Assessing the Accuracy of the Confederate Military Maps of Jedediah Hotchkiss

Brooks C. Pearson
Geography Program, Department of Geosciences
State University of West Georgia, Carrollton, Georgia, 30118 USA
bpearson@westga.edu

Introduction

This study begins assessing the accuracy of map information contemporary with operations during the 1862 Shenandoah Valley Campaign of the American Civil War (1861 - 1865). To accomplish this a geographic information system (GIS) was assembled with layers representing map data from current U. S. Geological Survey (USGS) 7.5' topographic sheets and from a sample of Civil War historical cartography: Jedediah Hotchkiss's 1862 "Map of the Shenandoah Valley"; Hermann Böÿe's 1859 "Map of the State of Virginia"; an 1861 Union triangulation survey of the Shenandoah River and its south fork; and Union Maj. Gen. Franz Sigel's 1862 Valley Campaign map. The scope of this project has thus been broadened from what the conference title here retained would suggest. For the purposes of the present study, the positional accuracy of the historical maps will be evaluated relative to ground truth as represented by the USGS information.

Maps Examined in the Study

The representation of the Shenandoah River in USGS data and in the study's sample of historical maps is seen in Map 1. This section describes the source maps entered into the GIS environment to conduct this study.

USGS map layers in the study GIS were heads-up digitized under my supervision from publically available digital 7.5' quadrangles by students in the West Georgia Geospatial Technologies Laboratory. For the study these and all other maps are projected to UTM Zone 17 using NAD 1927 spheroid datum.

The only comprehensive map of the Shenandoah Valley drafted under Confederate arms was Jedediah Hotchkiss's monumental "Map of the Shenandoah Valley" (Library of Congress Geography and Map Division (hereafter LOC) H89 as described in Stephenson (1989)). Hotchkiss was Maj. Gen. Thomas J. "Stonewall" Jackson's topographical engineer. Many scholars have attributed much of Jackson's exemplary performance in the 1862 Shenandoah Valley Campaign to Hotchkiss's presence on staff and have attributed his poor showing in the subsequent Peninsula Campaign to Hotchkiss's absence at that time (for details of Hotchkiss's merits see Hotchkiss (1973), Miller (1993), and Roper (1989)). Drawn in early 1862 from surveys conducted by Hotchkiss and Sgt. Howell S. Brown, LOC H89 is a 254 x 111 cm, three color manuscript penned on tracing paper at 1:80,000. Hotchkiss's map displays a 3/4-inch grid which does not generally agree with the graticule as defined on the map in d/m/s north of the equator and west of the "National Observatory, Washington." The use of what is today an unconventional meridional reference greatly complicated registering this map into the GIS since I was unable to determine the observatory's precise 1862 location. Lacking definitive data I

selected the longitude of the Smithsonian Institution's "Castle" as a surrogate. Some observed error in H89's positional accuracy undoubtedly results from this expedient.

Hermann Böÿe's 1859 "Map of the State of Virginia" would have been available to both Union and Confederate officers since it was the standard antebellum map of Virginia. The 1:650,000 piece is based on partial surveys conducted during the 1820s and benefits from limited corrections to the original copperplates effected by Louis Buchholtz in 1858-1859. The Böÿe-Buchholtz map is notorious for its unreliability, as discussed in Pearson (2001). The copy utilized in this study is a wide-format 1:1 photoreproduction obtained at the U. S. National Archives in Silver Springs, Maryland.

Two remaining Union maps of the Shenandoah Valley were examined for this study: Union Maj. Gen. Franz Sigel's 1862 Valley Campaign map and an 1861 Union triangulation survey of the Shenandoah River. The first work, the "Map of Route and Position, First Corps, Army of Va., Maj. Gen Sigel Comng., from July 7th to Septr. 10th 1862" was compiled from surveys and existing basemap information by Sigel's chief engineer, Maj. Franz Kappner. Scale is not given on the 58 x 90 cm map, but calculates to approximately 1:750,000. Although this study employed the National Archives' copy, the work is also housed at the Library of Congress as LOC 461 (Stephenson 1989).

The national archives also stores the last study map, an 1861 "Survey of the Shenandoah River." No information is provided about the cartographer but the presence of a triangulation grid lightly penciled in the background of this four foot long strip map bespeaks the data's survey origins. Although almost exclusively a map of the river course, ancillary details are provided such as tributary waterways, fords, as well as structures and settlements near the river. This map proved particularly troublesome to register, as discussed below.

Building the 1862 Shenandoah Valley Campaign GIS

Data from each of these maps and from current USGS 1:24,000 digital topographic quadrangles were digitized into shapefiles by students under my direction in the West Georgia Geospatial Technologies Laboratory. USGS information was heads-up digitized while the historical maps were entered on digitizing tablets. Positional information is encoded in the USGS data files and is assumed accurate for purposes of this analysis, serving as the control to which the historical works are compared. Coordinates are given on the Hotchkiss Valley Map. For all other maps, registration was facilitated by identifying coordinates from reference points from hardcopy USGS 7.5' topographic sheets.

The map for which registration was most problematic was the 1861 triangulation survey. Sixteen different common points were established between the 1861 map and current USGS 1:24,000 topographic sheets, but no permutation of these would yield an RMS error less than 2.5 meters when the map was registered into the GIS during digitizing. Even more troublesome was the fact that through numerous initial trials the map would register such that Harpers Ferry was nearly due east of the Shenandoah's headwaters instead of its actual NNE location. Eventually the map registered to the degree observed in Map 1. Given these complications it is obvious that data quality issues cloud interpretation of findings involving the 1861 Union triangulation survey of the Shenandoah River examined for this study.

Comparison of Historical Maps to Current USGS Information

For this preliminary investigation the relative and absolute locations of control points are

compared among the USGS data and the study's sample of four Civil War maps representative of topographic knowledge accessible to those engaged in 1862 Valley Campaign operations. Study reference points are illustrated in Map 2.

The first reference point is the confluence of the North Fork and South Fork of the Shenandoah at Front Royal. The second is at the apex of the largest of a double bend just to the NE of Morgan Knob on Massanutten Mountain. The apex of the bend at Good's Mill serves as the third, while the fourth is at Bowman's Crossing on the North Fork. The fifth is at Port Republic.

Table 1 below summarizes the results of this investigation.

Discussion of Findings

Most obvious from these findings is that the 1859 Böÿe-Buchholtz map is highly unreliable. This is anticipated in the literature as well as by even a casual examination of Map 1. Control points range between 1.8 - 23.0 km from their expected locations. Perhaps more importantly the angular relationships between control points on the Böÿe map and expected locations are wildly variable. Thus, positional distortion on the Böÿe map is unsystematic and therefore unlikely to be the result of projection or spheroidal transformation errors: these errors are present in the source map and not the result of error in digitizing.

The 1861 Union triangulation survey is likewise faulty, although more in terms of distance than directional instability. While its positional reliability improves markedly in the map's southern reaches, most control points were over 10 km from their expected locations. The angular characteristics of error are more homogenous than for the Böÿe work, however.

The second most reliable historical study map was Hotchkiss's Valley Map. Error in Hotchkiss's representation of the upper Shenandoah is between 1.7 km and 2.8 km from expected locations, while the lower valley is around 6 km from its mapped location. The angular displacement on Hotchkiss's map is fairly consistent, except for reference point 5. This regularity might indicate a projection transformation error rather than absolute error in H89.

Sigel's campaign map was decidedly the most reliable study map in terms of positional accuracy. Since Gen. Sigel was a notoriously unreliable commander, it is somewhat ironic that topographical engineering conducted under his direction would prove exemplary. Control points on the Sigel map are between 1.2 and 2.4 km from their expected locations. Furthermore, the azimuth of error is very consistent, suggesting that further study should be applied to determine if it results from transformation errors in introducing the map data to the GIS environment.

Conclusions

Further investigation will be required to thoroughly assess the accuracy of the historical maps examined for this study, but it is apparent from this preliminary examination that the quality of Civil War mapping of Virginia's Shenandoah River was highly variable. Positional accuracy for Hotchkiss's and for Sigel's maps is fairly good; that for the 1861 Union triangulation survey and for the 1859 Böÿe map is fairly poor. Further study will further develop the quantitative and qualitative comparison of the historical study maps to USGS data, especially in terms of their utility in support of field operations in the Civil War military.

Works Cited

Hotchkiss, Jedediah, 1973. Make Me a Map of the Valley: The Civil War Service of Stonewall Jackson's Topographer. Ed. Archie MacDonald. Dallas: Southern Methodist UP.

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Roper, Peter W., 1992. Jedediah Hotchkiss: Rebel Mapmaker and Virginia Businessman. Shippensburg: White Mane.

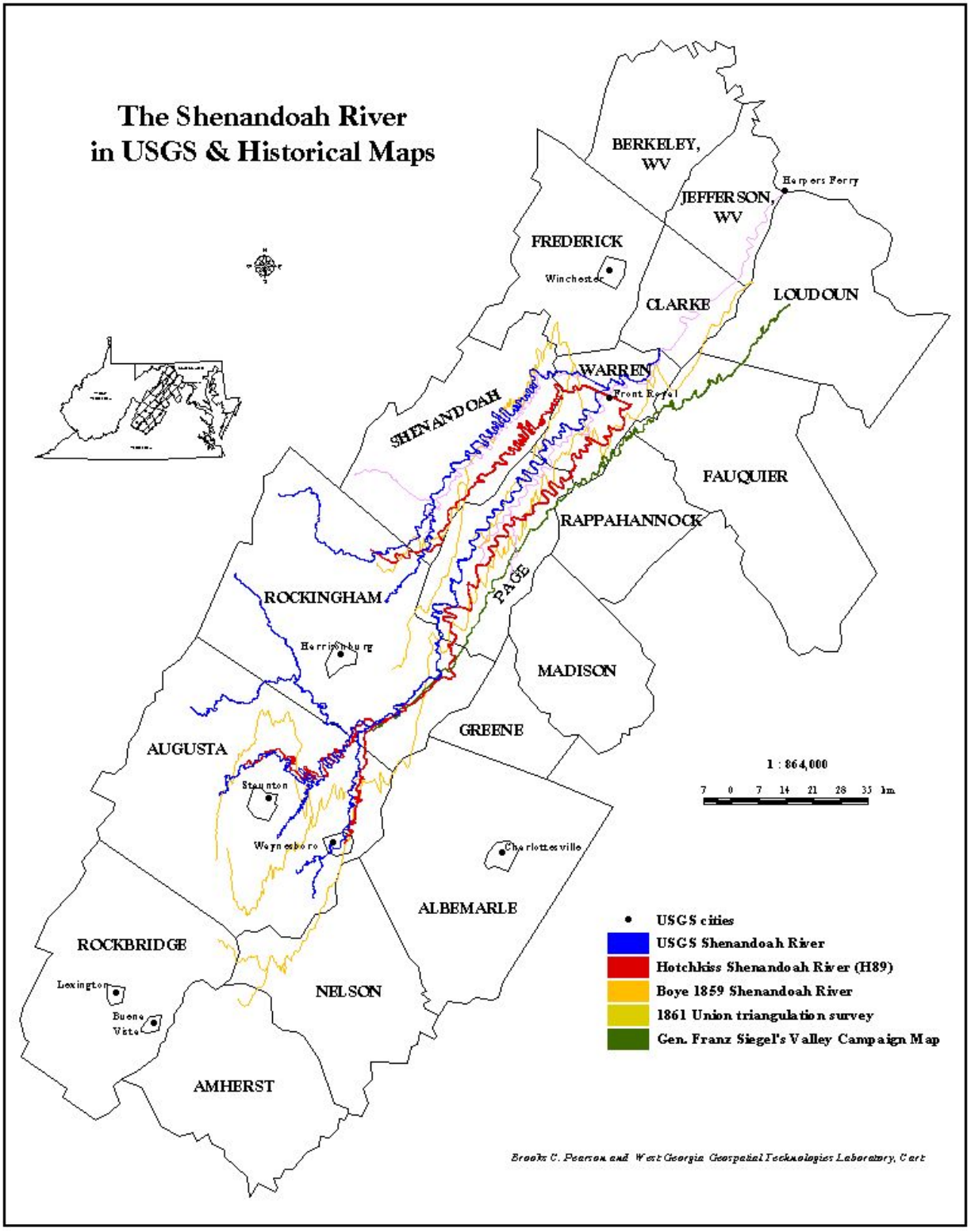
Stephenson, Richard W., 1989. Civil War Maps: An Annotated List of Maps and Atlases in the Library of Congress. 2nd ed. Washington: Library of Congress.

Table 1

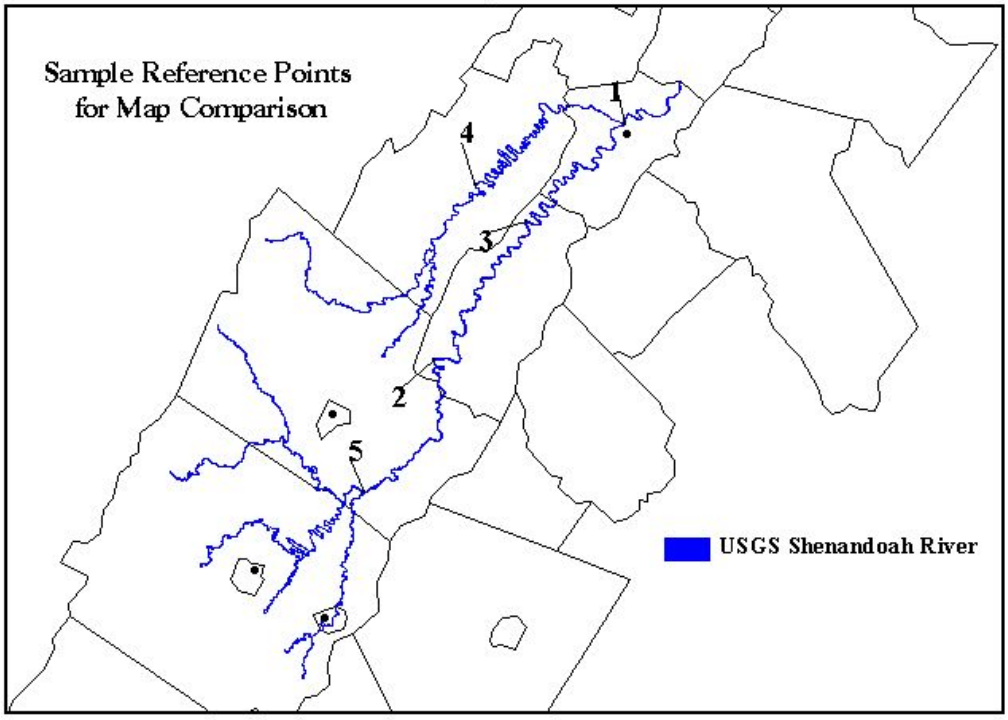
Control Point Locations on Historical Maps Compared to USGS Data

	Control Points				
USGS	***1***	***2***	***3***	***4***	***5***
absolute	78.19"W, 38.94"N	78.64"W, 38.53"N	78.42"W, 38.77"N	78.54"W, 38.84"N	78.81"W, 38.3"N
H89					
absolute	78.13"W, 38.91"N	78.61"W, 38.52"N	78.36"W, 38.75"N	78.46"W, 38.82"N	78.79"W, 38.3"N
distance	5,999 m	2,790 m	6,189 m	6,869 m	1,680 m
azimuth	130"	120"	115"	115"	70"
Sigel					
absolute	78.18"W, 38.94"N		78.4"W, 38.76"N	78.52"W, 38.84"N	
distance	1,159 m	n / a	2,443 m	1,394 m	n / a
azimuth	140"		130"	130"	
Triang.					
absolute	78.06"W, 38.9"N	78.56"W, 38.47"N	78.33"W, 38.73"N		78.81"W, 38.3"N
distance	11,859 m	10,260 m	10,068 m	n / a	1,149 m
azimuth	130"	140"	120"		130"
Böÿe					
absolute	78.24"W, 38.87"N	78.6"W, 38.47"N	78.38"W, 38.75"N	78.52"W, 38.84"N	78.95"W, 38.12"N
distance	9,436 m	7,069 m	5,535 m	1,775 m	23,040 m
azimuth	210"	185"	140"	125"	210"

Map 1


The Shenandoah River
in USGS & Historical Maps
BERKELEY, WV
JEFFERSON, WV
Harpers Ferry
FREDERICK
Winchester
CLARKE
LOUDOUN
WARREN
Front Royal
SHENANDOAH
FAUQUIER
RAPPAHANNOCK
PAGE
ROCKINGHAM
Harrisonburg
MADISON
GREENE
AUGUSTA
Staunton
Waynesboro
Charlottesville
ALBEMARLE
ROCKBRIDGE
Lexington
Buena Vista
NELSON
AMHERST
1 : 864,000
7 0 7 14 21 28 35 km
USGS cities
USGS Shenandoah River
Hotchkiss Shenandoah River (H89)
Boye 1859 Shenandoah River
1861 Union triangulation survey
Gen. Franz Siegel's Valley Campaign Map
Brooks C. Pearson and West Georgia Geospatial Technologies Laboratory, Cart

Map 2


Sample Reference Points
for Map Comparison
1
2
3
4
5
USGS Shenandoah River