height will have changed, so yet another run is then needed to make sure the remaining pages in the document are correct.

In the end, this input (and in fact all approaches based on `\halign`) is undesired in a batch process because it complicates (and slows down) typesetting way too much.

5. Using \bTABLE macros

The TABLE environment (so-called 'natural tables') is an alternative option for it does not actually use \halign and is therefore freer internally to do processing on measurements. Also, there is built-in support in TABLE for row spanning, and, furthermore, it dynamically calculates the column widths if needed. This last point is not the hardest thing to get right, but it is nice to be able to ignore that little detail.

At first glance, the input looks nice except for the reshuffling of the data:

```
\bTABLE
\bTR
  \bTD [style=bold] Tijd\eTD
  \bTD [style=bold] When I am dead\eTD
  \bTD [style=bold] To My Mother\eTD
  \bTD [style=bold] Proud Maisie\eTD
\eTR
\bTR
  \bTD [height=45pt] \hrule \smallskip 17:00\eTD
  \bTD [nr=2] \hrule \smallskip <<When I am dead (1)>>\eTD
  \bTD [nr=4] \hrule \smallskip  <<To My Mother>>
              \blank \rightline{Edgar Allan Poe}\eTD
  \bTD \hrule \smallskip <<Proud Maisie (1)>>\eTD
\eTR
\bTR
  \bTD [height=45pt] \hrule \smallskip 17:10\eTD
  \bTD [nr=2] \hrule \smallskip <<Proud Maisie (2,3)>>\eTD
\eTR
\bTR
  \bTD [height=50pt] \hrule \smallskip 17:30\eTD
  \bTD [nr=2] \hrule \smallskip <<When I am dead (2)>>
              \blank \rightline{Christina Rossetti}\eTD
\eTR
\bTR
  \bTD [height=45pt] \hrule \smallskip 17:45\eTD
  \bTD \hrule \smallskip <<Proud Maisie (4)>>
       \blank \rightline{Sir Walter Scott}\eTD
\eTR
\eTABLE
```

However, there are two problems, one minor and one quite big.

1. \bTABLE wants you to not mention cells that have been skipped due to spanning.
   This makes perfect sense in horizontal spanning, but it makes vertical spanning somewhat tricky as you need to keep track of any still active spans from earlier lines.

Tijd	When I am dead	To My Mother	Proud Maisie
17:00	When I am dead, my dearest, Sing no sad songs for me; Plant thou no roses at my head, Nor shady cypress tree:	Because I feel that, in the Heavens above, The angels, whispering to one another, Can find, among their burning terms of love, None so devotional as that of "Mother,"	Proud Maisie is in the wood, Walking so early; Sweet Robin sits on the bush, Singing so rarely.
17:10	Be the green grass above me With showers and dewdrops wet; And if thou wilt, remember, And if thou wilt, forget.	Therefore by that dear name I long have called you— You who are more than mother unto me, And fill my heart of hearts, where Death installed you In setting my Virginia's spirit free.	"Tell me, thou bonny bird, When shall I marry me?"— "When six braw gentlemen Kirkward shall carry ye."
17:30	I shall not see the shadows, I shall not feel the rain; I shall not hear the nightingale Sing on, as if in pain: And dreaming through the twilight	My mother—my own mother, who died early, Was but the mother of myself; but you Are mother to the one I loved so dearly, And thus are dearer than the mother I knew By that infinity with which my wife Was dearer to my soul than its soul-life.	"Who makes the bridal bed, Birdie, say truly?"— "The gray-headed sexton That delves the grave duly.
17:45	That doth not rise nor set, Haply I may remember, And haply may forget.	Edgar Allan Poe	"The glowworm o'er grave and stone Shall light thee steady; The owl from the steeple sing, 'Welcome, proud lady.'"
	Christina Rossetti		Sir Walter Scott

Figure 3. The \bTABLE attempt

2. \bTABLE cannot cope with overlapping vertical spans.
   Overlapping spans are silently ignored, and I have not found any way to overcome that. This is a big problem.
   Cells that use spanning do not listen to the height parameter, so tweaking heights does not work. The only way out that I could find to get correct output was to set explicit heights to the cells in the time ('Tijd') column. I was lucky that this column contains no spanning.

The output of this code can be seen in figure 3. In all, besides having cleaner-looking input, not much progress at all has been made compared to using \starttable. In fact, getting the correct values for the height parameters for the time cells is even more complicated than figuring out the heights for the \vboxes in the earlier attempt. (I did it by eye in this example).

6. Using **\startxtable** macros

There is another option left: the new xtables ('extreme tables') environment. The input looks a lot like the input for TABLE except for more explicit macro names, but the internal code is completely different.

xtables has the same issue as \bTABLE when it comes to skipped cells, but it will happily handle overlapping vertical spans, which is wonderful!

```
\startxtable
\startxrow
\startxcell \bold Tijd\stopxcell
\startxcell \bold When I am dead\stopxcell
\startxcell \bold To My Mother\stopxcell
\startxcell \bold Proud Maisie\stopxcell
\stopxrow
\startxrow
```

```
\startxcell \hrule \smallskip 17:00\stopxcell
\startxcell[ny=2] \hrule \smallskip
<<When I am dead (1)>>
%\vadjust{\kern-48pt}
\stopxcell
\startxcell [ny=4] \hrule \smallskip
<<To My Mother>>
\blank \rightline{Edgar Allan Poe}
\stopxcell
\startxcell \hrule \smallskip
<<Proud Maisie (1)>>
%\vadjust{\kern-12pt}
\stopxcell
\stopxrow
\startxrow
\startxcell  \hrule \smallskip 17:10\stopxcell
\startxcell[ny=2] \hrule \smallskip
<<Proud Maisie (2,3)>>
\stopxcell
\stopxrow
\startxrow
\startxcell \hrule \smallskip 17:30\stopxcell
\startxcell[ny=2] \hrule \smallskip
<<When I am dead (2)>>
\blank \rightline{Christina Rossetti}
\stopxcell
\stopxrow
\startxrow
\startxcell \hrule \smallskip 17:45\stopxcell
\startxcell \hrule \smallskip
<<Proud Maisie (4)>>
\blank \rightline{Sir Walter Scott}
\stopxcell
\stopxrow
\stopxtable
```

The output is shown in figure 4. In this source, there is only one tweak that is possibly needed: there are two commented-out lines in the source with `\vadjust{\kern-...}`. If I remove those comments, the extra whitespace below the top row of columns two and four shrink to the point where the output looks just fine. My guess is that with the overlapping spans, ConTEXt is being a bit too conservative in reserving vertical space. Since I am more worried about the correct alignment than with some extra whitespace, I could easily live with that. Besides, I suspect Hans can and will fix this in `xtables` once given a proper 'MWE' demo file.

Tijd	When I am dead	To My Mother	Proud Maisie
17:00	When I am dead, my dearest, Sing no sad songs for me; Plant thou no roses at my head, Nor shady cypress tree:	Because I feel that, in the Heavens above, The angels, whispering to one another, Can find, among their burning terms of love, None so devotional as that of "Mother,"	Proud Maisie is in the wood, Walking so early; Sweet Robin sits on the bush, Singing so rarely.
17:10	Be the green grass above me With showers and dewdrops wet; And if thou wilt, remember, And if thou wilt, forget.	Therefore by that dear name I long have called you— You who are more than mother unto me, And fill my heart of hearts, where Death installed you In setting my Virginia's spirit free. My mother—my own mother, who died early, Was but the mother of myself; but you Are mother to the one I loved so dearly, And thus are dearer than the mother I knew By that infinity with which my wife Was dearer to my soul than its soul-life.	"Tell me, thou bonny bird, When shall I marry me?"— "When six braw gentlemen Kirkward shall carry ye." "Who makes the bridal bed, Birdie, say truly?"— "The gray-headed sexton That delves the grave duly.
17:30	I shall not see the shadows, I shall not feel the rain;		
17:45	I shall not hear the nightingale Sing on, as if in pain: And dreaming through the twilight That doth not rise nor set, Haply I may remember, And haply may forget.		"The glowworm o'er grave and stone Shall light thee steady; The owl from the steeple sing, 'Welcome, proud lady.'"

<div align="center">Edgar Allan Poe</div>

<div align="center">Christina Rossetti</div>

<div align="right">Sir Walter Scott</div>

Figure 4. The \startxtable attempt

7. Conclusions

So why do I think there is a case for \valign if xtables are quite usable? When these table requirements that I show here first appeared, xtables did not yet exist.

So I hacked up a copy of the \starttable code that uses \valign, and that has worked reasonably well for a couple of years now.

I continue to use my hacked \starttable solution mostly because I find the needed reshuffling of the data and skipping cells when using xtables rather unwieldy.

But I am wondering: since xtables are basically framed objects shifted around, could there possibly be a future extension or variation of xtables with these two new features?

1. Reverse input order of rows and columns;
2. Allow data in the input for skipped cells
   (they could even be processed, as a special gimmick)

Even better would be if the \vadjust lines would no longer be needed, which is another reason why I will stick with the hacked \starttable for now.

Since the process that generates the pdf documents is completely automated, it is not feasible to correct the vertical space manually where needed. And while I could write the suboptimal output off to my clients as a 'known limitation', the fact of the matter is that I have a solution already that does work perfectly.

For now, there is no good reason to move away from the \valign that it took me so long to discover a need for.

8. Afterword

This paper was presented at the ConTEXt meeting in Sibřina in 2018. Soon afterwards, Hans extended ConTEXt to allow for a `\startxcolumn` inside `xtables`. With that, the input can now look like this (result in figure 5):

```
\startxtable
\startxcolumn
\startxcell \bold Tijd\stopxcell
\startxcell \hrule \smallskip 17:00\stopxcell
\startxcell \hrule \smallskip 17:10\stopxcell
\startxcell \hrule \smallskip 17:30\stopxcell
\startxcell \hrule \smallskip 17:45\stopxcell
\stopxcolumn
\startxcolumn
\startxcell \bold When I am dead \stopxcell
\startxcell[ny=2] \hrule \smallskip
<<When I am dead (1)>>
\vadjust{\kern-48pt}
\stopxcell
\startxcell[ny=2] \hrule \smallskip
<<When I am dead (2)>>
\blank \rightline{Christina Rossetti}
\stopxcell
\stopxcolumn
\startxcolumn
\startxcell \bold To My Mother\stopxcell
\startxcell [ny=4] \hrule \smallskip
<<To My Mother>>
\blank \rightline{Edgar Allan Poe}
\stopxcell
\stopxcolumn
\startxcolumn
\startxcell \bold Proud Maisie\stopxcell
\startxcell \hrule \smallskip
<<Proud Maisie (1)>>
\vadjust{\kern-12pt}
\stopxcell
\startxcell[ny=2] \hrule \smallskip
<<Proud Maisie (2,3)>>
\stopxcell
\startxcell \hrule \smallskip
<<Proud Maisie (4)>>
\blank \rightline{Sir Walter Scott}
\stopxcell
```

Tijd	When I am dead	To My Mother	Proud Maisie
17:00	When I am dead, my dearest, / Sing no sad songs for me; / Plant thou no roses at my head, / Nor shady cypress tree:	Because I feel that, in the Heavens above, / The angels, whispering to one another, / Can find, among their burning terms of love, / None so devotional as that of "Mother,"	Proud Maisie is in the wood, / Walking so early; / Sweet Robin sits on the bush, / Singing so rarely.
17:10	Be the green grass above me / With showers and dewdrops wet; / And if thou wilt, remember, / And if thou wilt, forget.	Therefore by that dear name I long have called you— / You who are more than mother unto me, / And fill my heart of hearts, where Death installed you / In setting my Virginia's spirit free. / My mother—my own mother, who died early,	"Tell me, thou bonny bird, / When shall I marry me?"— / "When six braw gentlemen / Kirkward shall carry ye."
17:30	I shall not see the shadows, / I shall not feel the rain; / I shall not hear the nightingale / Sing on, as if in pain:	Was but the mother of myself; but you / Are mother to the one I loved so dearly, / And thus are dearer than the mother I knew / By that infinity with which my wife / Was dearer to my soul than its soul-life.	"Who makes the bridal bed, / Birdie, say truly?"— / "The gray-headed sexton / That delves the grave duly.
17:45	And dreaming through the twilight / That doth not rise nor set, / Haply I may remember, / And haply may forget.	Edgar Allan Poe	"The glowworm o'er grave and stone / Shall light thee steady; / The owl from the steeple sing, / 'Welcome, proud lady.'"

Christina Rossetti

Sir Walter Scott

Figure 5. The `\startxtable` attempt, updated

```
\stopxcolumn
\stopxtable
```

The two `\vadjust` lines are still present and help with the vertical spacing, but my main problem is now solved: the complete table can now be input in its natural order. Thank you, Hans!