windows to activate. Custom software allows you the freedom to tailor maps and data to your own needs and many times include more than one thematic data display technique. Maps without data are essentially projection packages which allow the user to work with scale, viewing position, various coordinate systems, rotation, and distance measuring. I'm not sure data without maps should be included, but these packages do provide an extensive amount of geographically-coded data to help keep us better informed.

Mandel does a good job of describing which packages fall into a particular category and the strong points and shortcomings of each. I found his comments about the various packages quite candid and accurate with respect to the (Macintosh) packages I am familiar with. He lets you know about the quality and detail of the maps included, particular technical or hardware problems, data manipulation options and shortcomings, and in some cases, how useful a package is to learning. Also provided is a comparative table of the 24 different packages discussed and their qualities, as well as a list of costs, company addresses, and phone numbers. It would be a good idea to look over this article before your next mapping software purchase if you are a comparison shopper.

Finally, I agree with Mandel that the overall quality of these packages is quite good and gets better with each new release. One thing I would like to see is more input from professional cartographers during software development. For example, I think MapMaker is a very good product and I use it regularly, but its default shaded area (choropleth) maps have some basic cartographic problems such as: categories that overlap, poor light (low value) to dark (high value) progression and it allows you to use the choropleth technique inappropriately. Of course you can manually correct for these problems, but that assumes some prior cartographic training. There is more to data display on maps than simply merging a data and boundary file. Just because you know how to merge them doesn't necessarily mean you are effectively displaying an accurate geographic pattern or distribution.

Kenji Kimura; Yoshimasa Osumi, and Yoshirio Nagai (1990) CRT display visibility in automobiles, *Ergonomics* 33:6, pp. 707-718.
reviewed by Matthew McGranaghan, University of Hawaii, temporarily at the NCGIA—Orono, ME.

The paper does not explicitly address map displays, but the authors (from Toyota Motor Corporation's Human Factors Laboratory) are clearly thinking in that direction. The three experiments reported herein are straight-forward human factors experiments into the display of information on color CRTs in automobiles.

The first experiment addresses foreground-background color combinations to facilitate reading a display in the short time (they measured approximately one second) for which it is comfortable for a driver to look away from the highway. They derive a set of relations between recognition time, luminance contrast and chromaticity difference (in CIE 1976 UCS space).

The second experiment considered the upper limit on background luminance which does not seem "dazzling" to night-time drivers. Subjects "were sufficiently adapted to the same level of brightness as viewing oncoming headlights at night" before looking at a CRT screen. The change in pupillary diameter was measured as well as a subjective impression of "dazzle." A general equation is presented for predicting this luminance given the background's chromaticity.

The last perhaps is the most intriguing of these studies. In it, the authors attempt to define, in information theoretic terms (after Shannon and Weaver 1949), the amount of information which can be read from a display "at-a-glance." Subjects were asked to read "characters (numerals, numerals+hiragana, and alphabets)" from displays presented for one second. Error rates indicated that "... the amount of information which can be read at a glance was less than 20-30 bits."

This article exemplifies both the type of work in which cartographers should be involved for developing advanced automotive displays, as well as the difficulties inherent in reporting this kind of research. Cartographers can use the methods adopted by the authors (measuring pupillary diameter changes and applying information theory are interesting in this regard). However, the piece is disappointing in several respects.

None of the experiments is described in detail sufficient to allow replication. The first experiment considers foreground-background contrast without attention to the contrast's location in the color space, color categorization, or other concerns in color coding. The type and amount of low-light adaptation in the second experiment seems to assume a constant average illumination for on-coming cars. This seems unreasonable. The logic of measuring the information content of displays in the third experiment is sketchily presented at best, and the interpretation of "20-30 bits" is not clear. The result is that the direct application of these findings

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in display design is unlikely. Further, the piece reads as if it were heavily but quickly edited, leaving a number of awkward and confusing passages. Judging by the quality of driver interfaces I have seen in Toyota vehicles in the last several years, I suspect that the authors are holding their best material for a different market.

Matthews, Victor and James Moyer (1990). Bible atlases: which ones are best? *Biblical Archaeologist*, December 1990, pp. 220-231.

The article provides a survey of ten bible atlases published in the 1980s. The atlases are divided into two classes: student bible atlases and reference bible atlases. These atlases are reviewed according to the following criteria: visually attractive maps that accurately and easily show the locations of all places mentioned in the Bible, gazetteer, accurate information about the geography, topography, and climate, clear pictures and illustrations with informative captions, up-to-date information that reflects the most recent archaeological discoveries. The two atlases selected as the best are *The Moody Atlas of the Bible Lands* and the *New Bible Atlas* by Tyndale.

cartographic artifacts

BOOK REVIEW
Campbell, John (1991) *Map Use and Analysis*. Dubuque, IA: William C. Brown. 418 pp.
Reviewed by Joseph Stoll, The University of Akron

John Campbell prefaces his book *Map Use and Analysis* by stating that its aim is to "serve as an introduction to the fascinating world of maps with an emphasis on clarity of explanation" and assumes that its audience "has no specific prior knowledge of the topic." After thus explaining the purpose and general nature of the book, Campbell proceeds to cover a broad range of map-related topics over the space of twenty-two chapters. These topics include map projections, scale and generalization concepts, locational and land-partitioning systems, characteristics of map features, route selection and navigation, qualitative and quantitative information, remote sensing, computer-assisted cartography, special purpose maps, graphs, and map producers and information sources.

Campbell has produced a volume that deserves high marks for attractiveness, readability and scope. The appearance is clean and well-balanced. Figures are generally crisp and support the text well though the lack of color is noticeable. The somber black, white and gray tones are relieved only by the horizontal red stripes on the cover. The use of color in figures would increase the visual impact and help avoid the problem that occurs in Figure 12.1 where gray and black lines look nearly equally "black". The chapters are well organized, each beginning with a concise statement of its contents and concluding with a detailed summary. In this reviewer's opinion, the uninitiated reader on the subject of map use could justify the purchase of this volume — if only to read the summaries of the chapters.

Campbell inserts "sidebars" in this volume on the following subjects: The Analemma, Dates and Times, Units of Measurement, National Map Accuracy Standards, Levels of Measurement and Names on Maps. These inserts are visually set apart from the main body of text and provide the reader with explanations of details from the main text much like an inset provides an enlargement of an area on a map. Campbell's use of these sidebars adds interest both visually and intellectually.

Topics covered by Campbell relate to map users in a broad, comprehensive manner. Users of large and small scale maps will find material relevant to their applications. It is refreshing to see unique and less obvious (yet important) topics addressed such as charts, graphs and copyright laws. How many authors on the subject of cartography specifically address the design, application and interdependence of charts and graphs with maps? Regarding copyright law, informing the map user that avoiding penalties for copyright violations requires "scrupulously avoiding making unauthorized copies" (including single photocopies, or copies of copies with no visible copyright identification), leaves little room for misinterpretation.

Of special interest to me are chapters 16 and 17 which cover "Computer-Assisted Cartography" and "Digital Geographic Information Systems." These chapters are quite brief, yet they do address many important aspects in an understandable if general manner. Items addressed in these chapters include implementation of computer-assisted techniques, data capture, output, applications of computer-assisted techniques, data-base availability (including a good summary of United States Geological Survey and Census Bureau products), Digital Geographic Information System components, data forms, manipulation and analysis techniques and applications of Digital Geographic Information Systems. Related to the information contained in these chapters is Appendix C: "Sources of Mapping Programs and Data Bases for Microcomputers." Taken