AUTOMATED CARTOGRAPHY AT THE
U. S. BUREAU OF THE CENSUS

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The U. S. Bureau of the Census prepares maps for two basic purposes -- internal operational needs and the presentation of published data. Generally the difference is that maps prepared for operational needs are planimetric while those for publication are statistical. Some portion of both types of mapping has been automated at the Bureau. I shall spend the time alloted giving you a brief overview of our automation efforts -- including, if time allows, our problems and successes.

The reasons for automating cartographic activity at the Bureau varied with the type of map. These in turn determined which portion of the operation to automate. The first automation effort was the GBF/DIME (Geographic Base File/Dual Independent Map Encoding) Project. This project entailed the production of thousands of map sheets, the transcription and punching of millions of geographic records, and the digitizing of more millions of points along streets, political boundaries, and other features within most of the urban areas of the United States. Figure 1 is a close-up view of a metropolitan map. The dots along the streets are the points that were
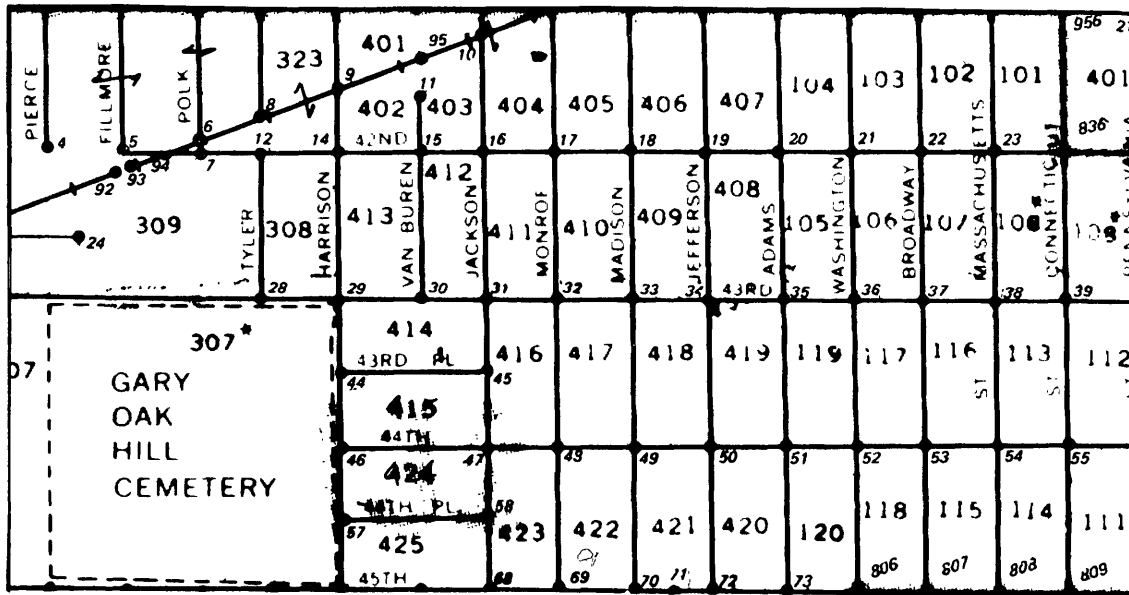

Figure 1. Example of a Metropolitan Map

digitized. Figure 2 shows one of our present digitizers. It is a card output device capable of taking the largest of our maps. The machine readings for each node point dot are outputted directly to cards. The cards are then read into our large Univac computers where the machine readings are converted to latitude-longitude, State plane, and a coordinate system we call map set miles. After conversion, the coordinates are merged with the other encoded geographic information. The result is a digital map of the metropolitan area.

Digitizing is only one part of the automation process. The system used to produce the GBF/DIME-Files is prone to error -- both human and mechanical. Automated plotting of the file is used to check the quality of the coordinates in the file. We currently create a paper plot at the same scale as the original map used in the digitizing operation. The plot is placed over the original map and a check is made for positional differences. Errors are corrected by redigitizing and merging new coordinates into the file.

The system may be complex by today's standards, but it has served us well. We have a national standard file which serves our needs and those of many other Federal and local agencies. We are currently upgrading our digitizing system through the acquisition of new equipment. The new digitizing system will include an interactive record retrieval and change station for correction of errors before sending the coordinates to be merged with the master files.

The other mapping effort is in automating maps for data presentation. All of you, I hope, have visited the Bureau of the Census display area. There you saw an excellent sample of our mapping for data display. We have applied automation to some operations in thematic mapping -- both dot and choropleth. I shall restrict my remarks to choropleth mapping because of time constraints.
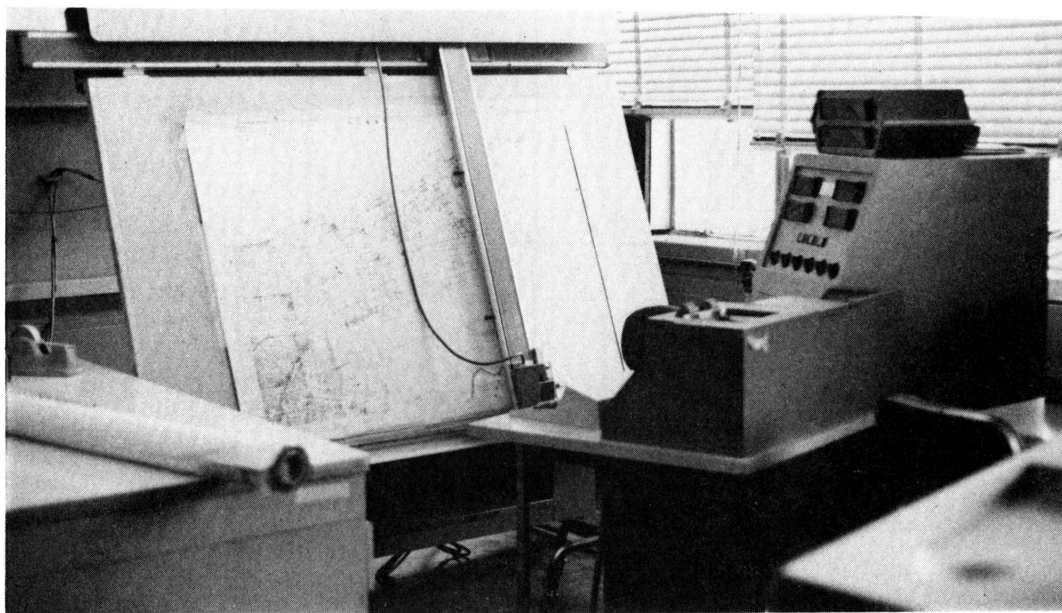
Figure 2. Digitizer at the Bureau of the Census

Two steps of choropleth mapping have been automated: data coding and open window negative production. Figure 4 on pp. 254-255 depicts the total system. Starting with a digital data base, we extract the items to be mapped and the geographic codes. The items are classed and held in an intermediate file. The other input is a digital description of the area to be mapped -- in this case, the counties of the United States. The digital county description for each county is processed into an image at the scale and in the coordinate position that it will appear on the microfilm. The images are merged with the data classes, the record sorted by class, and the images outputted to the microfilm plotter. The plotter produces one frame of microfilm per class plus one frame for the geographic area outline. The microfilm is sent to the cartographic staff where it follows a more or less conventional process into the final map.

The system produces maps of acceptable quality in a shorter time and at a lower cost than a completely manual system. The savings varies from product to product, but is generally about 80% or 90% of the manual cost.

In summary, the Bureau of the Census has applied computers to assist the cartographic effort for three reasons: 1) quality control of existing data, 2) speed, and 3) cost.

In the case of quality control, automation was the only reasonable way to go. Where speed of map production was the requirement, the time between request to final map has been reduced significantly. The cost of producing a single map has been reduced, but this has resulted in an apparent contradiction. For data display -- automation has resulted in no savings. Rather it has created more work because instead of a sponsor getting one map for $1,000, he is asking for and receiving four or more.