on that screen. The user can also display or save the references used to compile the maps on the screen.

- PRINT - Allows the user to print state and region maps or reports.

- MISC - This selection contains a "county learn game" that prompts the user with a randomly selected county name and allows 10 seconds to point to the named county. This can be quite challenging with Georgia's 159 counties, and as a new arrival, I scored poorly on several tries.

- ARROW KEYS - The user can page through the screens one at a time and, since they are organized by chapter, generally find related information. This is one of the most annoying aspects of the atlas. To move directly to another screen, which may be distant from your current view, the user must either use the bookmark system (20 function keys activate "bookmarks," which are active only for the current session) or move back into the main menu to scan the lists of chapters and screens. When the user selects one of the arrow keys to "page" to the next screen, the display "blacks out" for about a second, providing a distracting visual jolt.

The atlas was intended as a replacement for *The Atlas of Georgia*, a hardbound 286 page reference work published by the University of Georgia in 1986. The designers of *The Interactive Atlas of Georgia* have produced a useful tool for introducing K-12 students to some of the concepts of cartography, geography, computers, and a suite of information describing the state and it's people. As such, it should be a practical tool for high schools and colleges. The atlas falls short of the mark, however, in attempting to provide a serious research tool for the more advanced student or the university library.

In a cartographic sense, this atlas presents its portrait of Georgia in a rather inflexible fashion, perhaps a surprising characteristic for those who might expect a more "interactive" product. In general, the planimetry of the maps appear to be fairly detailed, although in several instances, notably on the pages in the "Physical Geography" chapter, there is an obvious misregistration between physical features and political boundaries. However, this only becomes apparent if one is using the "point and click" method of pulling up county outlines, so it's not terrifically obvious unless one is wondering why a particular boundary doesn't correspond with a particular river. The color selections used on many of the maps appear to be inappropriate and the user has no control over color selection. Likewise, class range selection is fixed and inconsistent, and there is no discussion of the scheme (e.g., quantile, natural break) used in each case. In other instances, choropleth maps are used inappropriately to represent raw values not equalized for population. The final effect is to approximate the act of paging through a paper atlas without much of the "interactivity" we might expect.

In summary, *The Interactive Atlas of Georgia* can be a useful tool for K-12 teachers or students, presenting a large volume of statistical information principally aggregated at the county level in a relatively easy-to-use format. Serious users may be disappointed by the graphical user interface, the cartographic inflexibility of the system, the lack of any internal graphic system, and the limited options for hard or soft copy output. In addition, there will certainly be many Macintosh users (who haven't sprung for the Power Mac yet) that will "pine" for a chance to access the atlas and its information. The designers have done a creditable job in replacing the hardbound atlas with a PC version. Perhaps, the next edition will improve in terms of interface, output, and interactivity. ❑

SOFTWARE REVIEW

EASY IMAGE
Version tested: 2.0. From Penmatrics, Inc., 225 S.W. Madison, Corvallis OR 97333. Phone (503) 757-3076. Fax: (503) 752-2027. $595.

System requirements: The program will run on any 386 desktop running Windows 3.0 or higher, but a 486 machine is preferable. A minimum of 4MB RAM and 3MB of hard disk space are needed, along with a VGA 256-color high resolution video card and monitor. The program was evaluated on a Gateway 486-DX4 100-MHz system with 16 MB of memory and a Mach 64 video card with 2 MB VRAM.

Reviewed by Mark D. Schwartz
Department of Geography
University of Wisconsin-Milwaukee

EASY IMAGE is a Windows-based image analysis package designed to meet the needs of two diverse groups. For general users with elementary needs, the program provides a complete set of tools for image display and enhancement. An add-on program, the Software Developer's Kit (SDK, $695), allows customized applications to be written in the C or C++ programming languages, and then incorporated into the basic EASY IMAGE engine. The SDK was not evaluated in this review.

The program permits basic image processing to be accomplished with the "point and click" ease of a Windows environment. The main menu includes an icon bar for quick access to major functions, a color palette to control image display, a histogram window that displays a bar graph representation of image data, and an information widow that reports information related to processing status or the current cursor position. Basic commands are also accessible along the top of the display in standard Windows format. The program supports reading and writing of TIF and BMP (up to 24 bit) formats. Other file types with one byte per pixel and non-essential header information can be imported into the program by specifying the characteristics. The PCX format is directly supported. Files can also be written in Resource IMG format.

Once an image has been brought into EASY IMAGE, it can be enhanced and manipulated in a variety of ways. Multiple images can be opened and viewed simultaneously in adjoining or overlapping windows. Area size can be controlled by zooming in or out a specified amount. An image can be registered to a real world coordinate system if it is already planimetrically correct. The formula function allows image algebra operations to be performed on one or more images. Options such as a normalized band ratio and standard equations allow the user to calculate the Normalized Difference Vegetation Index (NDVI) and average, brighten, darken, and increase or decrease contrast in an image. Users can also specify their own formulas.

Other features include the ability to crop an image and to produce a full color red-green-blue (RGB) composite from three individual bands of the same area. Statistics of the pixel values, such as average and standard deviation, are available with a click of the mouse. Images can also be resized or rotated. A standard image processing technique, the ability to stretch the contrast within an image, can be applied either through histogram equalization or a linear stretch with saturation.

While this product is marketed as a basic image processor, it also includes an number of advanced features. For example, a full set of filter functions can be applied to the image. Options include low pass, high pass, edge enhancement, or user-defined. Perhaps one of the most powerful features is image rectification. Many images lack planimetric accuracy, as well as not being registered to a real-world coordinate system. The rectification function allows both of these deficiencies to be corrected. With a minimum of four control points (known locations in a real-world coordinate system), the program can warp and georegister an image to a specified coordinate system. Classification of areas within images to known cover types can be accomplished though either an unsupervised (statistical group discrimination) or supervised (training site) approach. Lastly, the false color function lets the user assign colors to ranges of pixel values, giving color to a normally gray single-band image.

In order to evaluate program operation, I decided to tackle the problem of image rectification and georegistration. This is a common difficulty associated with incorporating remote sensing data into GIS analysis or simply developing a land cover classification. The test data were 768 x 1024 byte binary images of the northern portions of the Milwaukee metropolitan area. These were originally recorded by a NS001 Thematic Mapper Simulator (TMS) sensor onboard a C-130B aircraft. The images had a nominal resolution of 7.6 m. The date and time of the image set were not available. These data were provided to me by Michael Fitzgerald of the Aircraft Data Facility at the NASA Ames Research Center, Moffett Field, CA.

I selected for analysis the three bands commonly used in creating a near infra-red false color composite: Band 2 (0.529-0.603µm), Band 3 (0.633-0.697µm), and Band 4 (0.767-0.910 µm). The first step was to import the data, and this was accomplished by simply specifying the number of columns and rows in the file (the program terms these width and height). Next, I obtained latitude-longitude coordinates from a standard U.S.G.S. topographic map corresponding to four control points that could be visually identified on the image set. Using the rectification function, I was then able to point to each of these locations and register the coordinates. The points were saved to a file, so that I could recall them and rapidly rectify all three images in sequence. My final test was to produce a false color composite from these three bands. I first used the linear stretch function (with 5% saturation on each end of the curve) to increase the contrast of all three images. The composite function then created a combined image that simulated the appearance of a near infra-red false color photograph. This product was of acceptable visual quality, and I considered the whole procedure successful.

In general, I found the program easy to use and quite versatile. I was particularly impressed with its ability to open several images in different windows at the same time. After using exclusively DOS-based image processors, this was a refreshing and quite flexible option.

Most of my concerns about the program relate to the limitations of the available functions. This may not be a completely fair criticism of an admitted basic image processor, but some of these deficiencies could be easily addressed. First, I would like the option to write files out in the same format that they were read in. Many programs work with generic byte-binary formats and it would be useful to be able to export at least this additional format. Second, I was surprised that the composite function did not seem to automatically stretch the three component images as it was creating the full color composite. I had to do that as a preliminary step. Lastly, I was a bit disappointed in the manual. It did not offer much detail or explanation as to why certain functions might be desirable. The on-line documentation in the program was essentially the same as the manual. While basic users may not miss this, I was left wondering how long it would have taken me to use the program efficiently if I hadn't already had a fairly thorough background in image processing. It would seem that more extensive documentation would make EASY IMAGE a much more accessible product to the neophyte user. Overall, these are fairly minor concerns. The program appears to be exactly what it proposes to be–a low priced (I would say moderate), basic image processing program for the DOS-Windows environment. ❑

technical notes

The cover for this issue of *Cartographic Perspectives* is of a portion of the Oregon Department of Geology and Mineral Industries' *Elbow Quad Geologic Map*. The original map is in full color and measures 26.75 inches high and 40 inches wide. This *technical notes* section describes the design considerations and execution of the full color map.

AUTOMATED LARGE-FORMAT GEOLOGIC MAP PRODUCTION

by James E. Meacham
InfoGraphics Lab,
Department of Geography
University of Oregon

INTRODUCTION

The Department of Geography at the University of Oregon and the Oregon Department of Geology and Mineral Industries (DOGAMI) entered into a cooperative agreement to conduct cartographic research and to work on the development of an automated procedure in order to produce and to publish a multi-color version of *The Elbow Quad Geologic Map*. The work included: (1) the creation of digital cartographic files and geologic symbols, (2) the delivery of check plots, and (3) the creation of color-separation PostScript plot files.

METHODS

The research and production work was conducted on two computer platforms running MicroStation CAD software, an Intergraph Unix workstation, and a 486-PC. Intergraph MicroStation was chosen as the software package because of its compatibility with the computer mapping installations at the DOGAMI office, the Oregon Department of Transportation (ODOT), and the University of Oregon InfoGraphics Lab. The DOGAMI cartographers have traditionally created registered geologic overlays and combined them with existing U.S.G.S. film-separates of base map information. One of the purposes of this coorperative agreement was to developed a procedure to automate the creation of the geologic overlays.

PROCEDURE

The procedure developed for the creation of a geologic map was based on the on-going research being conducted for the publication of the *Official Highway Map of Oregon*. The cartographic procedure includes four major steps: (1) File Organization, (2) Map Data Input and Manipulation, (3) Geologic Symbol Design and Creation, and (4) Output of Map Images.

File Organization. The File Organization step includes: (a) planning and creating design files with the appropriate naming convention, (b) setting up of an organization scheme within the design files, and (c) determining the geographic coordinate and projection specifications of the design files.

Two files were created for the map portion of the project: *elbowmap.dgn* (line work, polygons and area patterns) and *elbowtxt.dgn* (text and symbols). These two files were referenced to each other using MicroStation's reference file capabilities. The time rock chart and geologic cross sections were created in another design file (*elbowpro.dgn*).

All the graphic cells (symbols) were designed and built from primitive elements and a descrip-