genuine masterpiece, a marvelous interactive program accompanied by a marvelous manual that gracefully explains the straight-forward computer mechanics involved and, more importantly, shows dynamic data analysis in action and chronicles the development of such displays. Alas, even in the MacSpin book, the graphics have the jaggies and murkies, too.

## ADDITIONAL REFERENCES

AUDOUZE, J. and ISRAËL, G., eds. (1985). *The Cambridge Atlas of Astronomy.* Cambridge Univ. Press, Cambridge.

MAUNDER, E. (1904). Note on the distribution of sun-spots in heliographic latitude, 1874 to 1902. *Royal Astron. Soc. Monthly Notices* **64** 747–761.

TUFTE, E. R. (1988). *Envisioning Information.* Graphics Press, Cheshire, Conn.

# Rejoinder

**Richard A. Becker, William S. Cleveland and Allan R. Wilks**

We would like to thank the discussants for their interesting comments. Our responses cover six areas: implementation of the methods of the paper, presentation of the graphs, the underlying software, the computing environment, brushing and rotation.

Since writing the paper we have studied dynamic methods in a color graphics environment—a Silicon Graphics IRIS 2400T workstation. Most of the original paper is based on an implementation of methods in a distributed processing system with an AT&T Teletype 5620 graphics terminal, which is monochrome. Our responses here will reflect more of the experience with the IRIS implementation.

## 1. IMPLEMENTATION

### Experimental vs. Tested: Field Testing

Comments by Huber and Eddy made us realize that one deficiency in the paper is an explicit statement about whether the methods in Sections 2.1 to 2.6 are experimental or well tested. We have examined a large number of dynamic methods by field testing, which will be described shortly. With one exception, the methods of Sections 2.1 to 2.6 are those that we tested and judged to be useful tools for data analysis. (The one exception is advanced strategies for rotation control, which we only reported but did not test.) We strongly urge software developers to implement these methods in their software systems. Wainer is quite right—we tried many other ideas that did not work out.

Field testing a method means using it on a variety of data sets including those where data analysis is in progress. At the moment, because the amount of theory about data display is small, extensive field testing is the only way to effectively judge a graphical method. Armchair thinking is not enough. In 1982, Tukey (1987b) wrote the following about the development of a graphical method:

- now we try it [the graphical method] on diversified data—trying to understand when its performance is less than adequate,
- and then we try to understand something of what modifications would help,
- and then we try the modifications,
- and then we repeat the last 3 steps as needed!

There is no substitute for adequate iteration. *Such iteration is the original developer's obligation.*

It is particularly important to try out methods in settings where people are attempting to learn about the world from the data, and where the methodology is a means to an end. One cannot fully assess a method by using just old data sets no longer of interest to anybody and dredged up just to test the method. In the paper, though, we used familiar or easy-to-convey data sets because of space limitations.

### NIH Means Not Implemented Here

In his first sentence, Eddy refers to "bias in favor of methods they and their colleagues have developed." "Developed" should be changed to "implemented." Many of the methods of the paper were invented by us. Many were invented elsewhere; we hope the extensive citations and bibliography make this clear. But except for the advanced strategies of Section 2.6, we discussed only methods that we implemented. This is as it must be. We could not write with much insight about methods that we did not field test, and we could not field test a method that we did not implement.

## 2. PRESENTATION

### Excitement

We quite agree with Tukey that "paper versions of screens with highlighted points are rather weak and