

**GEOLOGY OF THE
SOLFERINO (ITALY 1859 Jun 24)
AND
GETTYSBURG (PENNSYLVANIA 1863 Jul 1-3)
BATTLEFIELDS:
COMPARISONS, CONTRASTS, AND POSSIBLE CONNECTIONS**

Cuffey, Roger J.,

**Prof. Emer. Paleo., Dept. Geosciences (412 Deike Bldg.),
Pennsylvania State University, University Park, PA 16802**

Solferino, up till then the largest clash in mid-19th C Europe, was the decisive war-winning battle in one of the wars for Italian unification/independence.

Robert E. Lee as a professional soldier would likely have heard about it (especially Napoleon III's massive use of artillery), and could have applied its example 4 years later at Gettysburg, the turning-point of the American Civil War.

Abbreviations:

Fr = French

Au = Austrian

P-m = Piedmontese

Nap3 = French Emperor Napoleon III

F-J = Austrian Emperor Franz-Josef

VE2 = Piedmontese King Vittorio Emanuele II / Victor Emmanuel II

N, S, cent, E, W – compass directions

C = century

THE CRITICAL HIGH GROUND AT:



GETTYSBURG (1863) – Cemetery Ridge (Mesozoic sill)



SOLFERINO (1859) – Solferino ridge (Pleistocene moraine)

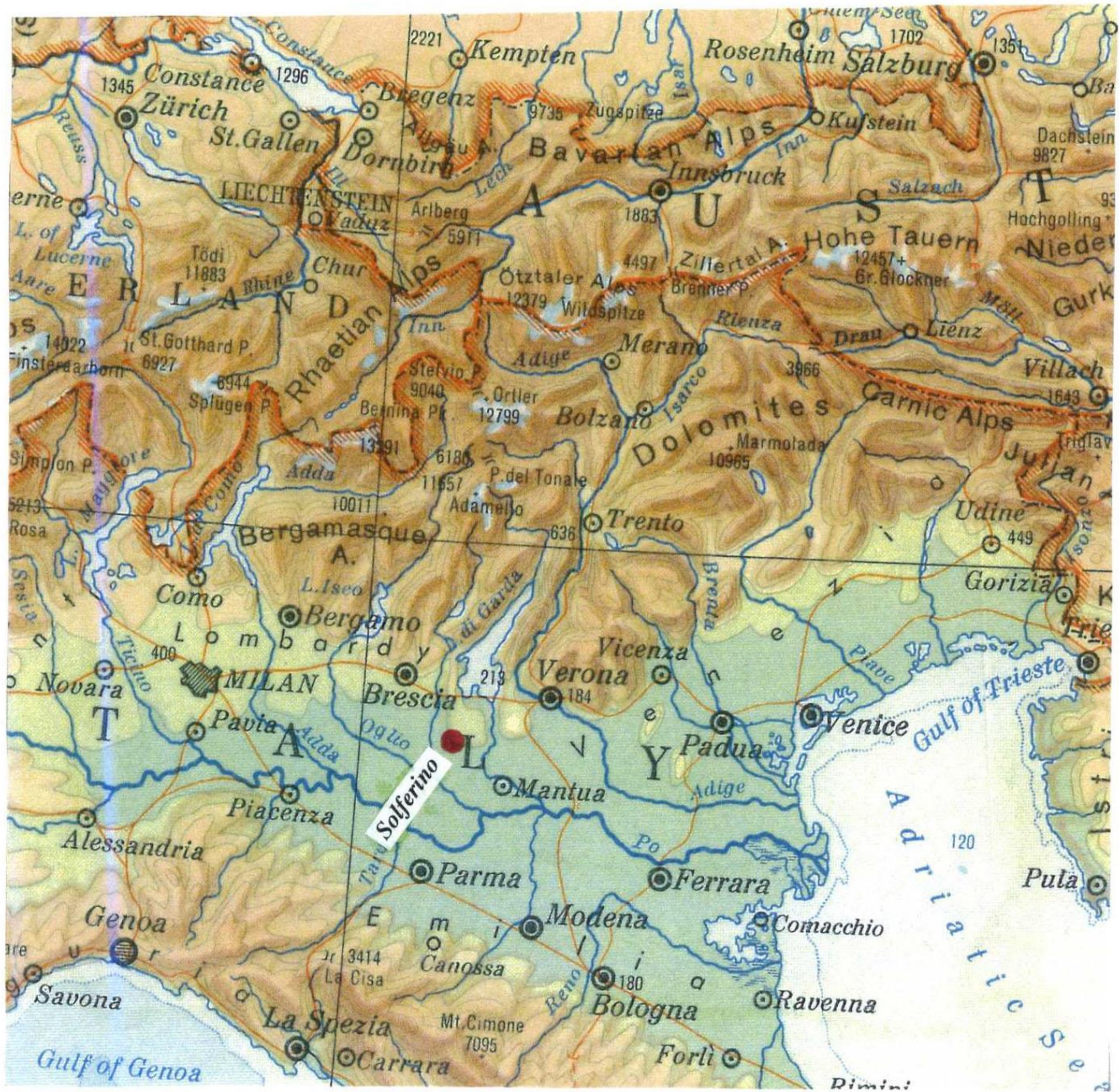
The critical high ground on two important mid-19th-century battlefields:

(upper) Cemetery Ridge at Gettysburg, Pennsylvania (1863 July 3), a low rise held up by an Earliest Jurassic diabase sill flanked by Late Triassic softer redbeds. [RJC photo 2003]

(lower) Solferino ridge at Solferino, Italy (1859 June 24), a higher end-moraine of Late Pleistocene age, surrounded by lower till plains. [RJC photo 2013]

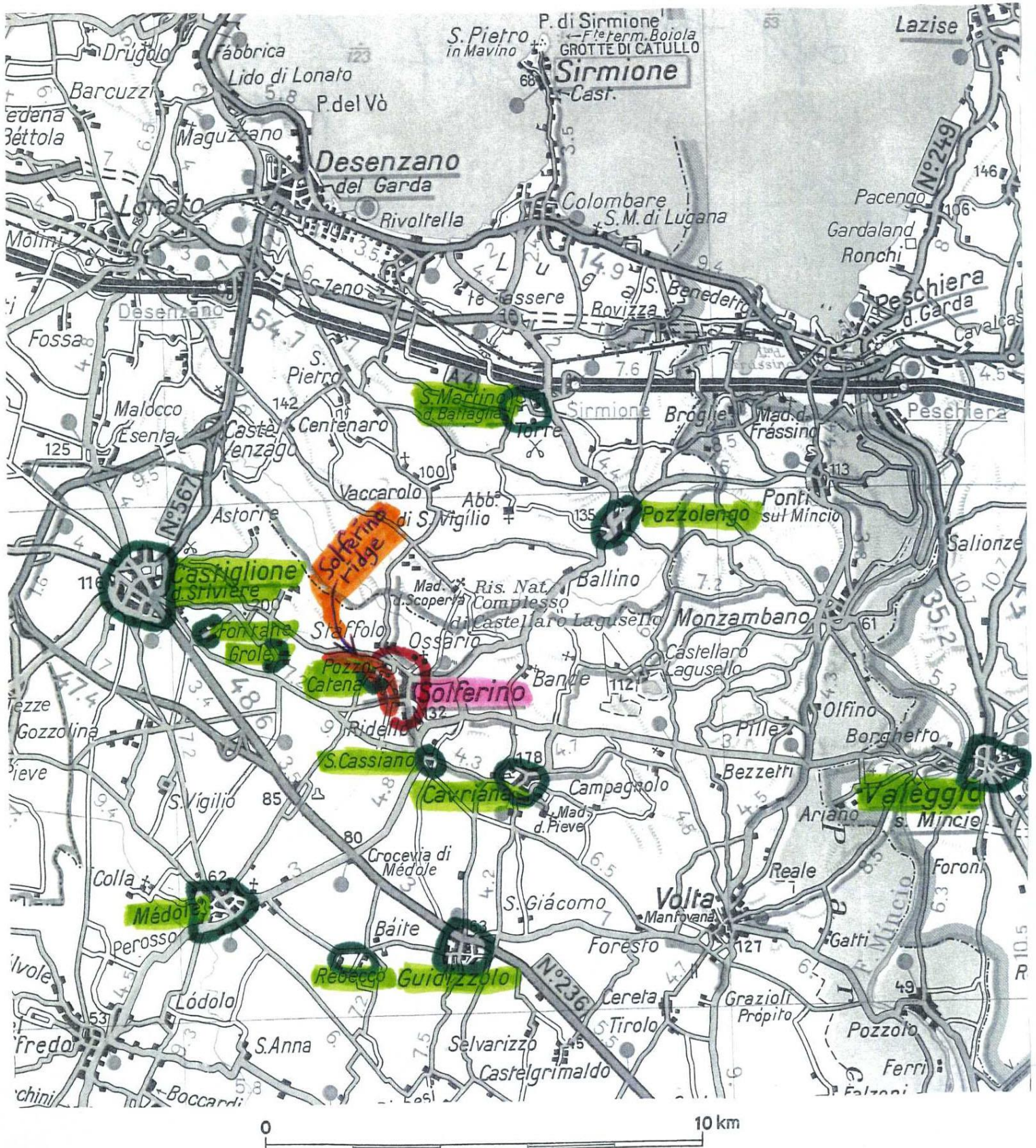
GEOGRAPHIC LOCATION OF THE SOLFERINO BATTLEFIELD (red dot)

Modified from *Prentice-Hall World Atlas* (J.E. Williams, 1960; p. 64)



PRESENT-DAY ROAD MAP OF SOLFERINO AREA

Modified from Lombardia map (Touring Club Italiano,
Carta stradale d'Italia, 1:200,000, foglio 2)



GEOLOGY

The Solferino battleground is dominated by a narrow, steep-sided, 100-m- (300-ft-)high ridge just W of the village of that name, with lower cultivated plains to both N and S,

thus noticeably higher than the 20-m-(60-ft-)high Cemetery Ridge at Gettysburg.

This Solferino ridge is an end- or terminal-moraine of late Riss (3rd Glacial; ~150 ka) age; it is one of the outermost moraines concentrically rimming the S end of Lake Garda.

The lowlands to the N are underlain by younger (Würm, 4th Glacial; 70-15 ka) till, and to the S by weathered older (mid-Pleistocene; ~300-600? ka) drift.

Bedrock does not influence topography here, unlike Gettysburg's Late Triassic redbeds vs. basal Jurassic diabase (220-200 Ma), whose contrast holds up Cemetery Ridge there.

The Solferino ridge consists of till, massive brown clay/silt, with many cobbles and pebbles floating in that matrix. It is hard, compact, and would have been difficult to dig fortifications into,

just as at Gettysburg, although in very different materials.

Those clasts are subrounded, probably water-worn by the ancestral lake before being picked up by the glacier filling its valley.

They include many volcanics, some carbonates, and a few crystallines:

- ~50-75% volcanics (red, gray).
- ~25-50% carbonates (mostly light-gray dolomitic micrite, minor shelly limestone).
- ~10-25% crystallines (pink granite, gray schist).
- ~ 1% occasional tan quartzite.

Those seem consistent with the bedrock types exposed in the Alps to the N of the battlefield.

These materials are visible in a few road-banks; the cobbles also appear in the oldest buildings, walls, and the tower, all built from the only locally available building stones in the immediate area.

Solferina area moraines

Giovanni B. Castiglioni

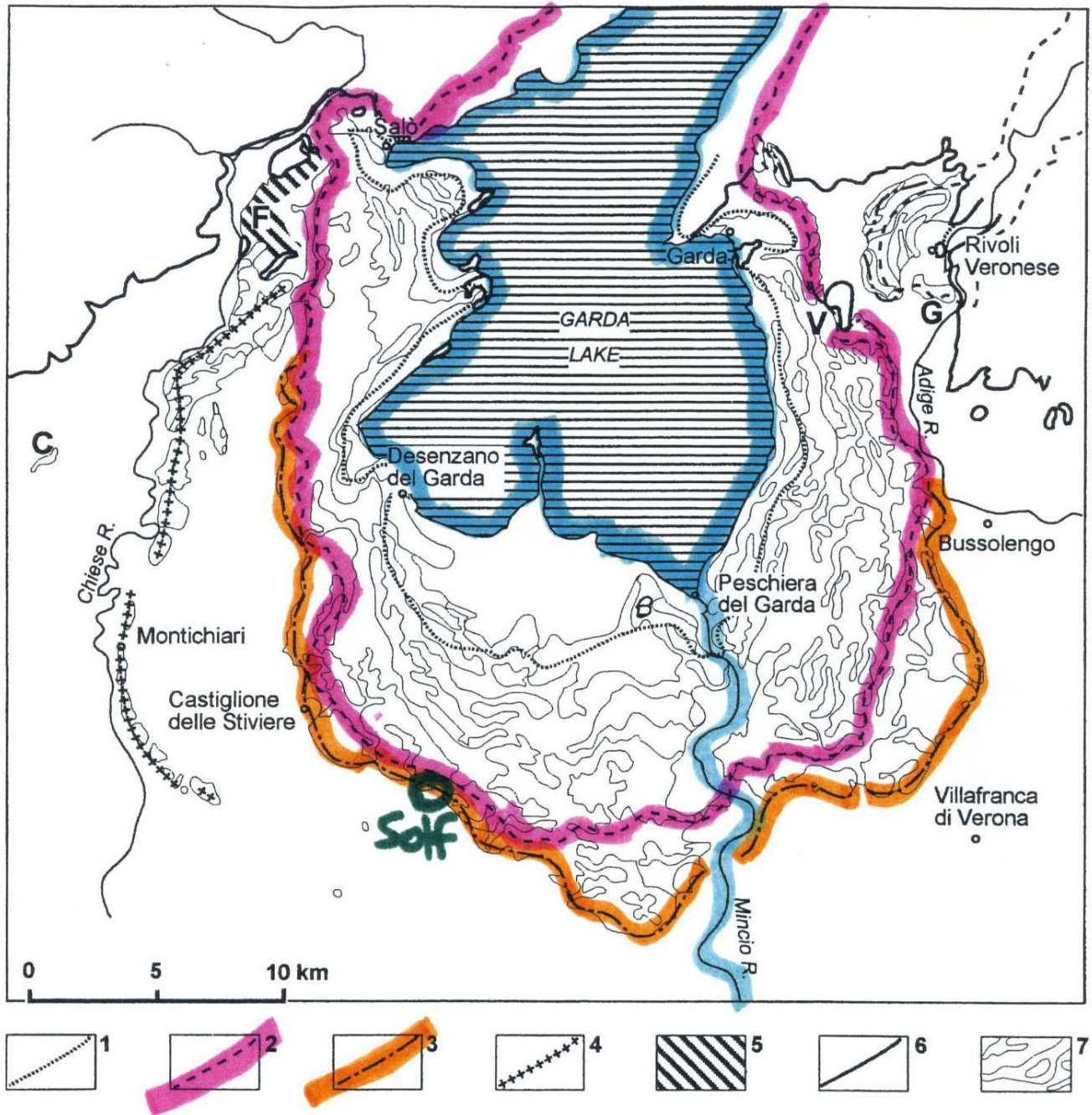


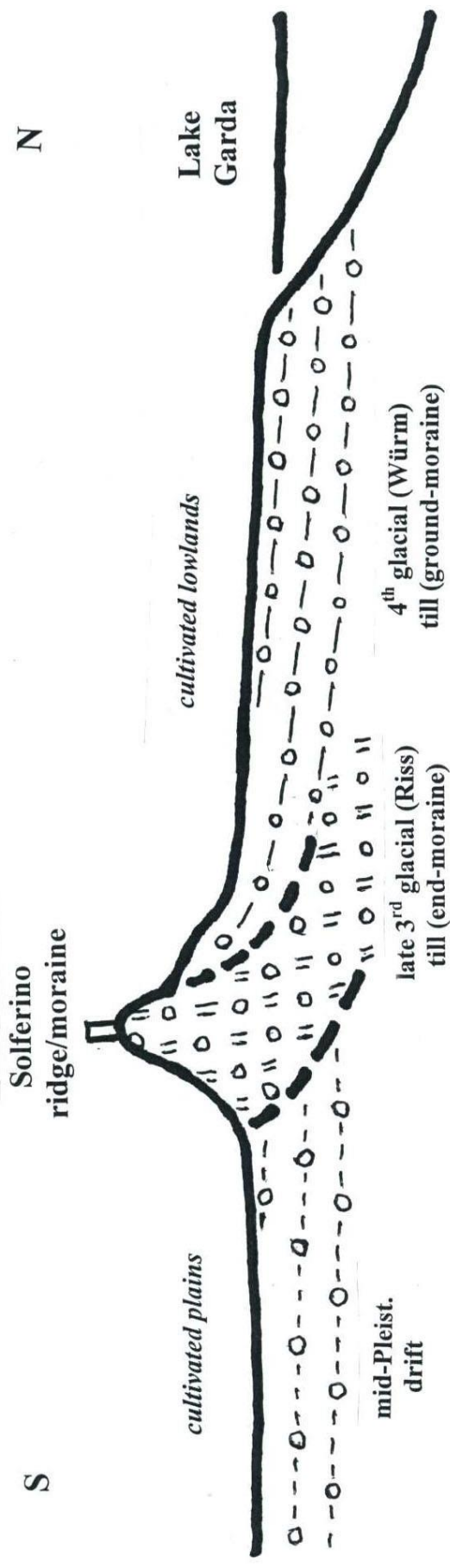
Fig. 1. Sketch-map of Lake Garda moraine complex, with limits of glaciations, according to various authors. Sites of particular interest: C: Ciliverghe hill. F: Monte Faita (see Figs. 2 and 3). G: Gaium quarries. V: Valsorda section.

Legend:

- 1 - Würm, after Venzo (1969a, 1969b).
- 2 - Limit of Würm moraines, after Habbe (1969).
- 3 - Limit of Young Riss moraines according to Habbe (1969) and limit of 'Solferino Moraine' (Late Pleistocene) in the main Garda complex, according to Cremaschi (1987).
- 4 - Old Riss moraines after Habbe (1969); Middle Pleistocene 'Carpenedolo Moraine' after Cremaschi (1987).
- 5 - Monte Faita moraine: Young Riss, after Habbe (1968; 1969); Early to early Middle Pleistocene, after Cremaschi (1987).
- 6 - Margin of outcropping pre-Quaternary relief (Geomorphological Map of Po Plain, 1997).
- 7 - Morainic ridges and intermorainic depressions.

Castiglioni, 2004, p. 210

Diagrammatic Cross-Section of the Solferino Battlefield
 (not to exact scale; RJC '13)



absolute ages/dates (TY=ka)	mid-Pleist. ~300-600?	late Riss ~150	entire Würm (late Würm) 70-15	Holoc./Rec. 12-0

Solferino ridge, a late-Rissian (~150 ka) end-moraine, with Solferino tower on its highest point, seen from low ground 3-4 km (above, and 5-6 km below) ENE of Solferino village.



Solferino tower atop Solferino ridge/moraine, seen from 0.5, 0.8, and 1.5 km E of Solferino village.



Solferino tower (La Rocca = The Rock or Fortress; also = Spia d'Italia = Spy of Italy) built 1022 AD (medieval, pre-battle) using locally available cobbles from the morainal till, 23 m (~70 ft) high: exterior from ground and low-level air, interior with ramp ascending to the top. Post-battle tree growth now obscures this tower from some angles important during the battle, but other places can still see it reasonably well.

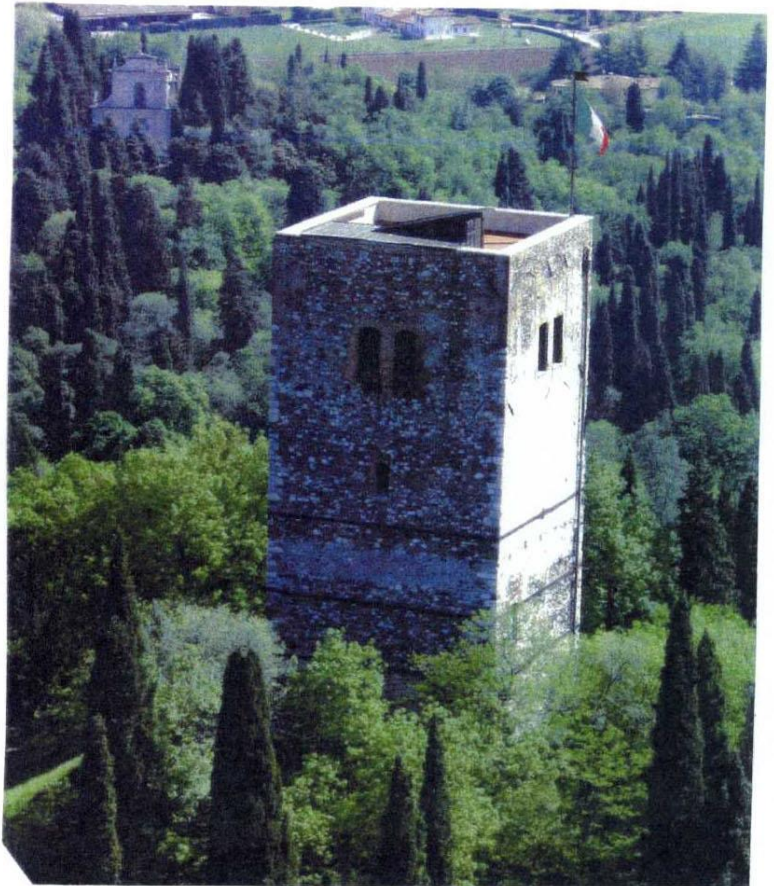
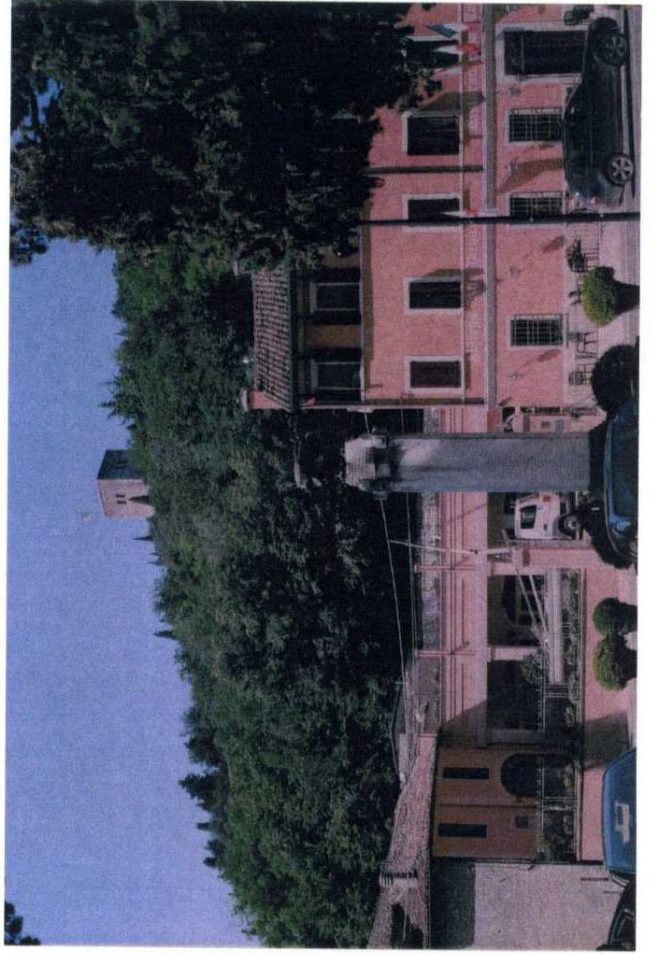




Figure *panorama*=6. View from top of Solferino tower, facing NW and downward along Solferino ridge crest; mid-day French assault came from the cemetery (far upper left), through the castle square (center right), and ultimately to the tower (on which the viewer is standing). [RJC 2 photos overlapping, 2013]

Present-day Solferino village: older apartment buildings along pre-automobile narrow street; new houses; hotel (Aubergo alla Vittoria) immediately below Solf. tower on hilltop.



**Present-day flat countryside E of Solferino village:
large farm estate (Corte Cassarole); crop fields and wood lots.**





More presently-visible battle damage at Solferino: shell holes in building wall outside entrance to Piazza Castello / castle square (very difficult to notice, because the steep road up from the village comes to a 4-way stop with no visibility to the right or left-behind, and you have to drive across and turn normal-left to go through this narrow gate/arch without scraping its sides). Br91

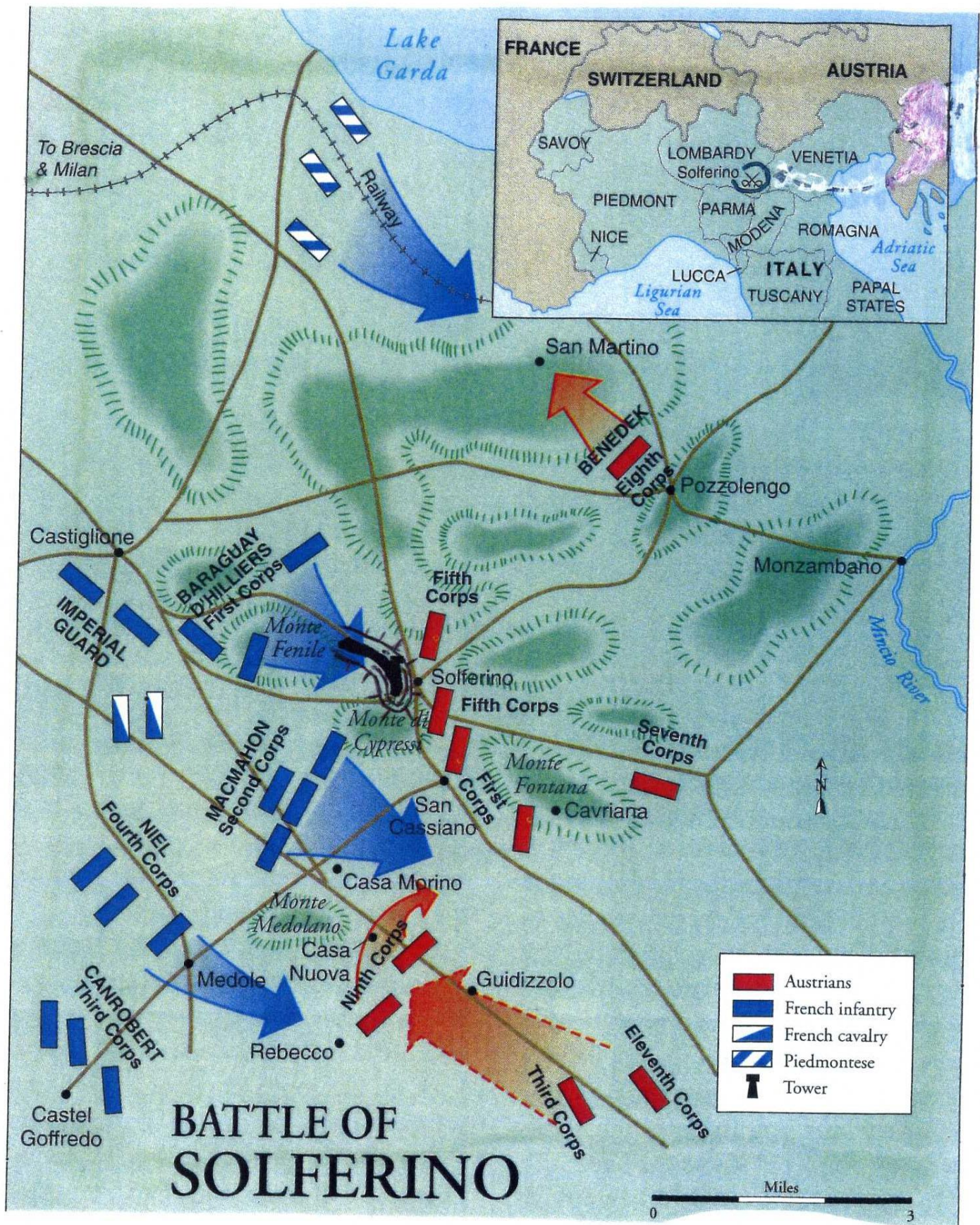


Figure *Uff mp*=8. Map showing in generalized fashion the troop dispositions around Solferino somewhat before the mid-day climax of the battle; heavy black curved line in center is the high crest of Solferino ridge. Modified from Uffindell (1999, p. 109).

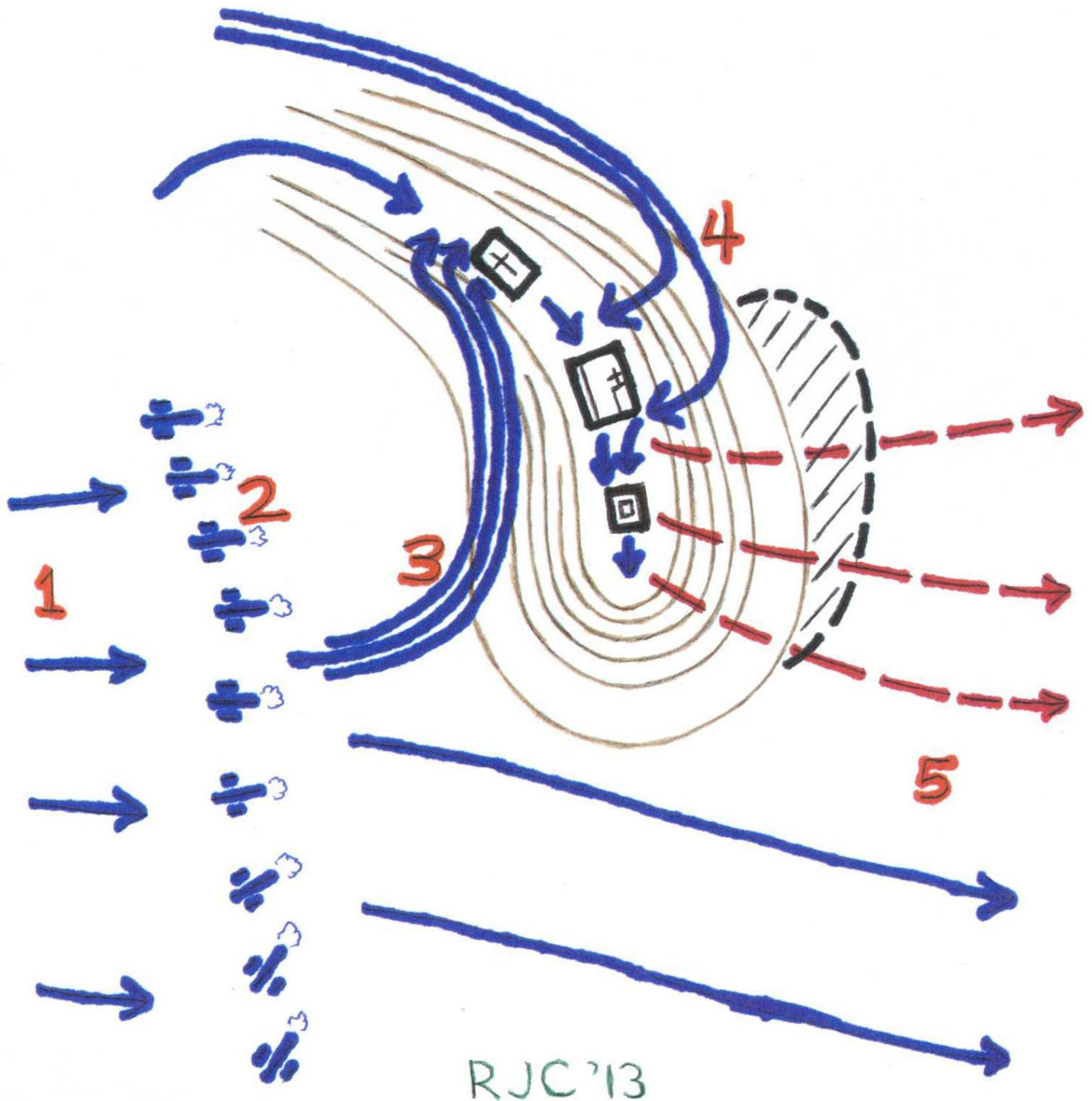
Battle: Critical Events

After considering the hour-by-hour progress of the Battle of Solferino, three events can be seen more clearly to have shaped its final outcome for the French:

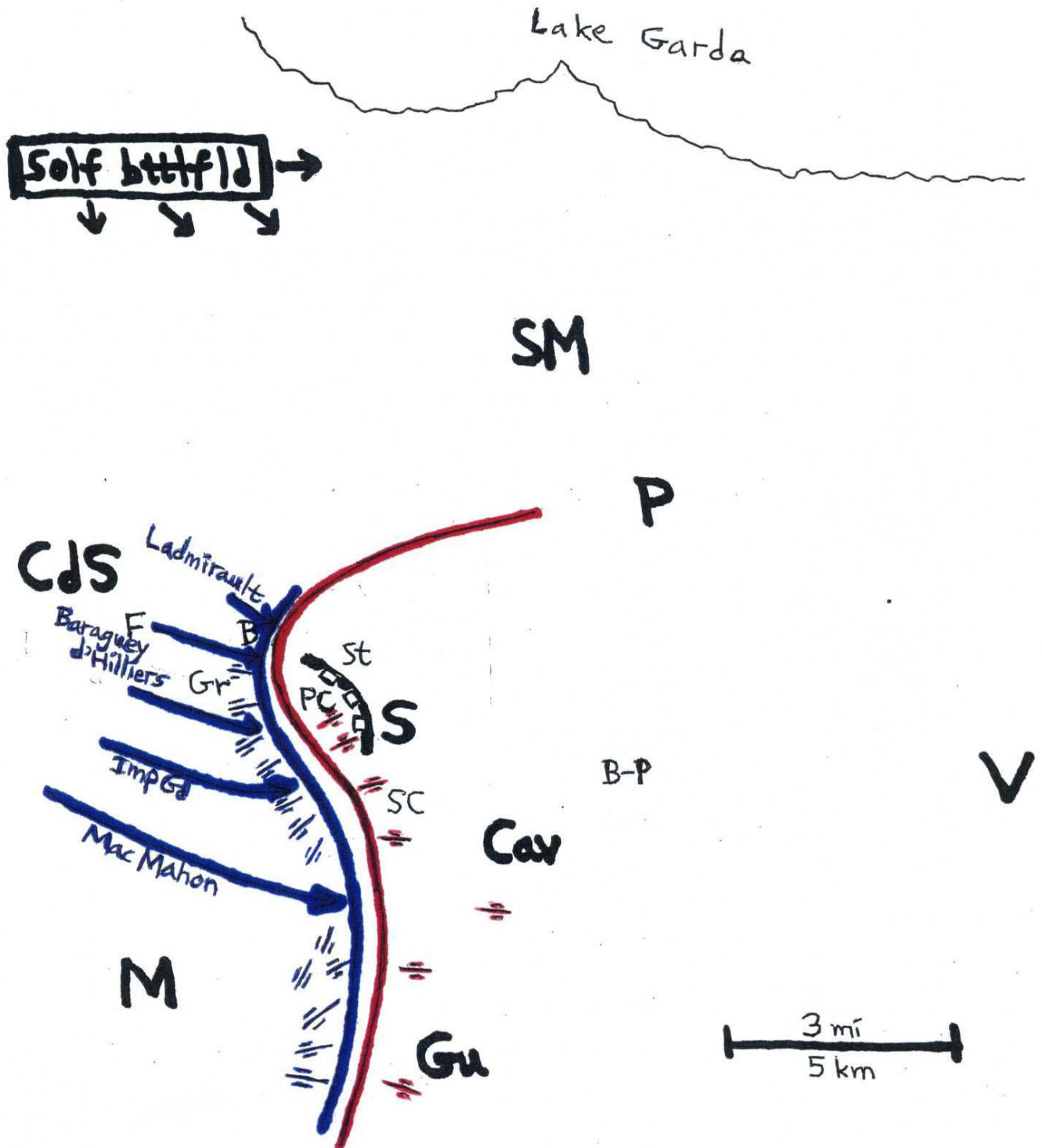
- Their initial massive artillery bombardment or cannonade against the Austrians up on the Solferino ridge-top;
- Their mid-day infantry assault up the W slope of that ridge;
- Their mid-afternoon infantry assault up its NNE slope.

These actions cleared the Austrians off the commanding high ground, and forced them to retreat off to the E by the end of the day.

Battle of Solferino (24 June 1859) – Critical Events: Schematic map/diagram, not to exact scale, but indicating the important topography (Solferino ridge) and troop maneuvers (1, initial French advance from the W; 2, mid-morning French artillery bombardment; 3, mid-day French assault up the W slope; 4, mid-afternoon French assault up the NE slope; 5, late-day Austrian retreat and French follow-up to the E); structures (NW to SE): cemetery, castle square with church, Solferino tower, Solferino village.



Battle 10:00 AM (24 June 1859): The Fr are getting better organized as they continue their E-ward attack (under Baraguey-d'Hilliers), especially getting many more guns into the fight, both on another low hill in their front (Monte Cipressi/Cypress Hill; Imperial Guard under d'Angely) and all the way down S to Rebecco (between Medole and Guidizzolo; Mac Mahon). Result is now a big artillery duel / cannonade [similar to E. Porter Alexander's later].



8-830A



8:00 AM: Nap3 at Fontane, watching his artillery open up on Solferino ridge (Meissonier's painting, 2 slightly different reproductions – note the cannon smoke better shown to the right in the black-and-white version). M'56, B16

(10A)

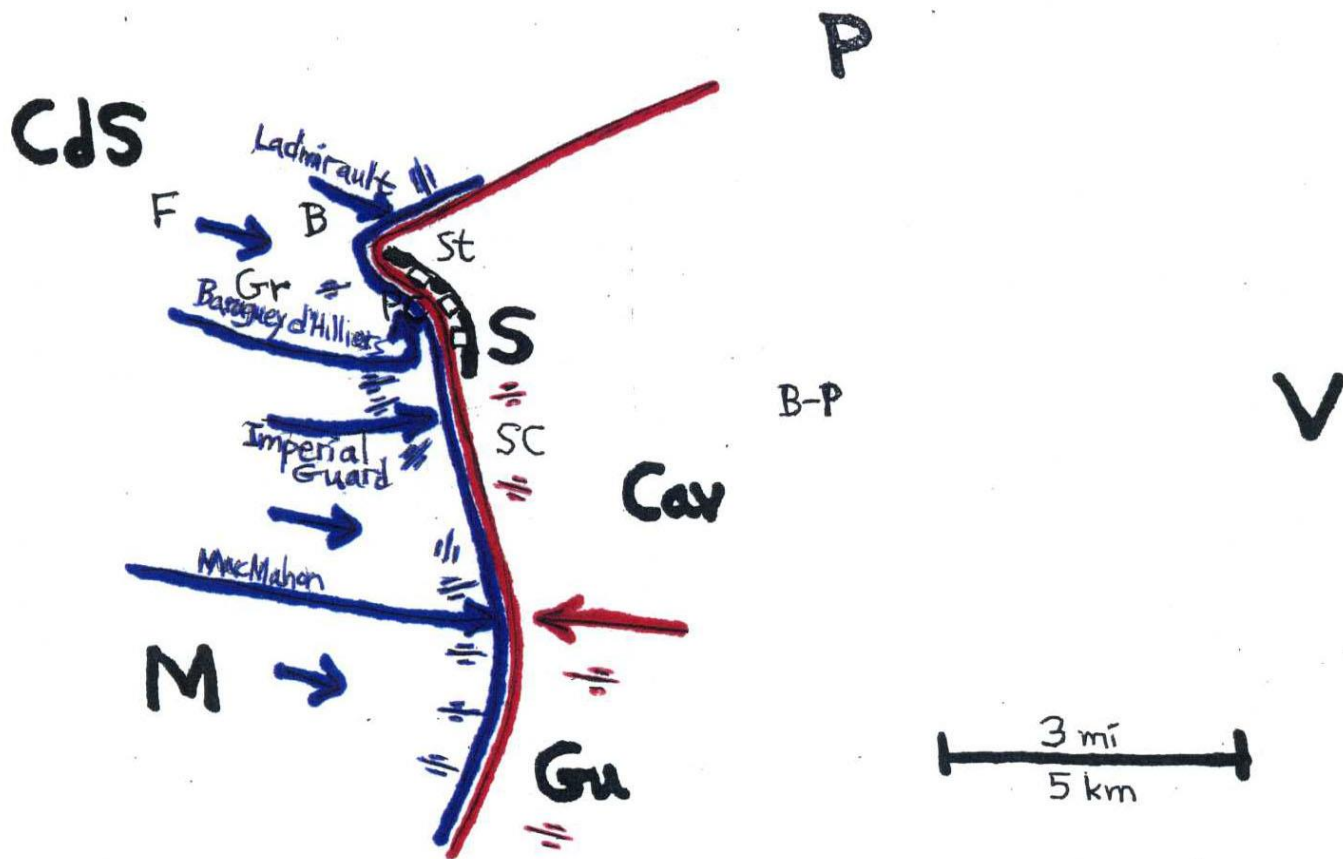


Bringing up more cannons. B back cover

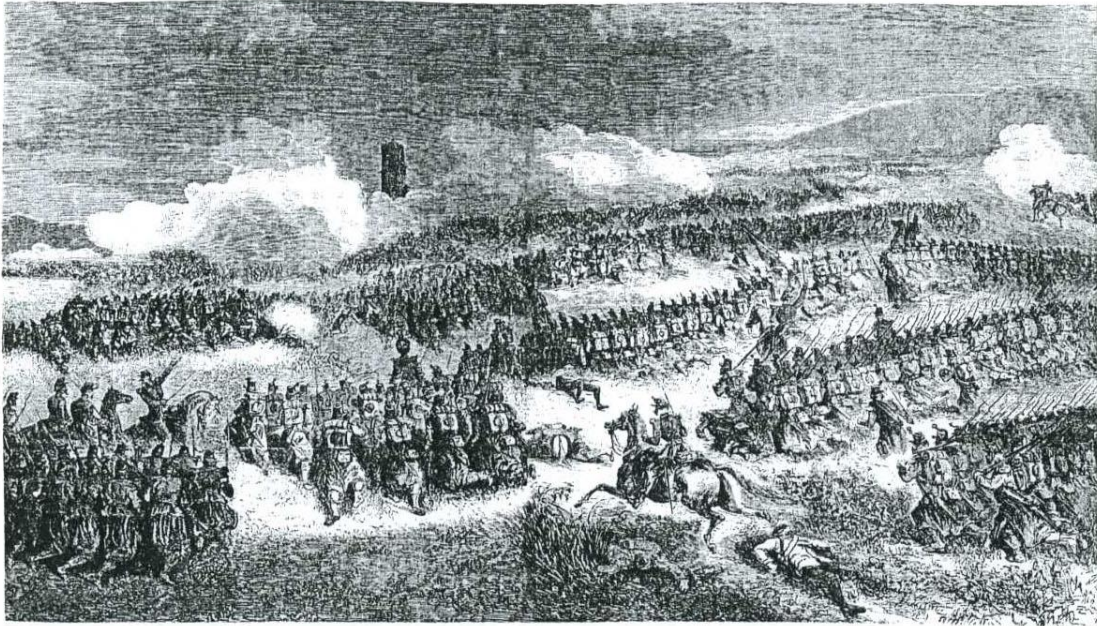


Setting up Fr guns to the S and opening fire (from Rebecca); note the Solferino ridge-top tower on the distant skyline. B28-29

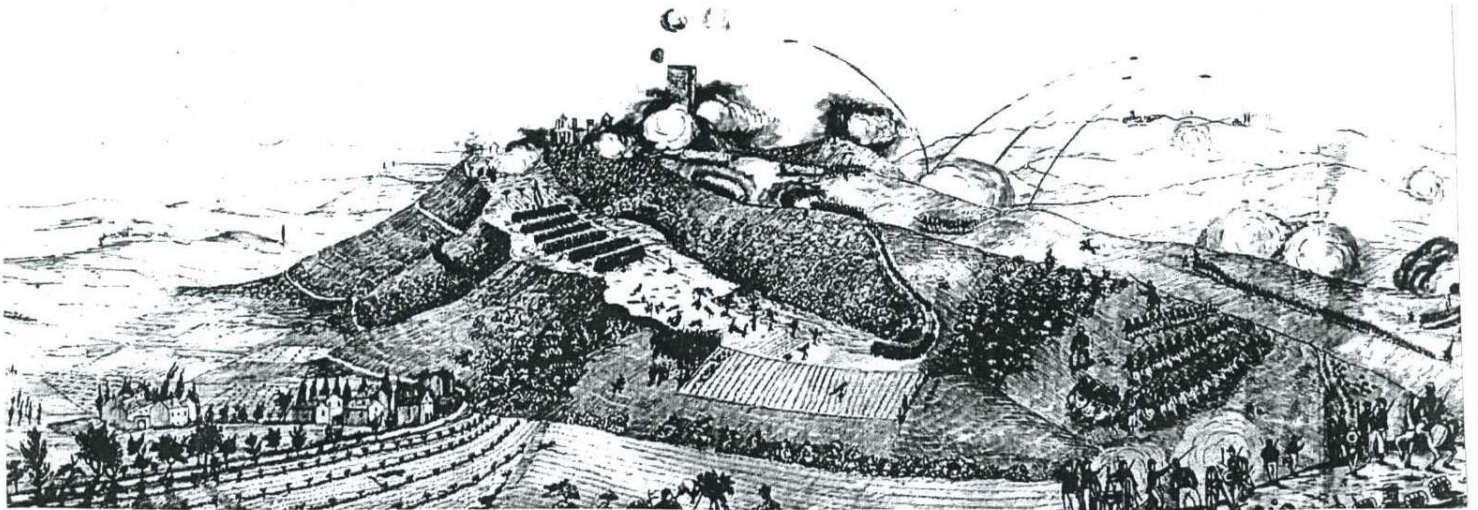
Battle 11:00 AM – 12:00 Noon (24 June 1859): Fr infantry assault up the W slope of Solferino ridge [similar to Pickett's Charge later], while their cannons continue to shell its top (especially around the tower [La Rocca or Spia d'Italia] up there).



11A-12N

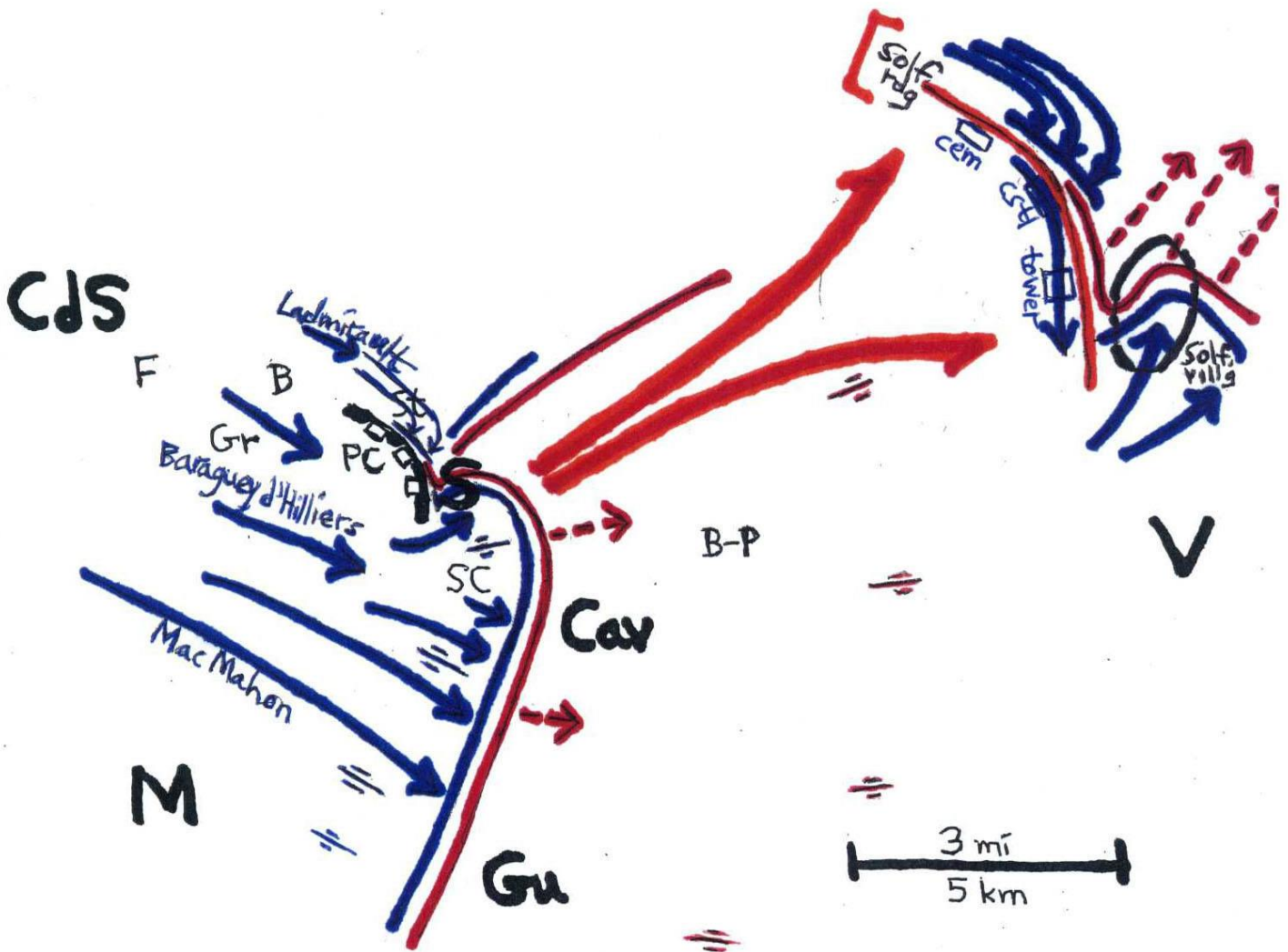


Fr infantry starting their assault on the W slope. Br77

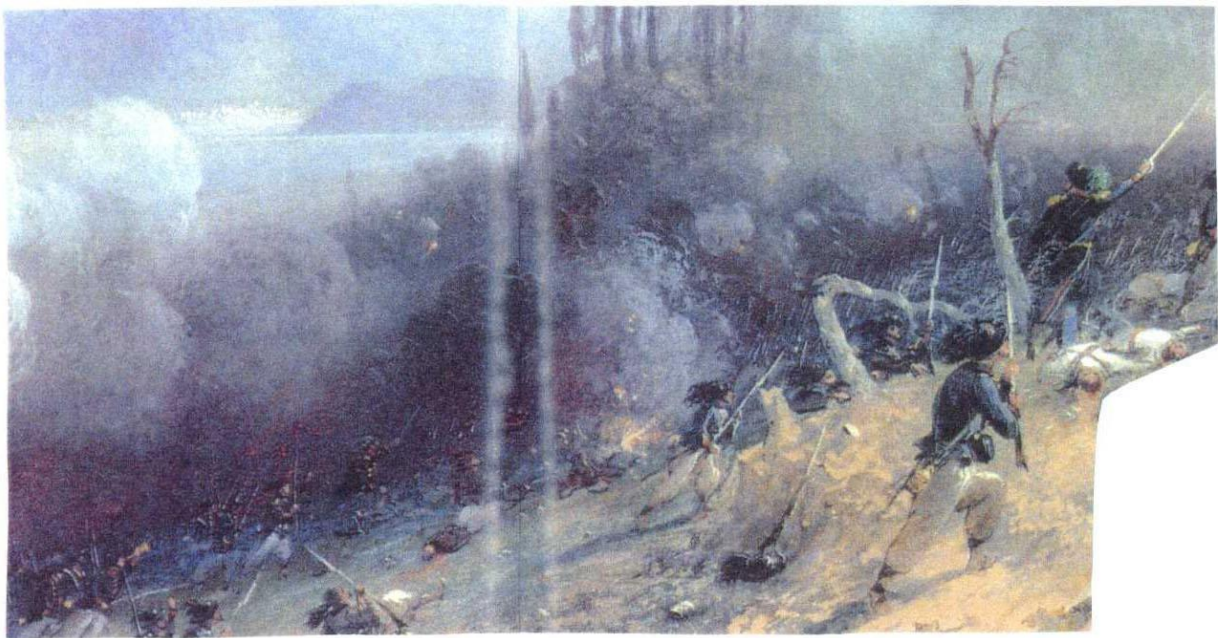


The Fr brigades going up the W slope, while Fr shells burst over the ridge top; the Au are starting to pull back to the SE and E, some of their guns going out a bit further E. B13

Battle 3:00 – 4:00 PM (24 June 1859): Ladmirault's division attacks up the NE slope of Solferino ridge, while the French troops already on top of the ridge finally take the tower, thus clearing the Au completely off the ridge top; the Fr also secure Solferino village below. The Au retreat NE and E into the lowlands, where some of their cannons continue to fire back at the Fr.



(3-4P)



Infantry assaulting up-hill/up-slope, illustrating Ladmirault's attack. B59, 19, 55

Ossuaries

American battlefields, including Gettysburg, contain military cemeteries with graves marked by small headstones or crosses. Occasional similar small ones can be found in the broad Solferino area, but much more obvious as memorials to the war dead are two specifically dedicated ossuaries (*ossario*), one in Solferino and another at San Martino.

Both are moderate-sized chapels, built a few years after the battle, in which skulls and bones collected from the surrounding countryside line the interior walls from floor to ceiling. The only specifically religious symbol present is a simple large wooden cross, standing free where the altar would normally be.

Many American visitors appear startled or shaken by these massive displays of death, since – so far as I am aware – nothing comparable exists on our soil. This tradition continued in Europe, culminating in the gigantic World War I ossuary at Verdun (France); perhaps its origins can be traced back to the Renaissance religious paintings showing hordes of skeletons pursuing hapless people.

(10+ yrs 1)

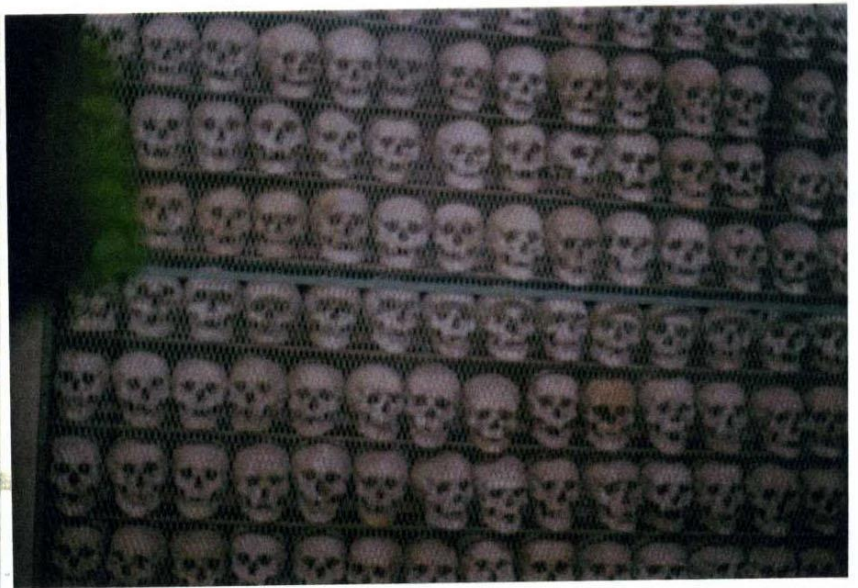
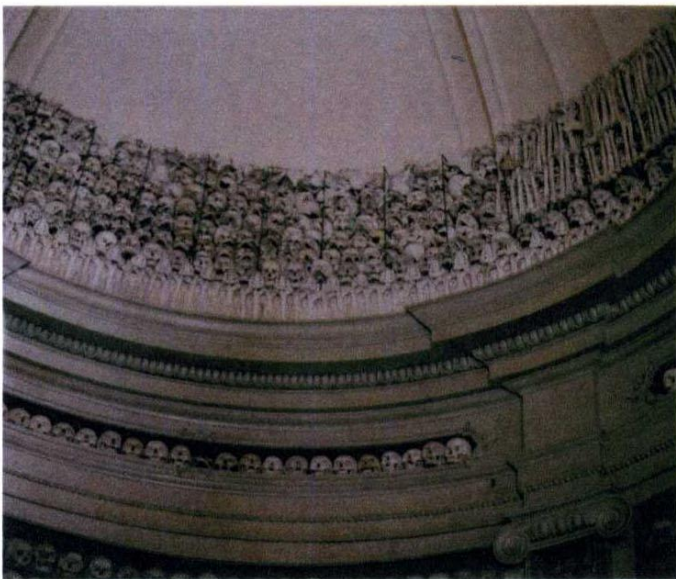
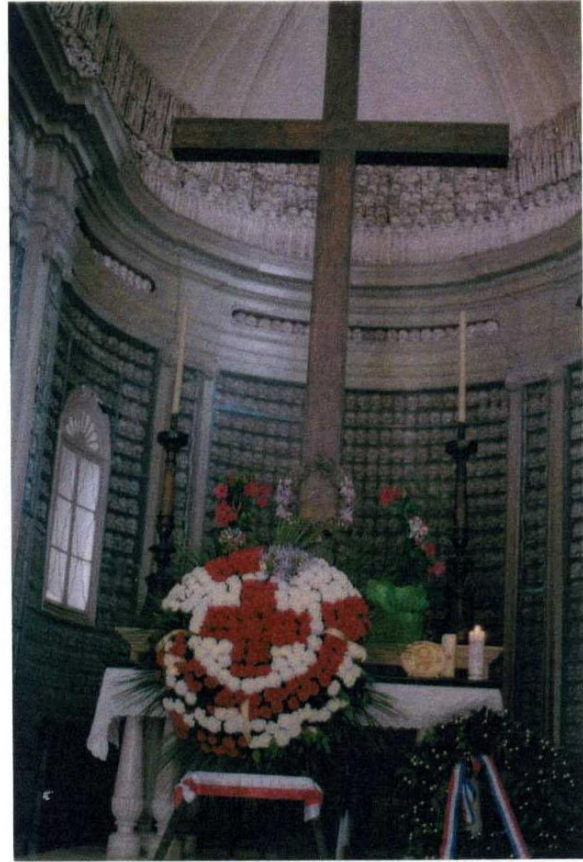


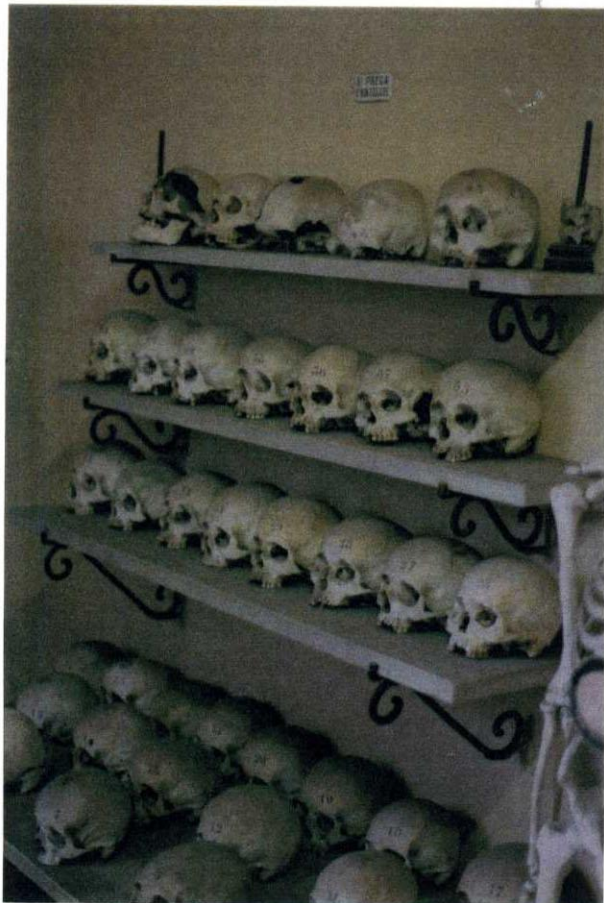
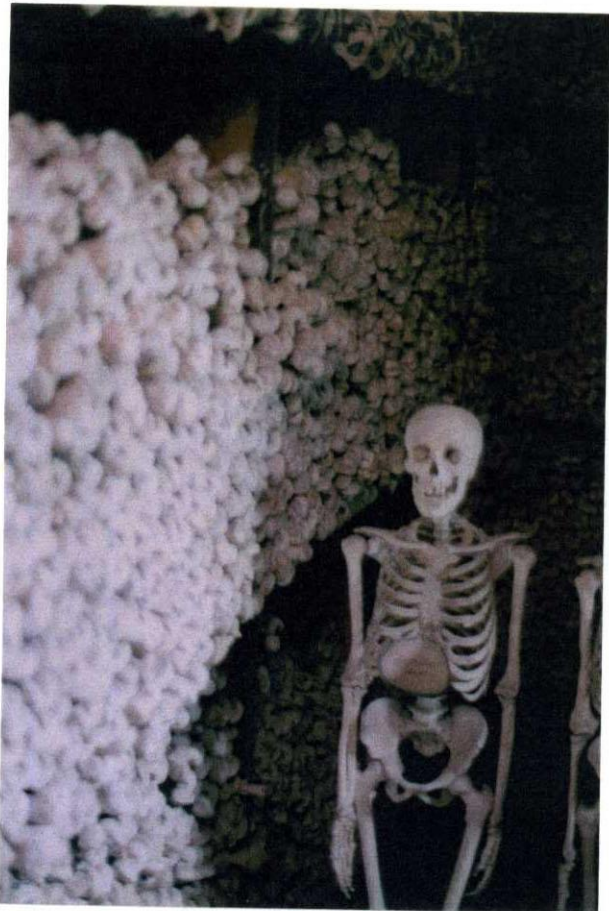
Bringing the bones into the Solferino ossario/ossuary (then on a nearly bare hilltop). G140



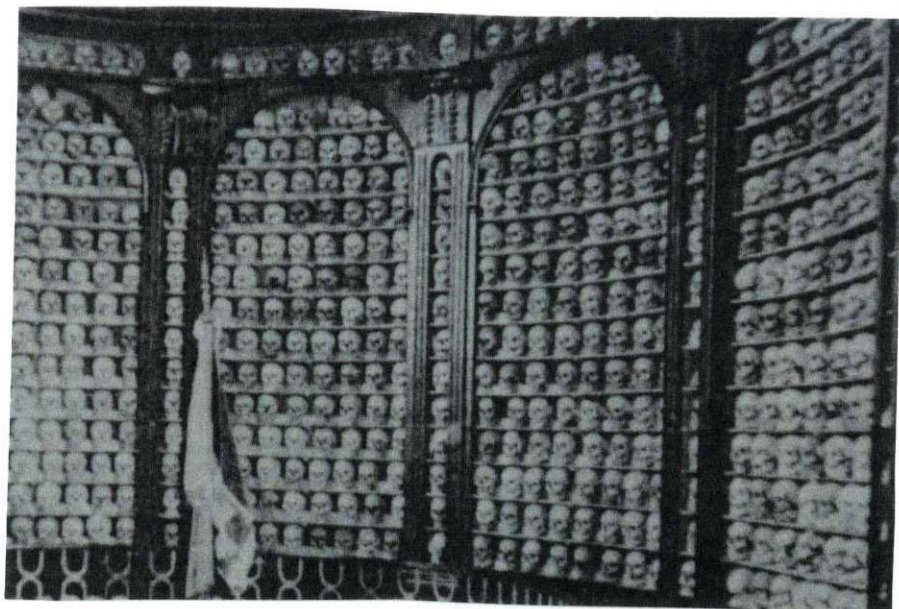
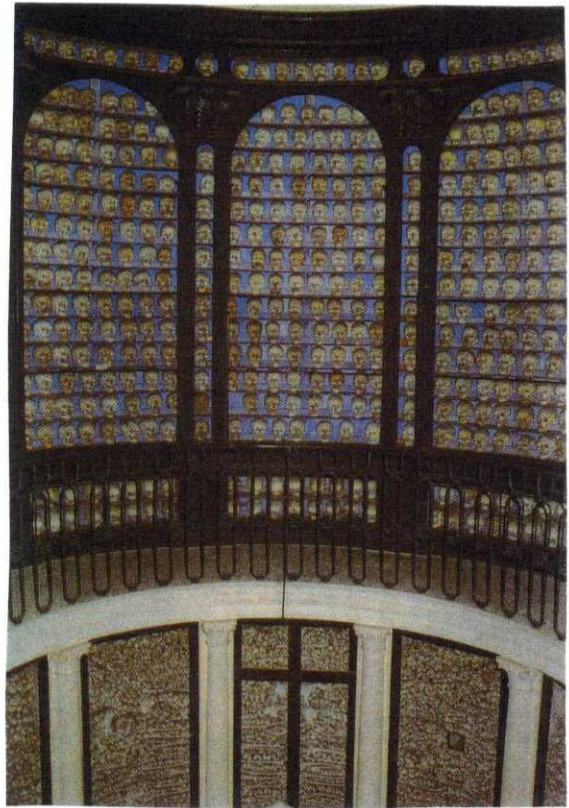
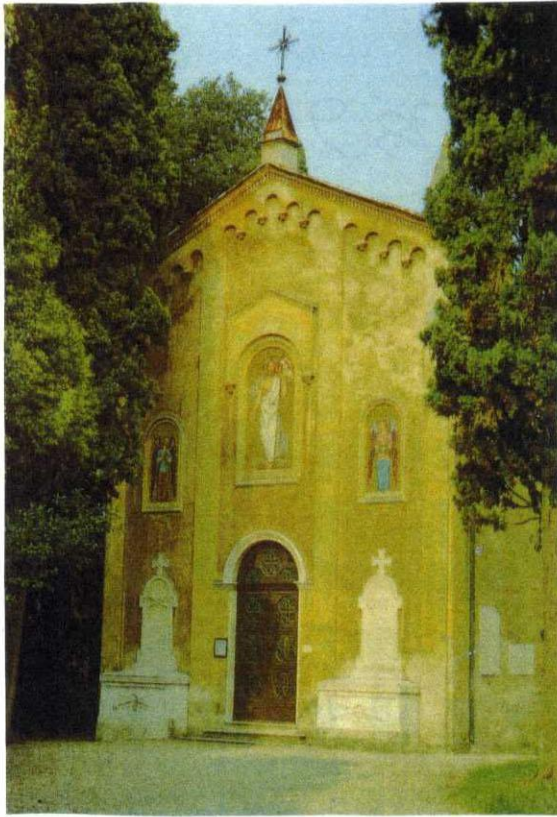
Ossario interior wall lined with skulls. 25A-15

Solferino ossario/ossuary - not a normal chapel; no altar, only a big cross; walls + alcoves packed with skulls + bones (killed in the battle). [I've worked with fossil human skulls etc., so am used to seeing such materials; but other visitors appeared shaken - I hope none of you will be offended/affected. [nice sample for intraspecific variability!]]





San Martino ossario/ossuary - much like the Sotferino one.



REFERENCES CITED

(At the end of each is a single letter,
which indicates the book from which the picture is taken from the pages indicated,
[for the poster pages])

- Borghi, B. 2008. 24 giugno 1859 – Solferino e San Martino, Le Pietre Raccontano La Storia [volume for the 150th anniversary]. Societa Solferino e San Martino & Tipolitografia Ciessegrafica, Montichiari; 107 p. B
- Borghi, B., ed. 2012. 24 giugno 1859, La battaglia di Solferino e San Martino, I luoghi della memoria; Quaderno didattico. Societa Solferino e San Martino, Desenzano del Garda; 31 p. T
- Brooks, R. 2009. Solferino 1859: The Battle for Italy's Freedom (Campaign 207). Osprey, Oxford; 96 p. Br
- Castiglioni, G.B. 2004. Quaternary glaciations in the eastern sector of the Italian Alps. In Ehlers, J., & Gibbard, P.L., eds., Quaternary Glaciations -- Extent and Chronology; Part I: Europe. Elsevier, Amsterdam; p. 209-214.
- Clark, C., & the editors of Time-Life Books. 1985. Gettysburg – The Confederate High Tide. Time-Life Books (Civil War Series), Alexandria; 176 p.
- Crane, S. 1900. Great Battles of the World. Lippincott, Philadelphia; 278 p. Cr
- Cuffey, R.J. 2004. Gettysburg Battlefield – Condensed Field Guide (May 2004). Privately distributed; 39 p.
- Cuffey, R.J. 2008. Virginia/Lee Memorial, Pickett's Charge, and the Battle of Solferino. In Fleegeer, G.M., ed., Geology of the Gettysburg Mesozoic Basin and Military Geology of the Gettysburg Campaign. Annual Field Conference of Pennsylvania Geologists (September 2008) [Guidebook], no. 73, p. 164-167.
- Cuffey, R.J. 2013. Virginia/Lee Memorial, Pickett's Charge, and the Battle of Solferino. In Fleegeer, G.M., ed., Rifts, Rocks, and Rebs: Terrain and Military Geology of the Civil-War Battle of Gettysburg, 1-3 July 1863. American Association of Petroleum Geologists (Annual Convention, Pittsburgh, Pennsylvania) Post-Conference Field Trip (23 May 2013) [Guidebook], (& Pennsylvania Geological Survey), p. 91-94.
- Cuffey, R.J., Inners, J.D., Fleegeer, G.M., & Lane, J.A. 2006a. The Gettysburg battlefield: Geology's impact upon military history. Geological Society of America Abstracts with Programs, v. 38, no. 7, p. 301-302.
- Cuffey, R.J., Inners, J.D., Fleegeer, G.M., Smith, R.C. II, Neubaum, J.C., Keen, R.C., Butts, L., Delano, H.L., Neubaum, V.A., & Howe, R.H. 2006b. Geology of the Gettysburg battlefield: How Mesozoic events and processes impacted American history. In Pazzaglia, F.J., ed., Excursions in Geology and

History: Field Trips in the Middle Atlantic States. Geological Society of America Field Guide 8, p. 1-16. C

Department of the Army. 1956. American Military History, 1607-1953 (ROTCM 145-20). U.S. Government Printing Office, Washington, D.C.; 510 p.

Dunant, H. 1862 (reprinted 2010). A Memory of Solferino (English translation of *Un Souvenir de Solferino*). International Committee of the Red Cross, Geneva; 147 p. R

Du Riche Preller, C.S. 1915. The moraine walls and lake basins of northern Italy. Geological Magazine, decade 6, v. 2, no. 9, p. 403-410.

Inners, J.D., Cuffey, R.J., Smith, R.C. II, Neubaum, J.C., Keen, R.C., Fleeger, G.M., Butts, L., Delano, H.L., Neubaum, V.A., & Howe, R.H. 2004. Rifts, Diabase, and the Topographic "Fishhook": Terrain and Military Geology of the Battle of Gettysburg – July 1-3, 1863. Geological Society of America (Northeast/Southeast Section) & Pennsylvania Geological Survey (Harrisburg), Field Trip Guidebook 4 (March 24, 2004), 105 p.

Inners, J.D., Cuffey, R.J., Smith, R.C. II, Neubaum, J.C., Keen, R.C., Fleeger, G.M., Butts, L., Delano, H.L., Neubaum, V.A., & Howe, R.H. 2006. Rifts, Diabase, and the Topographic "Fishhook": Terrain and Military Geology of the Battle of Gettysburg – July 1-3, 1863. (Geological Society of America National Annual Meeting, Philadelphia, Pennsylvania, Post-Meeting Field Trip, 26 October 2006). Pennsylvania Geological Survey Open-File Report 06-02, 105+ p.

Istituto Geografico Militare Italiano. 1960. Italy 1:100,000 topographic map series (many sheets/quadrangles).

Meyer, J., et al. 1888. Karte der Schlacht bei Solferino (24 Juni 1859). Meyers Konversations-Lexikon (Leipzig), 4th ed., v. 15, p. 10.

Morris, G. 2004. The Battle of Solferino. Battlefield Anomalies website, <http://www.battlefieldanomalies.com/solferino>

Salamida, J.C. 2005. Artists on war: Meissonier's passion for the military. MHQ: The Quarterly Journal of Military History, v. 17, no. 3, p. 52-57. M'

Societa Solferino e San Martino. 1989. Guida ai Monumenti di San Martino e Solferino. Societa Solferino e San Martino & Litografia Benacense, Lonato; 153 p. G

Touring Club Italiano. 2008. Carta stradale d'Italia, 1:200,000. Milano; multiple [road] maps.

Uffindell, A. 1999. Glory costs too much. MHQ: The Quarterly Journal of Military History, v. 12, no. 1, p. 102-111. M

Wikipedia [on-line encyclopedia]. [2013]. [entries for] Battle of Solferino, Lake Garda, Solferino [village], the various commanders, etc. W

Williams, J.E. 1960. Prentice-Hall World Atlas. Prentice-Hall, Englewood Cliffs; 122 p.