What's in a Name?

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Overview

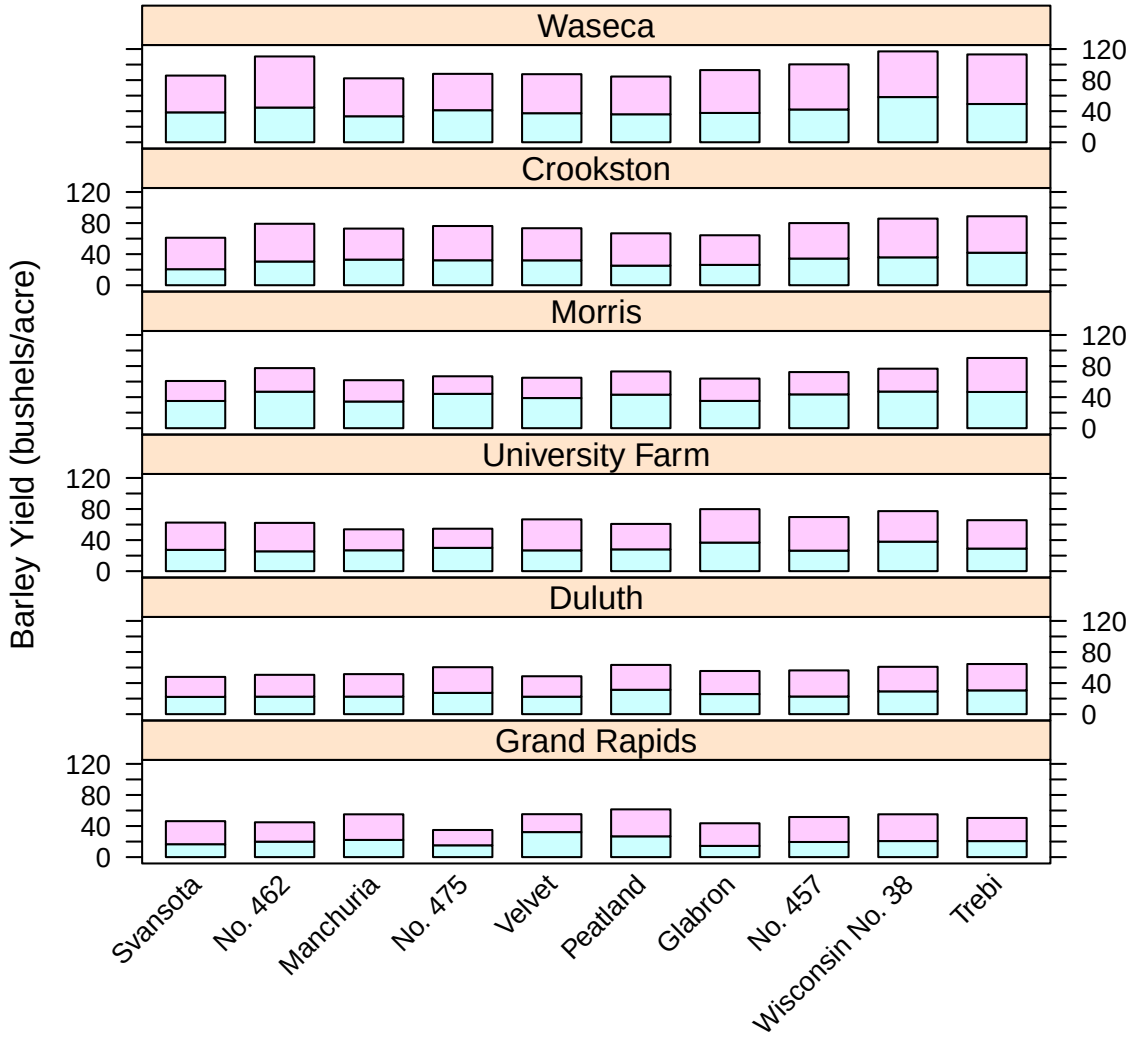
- Complex statistical graphics consist of lots of individual components.
- Many systems provide control over all aspects of a graphic through a large, nasty list of parameters (e.g., R's `par()` function).
- An alternative approach is to label the individual components of a graphic and provide tools for accessing and modifying them.
- More generally, the ability to post-process a graphic leads to some interesting possibilities.

Complex Statistical Graphics

- Complex plots contain **many** individual components.

```
> library(lattice)
> barchart(yield ~ variety | site, data = barley,
           groups = year, layout = c(1,6), stack = TRUE,
           ylab = "Barley Yield (bushels/acre)",
           scales = list(x = list(rot = 45)))
```

Complex Statistical Graphics



Complex Statistical Graphics

- The interface provided for controlling all of those details often consists of a very large list of parameters.
- In **lattice** this is provided by the `trellis.par.get()` and `trellis.par.set()` functions.

Complex Statistical Graphics

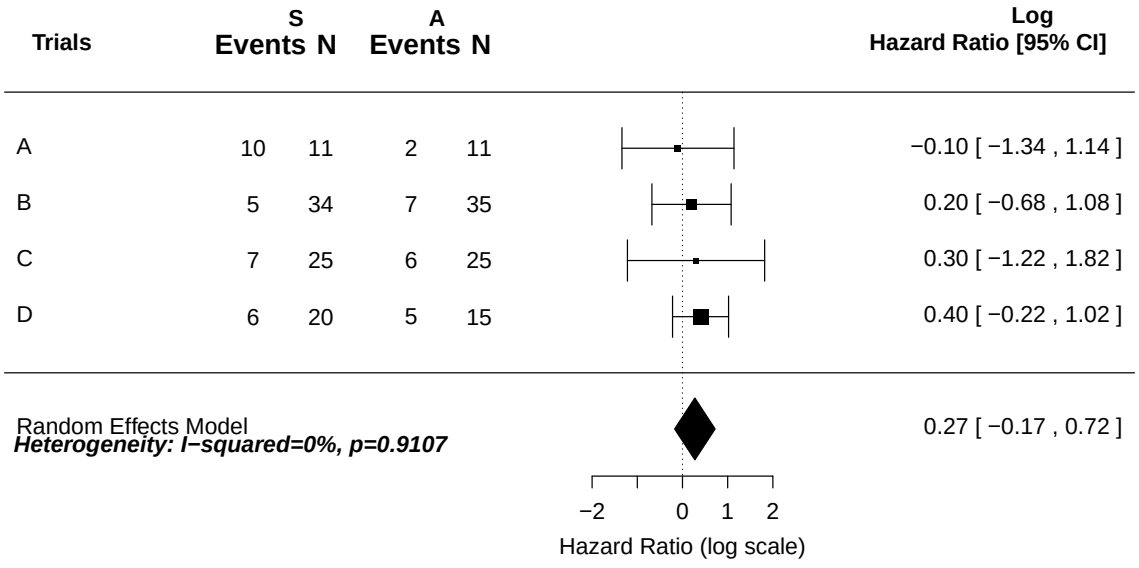
```
grid.pars

fontsize
     text
     points
background
     alpha
     col
panel.background
     col
clip
     panel
     strip
add.line
     alpha
     col
     lty
     lwd
add.text
     alpha
     cex
     col
     font
     lineheight
plot.polygon
     alpha
     col
     border
     lty
     lwd
box.dot
     alpha
     col
     cex
     font
     pch
box.rectangle
     alpha
     col
     fill
     lty
     lwd
box.umbrella
     alpha
     col
     lty
     lwd
dot.line
     alpha
     col
     lty
     lwd
dot.symbol
     alpha
     cex
     col
     font
     pch
plot.line
     alpha
     col
     lty
     lwd
plot.symbol
     alpha
     cex
     col
     font
     pch
     fill
reference.line
     alpha
     col
     lty
     lwd
strip.background
     alpha
     col
strip.shingle
     alpha
     col
strip.border
     alpha
     col
     lty
     lwd
superpose.line
     alpha
     col
     lty
     lwd
superpose.symbol
     alpha
     cex
     col
     fill
     font
     pch
superpose.polygon
     alpha
     col
     border
     lty
     lwd
regions
     alpha
     col
shade.colors
     alpha
     palette
axis.line
     alpha
     col
     lty
     lwd
axis.text
     alpha
     cex
     col
     font
     lineheight
axis.components
     left
     top
     right
     bottom
layout.heights
     top.padding
     main
     main.key.padding
     key.top
     xlab.top
     key.axis.padding
     axis.top
     strip
     panel
     axis.panel
     between
     axis.bottom
     axis.xlab.padding
     xlab
     xlab.key.padding
     key.bottom
     key.sub.padding
     sub
     bottom.padding
layout.widths
     left.padding
     key.left
     key.ylab.padding
     ylab
     ylab.axis.padding
     axis.left
     axis.panel
     strip.left
     panel
     between
     axis.right
     axis.key.padding
     ylab.right
     key.right
     right.padding
box.3d
     alpha
     col
     lty
     lwd
par.xlab.text
     alpha
     cex
     col
     font
     lineheight
par.ylab.text
     alpha
     cex
     col
     font
     lineheight
par.zlab.text
     alpha
     cex
     col
     font
     lineheight
par.main.text
     alpha
     cex
     col
     font
     lineheight
par.sub.text
     alpha
     cex
     col
     font
     lineheight
```

Large lists of parameters or arguments

- There are a number of problems with these sorts of interfaces:
  - It is hard to know/discover which parameter or argument controls which feature of the plot.
  - This is not helped by the fact that the list of parameters or arguments tends to be "flat", which does not reflect the structure of the graphic.
  - The interface is doomed to be uncomprehensive; it is inevitable that the user will want to change something that is inaccessible via the interface.
  - It is hard or impossible for the user to modify or extend the interface.

Large lists of parameters or arguments

- R-help 2011-24-08 from Paola Tellaroli.



"Even if I have specified `'col="red", border="red"'`*, color of squares and diamond rests black! Why?"*

Large lists of parameters or arguments

- R-help 2011-26-08 from Wolfgang Viechtbauer.

  "The thing is, there are so many different elements to a forest plot (squares, lines, polygons, text, axes, axis labels, etc.), if I would add arguments to set the color of each element, things would really get out of hand (as far as I am concerned, there are already too many arguments to begin with) ...

  *... what if somebody wants to have a different color for *one* of the squares and a different color for the other squares?"*

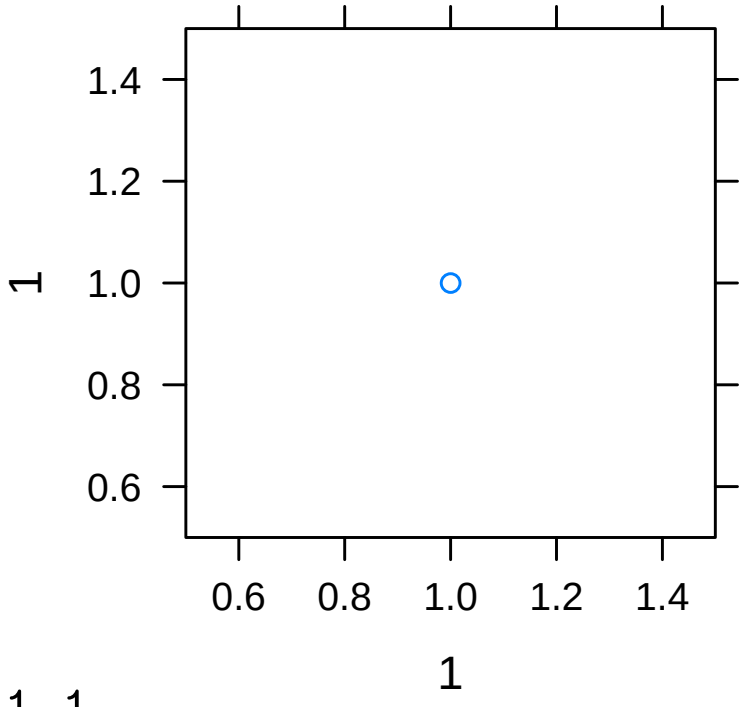
A low-level interface

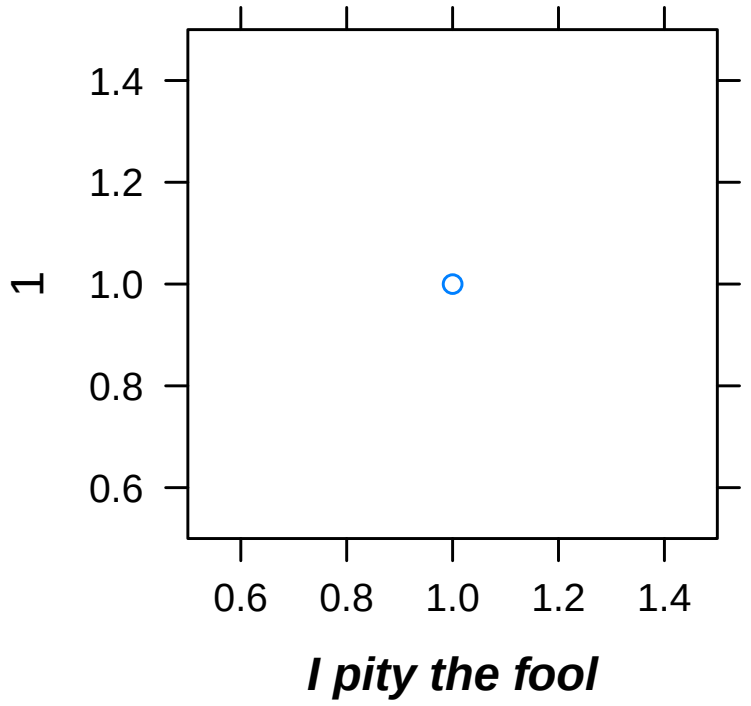
- It is convenient to have high-level interfaces for producing complex graphics, **but** ...
- It is **also** convenient to be able to treat the complex graphic as merely a collection of low-level components.

- The **grid** graphics system in R provides the infrastructure for such a low-level interface.
  - A **record** is kept of all components in a graphic.
  - Each component is **labelled**.
  - Components can be **accessed** by name and **modified**.

A low-level interface

```
> xyplot(1 ~ 1)

> grid.ls()

plot_01.background
plot_01.xlab
plot_01.ylab
plot_01.ticks.top.panel.1.1
plot_01.ticks.left.panel.1.1
plot_01.ticklabels.left.panel.1.1
plot_01.ticks.bottom.panel.1.1
plot_01.ticklabels.bottom.panel.1.1
plot_01.ticks.right.panel.1.1
plot_01.xyplot.points.panel.1.1
plot_01.border.panel.1.1
```





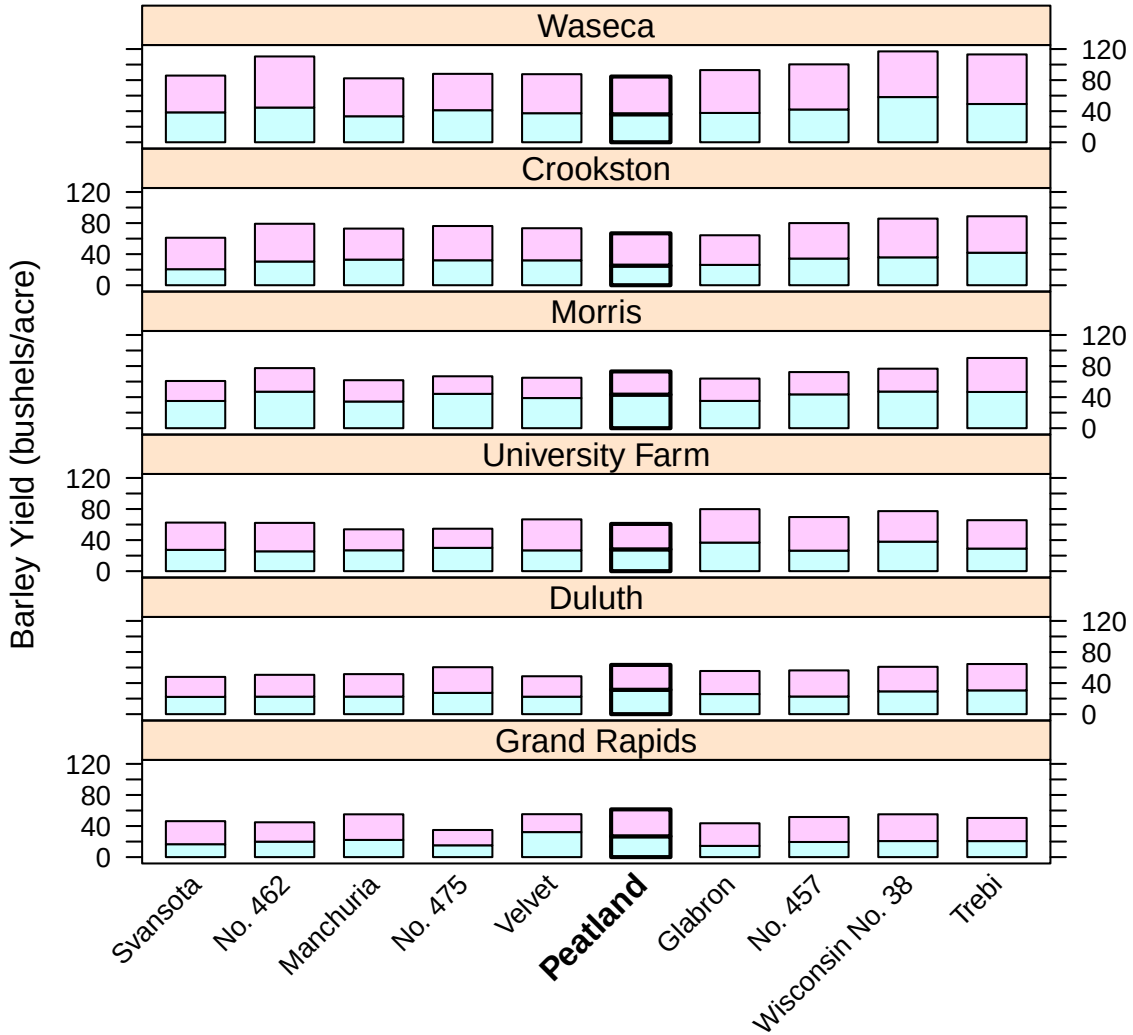

```
> grid.edit("plot_01.xlab",
            label="I pity the fool",
            gp=gpar(fontface="bold.italic"))
```

A low-level interface

- This low-level interface allows ...
  - the user to **access** and **modify** all of the individual components of the plot.
  - the user to access and modify different **collections** of components.
  - the user to **record** and **programmatically** control a set of changes.

```
> barchart(yield ~ variety | site, data = barley,
           groups = year, layout = c(1,6), stack = TRUE,
           ylab = "Barley Yield (bushels/acre)",
           scales = list(x = list(rot = 45)))

> grid.edit("barchart.pos.6.rect",
            grep=TRUE, global=TRUE,
            gp=gpar(lwd=2))

> fontface <- rep("plain", 10)
> fontface[6] <- "bold"
> cex <- rep(.8, 6)
> cex[6] <- 1
> grid.edit("ticklabels.bottom.panel", grep=TRUE,
            gp=gpar(fontface=fontface, cex=cex))
```

Complex Statistical Graphics



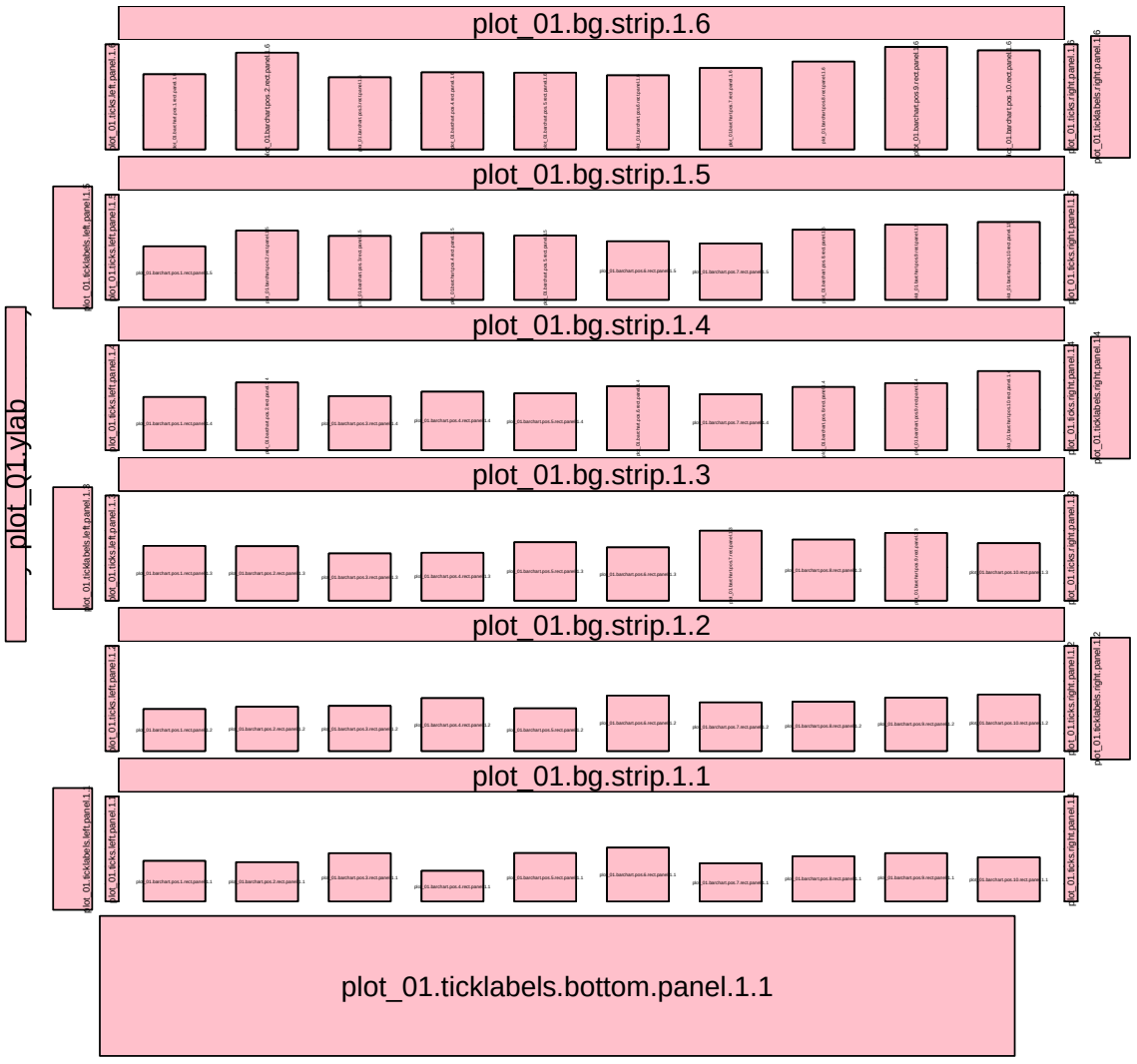
Other important details

- For this sort of low-level approach to work, a couple of other things are necessary ...
  - The people who write high-level graphics functions have to name everything that they draw
    (or allow me svn access to their code).
    - **lattice** now has an explicit naming scheme.
  - The naming schemes have to be documented and/or functions provided to assist with generating component names
    - The **R-forge** page for **lattice** has a document describing its naming scheme and there is a `trellis.grobname()` function.
  - There need to be tools to help with identifying the components of a graphic.

grid debugging tools

- The `grid.ls()` function lists the components in a **grid** graphic.
- The `showGrob()` function draws labelled rectangles to show the location and names of components.

grid debugging tools



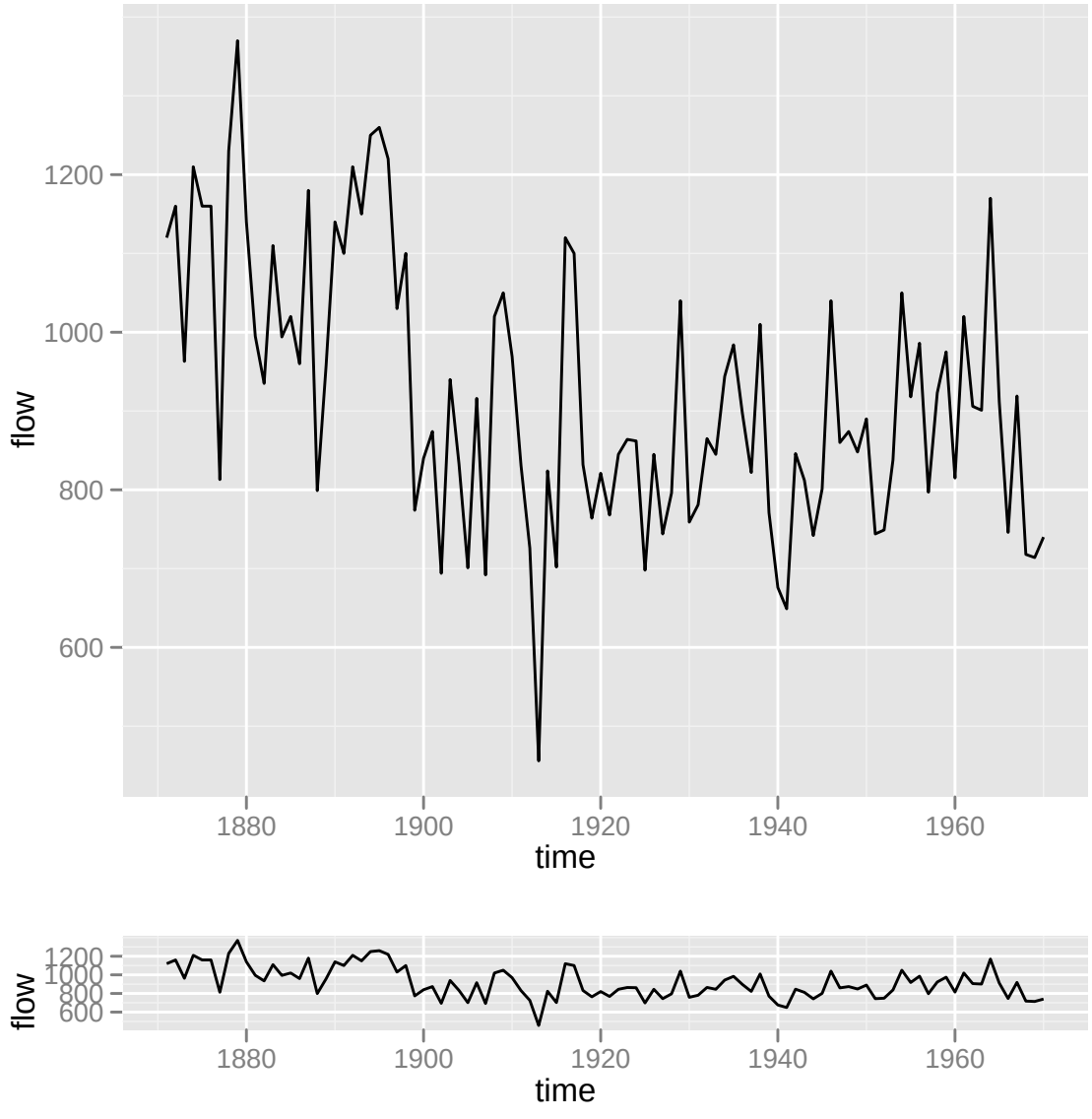
Other possibilities

- Having access to all components of a graphic by name provides a platform for more general **post-processing** of the graphic.
- The **gridSVG** package allows post-processing of a **grid** graphic to add dynamic and interactive features (in an SVG+javascript format).

The **gridSVG** package

```
> library(ggplot2)
> library(gridSVG)

> df <- data.frame(time=as.numeric(time(Nile)),
                   flow=as.numeric(Nile))

> thePlot <- ggplot(df, aes(x=time, y=flow)) + geom_line()
> pushViewport(viewport(layout=grid.layout(2, 1,
                                           heights=c(4, 1))))
> pushViewport(viewport(layout.pos.row=1, name="topvp"))
> print(thePlot, newpage=FALSE)
> upViewport()
> pushViewport(viewport(layout.pos.row=2, name="bottomvp"))
> print(thePlot, newpage=FALSE)
> upViewport(2)
```

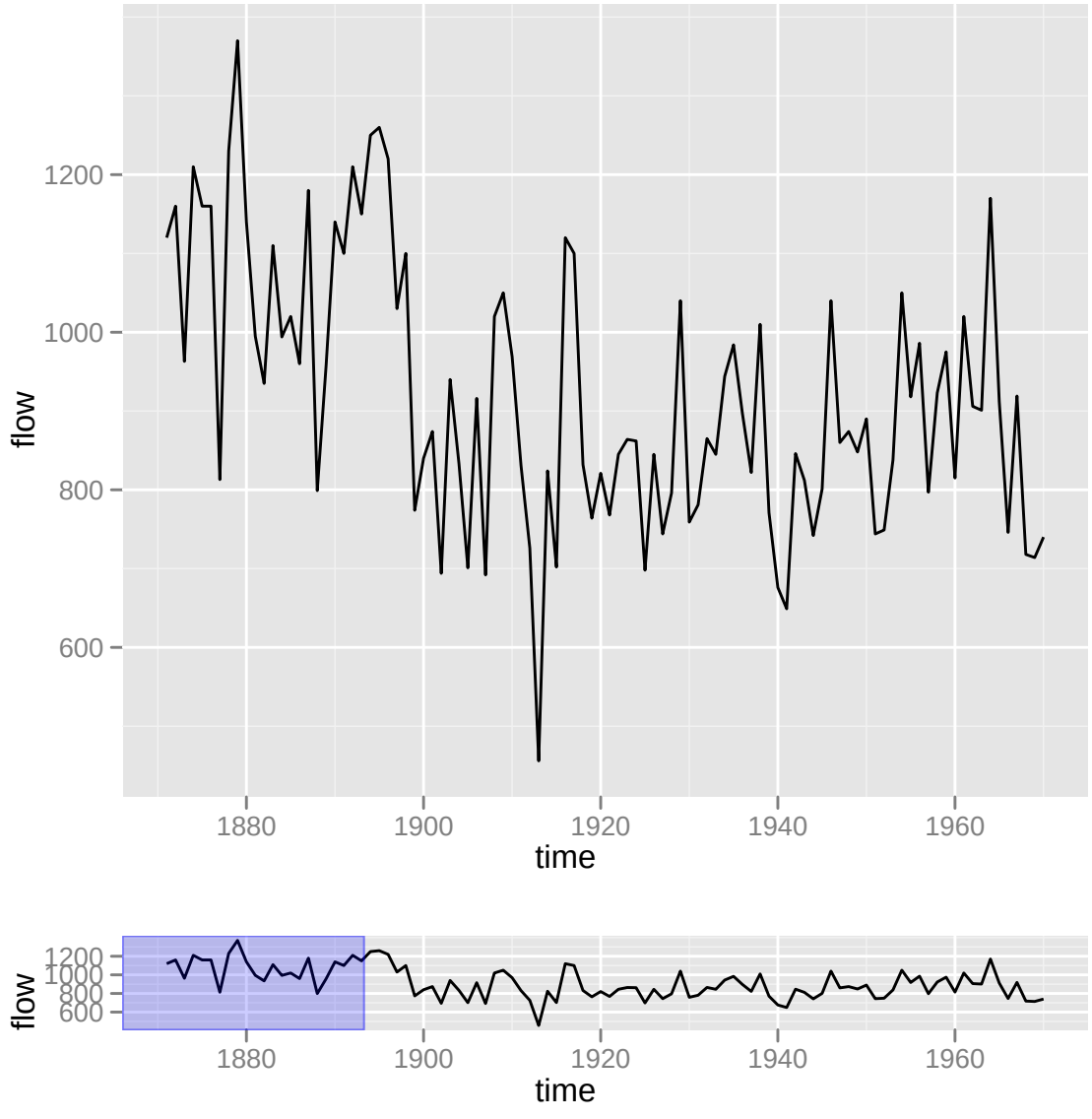
The **gridSVG** package



The **gridSVG** package

```
> downViewport("bottomvp")
> downViewport("panel-3-3")
> grid.rect(x=0, width=0.25, just="left",
            name="thumb",
            gp=gpar(col=rgb(0,0,1,.5), fill=rgb(0,0,1,.2)))

> grid.garnish("thumb",
               onmousedown="thumbDown(evt)")

> grid.script(filename="thumb.js")
```

The **gridSVG** package



```
> gridToSVG()
```

Interactive ggplot2 plot

A **grid** grob browser

- The **gridSVG** package can also be used to create tools that help with identifying plot components.

grid grob browser

Conclusions

- **grid** provides a low-level interface for accessing and modifying the individual components of a graphic by name.
- This low-level interface is a useful alternative to the typical high-level list-of-parameters for making arbitrary customisations to a graphic ...
- ... as long as the components have useful names and there are tools to discover/explore the names.
- A low-level interface is also useful for general post-processing of a graphic.

- A major benefit of providing access to named components of a graphic lies in what it lets **other people** do to the graphic.

Acknowledgements

- Velvet Ly helped to design the **lattice** naming scheme as part of her BScHons project.
- Simon Potter made many improvements to the **gridSVG** package as part of his BScHons project.
- The interactive **ggplot2** example makes extensive use of Duncan Temple Lang's **XML** package to post-process the SVG output produced by **gridSVG**.

References

- The **lattice** naming scheme is documented at `http://lattice.r-forge.r-project.org/Vignettes/src/naming-scheme/namingScheme.pdf`
- The **gridSVG** package is available from **R-forge** `https://r-forge.r-project.org/projects/gridsvg/`