

AN EXAMINATION OF STUART'S PROPOSED CAVALRY

CHARGE ON JULY 3, 1863—PART 1

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Friday, July 3, 1863, was the third and final day of fighting at the Battle of Gettysburg. While the Confederate assault known as Pickett's Charge assailed the Federal line from the west, a cavalry battle occurred three miles to the east. The engagement itself had no formal name at the time, but today it is known as the East Cavalry Battlefield (ECB). It is not connected to the main part of the national park and, consequently, receives far fewer visitors.

In general, the purpose of this cavalry attack, led by General James (JEB) Stuart, has been described in one of two ways:

1. protecting the left flank of the Army of Northern Virginia (ANV) while General George Pickett's Charge developed, being prepared to attack the Army of the Potomac (AOP) from the rear (east) if the opportunity arose, or

2. part of a grand plan of General Robert E. Lee, commanding, involving a coordinated attack on the Federal line from the west (Pickett), north (General Richard Ewell's Second Corps) and from the east (Stuart's Cavalry Division).

Lost Triumph: Lee's Real Plan at Gettysburg and Why It Failed (2005) by Tom Carhart, J.D., Ph.D., endorses the "grand plan" option, number two above. Although explained in more detail below, briefly, this proposal suggests that Pickett's Charge was not a haphazard tactical mistake of Lee's, but part of a three-part plan which failed. This book provides assertions to be examined in this paper relative to Carhart's proposed cavalry

charge on July 3. These assertions are summarized as required, but this paper will not serve as a book review. It is suggested that the reader refer to one of many web sites established for this purpose.

This paper will analyze the proposed attack from ECB to Culp's Hill in the following areas: 1) analysis of the number of mounted horsemen available for the attack, with theoretical models on how they might be deployed offered; 2) modern guidelines for equine exertion and what a historian today should consider; 3) topography and Federal forces along the route, within the limits of available maps; 4) discussion and conclusions. Contemporary maps, modern maps, and Geographic Information Systems (GIS) tools will be used, where apt. Unless otherwise indicated, all maps are oriented with North at the top. Results of the analysis herein will disagree with the assertions made by Carhart about this proposed charge.

However, some disclaimers are warranted. All discussion of generals in this paper is limited to facts and statistics. This paper will not "rate" generals and leaves that unnecessary task to others because the only substantive conduct is that *relative to the battle*. None of the points presented is intended to suggest that either side in that conflict was superior to the other: both North and South were part of the American culture. This paper never questions the incredible and inexhaustible courage and fortitude of the common soldiers who suffered, regardless of how their generals chose to fight battles.

BACKGROUND

By the beginning of June 1863, the Civil War was over two years old. Vicksburg, Mississippi, had been under siege by Federal forces under General Ulysses Grant for

approximately two weeks, and this required attention. Conventional wisdom has held that to take pressure from Vicksburg, General Lee was to take his Army of Northern Virginia north through Maryland into Pennsylvania to threaten its capitol, Harrisburg, and possibly Philadelphia, Baltimore, and Washington. The goal was to draw the Federal Army from Virginia and defeat it in a climactic battle in the North, the hope being that this would end the war. Behind the Blue Ridge Mountain, the Confederates would forage liberally on its march, paying for its booty with Confederate scrip.

The campaign north started in early June 1863. Shortly thereafter, Stuart's Cavalry Division was surprised by the Federal Cavalry Corps, which was on a reconnaissance mission near Brandy Station, Virginia. The ensuing battle lasted for most of the day and ended with an orderly withdrawal of the Union cavalry. Brandy Station, the largest cavalry battle in the Americas, was a watershed for the Federal cavalry in that the performance of its officers and men matched that of the Confederates for the first time in the war. Federal cavalry had orders to find the Confederate infantry and break up Stuart's cavalry. It tracked the Confederates, surprised them in the morning, mounted charge after charge, and withdrew in good order. Although the Federals technically lost, having left the field, the performance of the Federal cavalry bolstered its confidence in its ability to meet the Confederate cavalry on equal terms in the eastern theater.

Shortly after, the AOP started to move, maintaining an inner, concentric track to keep it between the ANV and Washington. Throughout the movement north, Stuart's cavalry fought many small engagements with Federal cavalry, whose mission was to find and track the Confederates and whose morale was increased by its performance at Brandy Station. At the end of June, Stuart and three brigades of his division departed on a

reconnaissance to locate the position of the Federal army and report this to Lee. This left four cavalry brigades guarding Lee's army directly. This mission would have kept him out of contact with the main army for a few days: this was expected. He was then supposed to guard the right flank of Ewell's Second Corps, the vanguard of the army.

Although Stuart left near the end of June, he arrived later than Lee expected and did not join the ANV until the afternoon of July 2, well into the second day of the battle. He brought Lee 125 captured wagons and Union prisoners, but no information. After crossing the Potomac River, Stuart found himself east of the AOP and was unable to move directly west through it to get to Lee, causing him to make a wide detour north around the Federals. His horsemen entered Gettysburg from Carlisle and met Ewell's Corps northeast of Gettysburg. Details of his excursion are not germane to this paper, but these facts seem evident:

1. Whether Lee gave Stuart discretion for the route, whether Stuart misunderstood his orders, or whether Stuart disobeyed his orders—all have their proponents and the issue is still debated. What is clear is that Stuart found the AOP between his brigades and the ANV, forcing him to go north to meet up with Ewell. For this paper, it is only important that Stuart arrived on the afternoon of July 2, too late to assist Lee with proper reconnaissance prior to the battle.

2. Stuart's delay, along with poor management of the remaining four cavalry brigades, resulted in Lee's being unaware of the location of the Federal Army. By June 28, when briefed by First Corps Commander General James Longstreet's spy Harrison, Lee first learned that the AOP was mere hours away rather than days as he had thought.

3. Stuart's men and horses were exhausted. For example, by the morning of July 1 in Dover, Pennsylvania, after a twenty-three-mile overnight ride from Hanover, "...his played-out horses went lame by the dozen even as their riders dozed in the saddle. Some of his men fell to the ground when their mounts stumbled or halted abruptly. A few troopers were so exhausted that even after striking the ground they went back to sleep."¹ A later section covers equine topics in more detail.

In *Lost Triumph*, Dr. Carhart claims that the key element of the third day's strategy was not the infantry assaults on Culp's Hill and Cemetery Ridge, but the cavalry attack three miles east of Gettysburg off the Hanover Road, ECB. Per his theory, Jeb Stuart's cavalry division was supposed to drive toward the Federal line from the rear (east) and overwhelm the Federal infantry, which was supposed to be reeling from Confederate infantry attacks on Culp's Hill and Cemetery Ridge. Repeated Federal cavalry attacks led by Generals David Gregg and George Custer prevented Stuart from accomplishing his mission, however, and the attack failed.

Describing Stuart's cavalry for this plan as a "high-speed, deep-strike force,"²

Carhart describes this proposed plan, for which no documentation exists, thus:

But to be sure the plan worked and the Union right wing would fall, Lee wanted Stuart to play the role of Fiorella at Castiglione and come up behind the Union right wing while it was being attacked from the front by Ewell. Lee told Stuart that timing was most important, that he had to let the attack mature until he got the signal from Lee. When that happened, he was to move down off Cress Ridge, follow Bonaughton Road to the Baltimore Pike, then turn right and race up to the rear of Culp's Hill.³

(Bonaughton Road appears also as "Bonnaughton Road" in some documents. For consistency, the spelling used in this paper follows Carhart. To complicate matters, the name of the modern town southeast of Gettysburg on the Hanover Road is Bonneauville.)

Per Carhart's map of the proposed route, when Stuart's force arrived behind Cemetery Ridge on the Baltimore Pike, it would split into two directions: west to attack the rear of the Federal line and north to attack the rear of Culp's Hill.⁴ Carhart refers to many battles that Lee might have used as models for this grand plan, one of which is the Battle of Castiglione in Italy. This was fought between the French Army under Napoleon Bonaparte and the Austrians in 1796. In that battle, however, the division led by General Pascal Fiorella was an infantry division, not cavalry.

Carhart also proposes an alternate plan, also for which no documentation exists:

If he was blocked by an infantry force, he could immediately move back up to York Pike and go a few ridges farther east, then come south all the way to the Baltimore Pike...But if this Union blocking force suddenly appeared when Stuart was supposed to be moving, after the end of the Confederate bombardment but before the Union artillery opened up on Pickett's men, then Stuart would have to try to go around the Union infantry and simply outrun them to the intersection of Hanover Road and Bonaughton Road.

If he was blocked by a cavalry force, that should prove a somewhat easier problem, since he would also have Jenkins's brigade with him. In the event that Stuart found his path blocked by a large force of blue horsemen, whether below Cress Ridge or even on Bonaughton Road, he should simply advance part of Jenkins's men, a force of mounted infantry, not cavalry. As they moved, Stuart should try to keep them out of Yankee sight if possible, until they reached a position between Gettysburg and the Union cavalry force. He would then have them dismount and form a north-south line, after which they would come out of cover, advance to the east, and take the Union cavalry force under fire. Facing that sort of surprise, no sane cavalry leader would stay in place while receiving rifle fire from a line of advancing infantrymen. Instead, they would simply use the mobility of their horses to ride out of range, probably off to the east.

But when that happened, Stuart's force would find itself between the Union cavalry and the battlefield, and it could no longer be stopped by them.⁵

Two things to note from these assertions:

1. Stuart *was* met by a cavalry force led by David Gregg and Custer, which stopped Stuart in his tracks, not exactly an "easier problem" as Carhart contends.

2. Carhart seems captivated with the presumed speed of Stuart's cavalry, using terms like "*race* up to the rear of Culp's Hill," "have to try to go around the Union infantry and simply *outrun* them," and "*high-speed*, deep-strike force." One question this paper will address is how fast cavalry could proceed on the proposed route.

The question of terrain is important, and Carhart mentions it often. His general description of the area states (italics added), "The Baltimore Pike comes up from the southeast well behind this picket line [ending near Wolf's Hill] and Culp's Hill, and it was the Union's supply route, the only *open door* into the federal rear area."⁶

A well-known author and student of cavalry actions at Gettysburg is Eric J. Wittenberg, J.D., who in 2002 published *Protecting the Flanks: The Battles for Brinkerhoff's Ridge and East Cavalry Field, Battle of Gettysburg, July 2-3, 1863*. In his 2013 update to this book, he added an Appendix C entitled "What was Jeb Stuart's Mission on July 3, 1863?" in which he disagrees with Carhart's hypothesis.⁷ In this, he states: "Any attacks against Culp's Hill would have been across the worst ground imaginable for cavalry operations—terrain described by Confederate staff officer Henry Kyd Douglas as 'that second Devil's Den.' No cavalry commander would have considered operating on that ground, especially one as capable as Jeb Stuart."⁸ And with this prompting from Wittenberg, this paper shall examine this ground to determine its potential to support such an attack

In prelude to the main discussion below, a bird's eye view of this area from the east should confirm this observation (Figure 1). This image captures the last leg of the proposed attack, that is up the Baltimore Pike to behind the Federal lines inside the top of the "fishhook." Although the area is covered with roads, it is punctuated throughout by

hills of considerable elevation and gradient. Based on the speed required for the proposed cavalry attack, these hills appear not to offer much in maneuver options.

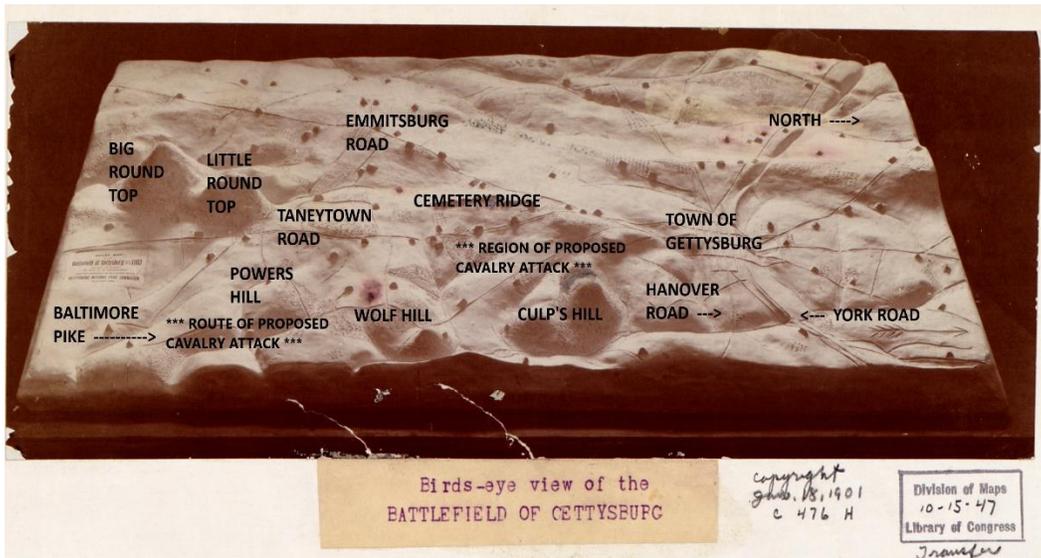


Figure 1. Aerial depiction of the Gettysburg area from the east. Photograph of a relief model entitled "Relief map of the battlefield of Gettysburg as it was in 1863." Library of Congress, accessed October 28, 2019, <https://www.loc.gov/item/2007630413/> ; also found on Wikimedia Commons at https://commons.wikimedia.org/wiki/File:Birds-eye_view_of_the_battlefield_of_Gettysburg_LOC_2007630413.jpg , search on 'Library of Congress Gettysburg map bird's eye view', go to Images tab.

THE METHOD

Dr. Carhart's proposed route is theoretical and is presented with full awareness that there is no documentation outlining the exact plan. In fact, Carhart spends nine pages explaining why he thinks that Lee suppressed any mention of the failed plan in official battle reports, i.e., to preserve the honor of his subordinates.⁹ Therefore, because Carhart's version of this plan is theoretical, then it should be acceptable for an examination of the plan's feature to use theoretical arguments supported by history and science, as needed.

The genesis of this paper was not to disprove Carhart, but to analyze his proposed route as to its efficacy; that it disagrees with Carhart is a result of the analysis only. This paper approaches Carhart's proposed cavalry charge through straightforward methods not appearing elsewhere, to wit:

1. Establishing a basis for analysis of the possible numbers of mounted troopers and the possible disposition of their column. These produce a basis for modeling theoretical speeds of the column. As will be seen in the next section, one cannot specify an exact or even an approximate number of mounted troopers or their disposition for the attack; therefore, the best course seemed to be a model that covers various combinations of numbers and column alignment.

2. A detailed list of horse management items geared specifically to the conditions of Stuart's cavalry on July 3, including water, food, horseshoes, load, climate, and terrain. These include both contemporary accounts and modern concepts of equine management.

3. Analysis of the roads for the proposed route of the Confederate cavalry. This includes usage of both contemporary maps and modern topographic maps of areas of interest on the Gettysburg battlefield. Where possible, modern GIS tools are used to highlight important features.

4. An accounting of Federal forces along Carhart's proposed route. This includes combat forces, supply units, ambulance wagons, stragglers, and prisoners-of-war.

FIRST THINGS FIRST: HOW MANY TROOPERS?

After an accounting of the number of men in each Confederate cavalry regiment, Carhart arrives at a total of approximately 6,000 for the four brigades (Wade Hampton,

Fitzhugh Lee, W.H.F. (Rooney) Lee, and Albert Jenkins), including artillery units.¹⁰ This number agrees with the estimates of Glenn Tucker (6,000) and Allen C. Guelzo (5,900)¹¹, but not with the estimates of other authors. Wittenberg claims that Stuart had only “perhaps 2,500 troopers on serviceable mounts.”¹² Scott Bowden and Bill Ward offer the numbers for each unit and arrive at a total of approximately 7,000, but state that their totals are from the start of the campaign (early June). They also state, “The three brigades (Hampton’s, Fitz Lee’s, and Rooney Lee’s under Chambliss) riding with Stuart during the time [of the] June 25 through July 2, 1863 raid suffered heavy losses, largely as a result of straggling.”¹³

Stephen Sears states the total in the three brigades as 4,800 of which 3,000 were engaged. He adds that Jenkins’s brigade adds only 430 to this total:

Stuart had three brigades—under Wade Hampton, Lee, and John Chambliss—that had ridden with him on their nine-day odyssey around the Army of the Potomac. By all accounts all three were much diminished in strength and perhaps even in spirit. The 2nd North Carolina, of Chambliss’s brigade, was down to 35 men from 145. The 9th Virginia of the same brigade, according to one of its officers, “was not more than one hundred strong, and the brigade could hardly have exceeded three hundred.” One of Chambliss’s troopers wrote that “No man can stand more, and I never wish to be called on to stand this much again. I had one horse killed under me and rode three others down.” The men were bone-weary and so were their horses, and neither were primed for a battle royal.¹⁴

Finally, in his official report on the battle, Stuart wrote:

I still believed that most of our army was before Harrisburg, and justly regarded a march to Carlisle as the most likely to place me in communication with the main army. Besides, as a place for rationing my command, now entirely out, I believed it desirable. The cavalry suffered much in this march, day and night, from loss of sleep, and the horses from fatigue, and, while in Fairfax, for want of forage, not even grass being attainable.

In Fauquier [Virginia], the rough character of the roads and lack of facilities for shoeing, added to the casualties of every day's battle and constant wear and tear of man and horse, reduced the command very much in numbers. In this way some regiments were reduced to less than 100 men...¹⁵

Stuart did not indicate how many of his regiments had diminished to less than 100 men, but did state that his command was reduced “very much in numbers.” The three brigades with him in his ride (Hampton, Fitzhugh Lee, and Chambliss (in command for Rooney Lee, who was wounded at Brandy Station in early June)) contained a total of 16 regiments. Per his battle report, “the cavalry” suffered in the march, not just part of it. This means that if some regiments were down to 100 troopers, then others were significantly diminished, lowering his total to some number less than 6,000. In “Inclosure [sic] 1” to his report, Stuart details his battle losses (killed, wounded, missing) for the campaign. For the three brigades listed above, these losses up to and including July 2 total 369 officers and men. Assuming he started with 6,000 men, this constituted five percent (5%) of his force. His report offers no numerical data on the number of exhausted men or on how many horses were lost either to action, sickness, or exhaustion.

It is also unclear how reduced Jenkins’s brigade (under the command of Lieutenant Colonel Vincent Witcher owing to the wounding of Jenkins on July 2) was, but per Stuart’s report in the third day’s cavalry battle, it “was chiefly employed dismounted, and fought with decided effect until the ten rounds were expended, and then retreated, under circumstances of difficulty and exposure which entailed the loss of valuable men.”¹⁶ In 1899, Witcher, commander of the 34th Virginia Battalion and apparently in temporary command of the brigade, wrote in a letter to a newspaper editor that his unit (Jenkins’s Brigade) numbered 432 men at the start of the battle on July 3.¹⁷ Dismounted and out of ammunition, they should not be counted in the total number of troopers available for Carhart’s attack.

A look at documented Federal horse status is helpful at this point. As part of the Chancellorsville campaign in May 1863, General George Stoneman, Commander of the Cavalry Corps, was to take the corps deep behind Lee's lines and destroy railroads and supplies. However, the corps became bogged down at river crossings and accomplished little offering, no support to the main battle between the AOP and the ANV. After the Federal defeat, army commander General Joseph Hooker relieved Stoneman and replaced him with General Alfred Pleasonton. The latter's report to General Seth Williams, AOP Adjutant-General, upon taking inventory of his command indicates the effect on horses of a hard campaign lasting almost two weeks (*italics added*):

Headquarters Cavalry Corps, Army of the Potomac

May 27, 1863

Brigadier General S. Williams,
Adjutant-General, Army of the Potomac:

GENERAL: I assumed command of this corps on the 22nd instant, relieving Major General Stoneman, and I desire to submit to the major-general commanding the Army of the Potomac the condition of the cavalry as it comes under my command:

First Division, late my own command: First Brigade, 1,546 serviceable horses, 371 unserviceable; Second Brigade, 1,228 serviceable horses, 364 unserviceable.

Second Division, Colonel Duffe commanding.

Third Division, Brigadier General Gregg commanding.

Of these two divisions, General Gregg reports "that a close inspection of the horses of these two divisions" on the 31st ultimo will show one-half of the whole number of horses unfit for "active offensive operations." The average of each of these divisions is about 3,000 men; consequently, the two have only about that number fit for service.

The Reserve Brigade, under Brigadier General Buford, is reported as follows: "There are 549 horses in the command" that cannot be recruited in a month. It will require 1,396 horses to "mount the whole command." This brigade on the last of March had 2,226 serviceable horses. The difference leaves only 830 horses fit for service at this time.

RECAPITULATION

Serviceable horses:

First Division.....	2,774
Second Division.....	1,212
Third Division.....	1,861
Reserve Brigade.....	<u>830</u>
	6,677
Deduct Kilpatrick's force and detachments, say.....	<u>2,000</u>
Effective strength.....	4,677

The effective strength of the corps by the March return was upward of 12,000 men and horses. It is now only *one-third* of that strength, and, so far as I can ascertain, is not fitted to take the field.

In taking this command, I cannot do myself such an injustice as to remain silent as to the unsatisfactory condition in which I find this corps. I shall use every exertion to bring it to a state of efficiency at the earliest possible moment, but the responsibility of its present state, it is proper the major-general should know, does not belong to me.

I am, general, very respectfully, your obedient servant,

A. PLEASONTON
*Brigadier General, Commanding Cavalry Corps*¹⁸

After two weeks of hard campaigning, only one-third of 12,000 horses are fit for duty. It should be noted that in Pleasonton's "Recapitulation" above, the brigade in the worst shape with only 830 horses is the Reserve Brigade. Per the Federal order of battle for Chancellorsville, this was the only brigade in the entire cavalry corps with regular regiments with five of six regiments being regulars. Its commander was General John Buford, one of the best cavalry commanders in the AOP.¹⁹ If his brigade of regulars was worn out, then it stands to reason that the Confederates would have been equally worn out by July 3.

Therefore, it is safe and reasonable to assume that Confederate horses would be affected similarly by a rough campaign: assuming otherwise flouts common sense and the science of animal husbandry. Although weather is covered in detail in a later section, it is

important to note that the Stoneman campaign occurred in late April and early May when the temperature was much cooler than late June and early July.

Thus, there is disagreement among historians and authors on the number of *mounted* Confederate troopers in the attack on July 3. Because the cavalry commanders maintained no daily records of manpower during their ride around the Union army, these numbers will probably never be known accurately. As noted above, after the intensive week-long ride, both troopers and horses were exhausted. This is well documented and accepted: what is not agreed upon is the effect this exhaustion had on Stuart's numbers. There is a large discrepancy between 6,000 horseman and 2,500, and if scholars cannot agree on the number, this paper is not the place to make that determination.

Equally important as the number of troopers is how long is the column they produce, which Dr. Carhart does not specify. Because the proposed route is along a country road, the number of troopers on the roads is important for analysis of the terrain. The following parameters are used in the analysis:

1. Because the total number is open to question, for computations involving Stuart's numbers, three values will be used: 2,000, 4,000, and 6,000 (minimum, average, maximum).

2. Each horse is allowed 16 linear feet along the road, a distance allowing for the length of the horse (8 feet) and for spacing between lines of horsemen (8 ft). Eight feet for the length of the horse is consistent with the value of 7 feet 8 inches used by the United States Forest Service in designing horse trails.²⁰ Rounding up to eight feet is enough for this analysis because it simplifies computations, and detracts nothing from the results. This measurement is also in line with an 1862 United States Army cavalry manual, which

specifies a horse's length at three yards long and that when forming, each horse will halt one horse's length behind the one in front (another three yards).²¹ This system allocates to each horse six yards, or 18 feet, in formation. The value of 16 linear feet in this paper conforms to this.

3. Computations of cavalry along roads will be performed as columns of two's, three's, and four's, allowing for the possible widths of a road. Note that the same 1862 cavalry manual specifies a horse's breadth (width) as one yard.²² The Forest Service manual also suggests on the same diagram a width per horse and rider at four feet. The analysis in this paper does not require horse width because the column sizes (two's, three's, and four's) compensates for this versus the assumed width of the roads and subsumes any consequence from horse width.

4. These computations ignore spacing between companies and regiments for simplicity, and they exclude artillery and wagons (and are therefore labeled as "Theoretical"), but they should provide a suitable range of results as a baseline against which to judge the effect of terrain and road conditions. To be clear, this is *not* a tactical formation. A tactical column would have vedettes ahead, squadrons or regiments on the flanks, and a rear guard. For tactical purposes, between each squadron there would be extra spacing, and between each regiment and brigade. As stated, the computations model a theoretical formation solely for uniformity and simplicity.

An example computation follows with all results rounded to one decimal place:

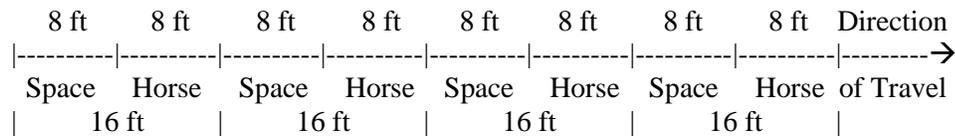
Step 1. For 6,000 mounted troopers in columns of four:

Number of rows of troopers = $6,000 \div 4 = 1,500$

Visually, this produces:

Row	1500	1499	1498	-----	3	2	1	
	Horse	Horse	Horse	-----	Horse	Horse	Horse	Direction
	Horse	Horse	Horse	-----	Horse	Horse	Horse	----->
	Horse	Horse	Horse	-----	Horse	Horse	Horse	of Travel
	Horse	Horse	Horse	-----	Horse	Horse	Horse	

Step 2. Assume a length allowance of 16 feet parallel to the road. This includes eight feet each for the horse and the space between each row of horses. These spacings produce the following diagram:



Step 3. Each row of horses takes up 16 ft of linear distance along the road; thus:

$$\text{Total distance for column} = 1,500 \times 16 = 24,000 \text{ ft}$$

Step 4. Using 5,280 ft/mile, the conversion is:

$$\text{Total distance for column} = 24,000 \div 5,280 = 4.5 \text{ miles}$$

Step 5. Show that the assignment of the rounded value of eight feet per horse is valid (rather than the 7 ft 8 in specified by the Forest Service) for this example computation:

$$1,500 \times 4 \text{ in} = 6,000 \text{ in for all rows of troopers}$$

$$\text{In feet, } (6,000 \text{ in}) \div (12 \text{ in/ft}) = 500 \text{ ft}$$

$$\text{In miles, } (500 \text{ ft}) \div (5,280 \text{ ft/mi}) = 0.09 \text{ miles.}$$

$$\text{Percent of total distance} = (0.09 \text{ mi} / 4.5 \text{ miles}) \times 100\% = 2 \%$$

Thus, the omission of four inches per horse results in a difference of two percent, and this may be ignored for the exercise herein.

The computation for the parameters indicated above produces the column lengths in Table 1:

Table 1. Length of Theoretical Cavalry Column Based on Number of Troopers and Column Size			
Number of Mounted Troopers	Column of 2 (Miles)	Column of 3 (Miles)	Column of 4 (Miles)
2,000	3.0	2.0	1.5
4,000	6.1	4.0	3.0
6,000	9.1	6.0	4.5

Table 1. Length of Theoretical Cavalry Column Based on Number of Troopers and Column Size. For simplicity, computations ignore spacing between companies and regiments.

The reason for theoretical computations is simple: Modern roads can easily fool modern observers. The modern two-lane roads in the Gettysburg area are deceiving because they are much upgraded over their condition in 1863.²³ It is important that the modern observer not be lured into thinking that the roads today are representative of their condition during the battle, either in width or surface. The hard “improved” roads of the 19th century were composed of packed crushed stones (a macadam road, named after John McAdam), and not paved as in the modern sense with asphalt or concrete. This is because horses require elastic footing.²⁴ Those roads were unpaved and narrow compared to modern roads, and they would not have been so neatly graded to modern standards. In addition, those nice, wide bridges over creeks today might not have existed, meaning that crossings over streams would have been necessary.

Contemporary maps of Adams County (as close as possible to 1863) show that most of these roads were simple farm roads and not suitable for high-speed, galloping cavalry. Photographs, both contemporary and modern, bear this out. Examples will appear in the discussion along the route below.

The range of values for the number of mounted troopers produces certain effects by inspection. Any proposed cavalry muster, travel, and attack on the roads in question must address these items:

1. The larger the number of troopers, the more combat power it contains. This is a direct proportion.
2. The larger the number of troopers, the less maneuverable it is, especially in an area constrained by country farm roads. This is an inverse proportion.

These relationships are shown in this schematic (Figure 2):

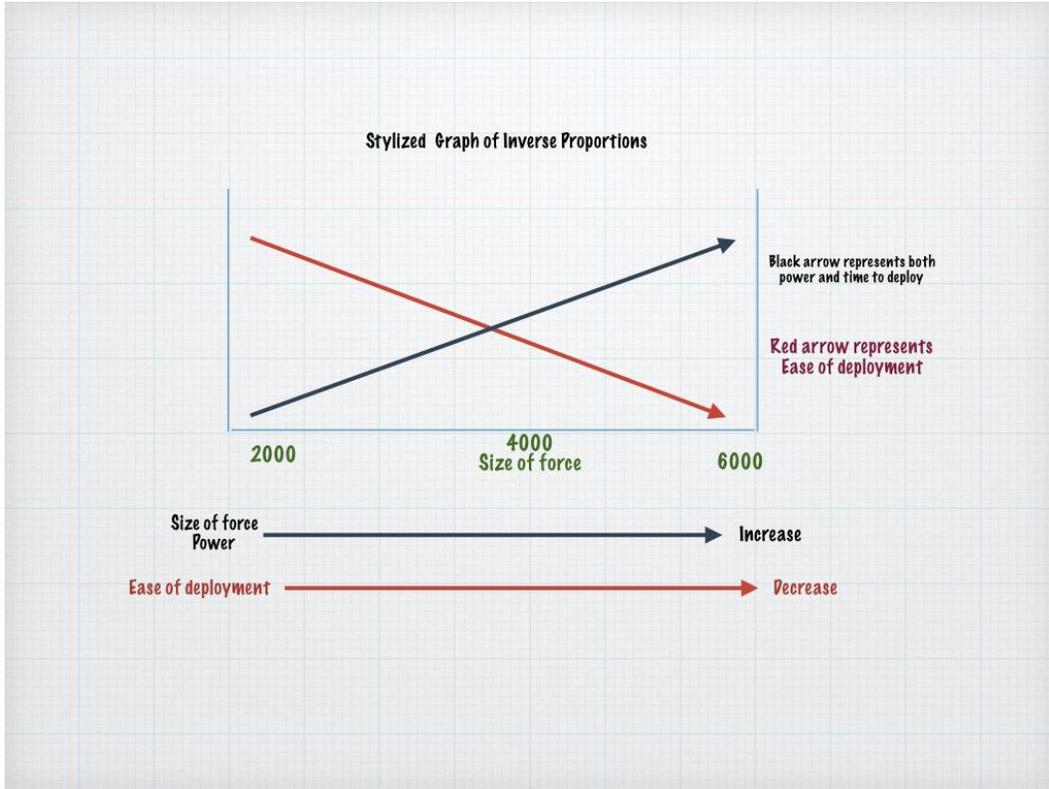


Figure 2. Stylized Graph of Inverse Proportions. This schematic illustrates the effect of a higher number on the power of a force and on its ease of deployment.

3. A longer column will also increase the time and potential space for any Federal response.

In general, a smaller force can deploy more rapidly and require less area to deploy as a unit than a larger unit. As the unit size increases, the resulting column becomes longer and less maneuverable. It takes longer to travel the roads and get into position. Depending on where Stuart's force exits roads to attack the Federals, there might not be enough area

to get into position quickly. Another consideration is that soldiers need not stick to a road in traversing the countryside. Both infantry and cavalry can go off road and walk in the fields along the roads: mounted cavalry of course can do this more quickly than infantry.²⁵

A final consideration in discussing the route and its effect on quick transport of hundreds of troopers is the Pennsylvania Dutch fence, more accurately, the post-and-rail fence and the worm fence. Their effect on July 3 during Pickett's Charge is well-documented: Confederate columns were halted at the Emmitsburg Road by fences on both sides that were too strong to tear down under fire. Instead, soldiers had to climb over them well within range of Federal rifles. Little known are Reynolds's orders on July 1. He first ordered his escort to tear down fences near the Codori House to make way for his men to get to the Seminary; later, he ordered pioneers forward to assist them in tearing down the fences. There were so many fences that men from the 76th New York, the lead regiment of Cutler's Brigade of the First Division, I Corps, were ordered to assist the pioneers in opening the fence lines.²⁶

An article in the Southern Historical Society Papers by General Lafayette McLaws, First Corps division commander, offers this view from the countermarch of his division prior to the attack on July 2:

After very considerable difficulty, owing to the rough character of the country in places and the fences and ditches we had to cross, the countermarch was effected, and my troops were moving easily forward along a road with fences on the side not giving room enough for a company front, making it necessary to break files to the rear...six thousand men standing in line would occupy over a mile, and in marching in the manner and over the roads we came they would extend a mile and a half. So you will perceive that to form line of battle by directing troops across the country broken by fences and ditches requires considerable time, and it was difficult, from the same causes, to get the artillery in position.²⁷

General Cadmus Wilcox, Third Corps brigade commander, recorded this about its advance on the same day: “In order that I should advance with those on my right, it became necessary for me to move off by the left flank, so as to uncover the ground over which they had to advance. This was done as rapidly as the nature of the ground, with its opposing obstacles, stone and plank fences, would admit.”²⁸

The effort involved in razing these fences appears to indicate that they were plentiful and sturdy (and probably post-and-rail), a severe impediment for quick movement and a dashing cavalry charge. In fact, during the real battle that occurred on ECB, both sides were stopped by fences, and these became battle lines for both mounted and dismounted troopers.²⁹ Witcher describes visiting the battlefield shortly after with Stuart and “saw where the Fifth Michigan charged us, and where we fought over the fence.”³⁰

Peter Blauner, VMD, an equine veterinarian, offers this view on the number of horses able to participate:

The question: Is it realistic for cavalry horses that have just completed a 9 day 150 +/- mile journey involving several skirmishes and limited food and husbandry, to cover 5 miles at speed on difficult terrain in dangerous weather and be fit to fight?

The short answer: An elite horse and rider could do it. With 2000 or 6000 horses to choose from perhaps there would be a dozen or three. The average troop horse/recently acquired farm horse with an average rider would more likely become a casualty before engaging the opponent.³¹

All of these aspects should be accounted for when offering a proposed attack for Stuart’s cavalry division.

THE HORSE (OF COURSE, OF COURSE)

It goes without saying that the horse is an important element of cavalry operations at Gettysburg; however, the proper care and feeding of these wonderful animals is not discussed much in the Gettysburg historiography. In fact, one would be hard-pressed to find a Civil War book offering details about equine care or weather effects as is found below. Without understanding the principles of caring for a horse, one cannot understand the equine parts of the campaign. This section will try to explain this.

Unlike today, the horse in 1863 was an integral part of the culture, and the principles and methods of caring for a horse were as common then as do-it-yourself auto mechanics today. The foot soldier tended to his own needs, but the horse soldier must also respond to the needs of his mount. Caring for a horse is a lot of work: feeding, resting, watering, brushing, shoeing, and so forth, all take time. The trooper was aware that he had to tend to his horse first at every opportunity, even at the expense of his own comfort.

A critical detail for cavalry plans (and for this paper) is the speed with which the cavalry columns listed in Table 1 could travel and the duration of the expedition. The time to travel the proposed route is based on the speed of the column. Four basic equine gaits are recognized today:

Walk	= 2.5 to 4 miles/hour (mph)
Trot	= 4 to 8 mph
Canter (Lope)	= 12 to 15 mph
Gallop	= 20 to 30 mph ³²

These numbers may be compared to those in an 1862 United States Army guide for staff officers, which states, “a man in quick time will make approximately 100 yards a

minute; in the same time a horse will walk approximately the same distance; at a trot approximately 200 yards, at a gallop around 400 yards.”³³ Converting these parameters to miles per hour gives the following values:

Walk	= 3.4 mph
Trot	= 6.8 mph
Canter (Lope)	= not included
Gallop	= 13.6 mph

There appears to be agreement in the two sets between walk and trot, but canter and gallop present a problem. Dr. Carhart often uses the verb “gallop” to describe Stuart’s proposed ride, but does not define its speed. And there is considerable difference between the contemporary and modern definitions for that term. For simplicity, a gallop will mean in this paper a speed greater than 15 mph. Per Dr. Blauner:

Current usage of canter and gallop is different than in 1862. At that time the “running” gait of the horse was called a gallop. Canter was little used and mostly applied to formal high school riding. In 1872 Edward Muybridge took picture sequences that for the first time showed that at speed the diagonal phase of the 3 beat canter disassociated and became the 4 beat gallop. Gallop in the 1862 army guide would have been a running gait that the horse could reasonably be expected to maintain and 13.6 mph is in line with that.³⁴

A healthy horse can cover 32 miles in 8 hours³⁵, presumably on relatively level ground, but it was doubtful that Stuart’s column would simply *walk* around the battlefield on horseback to reach its objective north of Powers Hill. It is doubtful that his horses could gallop for the entire length because the most a well-conditioned horse can gallop at full speed is two to three miles³⁶ and Confederate horses that day were not in the best of shape from Stuart’s own words. Whereas it is true that in 1860 to 1861, the Pony Express had averaged 9 to 10 mph over 15- to 25-mile stages, horses were changed at each stage.³⁷ And

those horses were rested and cared for much better than Stuart's had been in the week prior to the battle.

Per Dr. Blauner:

Average speed of a horse has a number of variables. Individuals vary widely. I have one horse that couldn't run 20 mph chased by a flamethrower. I have one that could run 30 mph for a hundred yards. I have one that could run 30 mph for 5 minutes, on a suitable surface, with no ill effects. No horse can gallop at full speed for long – mostly just to outrun an imminent threat. Even in the Kentucky Derby the last furlong is always the fastest. Part of the art of racing is knowing how long to “save” your horse and when to “make your move.”³⁸

Three circumstances support the spent condition of Stuart's horses. The first is from accounts of Confederate troopers on the march around the AOP. For instance, Lt. George W. Beale of the 9th Virginia Cavalry, wrote in a letter home about the mindset of these exhausted troopers at Carlisle:

Weak and helpless as we now were, our anxiety and uneasiness was painful indeed. Thoughts of saving the wagons now, were gone, and we began to consider how we, ourselves, might escape; but this was not so with that "lady's man," Stuart. He seemed neither to suppose that his train was in danger, or that his men were not in condition to fight.... Most of us were kept in our saddles to fight till 12 o'clock-though neither the prospect of a melee, nor the thunder of artillery, nor the bright red glare of a burning town, "in the enemy's country," kept me awake that night.³⁹

This account of the campaign is from the diary of a Lieutenant Holtzman of the 4th Virginia Cavalry:

June 30. We marched all night. Amusing time to see the boys lose their horses and hats.

July 2. This makes the fifth night without sleep with the exception of four hours. Traveling all the time.

July 3. (At Gettysburg). Only some twenty men with Company “D” out of fifty-six who started. Our raid is at an end. It makes ten days.

July 4. All seems to be quiet this morning. The first night's sleep to our division for eight nights.⁴⁰

The second circumstance is the condition of the horses (and troopers) in the Federal cavalry traveling the same areas under similar conditions. Prior to the battle, men of the 2nd Cavalry Division, AOP, documented their ordeal:

Wrote Pennsylvania Captain David M. Gilmore about the division's journey to Gettysburg: "think of three weeks marching over hot, dusty roads without regular rest or rations, under constant mental and physical strain, without a wash or change of clothing, and you have some idea of the exhausted condition of men and horses." Lt. Rawle Brooke of Gilmore's regiment added that "the intense heat at times was almost unbearable, the dust almost impenetrable. Horses by the scores fell from exhaustion along the road.... Officers and men, begrimed past recognition, tramped along on foot, leading their worn out horses to save their strength, well knowing how much depended upon it. Dismounted cavalymen, whose horses had fallen dead or dying, struggled along, some carrying their saddles and bridles in hopes of being able to beg, borrow, or help themselves to fresh mounts, others without anything but their arms."⁴¹

That was their condition on July 1 when General David Gregg's division entered Hanover Junction, Pennsylvania, around two p.m.

Also, Buford received approval to leave the area on July 2 for Taneytown and thence to the supply base at Westminster to rest and refit his horses. Buford's First Cavalry Division had been on the move since late June and had started the battle on July 1. His human losses were relatively light after that fight, and his men were tired, but his horses were exhausted. One can infer that Stuart's horses, having traveled a longer distance over the same period, were at least equally spent.

The third circumstance is Stuart's official report on the battle, which contains many references to the condition and care of his mounts. About June 26, he wrote, "We marched through Brentsville [Virginia] to the vicinity of Wolf Run Shoals [on the Occoquan River, Virginia], and had to halt again in order to graze our horses, which hard marching without grain was fast breaking down." For June 29, he wrote, "Here, for the first time since

leaving Rector's Cross-Roads [Virginia], we obtained a full supply of forage, but the delay and difficulty of procuring it kept many of the men up all night.” And for June 30, “The night's march over a very dark road was one of peculiar hardship, owing to loss of rest to both man and horse. After a series of exciting combats and night marches, it was a severe tax to their endurance. Whole regiments slept in the saddle, their faithful animals keeping the road unguided. In some instances, they fell from their horses, overcome with physical fatigue and sleepiness.”⁴² It seems clear from Stuart’s report that his horses were under considerable strain. One wonders if the series of battles on the 30th were “exciting” for the horses as well.

Stuart wrote of the cavalry battle on July 3, with characteristic bombast (italics added):

In these charges, *the impetuosity of those gallant fellows, after two weeks of hard marching and hard fighting on short rations*, was not only extraordinary, but irresistible. The enemy's masses vanished before them like grain before the scythe, and that regiment elicited the admiration of every beholder, and eclipsed the many laurels already won by its gallant veterans. Their impetuosity carried them too far, *and the charge being very much prolonged, their horses, already jaded by hard marching, failed under it*. Their movement was too rapid to be stopped by couriers, and the enemy perceiving it, were turning upon them with *fresh horses*.

The enemy's loss was unmistakably heavy; numbers not known. Many of his killed and wounded fell into our hands. [Stuart discusses his casualties including specific officers wounded or killed.]

Notwithstanding the favorable results obtained, I would have preferred a different method of attack, as already indicated...⁴³

Stuart’s “favorable result” was that he was stopped by Federal cavalry. Losses on both sides were relatively light with each side incurring fewer than 300 casualties, quite the opposite of his “unmistakably heavy” Federal loss. Given that the mounts of the opposing Federals had been on the road as long as Stuart’s, his reference to their “fresh” horses might

have seemed so owing to the poor condition of his own mounts: perhaps “fresher” horses would have been more apt.

More important are his comments about his men and his horses. His troopers were “gallant” and “impetuous,” but his horses were “jaded by hard marching” and failed under the charge. These descriptors reveal that his men were determined to attack, but the horses could not. This is an important distinction that is rarely highlighted, that is, a human can use willpower to overcome adversity, as did Stuart’s troopers (and many other soldiers in that war), but an animal is governed by instinct. Thus, a man knows with pride that he is part of Stuart’s cavalry and might act accordingly, but a horse does not know that it is part of Stuart’s cavalry: it just knows that it can go no longer. Care must be taken in describing Stuart’s attack to distinguish between a human’s persistent resolve and a horse’s instinct.

Stuart was not the only Confederate to note the weather’s severity. Although not from cavalry, comments such as these offer confirmation to Stuart’s observations:

“Having become exhausted from fatigue and the excessive heat of the day...”
COL Oates, 15th AL, OR, p. 393

“The scene of action was reached by a march of several miles under a broiling sun...” COL White, 7th GA, OR, p. 396

“The scene of action was reached by a march of several miles under a burning sun...” MAJ McDaniel, 11th GA, OR, p. 401

“Not withstanding [*sic*] the extreme heat and the fatiguing march...” LTC Shepherd, 2d GA, OR, p. 420

“Owing to the excessive heat, dry weather, and dust, the march was a severe one...”
MAJ Eshleman, Wash Arty, OR, p. 433

SOURCE: Official Records of the Union and Confederate Armies...⁴⁴

The speed and distance a horse can reach and maintain are based on several elements: health, climate, load, and terrain, to name a few. It is unknown what guidelines were followed in 1863, but horses on both sides suffered during the marches of their armies. Modern references for the care of horses can give an idea of what equine performance requires:

1. *Water.* An average horse requires approximately 5 to 15 gallons of water per day depending on its body weight and weather. After only two days without adequate water, a horse might start to show signs of colic, diarrhea, dehydration, or other life-threatening ailments. If the horse eats from fresh pastures, it might consume much of its water from the grass, but water consumption should still be monitored. Dehydration can lead to the loss of electrolytes (which include minerals sodium, chloride, and potassium), that can be especially deleterious in hot, humid weather.⁴⁵

Per Dr. Blauner:

Food and water are critical. Unfortunately, daily chores were probably not important enough to rate diary entries or letters. As a 21st century horseman, I cannot imagine getting adequate fresh water to 2000 horses. Horses' hooves churn up stream banks and bottoms. The first few get a good drink but the last in get mud. How often did they have an opportunity to drink? A horse in work in hot weather will drink 15-20 gallons a day. But their stomach only holds about two gallons at a time. Horses lose more electrolytes in their sweat than humans and when dehydrated can actually lose their desire to drink. Longer term dehydration leads to a cascade of physiologic problems that manifest as a physical inability of the muscles to function. Likely this was a primary cause for the horses that fell from exhaustion.⁴⁶

2. *Feed.* An average horse requires approximately 15 to 25 pounds of feed per day depending on its body weight: much of this should be roughage such as hay, even if grain is plentiful. A horse needs to eat throughout the day to maintain a continual flow of roughage through its digestive system.⁴⁷ Stuart's cavalry force arrived in the Gettysburg

area on the evening of July 2 and presumably the horses would have been fed, watered, and groomed between then and the next afternoon when the proposed cavalry charge would have begun. However, it is unclear how much feed they received.

It seems that some (the number is not recorded) of the 125 wagons captured outside of Rockville on June 28 contained grain for the horses. This was significant because high-energy, quick-feeding grain was more efficient than grazing. "Capt. William W. Blackford's comments are especially informative here: 'Here was a godsend for our poor horses, for every wagon was loaded with oats intended for Meade's army and it did one's heart good to see the way the poor brutes got on the outside of those oats.' Grain could be fed rapidly, and a pound of grain was worth several times the nutritional value of a pound of fodder gained from grazing."⁴⁸ Whether these wagons were a detriment to Stuart because of their slower speed or a bonus owing to the grain is beyond the scope of this paper. The question of how much of this grain was available on July 2 and 3 for Stuart's horses is unknown.

Per Dr. Blauner:

What were they eating? Horses only have one stomach (unlike cows and goats) and must grind their food thoroughly with their teeth. They eat slowly. Available forage in late June was likely to be tall and coarse and low in nutrition. My horses eat 10-20lbs of high quality baled hay per day. (In addition to pasture and grain) But balers didn't come along until the 1930's. Any transported forage would have to be cut by hand and carried loose in a cart. The captured grain may have done more harm than good. How many pounds could have been available for use – assuming some was taken to Lee? And any grain could have been used to feed men as well. 2000 horses, 5lbs each is 10,000 lbs. That's a lot of grain but not many calories/horse. A single 5 lb. feeding of oats to a horse unused to grain would be like giving one of the troopers a single Big Mac. It tastes good going down but has little impact on long term calorie deficit and causes significant gastrointestinal disturbance.⁴⁹

3. *Horseshoes*. The reader is invited to search the Internet for ‘For want of a nail origin’. Different sources trace it back to the 13th or 14th centuries, indicating that horseshoes and nails were important that far back.

It is unclear when Stuart’s farriers had time to shoe his horses or even if or how many farriers he brought with him on his reconnaissance. What is clear is that the condition of horseshoes was important to him. For instance, Stuart’s June 24 orders to General Jerome Robertson, one of his brigade commanders, stated, “Avail yourself of every means in your power to increase the efficiency of your command, and keep it up to the highest number possible. Particular attention will be paid to shoeing horses, and to marching off the turnpike.”⁵⁰ The statements show not only Stuart’s concern that his subordinate follow good equine management, but that improved roads (in 1863) were damaging to horseshoes and unshod horses could quickly become useless to his force.

How important were horseshoes? A generous supply of properly shod horses was a major concern of United States Army Quartermaster General Montgomery Meigs. The Union, of course, had far more resources than the South, but the requirement for shod horses could not be ignored:

On 16 June Meigs ordered Rucker to shod as many horses as possible and have them ready for issue to the AoP. He also sent messages off to New York, Philadelphia, and Indianapolis for them to ship horses to Alexandria as rapidly as possible and to continue until he ordered otherwise.⁵¹

(...)

Immediately after the battle, Meigs directed the Baltimore Depot to halt all through shipments of horses on 4 July and move them to Frederick, MD. By 6 July, there were over 5,000 horses on the way from New York, Philadelphia, Baltimore, Harrisburg, Indianapolis, Detroit, and Chicago.⁵²

Another question that arises is even if the Confederates had tried to keep their horses shod, would they have had enough farriers or time to do it? Dr. Blauner, who is also a certified farrier, offers this assessment:

Keeping shoes on horses is essential for maximizing their utility. Google ‘Cross section horse’s hoof’. You will see the hard outer surface of the hoof (hoof wall) is thin. The hoof wall bears the majority of the horse’s weight. Within the hoof the coffin bone is suspended and connected to the wall by the laminae. The sole of the hoof protects the bottom. A shoe protects the sole from bruising by lifting it slightly off the ground and it protects the hoof wall from wear. A bare hoof over rough ground will become broken up and the weight of the horse will be borne on the sole causing lameness. The hoof wall grows slowly, taking 9-12 months to grow out from top to bottom. The horseshoe nails must go in the wall. A nail that extends too far in is extremely painful and can lead to infection in the hoof.

Some of the troopers could probably shoe their own horses but it is a specialized skill. There must be nails, bar stock, tools and a forge. One imagines there were some shoes pre-made but it still required time and stock at the supply end. Also, the more damaged the hoof wall is, the more difficult it is to apply a shoe comfortably and securely. With modern machine made nails and good tools and a set of shoes that fit the horse prepared, it takes a farrier about 30 minutes to shoe a horse. Making 4 shoes from scratch another hour plus. Tacking on a shoe quick can be done in 5 minutes. If you have the shoe and nails and an appropriate hammer and clinch cutter and the hoof isn’t too damaged and the horse cooperates. They don’t always!⁵³

Dr. Blauner referred to a little known person in Civil War history, Henry Burden.⁵⁴

Prior to 1840, horseshoes and nails were made locally by a blacksmith. In the 1830s, working for the Troy Iron & Nail Factory in New York, Burden designed a machine to make railroad spikes, and in 1835 patented a machine to manufacture horseshoes: eventually, it produced 60 finished horseshoes (including nail holes) per minute. He purchased the company from his employers in 1848, renaming it Henry Burden & Sons. This company supplied the Union with millions of horseshoes and nails. The South had no such company and efforts to steal the design of Burden’s machinery failed. An

important target for destruction found by any Federal soldier were blacksmith shops, and anvils, tools, and horseshoe nails were confiscated or destroyed.⁵⁵

A website on horse care states, “Carrying a rider on any hard surface is a tough job for a horse. Assuming there are no dangers from car traffic...[list of modern hazards]..., there will always be that ‘shoe thing’ in the back of your mind when you are working or training on hard ground. Is everything okay down there? All four shoes holding on nice and tight?”⁵⁶ Horses can be made to work on hard surfaces, such as horse-drawn carriage rides for tourists in large cities, but these horses are pulling and not carrying weight and their working conditions are regulated by law. This is not true of cavalry, especially that of both North and South in late June 1863 in Maryland and Pennsylvania. Per Dr. Blauner:

Hard ground is very jarring and unpleasant to the horse. Modern asphalt surfaces are very slippery with horseshoes. Moving at speed on a modern type road is dangerous without special adaptations to the shoes unavailable in 1863. As an aside, shod horses make a huge racket on a paved road – not conducive to a surprise attack. 2000 horses would be audible for miles depending on the acoustics of the hills. Muddy footing also slows the horse down since he needs to guard against slipping. It is also tiring and increases likelihood of soft tissue injuries (e.g. bowed tendons).

In his official battle report, Stuart refers to horseshoes only twice. For June 19, he wrote this after an engagement with Federal cavalry at Middleburg, Virginia: “This attack was met in the most determined manner by these two brigades, which rough roads had already decimated for want of adequate shoeing facilities...”⁵⁷ Recall his statement above about “the rough character of the roads and lack of facilities for shoeing” in Fauquier, Virginia. Therefore, one cannot assume that all of Stuart’s force was adequately shod.

4. *Load*. One component not normally considered in discussing Stuart’s cavalry is the load each horse carried. One must start with the trooper. The average weight of

Civil War soldiers is not accurately known, but is generally given as around 140 pounds: more detailed statistics were kept in later periods. The United States Department of Agriculture has compiled such records. For the period 1885 to 1900, the average weights for men ages 25 to 29 for heights between 65 and 68 inches (5 ft 5 in to 5 ft 8 in, the average heights of Civil War soldiers) was approximately 148 pounds, which corresponds nicely with the value of 140 pounds above, although the data are from a slightly later period.⁵⁸ If the southern trooper was not fed as well as his northern counterpart, one can fairly assign an average weight of approximately 120-125 pounds to the southern trooper. (As an aside, it seems unlikely that many of the beefy actors portraying cavalrymen in director John Ford's western films would ever make it as cavalrymen in 1863.)

Then one must add equipment. At the start of the war, northern troopers were so laden with equipment that their horses were overtaxed; however, southern troopers did not enjoy the industrial abundance of the North, except when they captured Union equipment. Troopers of both sides gradually disposed of all non-essential equipment so that by 1863 their mobility and fighting ability were enhanced. Despite this, a minimum amount of equipment was required by troopers of both sides:

By this third spring of the war, the average trooper retained a saber and scabbard, a carbine fastened to a shoulder-sling, one or two revolvers with removable, preloaded cylinders, a rawhide "McClellan" saddle and underpad (often a sleeping blanket did double duty as a saddle cushion, with forage, rations, and ammunition carried in saddlebags, a haversack, and a cartridge box, respectively. Ideally, this paraphernalia weighed less than sixty pounds.⁵⁹

The southern horse, therefore, must carry a load of approximately 180 to 185 pounds, although it is easy to imagine that some supplies not essential to combat would be shed

before an excursion as that proposed by Dr. Carhart. As will be seen in the next segment, for the Gettysburg campaign, this load was carried in weather inimical to man and beast.

5. *Climate.* A horse can overheat from hot weather, high humidity, prolonged exposure to direct sunlight, and excessive work. Extensive exposure to high temperatures can result in heat stress, heat stroke, dehydration, muscle spasms, and colic. Horses cool by sweating, and the local climate can affect the ability of a horse to cool itself., which in turn affects its performance. Although horses can become acclimated to hot and humid weather, a horse working hard in such an environment can lose two to four gallons of sweat per hour.⁶⁰

Air comprises different gases, one of which is water vapor, the measure of which (compared to how much the air could hold at the same temperature) is called *relative humidity*. Relative humidity is measured in percent. A heat index designed for horses illustrates how air temperature and relative humidity affect horse cooling. An “index” is a composite value computed from a series of observations and used as an indicator or measure.⁶¹ Standard and Poor’s 500 Stock Index, commonly known as the S&P 500, is an excellent non-scientific example. Because each component of the computation has units, such as degrees, these units carry into the answer, although they are sometimes dropped in normal usage. (The “heat index” or “feels-like” temperature reported on television and radio for humans is calculated from a formula different from the equine one, and has its own unit of degrees.) The equine heat index formula is:

$$\text{Index} = \text{Air Temperature (in degrees Fahrenheit)} + \text{Relative humidity (\%)}.$$

The breakdown of the values follows:

EQUINE HEAT INDEX

HORSE COOLING EFFICIENCY

< 130	Most effective
130-150	Decreased
150-179	Greatly reduced
> 180	Can be fatal if horse is stressed ⁶²

Luckily for history, the air temperature was recorded faithfully during the battle by Doctor Michael Jacobs, professor of mathematics and natural sciences at Gettysburg College. He was also an amateur meteorologist who regularly took weather observations at 7 a.m., 2 p.m., and 9 p.m. Because of Dr. Jacobs’s interest and diligence for many years, a decent record exists of the weather in Gettysburg for all days of the battle. (Because Dr. Jacobs’s discussion refers to different cloud types, please refer to a basic text on meteorology or the website of the University Center for Atmospheric Research (UCAR) Center for Scientific Research for expert definitions and photographs. This can be found at <https://scied.ucar.edu/cloud-image-gallery>.)

For the days before the battle he recorded the following (day of week added):

	<u>7 A.M.</u>	<u>2 P.M.</u>	<u>9 P.M.</u>
June 25, Thursday	59	51	63
June 26, Friday	60	63	62
June 27, Saturday	61	63	67
June 28, Sunday	63	67	66
June 29, Monday	66	72	79
June 30, Tuesday	68	79	71

His notes for the period follow:

The entire period of the invasion is remarkable for being one of clouds, and, for that season of the year, of low temperature. From June 15th until July 22nd, 1863, there was not an entirely clear day. On the evening before the entrance into our town of Gen. Gordon's division, viz: June 25th, at 8 p. m., a rain began, which some may remember in connection with the arrival of the advance guard of the 25th Pa. militia, under Lieut. Hinkle, of the college company. This rain continued at intervals until Saturday, June 27th, at 7 a. m., the precipitation being in inches 1, - 280. At all the observations made on Saturday and Sunday, and until the nine o'clock observation of Monday night, the entire sky was covered with clouds. On the day before the battle, both at 7 a. m., and 2 p. m., the obscuration was again complete, with cumulo-stratus clouds moving from S.S.E. At 9 p. m., only four-tenths of the heavens were covered. During these days of sombre [*sic*] suspense, the records of the wind are those of almost an entire calm.⁶³

Briefly, this period was one of cool, cloudy weather with rain occurring at intervals with approximately one-and-one-quarter-inch of rain total. The winds were calm and stratocumulus clouds were entering from the south-southeast.

Two o'clock is normally a little early for the high temperature to occur, but rather than extrapolate an hour or two, this paper uses those afternoon temperatures as recorded by Dr. Jacobs. Per the National Weather Service (NWS) web site, climatology for Biglerville, PA, the closest town available on its pull-down menu (and the home of one of the authors), daily climatology maxima for the area for the period 1981 to 2010 for the dates in question are:

<u>DATE</u>	<u>DR. JACOBS OBSERVED MAX (DEG F)</u>	<u>DAILY CLIMATOLOGY MAX (DEG F)</u>
June 25, Thursday	51	83
June 26, Friday	63	84
June 27, Saturday	63	84
June 28, Sunday	67	84

June 29, Monday	72	84
June 30, Tuesday	79	84 ⁶⁴

Thus, for the few days before the battle, at least in Adams County, the maxima, ranging from 51 to 79 degrees were less than mean maximum temperatures. If these daily temperatures held for southern Pennsylvania and northern Maryland in general, then the weather during Stuart's ride might not have been as oppressive as it would become during the battle. (A study of the weather conditions along Stuart's route would be an admirable and useful endeavor, but it is beyond the scope of this paper.)

To continue, Dr. Jacobs's notes for July 1 (Wednesday) to 4 (Saturday) were:

FIRST DAY.-All through the first day, the entire sky was covered with clouds, viz: cumulo-stratus at 7 a. m. and 2 p. m.; and cirro-stratus at 9 p. m. A very gentle southern breeze, (2 miles per hour). Thermometer:

7 A.M.	2 P.M.	9 P.M.
72	76	74

SECOND DAY.-At 8 a. m., sky still covered, (cumulo-stratus). At 2 p. m., three-tenths are clear. At 9 p. m., there are cirrus clouds; wind as on preceding day. Thermometer:

7 A.M.	2 P.M.	9 P.M.
74	81	76

THIRD DAY.-At 8 a. m., sky again completely covered with cumulo-stratus clouds; at 2 p. m., only four-tenths of the heavens are covered, but with cumulus or the massive thunder-cloud of summer; at 9 p. m., seven-tenths cumulus. Wind S. S. W., very gentle. Thunder storm in neighborhood at 6 p. m. The thunder seemed tame, after the artillery firing of the afternoon. Thermometer:

7 A.M.	2 P.M.	9 P.M.
73	87	76

SATURDAY, THE FOURTH.-Rain in showers at 6 a. m., from 2:15 to 4 p. m., and at 4 a. m. of the 5th, aggregating 1.390. Thermometer:

7 A.M.	2 P.M.	9 P.M.
69	72	70

There were slight showers on the 5th and 7th; and on the 8th, a rain from 3 a. m. to 11:30 a. m., which measured 1.300. The maximum temperature for the month of July 1863, was 87 at the time of Pickett's charge.⁶⁵

Again, using the NWS climatology for Biglerville, PA, daily climatology maxima for the area for the period 1981 to 2010 for early July are:

<u>DATE</u>	<u>DR. JACOBS OBSERVED MAX (DEG F)</u>	<u>DAILY CLIMATOLOGY MAX (DEG F)</u>
July 1, Wednesday	76	85
July 2, Thursday	81	85
July 3, Friday	87	85
July 4, Saturday	72	85 ⁶⁶

To a meteorologist (one of the authors is degreed in the subject), these reports describe a pattern of increasing temperature over the three days of the battle: the temperature increased from 76 to 87 degrees, and the wind was slight but from the south. Temperatures for July 1 to 3 were closer to seasonal than in the week prior to the battle. The relatively cool, calm conditions before the battle indicate a period of low pressure until the end of June followed by high pressure starting June 30 or July 1.⁶⁷ Wind from the south-southwest indicates warm, humid, tropical air, and “gentle” wind (one assumes low speed) allows humid parcels of air heated by the ground to rise via convection to form clouds.

As a result, the cloud cover on July 3 changed from stratocumulus in the morning to cumulus by mid-afternoon. On July 3, the increase in cloud cover from four-tenths cumulus at three to seven-tenths cumulus by nine with a thunderstorm (cumulonimbus) by six indicates that the surface was heating throughout the day. It is possible that an inversion layer (a layer of high temperature) above Adams County trapped the air beneath, retarding the growth of cumulus for most of the day until the heat buildup at the surface allowed the warm, humid air to rush upward causing the storm later in the day. This would be another cause of heat and high humidity near the surface, but there is no way to prove this today.

In summary, one can state that for July 1 to 3, the atmosphere changed from one of quiet high pressure to one of rainy, tropical air. By July 4, the temperature at 2 p.m. had dropped 15 degrees to 72 with rain starting at 6 a.m. and remaining steady till late afternoon; this is when Lee started his retreat to the mountains thence to Virginia.

At this point, one can turn to the Equine Heat Index, described above as the sum of temperature and relative humidity. Using simple algebra, one can derive possible humidity values based on a temperature of 87 degrees. To do this, one need only reverse the formula to:

$$\text{Relative humidity (\%)} = \text{Index} - \text{Air Temperature (in degrees Fahrenheit)}$$

Using the thresholds for the equine heat index gives these possible values for relative humidity:

$$\text{Relative Humidity} = 130 - 87 = 43\%$$

$$\text{Relative Humidity} = 150 - 87 = 63\%$$

$$\text{Relative Humidity} = 180 - 87 = 93\%$$

This simple computation shows that at 87 degrees, even a relative humidity as low as 43 percent can start to have negative effects on a horse's cooling efficiency. Of course, a thunderstorm did form in late afternoon by six, so a combination of temperature, humidity, and upward convection did exist to cause the storm.

Another parameter used to indicate discomfort is the dew point temperature, referred to simply as "dew point," which is the temperature to which the air must be cooled to achieve a relative humidity of 100 percent. Unlike the more familiar relative humidity, dew point is not based on the ambient temperature (although it is an input to the computation for relative humidity) and is therefore an absolute measure of discomfort. According to the National Weather service, these are the comfort levels one can expect in summer:

<u>DEW POINT TEMP</u>	<u>COMFORT LEVEL</u>
< = 55 deg F	Dry and comfortable
55 to 65 deg F	Becoming "sticky" with muggy evenings
> = 65 deg F	Lots of moisture in the air, becoming oppressive. ⁶⁸

To compute possible values for the dew point on July 3, it is only necessary to find dew points corresponding to the temperature of 87 degrees and relative humidity computed above for the horse heat indices above. This equation is far more complicated than this paper requires; however, the website for a course offered by Meteorology Department of the Pennsylvania State University has a link to a "handy relative humidity calculator" tool.⁶⁹ This is adequate for this exercise because only an estimate of the values is required. Note that the temperature input is constant at 87 degrees and that the dew point temperature

can never be greater than the ambient air temperature. The raw results for the relative humidity corresponding to the thresholds for the Equine Horse Index follow:

<u>INPUT TEMP (Deg F)</u>	<u>INPUT DEW POINT TEMP (Deg F)</u>	<u>OUTPUT REL HUM (%)</u>	<u>EQUINE HEAT INDEX</u>
87	62	43	Decreased
87	73	63	Greatly reduced
<i>87</i>	<i>84.7</i>	<i>93</i>	<i>Can be fatal (Dew Point unlikely)</i>

Again, according to Dr. Nese, Teaching Professor in Meteorology at the Pennsylvania State University, dew points in Pennsylvania greater than 75 degrees are uncommon and above 80 are even more rare: this eliminates the third row (in italics) as highly unlikely. The remaining two rows (in bold) show that, even with a relative humidity as low as 43 percent, it is possible to have a dew point temperature producing a negative effect on both men and horses. Higher dew points (up to the mid-seventies) would have been even worse. Experience might indicate that Dr. Jacobs's temperature of 87 degrees, with a dew point around 73 degrees, could have produced the weather conditions experienced on July 3, and this would have been harmful to horses. In summary, it seems clear that reports of weather oppressive to both man and beast during July 2 and 3, especially from Southern soldiers reared in much warmer climates, are well-founded and consistent.⁷⁰

6. *Terrain.* Because the terrain over Carhart's proposed march is covered in detail in the next section, this segment is added to complete this list in this section. One universal element of terrain is slope. Consideration must be given to slope (or incline or grade) in

discussing the speed of a horse. The 1862 manual for staff officers states, “Cavalry can act with facility only on ground that is flat, smooth, and open; it may charge in an effective manner up slopes of five degrees. On those of fifteen degrees, which it cannot descend at a trot, it cannot be actively used.”⁷¹

It is interesting to compare the grades above for horses with those for modern, *mechanized* (non-horseflesh) conveyances. For instance, for modern railroads, most grades are one percent or less and grades steeper than approximately 2.2 percent are rare.⁷² And for interstate highways, the maximum grade is normally six percent with seven percent allowed in urban areas.⁷³

For horse trails, the Forest Service design recommendations are shown in Table 2. The values in this table combine two concerns: equine (horse and mule) mobility and erosion (to minimize trail maintenance). Note that these are much steeper than those for rails and highways above, and that steeper slopes (greater than 15 percent) have a short limit on length of 200 feet. Although horses and mules can climb steep grades as high as 20 percent, it is easier for them to maintain their balance climbing rather than descending because in the latter, most of their weight is on their forelegs.⁷⁴ Note that five of the six cells in Table 2 have an upper limit of 15 percent along with specification as to the maximum distance at this grade and this is pretty much in line with the 1862 manual cited above.

Table 2 - Suggested design grades for horse trails. Agency specifications may vary.			
Length of pitch	Low level of development**	Low level of development**	High level of development**
Target range* (Over at least 90 percent of trail)	Less than or equal to 12-percent grade	Less than or equal to 10-percent grade	Less than or equal to 5-percent grade
Steep exceptions*	20-percent grade for no more than 200 feet	15-percent grade for no more than 200 feet	15-percent grade for no more than 200 feet 8- to 10-percent grade for 500 to 800 feet 10-percent grade for no more than 500 feet
<p>* May not meet accessibility requirements. ** Base any grade variances on soils, hydrological conditions, use levels, and other factors contributing to surface stability and erosion potential.</p>			

Table 2. Suggested design grades for horse trails. Agency specifications may vary. From United States Forest Service, Chapter 4—Designing Trail Elements—Continued, Table 4-3 in original, accessed October 28, 2019, <https://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232816/page08.htm> , search on ‘horse trail grades’.

Dr. Blauner on grades:

Grade is tiring and slowing. Both up, due to increased exertion, and down, due to increased requirements of balance and proprioception. Horses are capable of scaling very steep inclines. I suspect the Forest Service grade guidelines have more to do with erosion control than equine limitations.⁷⁵

Dr. Blauner referred to a race known as The Tevis Cup, a race of 100 miles in one day, billed as “the world’s best known and most difficult equestrian endurance ride.” This race starts near Truckee, California, (elevation 7,000 feet) to Auburn, California at 1,200 feet elevation, along the Western States Trail. In one section, it covers approximately 2,400 feet in 4 miles and one of its famous landmarks is a steep volcanic outcrop called Cougar Rock. However, this race is only for healthy, well-conditioned, and well-rested horses

whose condition is monitored by veterinarians at many stations en route, probably more per mile than any other event.⁷⁶ Of course, this is not the case with Stuart's horses on July 3. In the discussions below of the roads in the proposed route, grades are discussed in detail. Details on definitions related to topography and topographic maps are covered in Appendix A, Topographical Definitions.

GETTYSBURG TOPOGRAPHY OVER THE PROPOSED ROUTE

The proposed route for Stuart's attack on the Federal rear is "to come down off Cress Ridge [on the northwest side of ECB], cross Hanover Road [modern Pennsylvania Route 116] and take the "Bonaughton Road" [non-existent today] southwest to Baltimore Pike, then turn up it and race into the Union rear."⁷⁷ This statement defines the three legs of route used in this paper: Leg Number 1, East Cavalry Battlefield; Leg Number 2, + "Bonaughton Road"; Leg Number 3, Baltimore Pike. Briefly, the geology under the part of the battlefield under discussion is diabase, a very hard rock. Because of erosion, much of the ground is rocky with little shallow soil.⁷⁸

A contemporary map of the area in question is shown in Figure 3 followed by a modern map of the same area (Figure 4). Note that in the contemporary map, the road known today as the "Hanover Road" was labeled as the "Bonaughton Road." On Dr. Carhart's map on pages 218 and 219, the Hanover Road is labeled as today, but he refers to the second leg of the proposed route as the "Bonaughton Road," as shown on Figure 3.⁷⁹ For consistency with Carhart's nomenclature, this paper will use the Hanover Road to indicate the current PA Route 116 and "Bonaughton Road" to indicate that road as Carhart depicts; this depiction is shown in Figure 4.

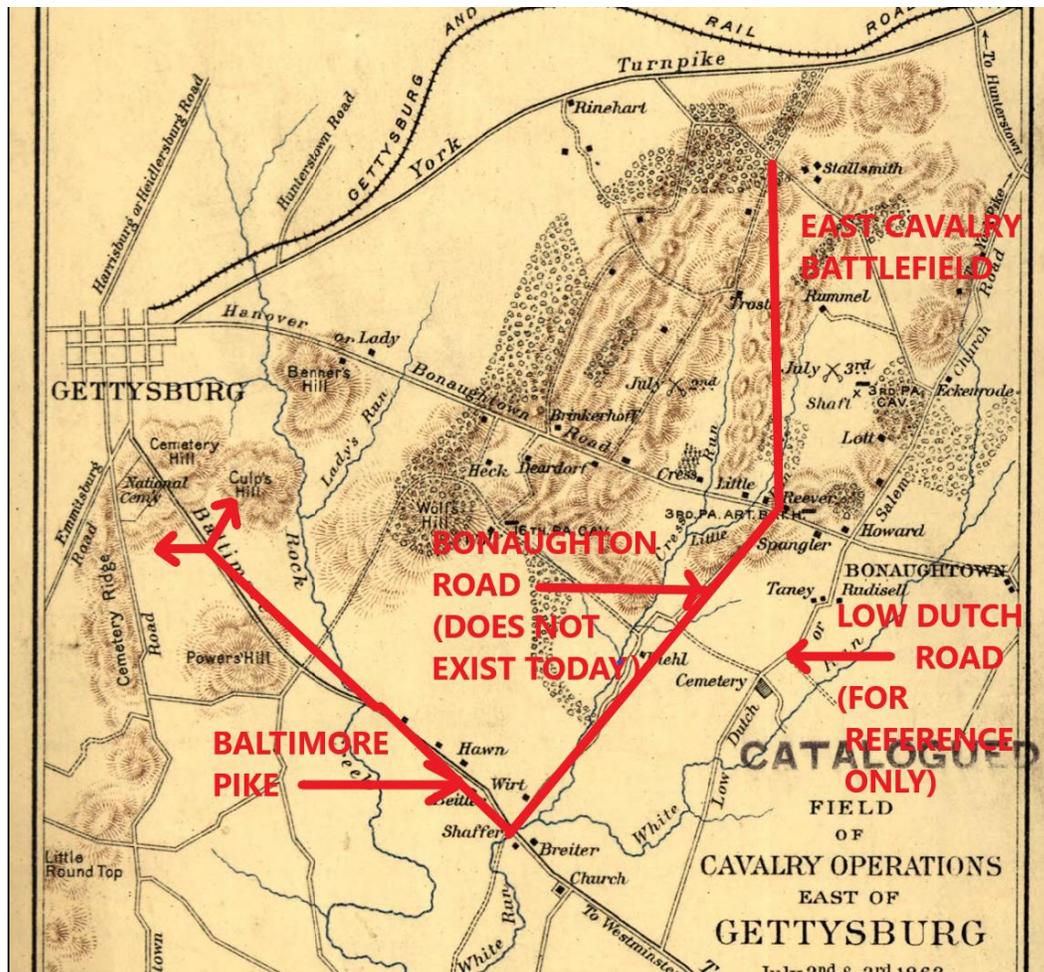


Figure 3. Section of 1863 map “Field of cavalry operations east of Gettysburg, July 2nd & 3rd 1863 by Julius Bien and annotated for this paper. The path in red depicts the approximate route of Stuart’s charge as proposed by Carhart. From Library of Congress web site, accessed October 29, 2019, <https://www.loc.gov/item/99447495/> , search on ‘Gettysburg maps, Library of Congress’.

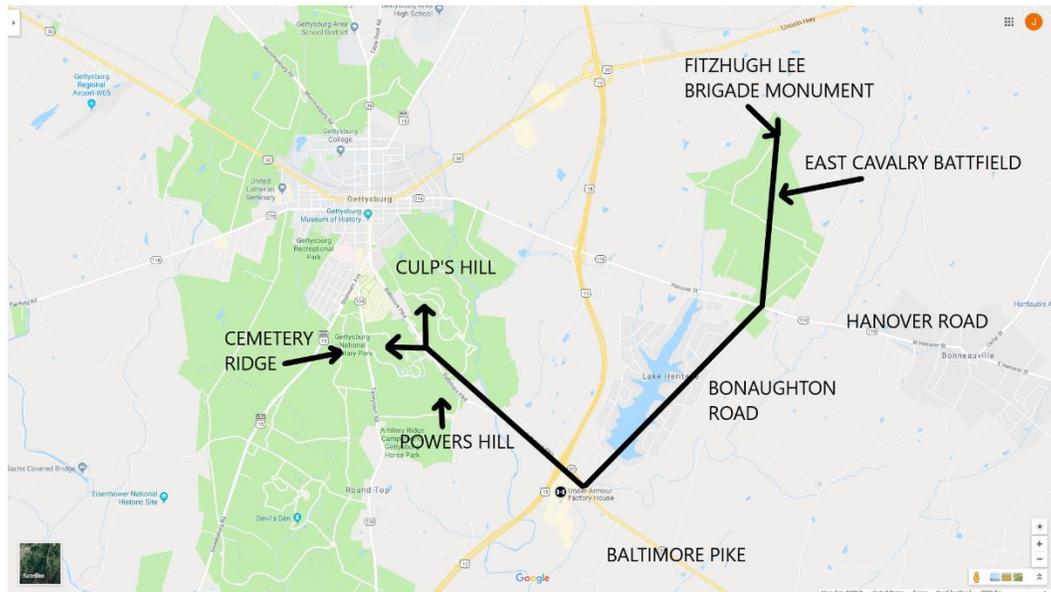


Figure 4. Carhart’s proposed cavalry route for July 3, 1863, depicted on modern map annotated for this paper. Map from Google Maps.

The first task is to determine the length of this route, which is discussed in the next few paragraphs. (Because of their frequency in this paper, the “Bonaughton Road” is abbreviated as BR, the Baltimore Pike as BP.)

These areas were studied in Spring 2019 by the authors. Because direct routes for much of the proposed route do not exist, Google Maps “Measure Distance” option was used. The first task is to measure the distance diagonally across ECB. A convenient starting point is the bend in Confederate Cavalry Avenue at the monument for Fitzhugh Lee’s brigade and ending at the Hanover Road. These start and end points approximate the corresponding spots on Carhart’s map.

In traveling this route, because “Bonaughton Road” does not exist today, Low Dutch Road was used to travel from the Hanover Road to Baltimore Pike. It should be noted that Lake Heritage, to the west of LDR did not exist in 1863. Today it is an artificial

lake, part of the Lake Heritage housing development. (This is a gated community which the authors were not allowed to enter.) The distance of LDR was measured on the odometer as 2.2 miles and agrees with the Google Maps distance of 2.23 miles, verifying the Google Maps values for the rest of the paper. Carhart offers nothing about the foray other than “follow Bonaughton Road to the Baltimore Pike, then turn right and race up to the rear of Culp’s Hill,” as quoted above; the authors tried to determine the most likely spot on the BP for the “rear of Culp’s Hill.” Comparing Carhart’s map to modern maps, the terminus of the trip (and the start of the attack) corresponds to a section of the BP between the entrance to the National Park complex and Hunt Road. This seemed to be the right point to catch the Federals fleeing from Pickett’s Charge.

Therefore, distances are as follows:

Across East Cavalry Battlefield = 1.4 miles

“Bonaughton Rd.” from Hanover Road to Baltimore Pike = 2.1 miles

Baltimore Pike from “Bonaughton Rd.” to Powers Hill = 1.7 miles

Subtotal (Hanover Rd. to Powers Hill) = **5.2 miles**

For clarity, especially in the computations below, this number may be rounded down to **five miles (5.0 mi)** with no ill effect. This actually brings the number closer to Carhart’s value of three miles, stated thus (italics added subject to later recall): “After firing those signal shots, Stuart planned to wait with his men on Cress Ridge until he heard the artillery barrage end. From that moment, he would have twenty minutes to move his force one mile to Bonaughton Road, another mile to Baltimore Pike, three-quarters of a mile to the rear of Culp’s Hill—*less than three miles, all at a trot or a canter in fifteen or twenty minutes.*”⁸⁰ (On Google Maps, the straight line “as the crow flies” distance between

the Fitzhugh Lee monument and Culp’s Hill measures 3.4 miles, which might be the source of Carhart’s value.) Elements of terrain will be discussed in order of the proposed route from ECB.

With the length of the route known, it is useful to compare the possible lengths of the theoretical (not tactical) columns to it. Subtracting the theoretical column lengths in Table 1 from the total length of the route, five miles, produces Table 3. These values indicate how stretched out the column would be along the route. The most extreme case is for 6,000 troopers in column of two: in this case, the head of the column could be attacking Federals behind Culp’s Hill while the end of the column had not yet started.

Table 3. Comparison of Theoretical Cavalry Column Length to Total Distance of Proposed Cavalry Route of 5 Miles			
Number of Mounted Troopers	Column of 2 (Miles)	Column of 3 (Miles)	Column of 4 (Miles)
2,000	-2.0	-3.0	-3.5
4,000	+1.1	-1.0	-2.0
6,000	+4.1	+1.0	-0.5

Table 3. Comparison of Cavalry Column Length to Total Distance of Proposed Cavalry Route of 5 Miles. Positive values indicate that the column is longer than the route; negative values indicate that the column is shorter than the route.

Dr. Carhart spends two chapters on classic battles in history and on Napoleon, extolling the cavalry charge in both with words such as “thundering” and “shock.”⁸¹ However, Brent Nosworthy notes that “As opposed to the theoretical model employing a charge at speed, in actual practice many heavy and medium cavalry regiments during the Napoleonic Wars only charged at the trot, or even at a fast walk.”⁸² The question of

whether the troopers would be galloping behind Union lines is still open. (For the record, Civil War cavalry, because its missions were primarily reconnaissance, screening, protecting flanks, etc., is properly labeled as medium or light cavalry. It also fought dismounted, as did dragoons. The main mission of heavy cavalry was to attack major parts of the enemy's line. This is one reason, of many, why the Charge of the *Light* Brigade was ill-advised.)

That said, a table containing durations of the trip based on a common gait is helpful to offer an approximation of the times involved and a baseline for later analysis. Producing this table involves simple computations that assume a constant speed along the entire route assuming a dry, uniform, level road over the entire route and irrespective of forming or bunching of the column at intersections or water crossings. The speed chosen for this exercise is 10 mph, a value between the trot and canter gaits (based on the horse speeds above) that Carhart uses for his prediction.

The example chosen from Table 1 is for 6,000 troopers riding in column of two.

Step 1. Compute the time it takes for Row 1 of horses to travel the entire route.

This is the same for all cases. This uses a simple formula from high school science:

$$\text{Speed} = \text{Distance} \div \text{Time, solving for time yields}$$

$$\text{Time} = \text{Distance} \div \text{Speed} = 5 \text{ miles} \div 10 \text{ miles/hour} = 0.5 \text{ hour}$$

$$= 0.5 \text{ hour} \times 60 \text{ minutes/hour (convert to minutes)}$$

$$= \mathbf{30 \text{ minutes}} = \text{Duration for head of column to reach terminus.}$$

Step 2. Compute the time it takes for the column to exit the route at the same speed, which is the same time it takes the last row of horses to travel to the terminus after the time computed in Step 1. This distance is the length of the column. Using the same

parameters in the example for Table 1, for 6,000 mounted troopers in column of two, the total length of the column is 9.1 miles:

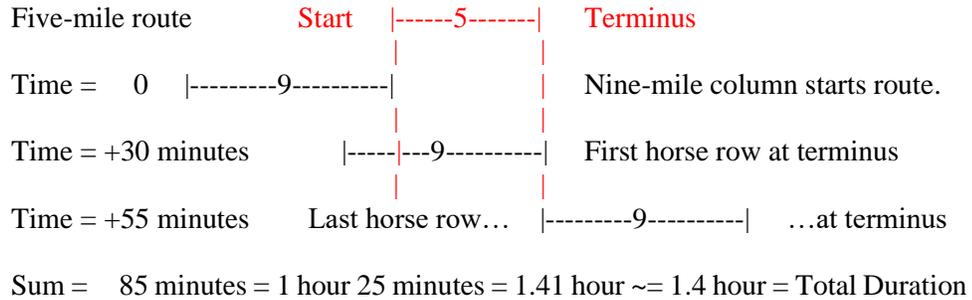
$$\begin{aligned} \text{Time} &= \text{Distance} \div \text{Speed} = 9.1 \text{ miles} \div 10 \text{ miles/hour} = 0.9 \text{ hour} \\ &= 0.9 \text{ hour} \times 60 \text{ minutes/hour (convert to minutes)} \\ &= \mathbf{55 \text{ minutes}} = \text{Duration for rear of the column to reach terminus.} \end{aligned}$$

Step 3. Compute the total time for the entire column to exit the route by adding the two times in bold:

$$\begin{aligned} \text{Total Duration} &= \text{Time (Head of column)} + \text{Time (Rear of Column)} \\ &= 30 \text{ minutes} + 55 \text{ minutes} \\ &= 85 \text{ minutes} = 1 \text{ hour } 25 \text{ minutes} \\ &= \text{Duration for entire column to exit route.} \end{aligned}$$

A visual depiction of this process follows. Distances depicted are not to scale.

This scheme is represented visually thus:



Note that the numbers may be rounded to one decimal point for comparison. The column lengths from Table 1 produce the travel durations in Table 4:

Table 4. Total Travel Durations of Theoretical Cavalry Column Based on Uniform Speed of 10 mph Over Distance of 5 Miles				
Number of Mounted Troopers	Column of 2 (Hours, Minutes/ Decimal Hours)	Column of 3 (Hours, Minutes/ Decimal Hours)	Column of 4 (Hours, Minutes/ Decimal Hours)	Avg for Number of Mounted Troopers (Hours, Minutes/ Decimal Hours)
2,000	0 h 49 m 0.8 h	0 h 42 m 0.7 h	0 h 39 m 0.7 h	0 h 43 m 0.7 h
4,000	1 h 07 m 1.1 h	0 h 54 m 0.9 h	0 h 49 m 0.8 h	0 h 57 m 1.0 h
6,000	1 h 25 m 1.4 h	1 h 06 m 1.1 h	0 h 57 m 1.0 h	1 h 09 m 1.2 h
Average for Column Width (Hours, Minutes/ Decimal Hours)	1 h 07 m 1.1 h	0 h 54 m 0.9 h	0 h 48 m 0.8 h	Average for table = 0 h 56 m 0.9 h

Table 4. Total Travel Durations of Theoretical Cavalry Column Based on Uniform Speed of 10 mph Over Distance of 5 Miles. For simplicity, computations ignore spacing between companies and regiments and assume uniform, level road conditions.

Table 4 offers insight into the proposed route, to wit:

1. This table was produced assuming theoretical, uniform conditions: the average time for all nine column configurations is 56 minutes, nearly one hour. Of course, conditions on July 3 were not ideal, from horseshoes to temperature. Note that any impediment to the march, such as for forming or slowing down for crossing a creek, should *add* a defined increment of time to the total time for the cell in question. This paper will not attempt to assign a time delay value to each impediment, but notes here that each impediment discovered below adds to the total duration of the ride.

2. In a canter (per modern definition), the shortest time for completion of the route is for 2,000 troopers in column of four, and this is 39 minutes. If one assumes that the horses gallop in a charge for, say, the last mile, then this means that four miles are still

traveled at a lower speed, meaning that the trip will take approximately 35 minutes. The reader may assume that any duration spent in a gallop would decrease the total time by a defined amount.

3. The situation for the proposed 6,000 mounted troopers is worse, with the shortest route taking 48 minutes (for column of four). This means that when the first line of troopers reaches the attack location after 30 minutes, it still takes another 18 minutes for the full complement of 6,000 troopers to appear. Again, galloping the last mile offers some improvement, but the entire journey still takes around three-quarters of an hour.

There is a historical analogy to this delay in bringing up the rear. On May 2, 1863, at the Battle of Chancellorsville, General Thomas Jackson led about 30,000 men (infantry, artillery, and cavalry) on a 12-mile, roundabout march for a surprise attack against the Federal right flank. The road was narrow and this narrowed the column, but it was otherwise not impeded and progress was steady. At the head of his column, Jackson arrived at the rally point around two p.m., after eight hours of marching, but he did not start his attack until 5:15 (10 hours *after* the march started), the interval of three-plus hours spent waiting for his regiments to emerge from the road and form. As it was, his third line had not formed completely when he started his attack, but in early May, with no daylight savings time, sunlight was at a premium and the surprise attack had to start.⁸³ Although the Chancellorsville case involved mostly infantry, the principle is the same for cavalry and has been applied above.

At this point, it is useful to compute the speed required for a column of troopers to achieve the performance required by Dr. Carhart's parameters above. Taking his value for distance as three miles (although he suggests that it is less than that distance), his time

estimate of 15 and 20 minutes, and using the same high school physics formula with uniform road conditions, and so forth:

$$\begin{aligned}\text{Speed} &= \text{Distance} \div \text{Time} \\ &= 3 \text{ miles} \div 15 \text{ minutes} \\ &= 0.2 \text{ miles/minute} \times 60 \text{ minutes/hour (convert to minutes)} \\ &= 12 \text{ mph}\end{aligned}$$

$$\begin{aligned}\text{Speed} &= \text{Distance} \div \text{Time} \\ &= 3 \text{ miles} \div 20 \text{ minutes} \\ &= 0.15 \text{ miles/minute} \times 60 \text{ minutes/hour (convert to minutes)} \\ &= 9 \text{ mph}\end{aligned}$$

These speeds are within the range of a trot or a canter, as Carhart states, and approximate modern values as indicated above, except that Carhart offers no hint as to the form Stuart's column might take over the BR (column of two, three, or four). Remember that these computations were for speed only, and not how long it would take Stuart's entire column to exit the roads to conduct the attack. This stipulation also governs the computations in the next paragraph.

However, if Carhart's proposed plan allows for only 15 to 20 minutes to travel the entire distance from the top of ECB to the point of attack, it is a different story. Using the value of 5 miles for the total distance of the ride to the attack, one gets, as above:

$$\begin{aligned}\text{Speed} &= \text{Distance} \div \text{Time} \\ &= 5 \text{ miles} \div 15 \text{ minutes} \\ &= 0.33 \text{ miles/minute} \times 60 \text{ minutes/hour (convert to mph)} \\ &= 20 \text{ mph}\end{aligned}$$

$$\begin{aligned}\text{Speed} &= \text{Distance} \div \text{Time} \\ &= 5 \text{ miles} \div 20 \text{ minutes} \\ &= 0.25 \text{ miles/minute} \times 60 \text{ minutes/hour (convert to mph)} \\ &= 15 \text{ mph}\end{aligned}$$

Remember that 15 mph is at the upper limit of a canter per the modern definition, but 15 mph was a gallop in 1862. At 20 mph, a horse is galloping by either definition. The reader must decide if Stuart's exhausted horses could gallop at 20 mph for five miles and then mount a charge on July 3, 1863, the hottest day of the month. The topology of each of Carhart's three legs follows.

Leg Number 1: East Cavalry Battlefield (1.5 miles across). The terrain on ECB was suitable for a cavalry attack. This was recognized by Stuart, Custer, General David Gregg, and Colonel John Irvin Gregg, cousin and subordinate of David Gregg. It was also suitable as an approach toward each of the proposed routes to the rear of the Federal line. An authoritative discussion of that terrain may be found in "The Role of Geology and Terrain in the Defeat of Stuart East of Gettysburg, July 3, 1863," an article appearing in Spring 2013 issue of *Pennsylvania Geology*, the newsletter of the Bureau of Topographic and Geologic Survey Department of Conservation and Natural Resources of the Commonwealth of Pennsylvania.⁸⁴ Of course, a cavalry battle did occur there, and it is mentioned here for completeness and as the potential staging area for the proposed routes. For Carhart's proposed attack to occur, the battle on July 3 is assumed *not* to have occurred.

One thing to note about ECB is the remnant of the old road between Hoffman Road and LDR. This road appears on an 1872 map of Adams County (Confederate Cavalry Avenue and Gregg Avenue were built by the National Park Service and of course did not

exist in 1863). At the location of the Fitzhugh Lee Brigade Monument, if one looks to the southeast rather than down the curve of Confederate Cavalry Boulevard, one finds a path that continues from Confederate Cavalry Boulevard. An image of this road appears here (Figure 5), as seen from the bend in Confederate Cavalry Boulevard:



Figure 5. Remnant of the old road between Hoffman Road and Low Dutch Road on East Cavalry Battlefield. It extends southeast from the Fitzhugh Lee Brigade Monument. Photo by Terrence Salada, March 2019.

On the map below (Figure 6), the Rummel Farm is denoted by the blue pin in the middle (although on the corresponding satellite photo below, the buildings are to the

southeast of the blue pin). The old road is the black diagonal line across the middle of the image.



Figure 6. The old road on East Cavalry Battlefield is the black diagonal line across the middle of the modern map annotated for this paper. The Fitzhugh Lee Monument is at the bend in Confederate Cavalry Avenue where the old road starts. Map from Google Maps.

On the corresponding satellite image (Figure 7), the path of the road is denoted by the nook in the woods at the bend in Confederate Cavalry Avenue near the top of the image and following the boundaries of the fields.



Figure 7. Satellite image of the old road on East Cavalry Battlefield depicted as the red diagonal line across the middle of the image annotated for this paper. The Fitzhugh Lee Monument is at the nook in the woods near the top of the image. Satellite image from Google Maps.

This road is typical of the roads that existed at the time of the battle, i.e., farm lanes, meant not for the fast movement of cavalry, but rather for the slow movement of wagons and animals from farm to farm or farm to town. In addition, in 1863 such roads were normally fenced on either side to keep cattle in pastures. The reader should keep the image of such a road in mind during the discussion of LDR and BR below. Per maps of Adams County by the Pennsylvania Department of Transportation, this road, numbered as part of T483, was depicted as an unimproved road as of 1953 and 1966. This indicates that the road was made large enough for vehicles during the 20th century and was wider than in 1863, but probably not by much. However, on the 1980 map, it does not appear and T483

ends at the Fitzhugh Lee monument. This indicates that the road had fallen into disrepair and did not meet even the unimproved road criteria.⁸⁵

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Much of the historical information in this paper is of a general nature and can be found in most works on the subject; therefore, no footnotes are provided for these data. However, they do appear for quotes and for the more obscure items herein.

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³ *Ibid.*, p. 159.

⁴ *Ibid.*, pp. 218-9.

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¹⁶ *Ibid.*

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