



In this presentation, we examine maps in historical context to determine if they have techniques and symbology that can be adapted for maps today and if so, how that can be done. Ours is a typical “history of cartography” approach, in which we try to determine the “underlying technical process of creation” (Kimerling 2006.)[\[1\]](#)

[\[1\]](#)Kimerling: “Historical cartography is based on viewing maps as a rich source of geographic information to be used in reconstructing past events. The geographic content of maps is of prime concern. Determining the geographical accuracy of features shown on historic maps is an important aspect of this focus on maps content. In contrast, the history of cartography involves studying how maps were made and who made them in different historical periods. Maps are viewed as physical artifacts whose physical form reflects an underlying technical process of creation. A historian of cartography would carefully examine a map and try to determine such things as the data sources used to create it, if it was drawn by pen and ink or engraved on copperplates, how colors were added to areas, and how it was printed or otherwise reproduced.”



Why would we want to do this?

Firstly, and most obviously, the symbology and mapping techniques could be used to enhance the affective design of the map – that is, the look or feel of the map. The symbols we created and the methods we developed can help transform modern geographic information systems (GIS) data into maps that have a historical look or feel to them. This affect can be achieved using state-of-the-art GIS software. Using the effects does not mean that they will always produce a historical looking map. For example, using a parchment fill and a special font does not necessarily mean that the map has to have a historical look to it; these effects could instead promote a more freeform, hand drawn albeit modern and artistic look.

Secondly, in some cases, with the right maps for the right purposes, using these techniques and symbology can actually improve the effectiveness of maps. For example, one technique for creating a coastal vignette using horizontal hatching or, as we call them, "coastal rakes", was used historically because it was difficult to achieve fine gradations of ink. Once we had the ability to use half tones, this effect could be easily achieved. The historic coastal rakes technique is useful today for black and white maps and maps intended for photocopying where fine gradations of ink are difficult to achieve and reproduce. As another example, pictorial symbols, such as hill, town or castle symbols, are easier and more intuitive for quick map-reading, such as when the reader is touring and looking for or navigating by landscape and landmark features. Maps for these purposes do not always require detailed terrain depictions, although for navigation and way-finding, it might still be necessary to include on the map landmarks such as hills, towns and castle ruins.

Finally, we believe that the symbology and techniques we describe in this presentation can be used to make maps that are more eye-catching to the map reader. This will result in the map reader being drawn to the map more quickly and easily and the map holding the reader's attention longer. Why? Because of the increased novelty, beauty and density of information on the map.

As regards novelty, using these mapping techniques does not necessarily result in period reproductions, but the map effects are different and eye-catching. A map reader will be more apt to spend a little time trying to figure out what makes a map different if it uses symbols and fonts that are not often seen. Using historic map symbology and techniques on a modern map creates a novel look, and using mapping methods that are uncommon makes the map distinctive and therefore more interesting to the reader. Fonts that they have not seen before, symbols that are new to them, and borders or cartouches create a fresh look, despite their historic appearance. Because the map is not designed with Ariel font, small black circle point symbols, simple black line symbols and the now all too often seen hillshading makes the map different, so the reader will be tempted to investigate what makes it is that makes it unusual.

As regards beauty, the map effects are pleasing to the eye. They use symbology that many people are familiar with through casual if not calculated knowledge of historical maps. Also, people like a hand drawn look – the slight variation in the symbology (e.g., slightly varying line widths and curves that are not perfectly round) mitigate the cold "machine" look that computers cannot help but render. Understanding this appeal, software companies, like Adobe, are now starting to package tools to achieve these effects in their software, like Illustrator.

As regards density of information, the symbols add complexity to the map; that is, they increase the amount of detail and information displayed on the map. Pictorial symbols are more complex and have more detail than the more abstract yet simple geometric symbols, such as circles or squares, that are often found on maps. Pictorial symbols also carry meaning that is more immediately understood by the reader since the symbol mimics the feature it represents. "Mimetic symbols are desirable on maps when they are unambiguous and easy to understand" (Robinson, et al. 1995). Mimetic symbols can be used to represent either quantitative or qualitative variation in the attribute being mapped. For example, town symbols can be used to represent either quantitative variation in the amount of population, while using different hill symbols allows the

Outline

- *Map examples for 3 general time ranges*
 - *Selected historical map*
 - *Special cartographic effects*
 - *David's maps*
 - *Symbology & labeling*
 - *Details about selected methods*

Late 1500s - 1600s

Early to mid-1800s

Late 1800s - early 1900s

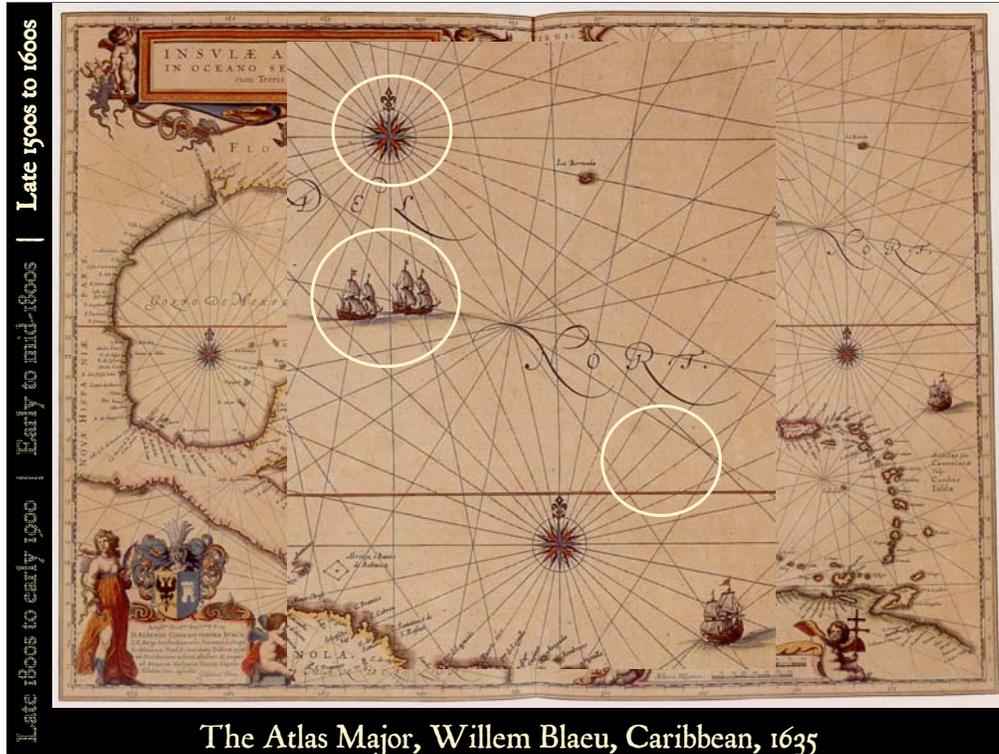
This presentation is organized by three rough time periods: the late 1500s to 1600s, the early to mid-1800s and the later 1800s to early 1900s. For each, we show you the historical maps that we examined to learn more about how the maps were made and the technical processes underlying them. We identify selected cartographic effects that we then explored further to determine if they could be replicated using computers and GIS. We show you the maps we made to test the development of these techniques, and for each we describe the symbology and the labeling, as well as provide detailed descriptions for selected mapping methods.



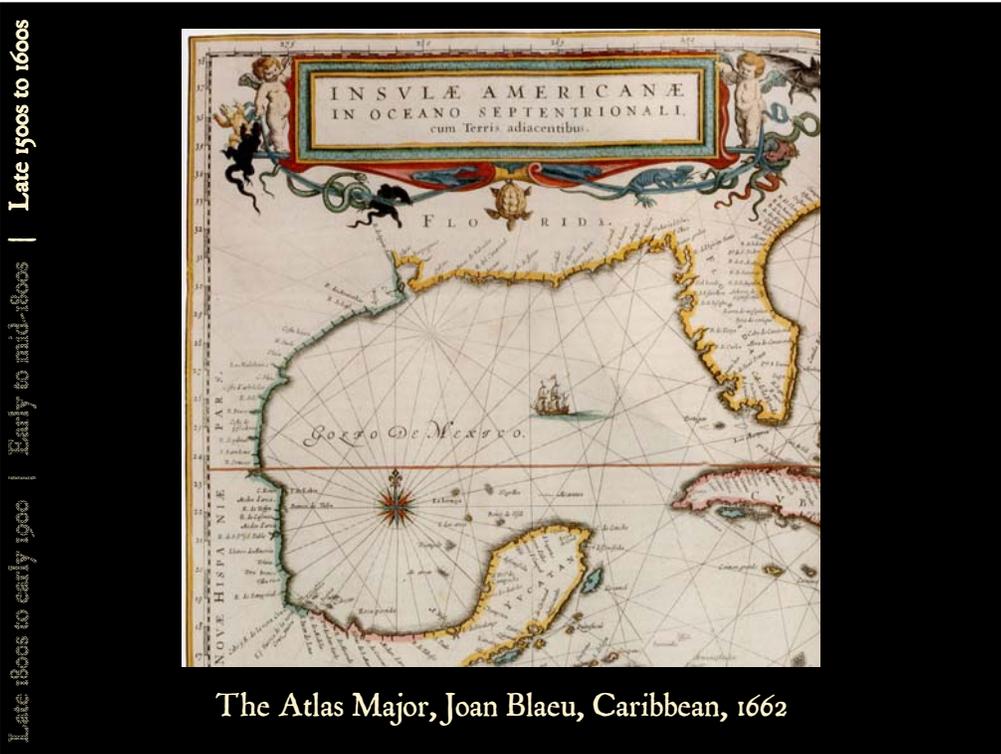
To help you, we have posted this presentation and related resources on a web site so that they can be downloaded. The instructions for the techniques described in this presentation, along with graphics of the maps, and the ArcGIS styles and their related fonts and picture images are freely available, as are copies of this presentation and the related paper we are working on.



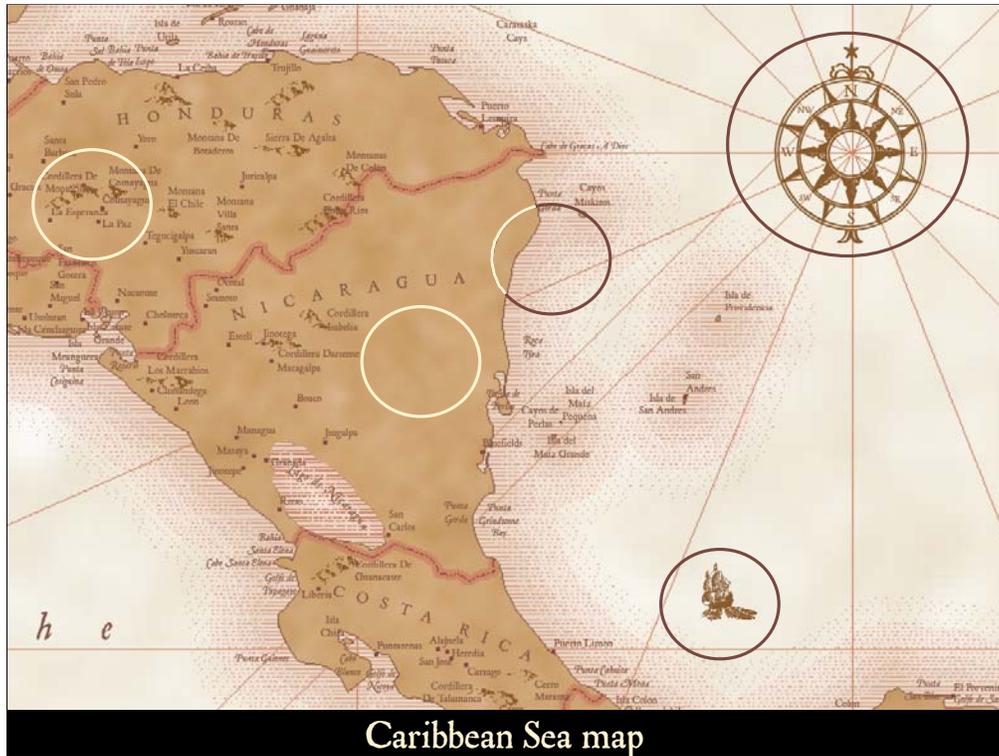
The first time period we examined was the late 1500s to 1600s. The Mercator map of the Arctic has two effects that we inspected more closely – an effect we call “coastal rakes” and symbology Denis Wood (1992) has called “hillsigns”.



A 1635 map of the Gulf of Mexico by Willem Blaeu was the predecessor to one made in 1662 by his son Joan. The 1635 map has rhumb lines radiating off of compass roses. It also has illustrated marginalia, and decorative ocean art in the form of various ships. Additionally, the map appears to be printed on parchment paper.



The later Blaeu map was likely a reprint of the earlier version, as map plates were often re-used. Since it was not always worthwhile to re-engage plates for each new edition of an atlas, the printing plates would sometimes be purchased at a later date by a new mapmaker and then reprinted, perhaps with minor changes. On the 1662 Blaeu map, the colors are more varied and vibrant, as is well illustrated in the cartouche.

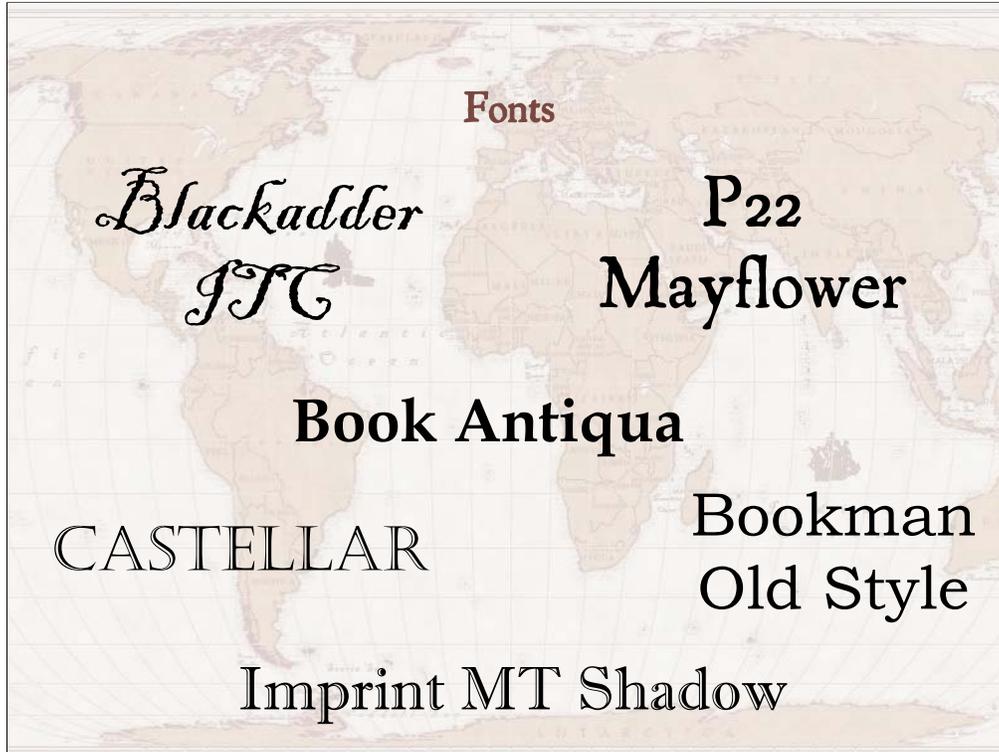


A Caribbean Sea map was created to develop and demonstrate some of the mapping techniques found on the previously described maps. On the Caribbean Sea map, notice:

- the hills signs which are used to symbolize physiographic features such as mountain ranges and hills.
- the coastal rake which is used to symbolize the shoreline areas.
- the decorative north arrows connected by rhumb lines (lines of constant bearing).
- the parchment fill used for the background, and
- the various illustrated map surrounds, including the ocean art, such as the ship shown here.

NOTE:

The text fonts used on this map included Blackadder ITC for the graticule labels and P22 Mayflower for all other text and labels.



On this map, the Blackadder ITC and P22 Mayflower fonts were used. These fonts, as well as the additional fonts shown here, were also used in the other maps we made. The Mayflower font was the only one purchased for the maps you will see in this presentation.

NOTE:

The Blackadder ITC font, which comes with the standard Windows fonts, was inspired by the “eerie transformation of insurrectionist Guy Fawkes’ signature after he was tortured”. British designer Bob Anderton’s based his Blackadder ITC design on hand written letterforms typical of the 16th century. “Anderton captured the flurried scrolls and curlicues of the era and then added the sinister tremble that defines Blackadder ITC. This elegant, yet menacing display face is perfect for theatrical uses and scare tactics” (<http://www.fonts.com/FindFonts/detail.htm?pid=204105>).

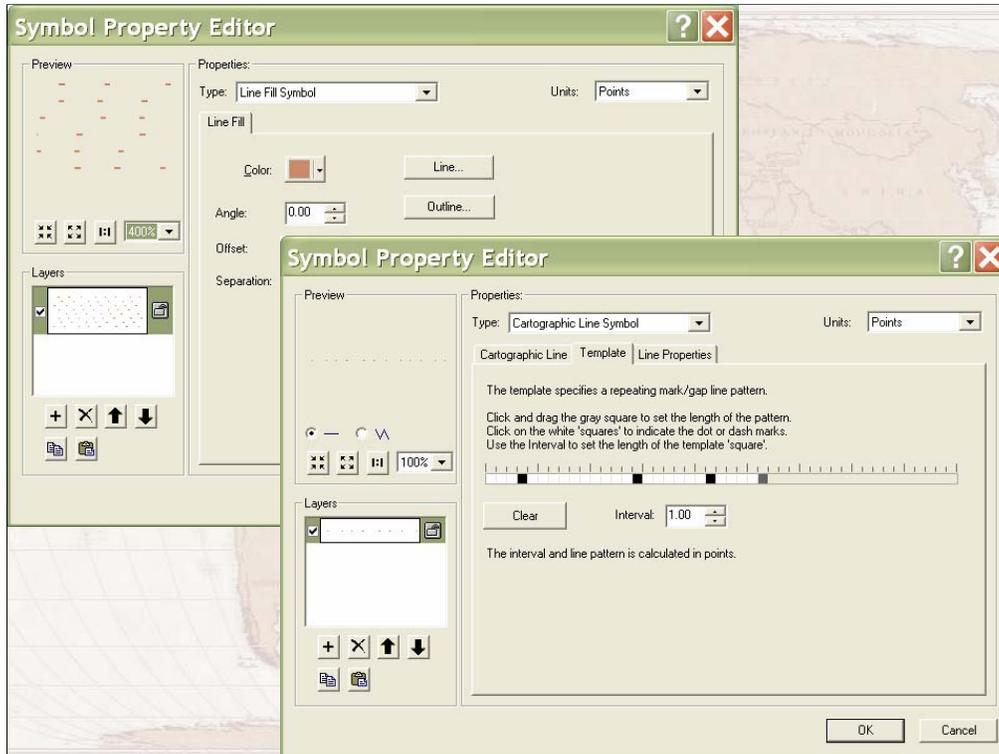
P22 Mayflower is a classical Roman font taken from a Bible of 1610, which was the edition likely carried to America by the pilgrims on the Mayflower.



Coastal rakes were used as an alternative to the more commonly seen coastal vignettes that use graded colors. Both effects can be achieved with GIS using either constant or variable width buffers; the difference lies in how the buffers are symbolized. The coastal rake effect is achieved by symbolizing the buffers with fill patterns that are composed of lines. A variety of fill patterns were created for the various buffers.

NOTE:

In either case, one advantage we have over our cartographer colleagues of the past is that while their maps each had to be laboriously painted, etched or engraved by hand, these methods can be replicated quickly and easily with GIS.



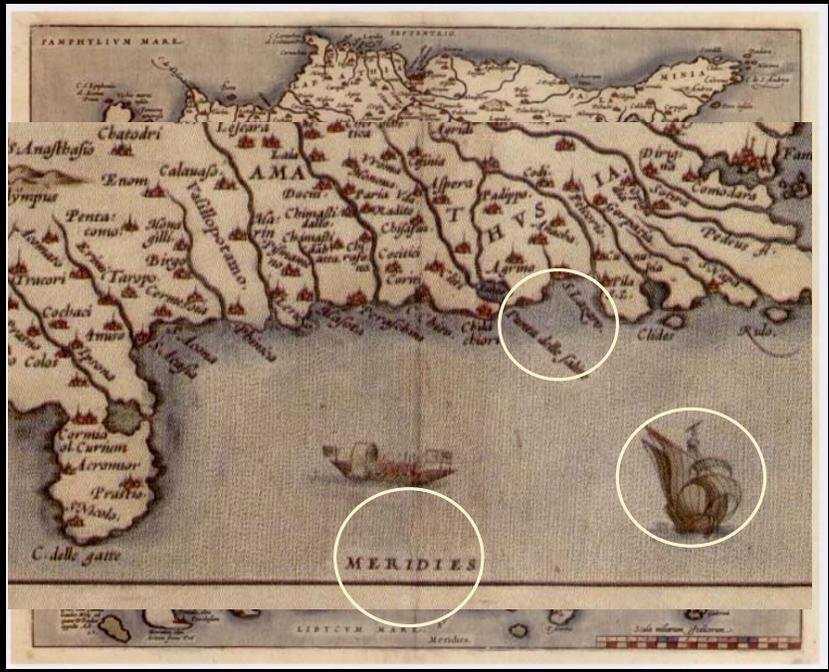
Each is simply a line fill pattern with different irregular spacing for the dashes. These figures illustrate variations in the symbols that were created for the Caribbean Sea map.



- *North arrow and rhumb lines*
 - *North arrow used to digitize rhumb lines*
 - *Rhumb lines are GIS features so they are placed under land masses*

For the rhumb lines, the north arrows were used to digitize lines as GIS features connecting points of equal bearing. Because the lines are GIS features, they can be placed under the land masses, helping to promote figure-ground.

Late 1500s to early 1600 | Early to mid-1600s | Late 1500s to 1600s



Cyprus & Crete, Theatrum Orbis Terrarum, Abraham Ortelius, 1570

We found some additional interesting cartographic effects on other maps from the late 1500s to the 1600s. This Ortelius map has a hand-painted coastal vignette. It also has orientation text along the four map margins and decorative ocean art.



Late 1600s to early 1900 | Early to mid-1600s | Late 1500s to 1600s

The next two maps by Saxton are different copies of the same map, illustrating the differences that can occur with hand-colored maps, although this first one is more faded than the next.

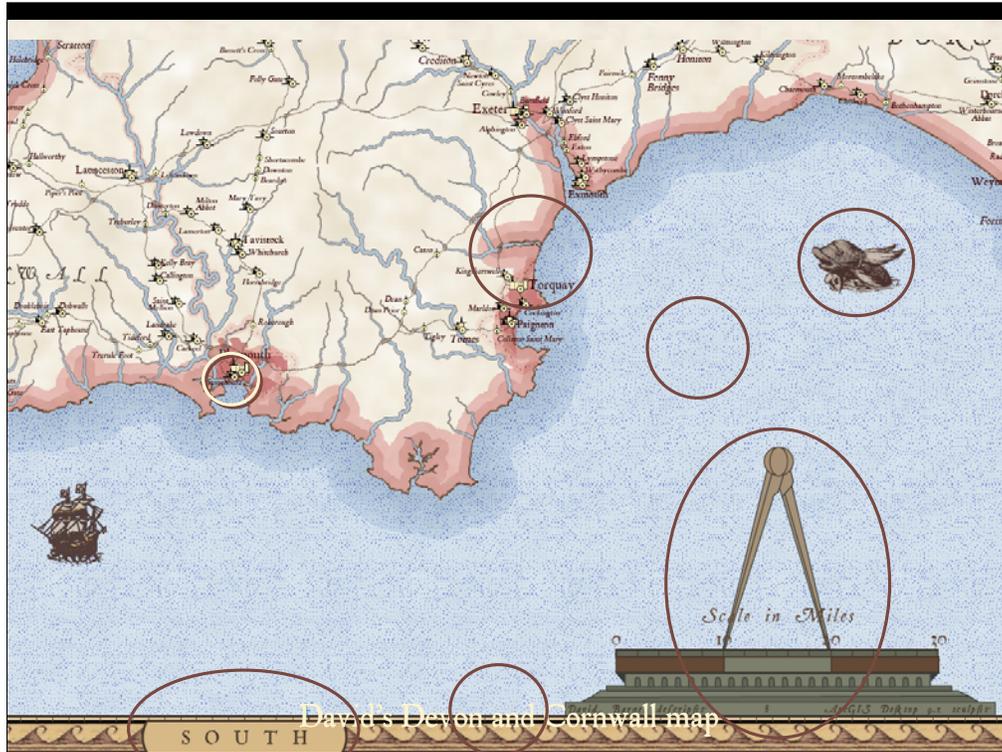


These maps illustrate the use of a stipple pattern for the ocean, thick tapered stream lines, a narrow band of coastal rakes and decorative ocean art. The colors on this map are included in an ArcGIS style and are identified with ruddy British-period names, like Ox Blood, Privet Berry and Popinjay.

David's
United
Kingdom
map



To see how some of these effects could be achieved, a map of England was created, then...



a larger scale map of for Devon and Cornwall was compiled in order to compare the results developed using GIS with those of the Cornwall maps by Saxton.

Notice on our Devon and Cornwall map:

- the stippling in the ocean which was created using a dotted fill pattern placed over a parchment fill,
- decorative ocean art which is created as graphic points symbolized using special picture markers,
- the graded color vignette and coastal edging which simulate a hand painted effect,
- cultural features such as the cities which are shown with mimetic symbols,
- the decorative border,
- with orientation labels indicating the cardinal directions, and
- the ornate scale bar.

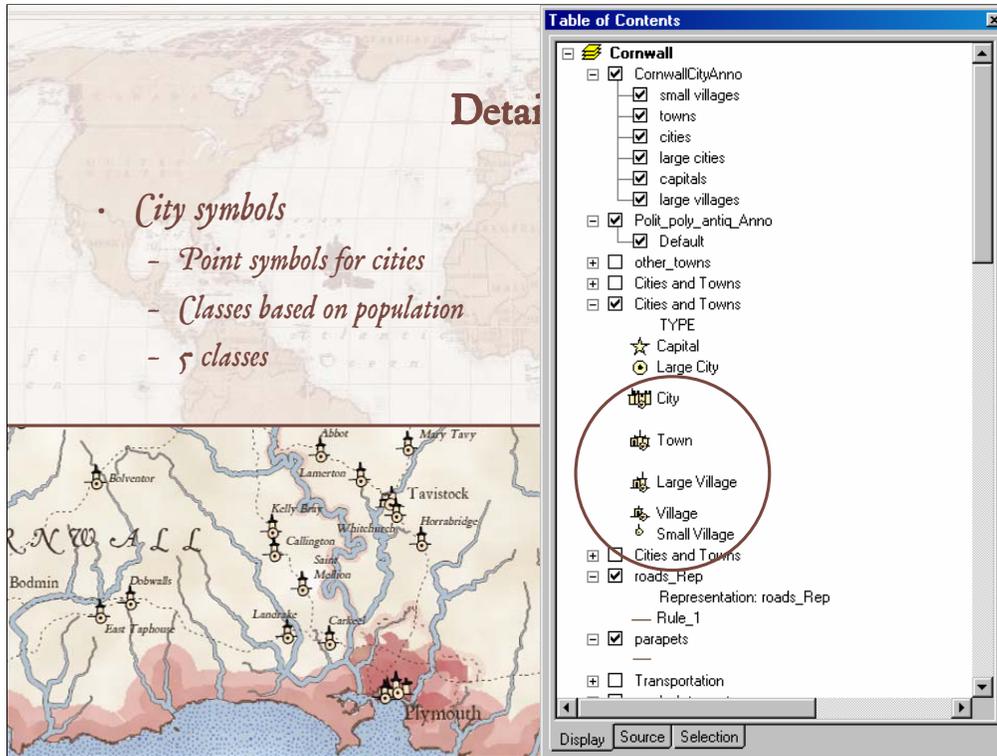
The border pattern is from the Isle of Wight map by Saxton. The scale bar "pedestal" and dividers are from Mercator's map of Iceland, 1595...



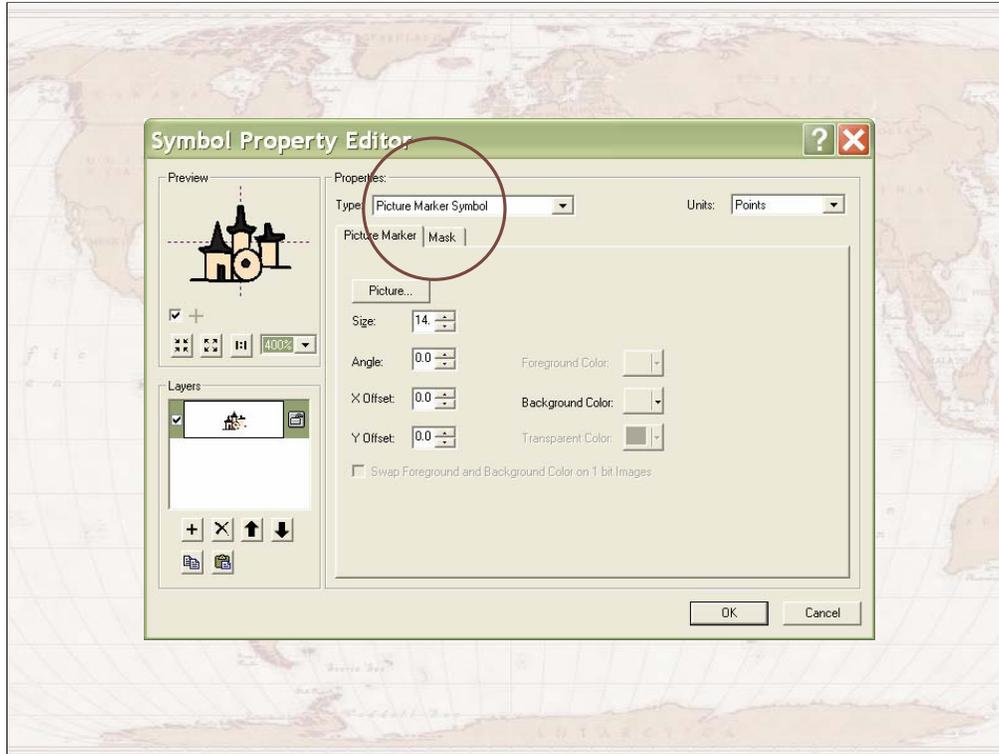
As is the cartouche.

NOTE:

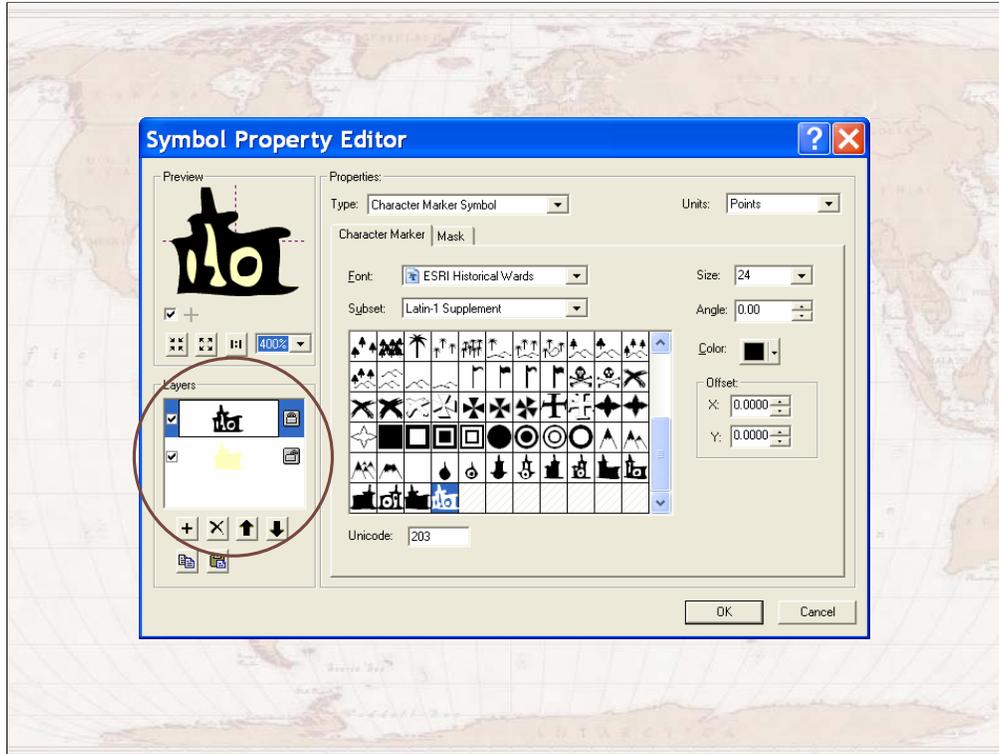
The text font used for most of the labels on this map was again P22 Mayflower.



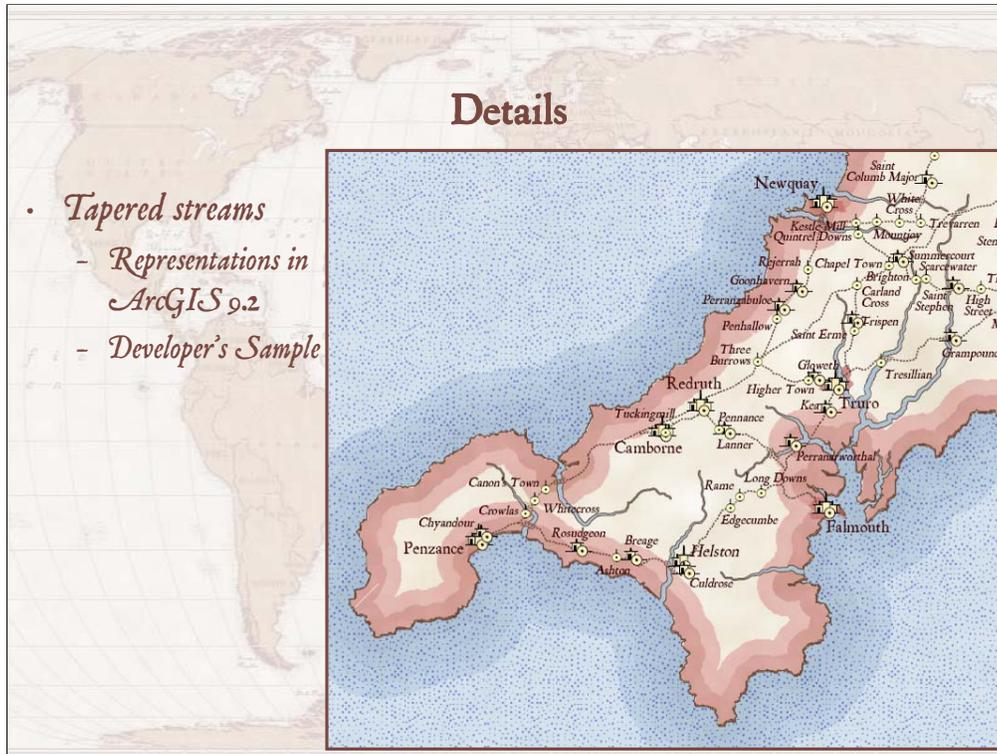
The cities were symbolized using mimetic point symbols. Five symbols were created to symbolize five classes of cities based on population.



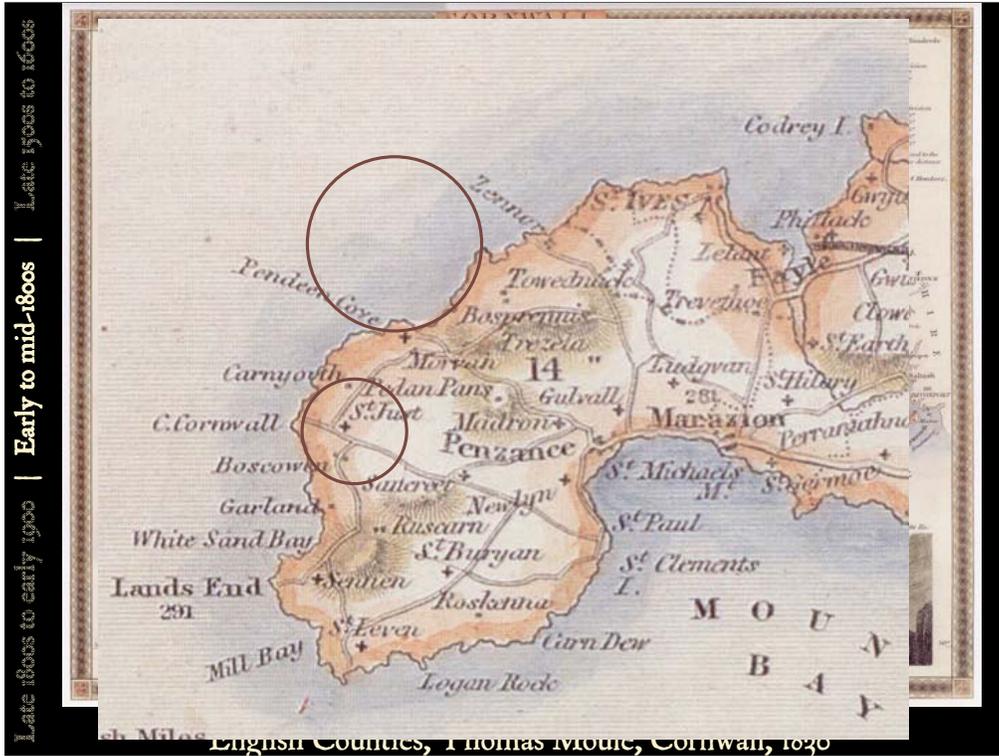
The town symbols were created simply as drawings that were saved in Enhanced Metafile or .emf format. Then, in the GIS, the .emf image was used to create a picture marker symbol. The various symbols were then assigned to the five population classes of cities.



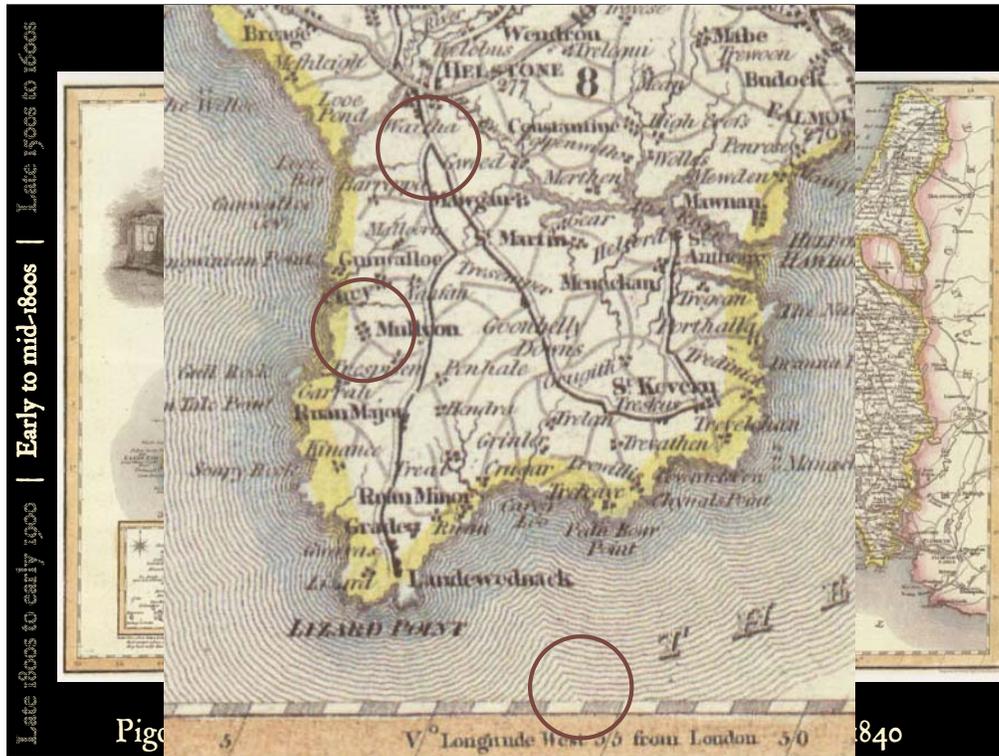
Another option is to save them in vector format in a font and then reference that as a character marker symbol. One advantage is that you can create multiple layer symbols and color the layers any way you want. Another advantage is that scalability of the vector font is usually better.



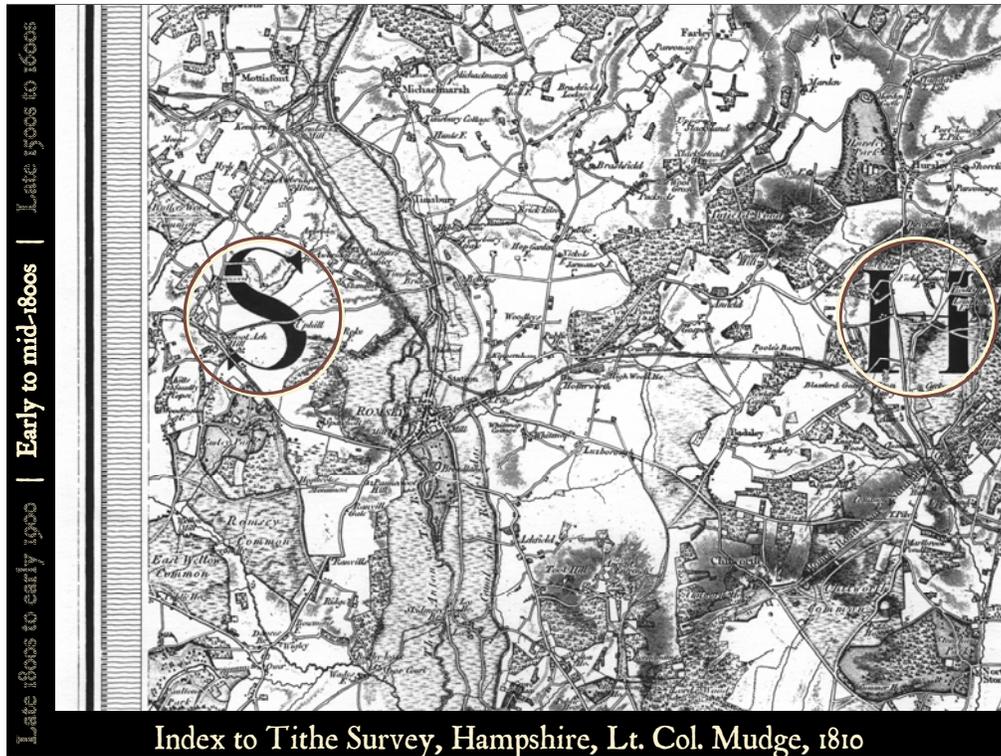
Another effect that was able to be replicated with GIS was the tapered streams. This was achieved using “representations” which is a new software enhancement in ArcGIS 9.2. The tapered stream effect is a Developer’s Sample that will be available as a download when it is ready, post-9.2.



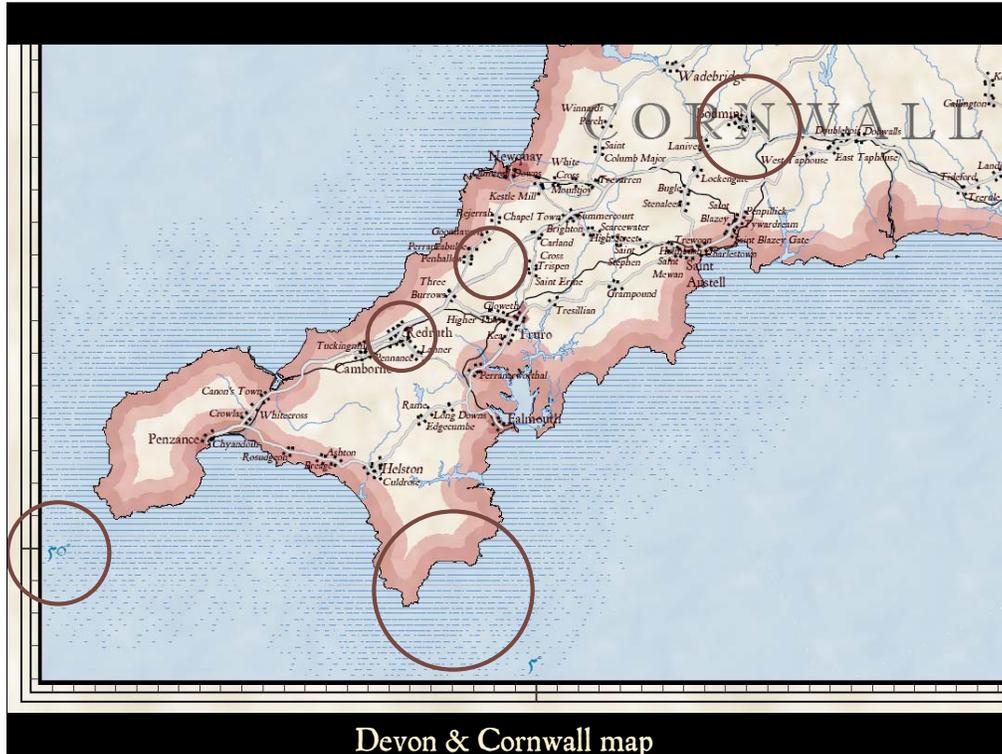
The next time period that was examined was the 1800s. For this time period, the Moule map has such cartographic effects as cased roads and a more subtle coastal rake.



An 1840 map of Cornwall has little black squares along roads to represent the towns and cased lines for the major roads. In addition, the map has a decorative border that is calibrated to the graticule.



The Tithe map illustrates a number of intriguing cartographic effects but mostly we want to point out the beautiful layering of geographic features over the text to promote visual hierarchy.



To test the development of some of these methods, the map of Devon and Cornwall was further modified. Notice on this map:

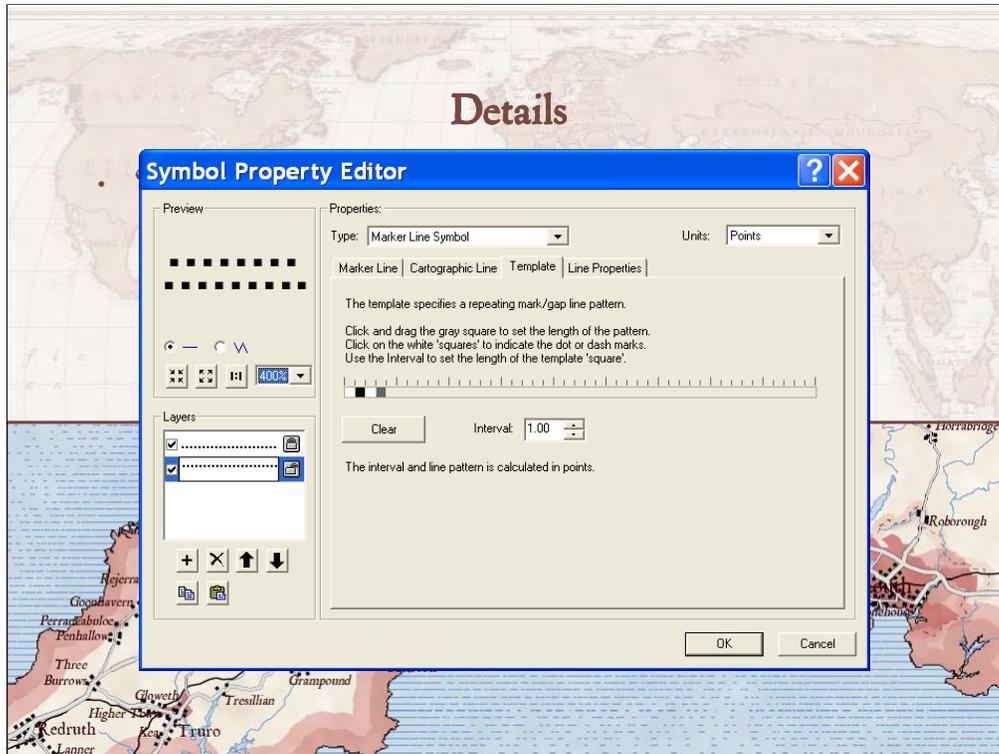
- the coastal rake that was used to symbolize the shoreline areas,
- the cased line symbols used to represent the transportation features,
- the replication of the symbology for the populated areas using building point symbols placed alongside roads, and
- the use of a decorative border calibrated to the graticule.
- In addition, the geographic features are superimposed on the type that labels the counties.

NOTE:

The fonts used on this map are primarily from the P22 Mayflower font family; however, Imprint MT Shadow was used for the county names.

“Imprint holds a special place in the Monotype typeface library. It was the first typeface designed specifically for mechanical composition. Commissioned by E Jackson, E Johnston, J Mason and G Meynell for a new periodical, called the Imprint, which they were planning. Described later as “a modified old style with a Caslon oldface motif.” The more archaic features of Caslon were dropped, the weight was increased but certain old face characteristics were retained. The magazine for which Imprint had been commissioned was short lived but the typeface became popular and widely used for book setting. The Imprint font has influenced many later book face designs”

(http://www.fonts.com/findfonts/detail.htm?pid=205584&grab_id=0&page_id=1048&query=Imprint%20MT&SCOPE=Fonts).

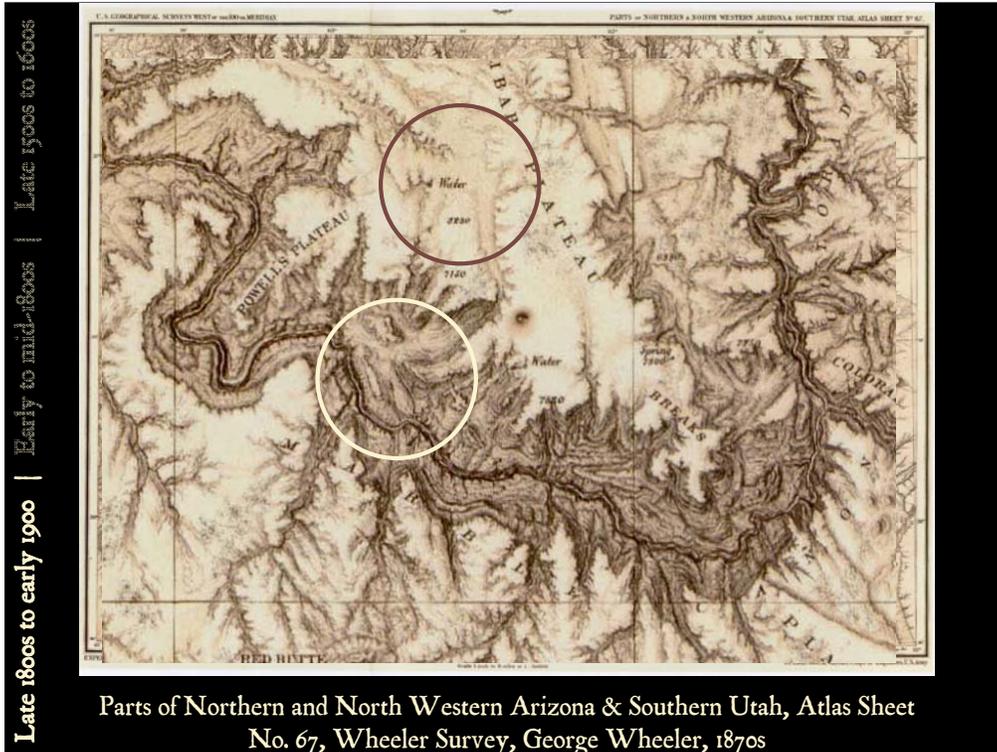


The effect that was used to symbolize building points alongside roads was driven by GIS data processing.

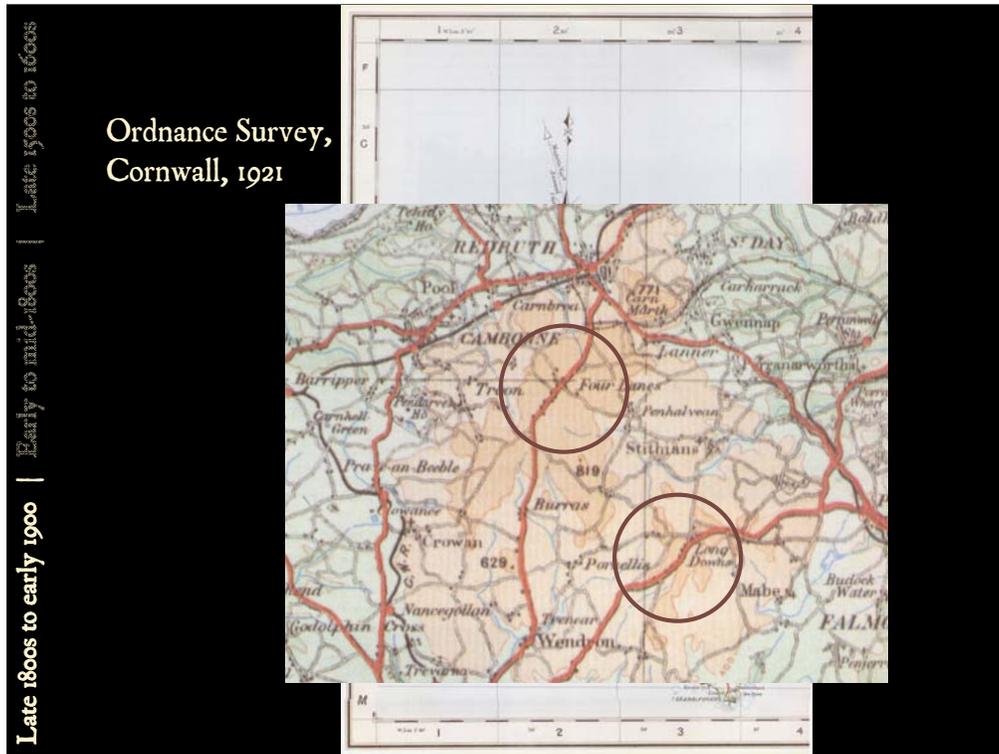
First, we buffered the city areas using three different sizes of buffers based on the population. These buffers were used to clip the road lines so that he could identify where we wanted to show the building points – that is, where the roads ran through populated areas.

We created a line symbol with two layers – one for each side of the road. Each of the layers was offset to one side of the road, and used a marker line symbol with staggered points from a different template.

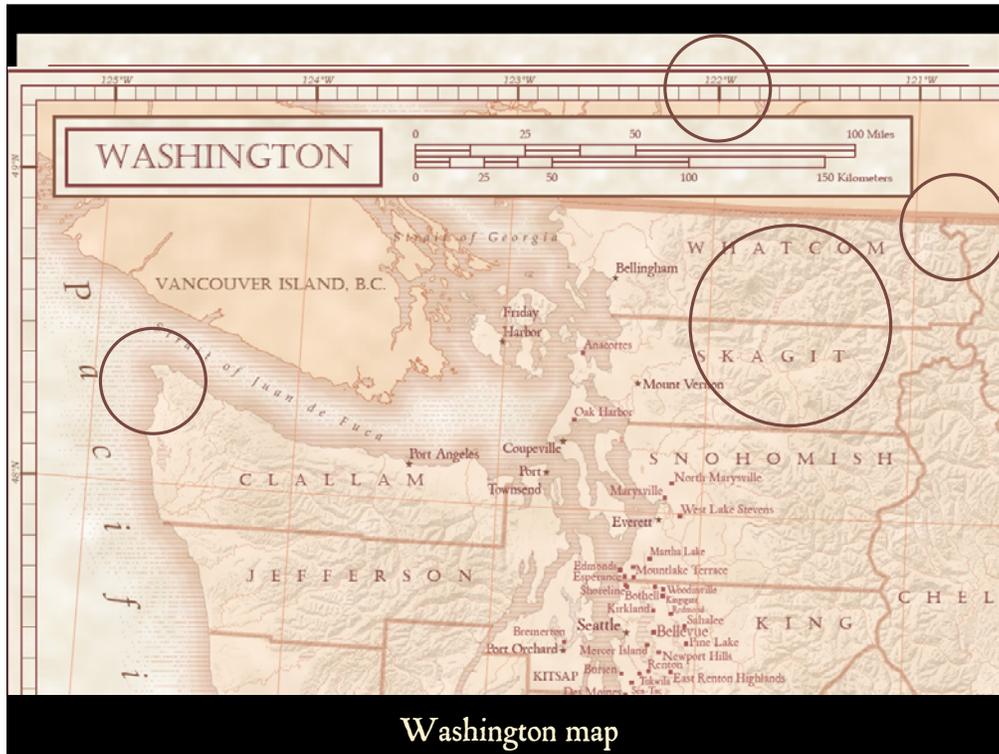
These line symbols were then placed alongside the roads in the populated areas only.



The last time period we examined was the late 1800s to early 1900s. The Wheeler map from this time period shows wonderful hand-drawn hillshading and the map is awash with sepia tones.



The Ordnance Survey map is a printed color version of an older Victorian (1890ish) black and white linework map. You can see clusters of little black squares representing roadside towns and villages. On this map, the terrain is represented with hypsometric tinting.



On our map, you can see that we were able to reproduce the effects for:

- the hillshaded effect which of course uses DEMs and hillshading functions in the software and a brown color ramp rather than the default black one,
- the coastal rakes combined with a graded color coastal vignette,
- a sepia tone which is created as a transparent polygon fill over the hillshade, and
- a decorative boarder calibrated to the graticule.

The effects we used on this map would be useful for a limited color palette such as black and white map production or grayscale conversion.

NOTE:

The fonts on this map included: Book Antiqua, Bookman Old Style, and P22 Mayflower for most labels and text, Castellar for state/province names

Book Antiqua is almost exactly the same font that Palatino Linotype, Palatino Linotype is included in Windows 2000/XP while Book Antiqua was bundled with Windows 98. This font is included in standard Microsoft products.

The origins of Bookman Old Style lie in the typeface called Oldstyle Antique, designed by A C Phemister circa 1858 for the Miller and Richard foundry in Edinburgh, Scotland. Many American foundries made versions of this type which eventually became known as Bookman. Monotype Bookman Old Style roman is based on an earlier version of Monotype and ATF models. The italic has been redesigned



- *Decorative border calibrated to the graticule*
 - *Grids and graticules property of the data frame*
 - *Setting the tick intervals*
 - *Use a double border*
 - *Set the tick length to fit the space between the two lines*

The calibrated border is actually very easy to replicate with ArcGIS – it is simply a property of the data frame, so if you resize or reposition your data in the frame, the border will update automatically. This effect used a graticule border that was shown with a double line symbol, and the axis ticks were simply spaced and sized to fit between the double lines.

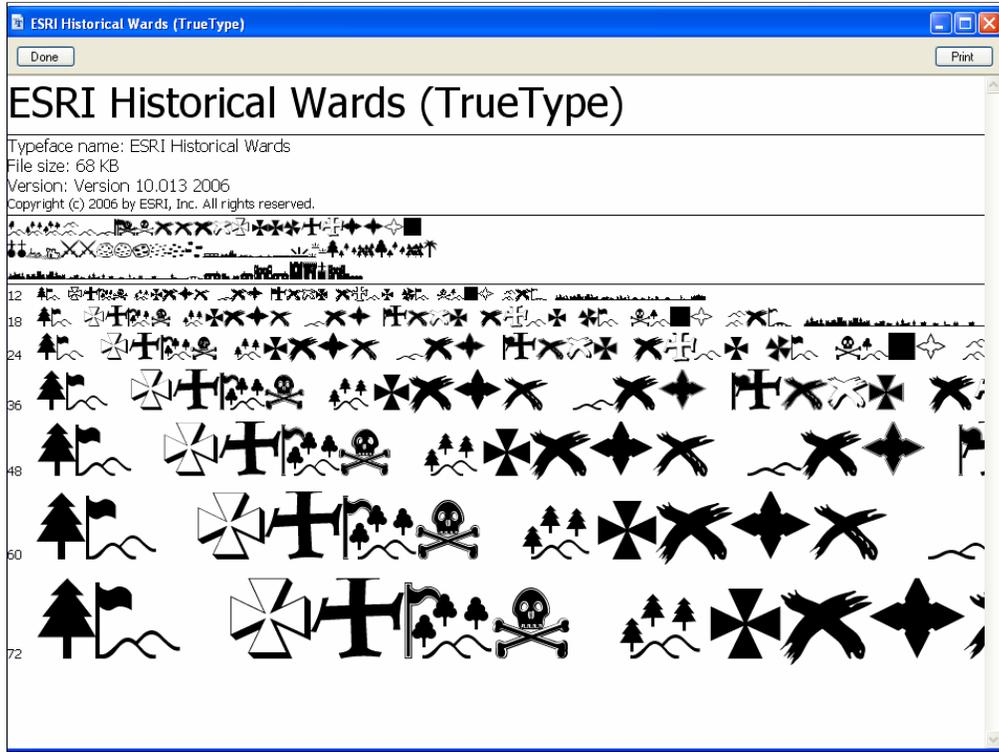


As a reminder, we have posted the resources related to this presentation on a web site so that they can be downloaded. This includes a number of things, such as...

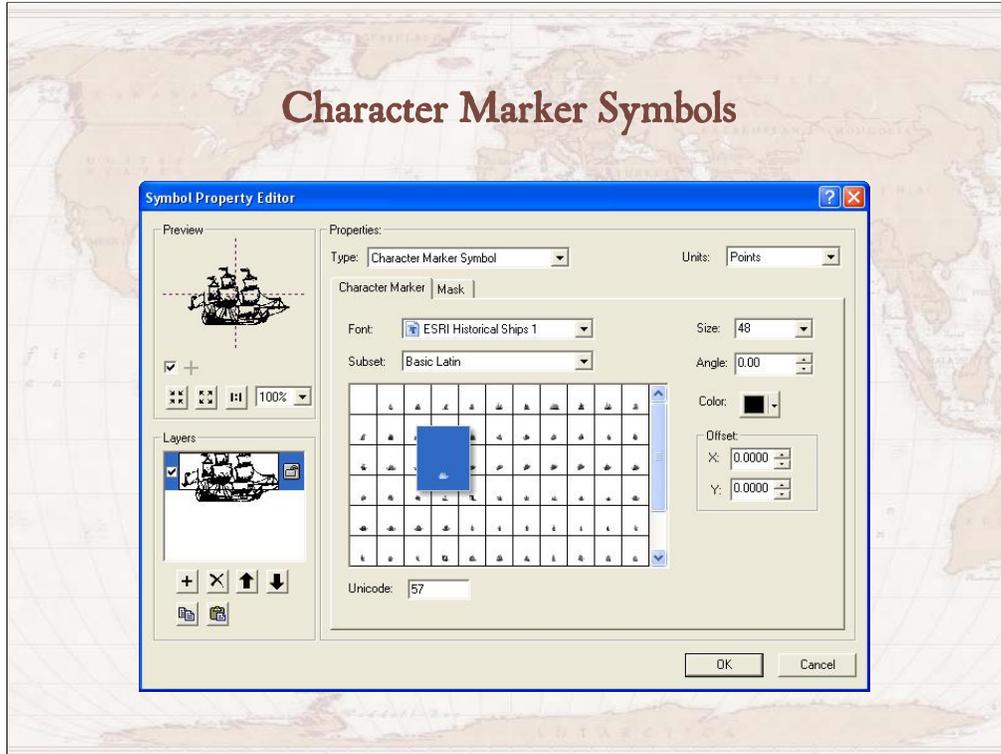


The ArcGIS historical styles – these include symbols – still under development – for:

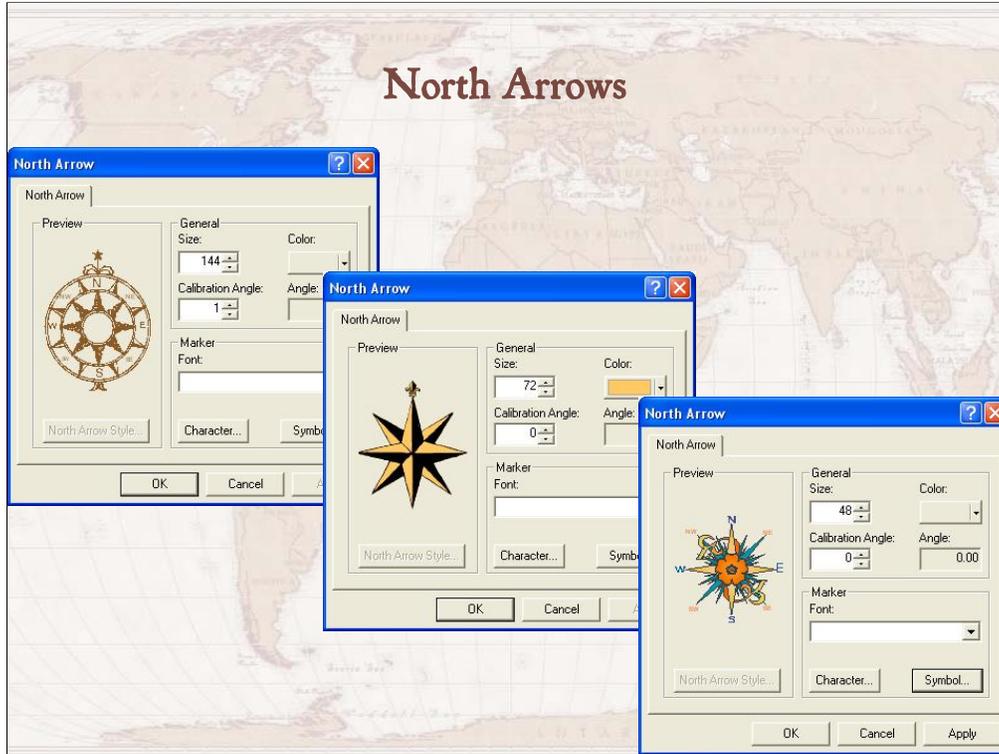
- North arrows
- Backgrounds – like the parchment and ocean stipple we showed you earlier
- Colors
- Fill symbols
- Line symbols and
- Marker (or point) symbols



The marker symbols are most often character marker symbols which reference True Type fonts, like this one for the historical wards for cities and towns and such. The fonts are also included for download.



Here is another of a marker symbol crated using a font – this came from a set of symbols for ocean art. Some are already angled for rhumb lines in a Mercator projection.



The north arrow symbols are not just point symbols – they have north arrow behaviors associated with them, for example, they will rotate if you rotate the data in your data frame.

Image Files for Symbols



Some of the symbols, such as points and fills, reference image files instead of font characters. Some of the 138 .emf files that we have produced are not referenced in the styles but you can use them to make your own symbols. These, in addition to the symbols and fonts I mentioned previously, are also available for you as resources.

As a final note, we are thinking that it might useful to describe in more detail how symbols are created and used in ArcGIS – this involves 1) how you conceive of your symbology and 2) how your concepts take form through using GIS software. If you think this might be a good idea for either this venue or some other such as the ESRI User Conference, just let us know.

Resources

The collage features several elements:

- A screenshot of the ArcGIS 'Map Properties' dialog box, showing the 'North Arrow' tab.
- A screenshot of the ArcGIS 'Map Properties' dialog box, showing the 'Style' tab.
- A screenshot of the ArcGIS 'Map Properties' dialog box, showing the 'Data Frame Properties' tab.
- Four small map thumbnails: a historical map of the British Isles, a topographic map of a coastal region, a map with a red boundary, and a map with a grid overlay.

- support.esri.com/datamodels ↗
- *Basemap* ↗ *NACIS2006.zip*
 - *Instructions for the mapping techniques*
 - *PDFs of the maps*
 - *ArcGIS styles*
 - *fonts & picture images*
 - *This PowerPoint presentation*
 - *PDF of the paper (in progress)*
- *Poster session*

Thank you!

Here's that URL one more time.

Thank you for your attention.