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Visualizing the map-making process: 
Studying 19th century Holy Land cartography with MapAnalyst

Keywords: map production; Holy Land; planimetric accuracy; Charles William Meredith van de Velde; Justus Perthes

Summary: This paper tests the potential of MapAnalyst for reconstructing and visualizing the production process of historical maps. MapAnalyst is an open source computer program for analyzing historical maps in various ways, accessible also for the technically inexperienced user. Within a German-Israeli research project on Holy Land cartography in the mid-19th century, we examined two editions of the “Map of the Holy Land” (1858 and 1865) by Charles William Meredith van de Velde with the help of MapAnalyst. Aided by additional sources, published and archival, we could not only prove that the map is much more heterogeneous than visible at first sight, but that the third party sources the cartographer used to make his map were verified and ranked according to an internal system of reputation that not necessarily resulted in increased planimetric accuracy.

Introduction: Holy Land cartography and cartographers

Geography and mapmaking in Europe in the mid-19th century were not necessarily national endeavours, nor were the emerging fields of Palestine research and biblical geography. Thus the subject of this paper, an English-language “Map of the Holy Land”, was made by a Dutch cartographer with a German publishing house. Moreover, the origins of this truly international project were in London, where probably in 1854 two gentlemen met, one Dutch, one German.¹ Both were in their thirties and shared a vivid interest in geography and cartography. August Petermann, born 1822 in a small Thuringian town, had been trained as a cartographer at Heinrich Berghaus' Geographische Kunstschule at Potsdam. He had then moved to Great Britain in 1845, at that time the epicenter of geography, to work with A. K. Johnston and later to start his own cartographic business. In 1854 he was on the brink of a career with the Gotha publishing house of Justus Perthes, where shortly after he founded the “Mittheilungen aus Justus Perthes' Geographischer Anstalt”, or Petermann's notes, a journal that would dominate the European discourse on geography and “summarise and graphically illustrate the results of new geographic explorations in precisely executed and carefully detailed maps”.² His Dutch counterpart Charles William Meredith van de Velde came from a navy family in the Frisian town of Leeuwarden in 1818 and had joined the Dutch Royal Navy at 14. He there

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¹ The earliest surviving letter by van de Velde to Petermann dates from December 8, 1854, but hints to an earlier meeting. The correspondence is held by the Perthes Collection Gotha, part of the Research Library Gotha of Erfurt University, in the following quoted as FBG-SPA. We are deeply indebted to Petra Weigel and Sven Ballenthin of the Perthes Collection for their most generous help in locating and working with this correspondence and related archival materials.
received a thorough training as surveyor and cartographer, but also showed considerable artistic talent. After a career in the navy surveying departments and the Dutch colonies, he quit service at the end of 1846 as a lieutenant (Klaassen 1979: 79) and henceforth dedicated his time to map-making and landscape painting. He was also an ardent Protestant and apparently active in missionary activities (Molhuysen and Blok 1927: 1225–1226). In 1850/51 he traveled to the Holy Land – back then also referred to as southern Syria – to make a measurement-based map of the region that had long been considered a desideratum (van de Velde 1858b: 1). After some difficulties finding a suitable publisher, August Petermann recommended Justus Perthes at Gotha. Interestingly enough, there are no later traces of Petermann’s involvement in the surviving correspondence of van de Velde and the publishing house. Perthes eventually published the map in eight sections (in 1:315,000 scale or 1/3 inch to a mile) in 1858, followed by an updated second edition in 1865/66. By and large, the “Map of the Holy Land” was considered the most accurate cartographic representation of the region until the Palestine Exploration Fund’s (PEF) “Map of Western Palestine”, published in 1880 (Conder and Kitchener 1880). We will discuss this claim in depth later on. Besides its accuracy, reviewers also praised the maps’ beauty and clarity (so Anon. 1859: 205-206).

Van de Velde was a rather interesting protagonist of the nascent Palestine research in the 1850s and 1860s. Similar to others in his field, he had a military background, not an academic one, but was obviously driven more by faith than by military ambitions (van de Velde 1858b: 1). He was also not confined to mapping but ventured into biblical geography, writing a two-volume travelogue with a very distinct view of the country and a great many attempts at identifying biblical places. Furthermore he was a gifted artist, publishing a precious collection of no less than one hundred lithographs of the Holy Land, including sites in today’s Lebanon and Syria (1857). He thus expressed his view of the region in various media – narrative, visual, and cartographic –, which make for three very different images of the same region and the same person’s travel experience. Although we cannot go into detail here, the discrepancy of these three Holy Land images is a fact worth mentioning but mostly overlooked.

The former Dutch navy lieutenant, cartographer, artist, and biblical geographer was later also active in humanitarian missions, the earliest in Syria on his second trip to the Holy Land in 1861/62, where he investigated the state of the Christian population after the 1860 Druze-Maronite massacres (van de Velde 1865c: 1). Together with Henri Dunant and others, he co-founded the Red Cross precursor organization at Geneva (Rombach 1962). It is not entirely clear how he managed to sustain himself financially in all his endeavors. As a matter of fact, his family was not wealthy; his father had been a medical officer in the navy (Klaassen 1979: 79; de Vries 1996: 15). Van de Velde never married and, as we can see from the ten-year correspondence with his publisher, was constantly changing domiciles, zigzagging between London, Paris, Utrecht, and summers in the Swiss mountains. Unlike his correspondence with Perthes, his late papers have apparently not survived.

The map in question here was the second larger map van de Velde published, the first being a map of Java (1845; scale 1:700,000). The “Map of the Holy Land” (1858a) was based on his eight-month survey in the region in 1851/52, which he combined with cartographic and surveying data by third parties. One of the most unusual facts about this map is that, except for engraving the copperplates, van de Velde did almost everything himself. Even when measuring on location in Palestine and Syria, he got by with a few local aides which were rather guides and interpreters than technical assistants. In fact he was more or less a one-man surveying party. Although in the mid-19th century, today’s academic subjects had only

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3 Many thanks to Ayelet Rubin of the Laor Map Collection, The Jewish National and University Library, for a glimpse at the wonderfully preserved copy from the collection of Jacob Wahrman (1924–2005).
begun to take shape as distinct professional disciplines, a surveyor-cum-cartographer-cum-landscape painter-cum-travel writer was certainly rare. Even more peculiar was the idea of “mapping Palestine single-handed”, as almost 50 years later an obituary would put it (Anon. 1898). On a final note we have no definite clue how he funded his surveying trip, although we know of his close proximity to Protestant missionary societies in Palestine like the “London Society for Promoting Christianity Amongst the Jews”. Since he worked without trained assistants, he had to resort to instruments that lagged behind the technical standards of his time. He did not use a theodolite, as it needed several people to be operated (van de Velde 1858b: 3–4). He most likely would also not have gotten his hands on one of the costly and mostly military-owned theodolites of his time. Yet although he measured his angles with only a 7-inch surveyor’s compass,4 jotting down the hours traveled between two locations (1858b: 23), he managed to create a map that was deemed one of the most accurate of the region (Tobler 1867: 243 on the 2nd edition: “entschieden die beste [Karte], die wir jetzt kennen.”). The map was engraved on copperplate and the prints lightly colored by hand: lakes and coastal lines blue, borders of the Ottoman pachaliks green and pink, the traveled route in red. It displays an area about 380 km long and 200 km wide, ranging from E 034°30’ to E 037°00’ and N 034°30’ to N 030°55’ (Greenwich meridian), or from Tripoli (a coastal city in today’s Lebanon) to Rafah, nowadays the border between Gaza and Egypt, and from the Mediterranean to the Negev desert and the regions east of the river Jordan. The second edition was published in English and German, in 1865 and 1866 respectively (the 1858 edition had been English only). The German edition featured hypsometric layers (Höhenschichten) in color, a recent Perthes hallmark. There are various copies of the map available online, the highest resolution at the Amsterdam Free University library website.5

Map-Making as a socio-technical process: Why MapAnalyst?

MapAnalyst (www.mapanalyst.org) is an open source computer application for the “analysis and visualization of geometric properties of historical maps” (Jenny 2006: 239) launched by a Swiss team of experts in 2005. Simply put, the application links points on a historical map to points on a current map, then references both in the same system to compute a variety of differences between them. So far, MapAnalyst has mostly been used for measuring planimetric accuracy and comparing various historical maps (e.g. Heere 2011). While there is nothing wrong with that, we want to take this one step further and see how MapAnalyst can help us shed light on the processual aspects of map-making. As the program is easy to use and free, it enables researchers without previous experience to carry out computer-assisted map analyses, making GIS technology accessible outside the GIS expert circles.

Since the 1970s, sociology of science has increasingly focused on research practices and the social construction of scientific facts (pioneering: Latour/Woolgar 1979). Beside the laboratory, historical science studies currently lay emphasis on the “field” as place of knowledge production, including the special role of mapping and the production of geographical imagination (such as Edney 1997, Driver 2001). Accordingly, historians try to reconstruct the process of knowledge production by examining the various stages and places of observation, communication, and transformation of knowledge (e.g. Nielsen et al. 2012). Moreover it has become clear that we need a procedural understanding of mapping (Kitchen et al. 2012).

4 A “‘boussole d’arpentage’ with two levels, cross-threaded plunging telescope and vertical semicircle with nonius” (van de Velde 1858b: 3-4). He later removed the vertical semicircle as he found no use in measuring horizontal angles (ibid.).
Yet up to now, there are few studies on the exact process of “map-making” as a socio-technical construction of knowledge, and even less within the history of cartography (Schelhaas and Wardenga 2011). A map is never an isolated product (Wood and Fels 2008: 8–12 on the paramap; Schunka 2011 on map commentaries). In our case, the “Map of the Holy Land” was just one of several media C. W. M. van de Velde used to convey his Holy Land experience. Besides his map, the travelogue (in Dutch, German and English), and a luxury album of lithographs, he also published an extensive “memoir”, a sort of manual to account for the sources and the good practice of his map-making. Combining the information from these sources with MapAnalyst’s potential, we hope to join quantitative and qualitative means to ultimately reconstruct the map-making process. Thus we are not only interested in the map’s planimetric accuracy but also in the “graphic presentations of planimetric accuracy [that] allow for discovering and understanding new facts about a map” (Jenny, Weber and Hurni 2007: 89). After all, it is to be expected that historical maps are not as accurate as today’s. It is also obvious that they become the more accurate the more recent they are. A narration of cartography constantly progressing towards a “truer” depiction of Euclidean space – or “reality” – does not appeal to us anymore today (Speich 1996: 4–6). In his research review of recent findings in the history of cartography, Daniel Speich (1996) distinguished between map history (“Kartengeschichte”), history of cartography (“Kartographie-Geschichte”), and history of maps and cartography as part of a larger cultural history (“Karten als Quelle der Geschichtswissenschaft”). Our aim is to find somewhat of a middle ground: We want to use the tool kit of map history in order to supplement the cultural historian’s toolbox, without classifying maps as “wrong” or “right” and cartographers as “successful” or “unsuccessful” (Speich 1996: 4–5). While MapAnalyst seems to reiterate some assumptions of traditional map history when it speaks of “displacement”, “distortion” and “true value”, this is not part of its approach or methodology and is probably the habitual usage within map history.

Setting to work with MapAnalyst

Course of action

There is no need for another MapAnalyst manual, as the existing one is instructive and easy to read (http://mapanalyst.org/man/man.html). We rather want to share our experience as users with little previous knowledge on map computations and digital map analysis. To our delight, we found that basic computer skills suffice to start working with MapAnalyst. However, not having skipped your statistics lectures helps to better understand the capabilities and results of the program. So special thanks goes to MapAnalyst’s developer Bernhard Jenny for his comprehensive answers to our questions.

Our starting point is, of course, the old map in digitized form. The size of the scan uploaded should be consistent with the physical size of the (usually printed) old map, in order to correctly compute the map’s scale (see http://mapanalyst.org/man/mapimages.html for details). The old and the reference map should ideally be based upon the same projection method. If not, MapAnalyst can compensate this by an affine transformation (Jenny 2006: 240). The user can then add a current, georeferenced map of his own choice. For our purpose, OpenStreetMap (OSM) as MapAnalyst’s built-in reference (as of version 1.3.22) was perfectly satisfactory (on mapping the West Bank and the Gaza strip for OSM, see JumpStart (2010: 5–6); on OSM as reference map, http://mapanalyst.org/man/openstreetmap.html).

Using OSM has several advantages. First of all, the maps in question depict a highly contested area today, governed by Israeli civil and military authorities, by the Palestinian National Authority as determined in the Oslo Accords, and by Lebanon and Syria. Maps and mapping in this geopolitical hotspot cannot escape
being political. While we cannot eliminate political and economic influences on geodata, we hope to at least minimize them by using the open and public-domain OSM. At the same time, because of OSM’s participatory nature, we hope to find a great number of details mapped and thus increase our chances to locate the small villages depicted during the 1850s.

Secondly, OpenStreetMap is free, so no fees incurred for purchasing geodata from various state and administrative bodies. However, we also encountered OSM’s limitations when its data was scarce in peripheral areas. In some regions of Syria and Lebanon, OSM contains place names in Arabic only but does not show the layout of towns and cities on the ground. This becomes problematic when choosing control points in MapAnalyst. These “linked points” are locations that the user marks as identical on the old map and the reference map, creating a set of matching points. As all further computations are based on these control points, they should be placed with utmost care. In our case, more than 160 years have elapsed since the data collection for the “Map of the Holy Land”. At least half a dozen wars have been fought on the ground (and in the air), towns and villages have been destroyed, some re-built at a different location, and many were renamed after 1948 (Benvenisti 2000). Modernization has since reshaped the face of the earth. Especially on the territory of the state of Israel, the landscape has often changed so dramatically that it is almost impossible to identify places from the 1858 map. Our initial plan had been to analyze the entire map. Yet after trying to find a sufficient number of reliable control points on Israeli territory, we decided to base our analysis only on parts of the map that depict today’s West Bank, Lebanon, and Syria. This is simply a consequence of diverging degrees of modernization in Israel and its neighboring states and territories. The more a landscape has changed since the making of the historical map the harder it will be to find control points. Even natural features like coastlines and river courses can change or be altered over time. Mountain tops, probably the most stable natural feature, only come into consideration if clearly designated on the historical map.

So for our analysis, we chose sections 2 and 5 of the eight-sheet 1858 map. Referring to the area depicted in section 2 (today Lebanon and Syria), we can assume that the majority of places has not changed location substantially since the 1850s. In this region, OSM gives place names only, but no street grids or ground layouts. On section 5, we analyzed only the area outside of today’s Israeli state territory (delineated by the Green Line) for the reasons given above. After thus narrowing down the area under consideration, we were indeed able to locate a sufficient number of places from both sections of the 1858 map. Yet we still had to make sure that places and natural features were the same: If the town of Sebastiyeh (Samaria) (section 5) is identical with Sebastia (Oslo Accords Area C) or if el Hûrmûl (section 2) is today’s Hermel (Lebanon,اﻟﻬﺮﻣﻞ). If today’s location differed extremely from the 1858 map we assumed that either the place had changed its location significantly or van de Velde had assigned the wrong name (on his difficulties collecting place names from locals, 1854b I: 217-218), so we excluded these from our analysis.

Most towns and villages are designated by point symbols on the old map and can easily be marked on the reference map. But if OSM shows the outlines of settlements while the old map does not, locating the center of cities and towns can be challenging. When OSM gave only place names to indicate a town’s location, we placed the “linked point” at the center of the place name lettering. We are well aware that this may result in distortion, yet found no better solution. Van de Velde himself had a similar problem in 1851/52, not finding

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6 Throughout the paper, we will refer to places by today’s common (often transliterated) names as they appear in the English Wikipedia or in the Geonames Database (http://www.geonames.org). If need be, we will add alternative place names in brackets. Spellings in italics refer to place names as they appear on the map. NB. both “memoirs” to the map sometimes deviate from the spellings of the map (van de Velde 1858b, 1865a in German and 1865c in English).
prominent points in a typical Arabic village and finally deciding on “bearing the accurate middle of such a place” (1858b: 3).

After the user has placed as many “linked points” as possible, MapAnalyst is ready for computation. The function “Compare Transformations” helps to find the most adequate method for transforming the old map into the coordinate system of the reference map. OSM uses the Mercator system that is not ideal for comparison with old maps (Jenny 2010: 179). But as van de Velde used a conical projection (1858b: 23, following Hughes 1843), resulting in parallel lines of latitude and only very slightly tilted lines of longitude, both projections produce rather similar results. MapAnalyst then re-projects OSM’s Mercator and the old map’s projection into a transverse cylindrical equal area projection – in several steps and guided by the control (“linked”) points the user has set. This method works best for small and medium scale maps like ours (Jenny 2010:179). We chose the Helmert transformation that adjusts four parameters (both axes, scale, and rotation of the coordinate system). The more complex 5- or 6-parameter affine transformations supply additional insights only in very specific cases, such as a pronounced shrinking of the paper or shearing of the map, and would not have yielded more information in our case.

Types of output

First of all, MapAnalyst computes a variety of data for the old map. Given that the map was imported in correct scan size, the program calculates its average scale, which might diverge from the map’s given scale. MapAnalyst also shows the standard deviation of the control points, which – in more complicated cases – helps to decide which transformation method to choose.

One of the most appealing results is the Mean Position Error (MPE), the mean difference between the “linked points” in the historical and the current map in the newly computed common coordinate system. With this, we can assess the planimetric accuracy of the map and compare various maps in this respect. Yet if accuracy varies greatly within the given map, as can easily be the case, the MPE may give a wrong impression (Nell 2009: 19). Moreover, as with all statistical values, the MPE may be influenced by outliers. Overall, MapAnalyst’s forte are the various ways of visualizing differences between the old and the reference map, going far beyond measuring planimetric accuracy (Jenny and Hurni 2011: 405). One type of visualization are the “displacement vectors”. For each point on the old map that was assigned to a control point on the reference map, the length and direction of deviation is graphically represented with a vector arrow in the new, common coordinate system. The arrow points from the respective location on the old map to the location’s position on the reference map. This provides an instant visual idea of the homogeneity (or heterogeneity) of the map’s geodata. Outliers are highlighted in color and can thus be easily identified and excluded from computing the MPE, if need be (Jenny et al. 2007: 90).

Distortion grids have been used to visualize map properties since the late 19th century, albeit hand-drawn. Today, they are computed in automated standard procedures. MapAnalyst’s distortion grid is based on a method developed by Dieter Beinecke, intended to minimize the influence of outliers (Beinecke 2001). This visual grid, indicating the historical map’s distortion in comparison to the reference map, will be the more deformed the more the old map differs from the reference map. We have to bear in mind that areas with relatively few control points may appear less distorted simply due to data sparsity (Jenny 2006: 242).

Another way to visualize differences between the old and the new map are inaccuracy circles. This method dates back to Peter G. M. Mekenkamp (1990) and shows the control points’ inaccuracy only in relation to their neighboring points (Nell 2009: 28). While this visualization method might lack information on direction and absolute deviation, it is ideal for detecting local patterns. Combined with the vectors of
displacement, it enables us to identify groups of control points with similar displacement patterns that ultimately point to a common source of the map’s geodata for this specific area (Heere 2011: 194–195). Furthermore, MapAnalyst can compute the old map’s rotation and, based on this, display isodeformants that show areas of similar scale and rotation within the map (Jenny et al. 2007: 92). In our case, this did not yield greater insights, except for the fact that the map shows no significant variation in scale and has a rotation between zero and one degree clockwise. Our map is simply too “modern”, that is to say it was made at a time when mapmakers could easily render geodata into a map of homogeneous scale, perfectly aligned to north.

Findings of MapAnalyst

Comparing two sections of the same map

In the following, we want to discuss our analysis of two sections of the 1858 “Map of the Holy Land” (1858a). Section 2 depicts today’s northern Lebanon and the westernmost part of Syria, with the Lebanon and Anti-Lebanon ranges and the Beqaa valley. The sheet’s southeastern corner covers today’s suburbs of Damascus, its northwestern corner a small strip of the Mediterranean with the coastal town of Tripoli. In the second edition of the map (van de Velde 1865b), this coastal strip was extended north up to today’s northern border of Lebanon. Section 5 stretches from the Mediterranean to the Jordan valley and covers today’s central Israel and the West Bank. The sheet’s southernmost map border shows Jerusalem; the northernmost part is Mount Precipice in the Lower Galilee. Both sections describe different types of landscape and have a different history. The area depicted in section 5 might be considered “biblical heartland” and had been mapped and geographically described comparatively well already by the 1850s. Moreover, Section 2 depicts mostly mountainous terrain and wide open areas in the east, deserts and semi-deserts with few permanent settlements, thus having less mappable features. Consequently, both yield an uneven number and pattern of control points (section 2: 156 points, section 5: 183 points). Nevertheless, we think that both sections are well suited for analysis if we bear their differences in mind.

According to the computations of MapAnalyst, the Mean Position Error (MPE) in section 5 is lower than in section 2. Converted to meters on the ground (as represented on the map), the locations marked by control points in section 2 deviate by an average of ±2.445 m (=MPE) from their position on the reference map, compared to only ±2.197 m in section 5. The maldistribution of control points mentioned above plays a decisive role here, yet is difficult to compensate. When deliberately omitting points on section 2 in order to mimic the pattern of section 5, the MPE of both sections is roughly the same. Yet if we exclude those control points on section 2 that are at the periphery of van de Velde’s travel route, the MPE improves significantly, making section 2 much more accurate (in terms of MPE) than section 5. So it becomes apparent that planimetric accuracy is, with all due respect and consideration, very difficult to measure and compare in absolute terms.
In section 2, places digress particularly on the eastern edge of the map. The greatest deviation is computed for the village of Bureij (today Syrian Al Burayj, south of Homs; MPE of ±9.128 m). Likewise in section 5, it is apparent that eastern, in terms of the cartographer’s route, “peripheral” areas have less accurate positions. Here Berdela (today Bardala, in the West Bank 28km northeast of Nablus), in the northeast of the sheet, shows the highest MPE of the section (±7.753 m). When visualizing relative inaccuracies by means of displacements circles, it becomes obvious that in section 2 places that digress a lot in terms of absolute location at least have similar relative positions. In contrast, in section 5 there is a cluster of high relative position inaccuracies at the sheet’s center, the heart of the Judean Mountains. There are no such coherent patterns in section 2, which might be caused by the lower density of control points only.

An interesting effect of our analysis were not only the results of MapAnalyst’s computations, but insights gained while placing control points. As mentioned above, we were able to locate a great number of points in a comparatively small zone of sheet 5. On the ground, this area has apparently remained relatively unchanged or has preserved names and locations of places for over 160 years. While this seems trivial, it becomes significant when compared to the part of the map that depicts today’s Israeli territory.
We can also see that the map was based on very heterogeneous data. Van de Velde measured distances and angles himself in the territory of both sheets 2 and 5 when visiting the region in 1851/52. Only after close scrutiny it becomes apparent how much the extent of his measurements varied. For section 2, he only took angles from five locations. In the “memoir” to accompany the map, he admits to not having contributed much to section 2, leaving us to suppose that he most likely used third party data:

“[...] we could ourselves add nothing to the geographical knowledge of these parts, beyond what we saw on our journey from Cedars by ‘Akurah and Afka to Beirut.” (1858b: 30).

Opposed to that, he was able to measure angles from no less than 32 places on the territory depicted in section 5. Here, in the “biblical heartland” of Judea and Samaria, he was able to base his own work on a broad stock of (European) geographical knowledge. Names and locations of places and natural features were well-known and ready to be placed on a map; he only had to verify them and measure their location more precisely than had previously been done. If we visualize the stock of knowledge needed to produce a relatively accurate map, one that would hold up to the European standards of van de Velde’s time, we could say that in this region, van de Velde had to add only the last 20% to reach the cartographic and scholarly level of sufficiency. However, in regions with a smaller stock of verified geographical and biblical-geographical knowledge, his endeavor was most likely to exceed what could be done by a single person.

Figure 2: Section 5, detail (1858a), relative inaccuracy. Yellow circles mark places where van de Velde measured in 1851.
Cross-checking his measurement bases (van de Velde 1858b: 57–85) with MapAnalyst’s displacements vectors, we could not explicitly verify that the locations measured by him were always more accurate than others on the map. The comparison showed, though, that where van de Velde had not been able to measure, section 5 shows a greater relative inaccuracy as visualized by displacement circles. This is the case for example south, west and north of Nablus (نابلس; Nabûlûs on the map; the Roman Neapolis and biblical Shechem) (fig. 2), and indeed suggests that his survey was able to improve location accuracy. The reason for diverging patterns of measurings and accuracy within the map becomes clear when we consult his travel narrative and map memoir. Both include information on how, where and when he measured his angles – and where he did not. As he had set forth to survey and map “Palestine single-handed”, every little disturbance could tear a hole in his triangulation net. For instance, bad weather kept him from measuring between Nablus and Jaffa – a route that, as he wrote, lay “out of the course of ordinary tours” [sic] and had not been surveyed well (1854b I: 410-411). On a limited time budget, he often had no chance to visit a region twice. When transversing the area that would become section 2, today’s southern Lebanon, he was just recovering from an illness, wanted to catch his ship and so had little time for surveying (1854b II: 460–462). Indeed, his bearings in this area are too few to decide if they improved upon location quality.

Surveying: Priorities and external influences

In section 2, most villages show a good relative location accuracy, a fact that hints to a common base of comparatively high accuracy. Much differently, in section 5 we can identify a large coherent cluster of diverging points northwest of Nablus. In the travelogue, we find that van de Velde encountered a multitude of problems when passing through this region. On his way from Megiddo to Jenin, the heat and sun in the Jezreel valley were so intense that he was unable to measure (1854b I: 357–359). In Nablus, rain and storm kept him from ascending Mount Gerizim and Mount Ebal to measure, “no small disappointment for my surveys” (1854b I: 410). Between Kerawa and Kefr Kasîm (present day Kafr Qasem, just west of the 1949 Armistice Line), the rain turned into an outright “deluge”, making him forget even the most basic rules of the trade, such as noting down place names:

“In the confusion I left the village without ascertaining its name. Surveying in such weather is, of course, out of the question. Not much even of the general appearance and condition of the country can be seen.” (1854b I: 415–416)

If we assume that van de Velde was able to improve location accuracy through his measurings we can also state that the map-making process was highly prone to external factors the surveyor had no influence upon – like weather conditions. While this may sound trivial, it is characteristic for mapping endeavors like his that aimed at a state-of-the-art survey with less than perfect means. It was not until the 1870s that the Palestine Exploration Fund made the dream of mapping the region with the standards of an Ordnance Survey come true (Conder and Kitchener 1880).

Within these specific restraints, van de Velde had to prioritize. Which area to measure first when time was scarce? What was more important, keeping his diary, measuring angles or drawing the landscape? These decisions had to be made over and over on his trip, and we find instances when measuring and mapping were actually not his priority, like on his hasty journey from Damascus to Beirut:

“Two picturesque bridges, a bold waterfall, and many other interesting points along my path, made me regret my having to hasten so rapidly past. At one of those bridges, the first that one meets in coming from Damascus, I halted, however, for an hour and a half, to take a sketch of the stream [Barada] which by Naaman [2 Kings 5:12] was so justly held in high renown.” (1854b II: 462).
Although this region had not yet been surveyed thoroughly, he chose art over mapping. As we mentioned above, van de Velde was never a cartographer only, but just as well a distinguished artist, among other interests. From today’s perspective it might seem as if art was a lesser – or at least less precise – way of comprehending and appropriating the landscape than mapping. The instance quoted above suggests that for van de Velde, it was not. The scenic mountain views of Lebanon – a region with fewer biblical sites than Judea and Samaria – inspired him to draw, whereas the biblical heartland required him to measure. In his travel narrative, we find a similar incident when together with two other travelers, he visited “a district hitherto unexplored” (1854b II: 347) east of the Jordan. To his great dismay, the haste of his companions did not allow him “to take a sketch of the scene” that was “so attractive to me, as well as the view of the surrounding country so charming, that I had great difficulty in tearing myself away from it” (ibid. 355). Without going into detail here, we can definitely say that for him, drawing was less of a scientific aide of perception it was for other explorers (Brogiato et al. 2005). It was a means of artistic expression, used to capture beauty, visual attraction, or the characteristics of a view. In the travel narrative, van de Velde repeatedly refers to his sketches as means of better comprehension of a site, a scene, an impression, referring to the aesthetic and emotional grasp of the reader being enhanced by visual means of his sketches.7

Gaps and question marks: tracing data deficiencies
The map uses the words “not examined” to mark areas not yet surveyed properly. This is both a call for action for future researchers and exonerates the cartographer from responsibility for poor data. As it turned out, there are more such markers on section 5, suggesting that section 2 had actually been surveyed better. But quite the contrary:

“In a general way we must observe, that the whole region between the high dorsal ridge of Lebanon and the coast is yet very imperfectly known, and the want of points fixed by triangulation is here sadly felt.” (van de Velde 1858b: 30)

What to make of this? In the “memoir”, van de Velde took great care to account for his map’s sources (1858b). He did so, as we would put it today, in compliance with the good standards of (mid-19th century) map-making. So we could conclude that areas of the map that were not marked this way were – well, “examined”, or based on state-of-the-art measurings. Yet we found that in regions lacking previous surveys or other qualified sources of geodata, the cartographer rather decided to cover up the gaps. For the sake of creating the illusion of a uniform map, he chose not to document all its deficiencies equally.

In the map section between the Lebanon ridge and the Mediterranean (referred to in the quote above), we find the only “not examined” marker of sheet 2. Yet for this area in particular, van de Velde gives numerous sources, while for the rest of the sheet, he just broadly refers to J. L. Porter’s travel accounts (“have furnished our chief materials”, 1858b: 33; see Porter 18568) and Major Scott’s map (“laid down with much accuracy”, 1858b: 34; see Rochfort Scott 1846). In documenting his sources for this section, he actually refers to Scott’s map time and again. We can thus assume that for want of own measurings, he took the two

7 For example: “I was yet more struck by the ruins of a temple in the middle of the village, a sketch of which I promise to bring you.” (1854b I: 175); “I have perhaps made too heavy a demand on your imagination, my friend, in asking you to transport yourself in thought to the ruins of Cesarea. Well, then, I trust ere long to come to your aid with the sketch I have taken of them.” (1854b I: 340–341); “[...] cannot you imagine the magnificence of the sight? Well, then I have tried to preserve for you some idea of it by means of a faithful sketch.” (1854b II: 101). Throughout the paper, we quote van de Velde’s texts and letters in the original, which often deviates from today’s standard orthography and punctuation.

8 Röhricht 1890 wrongly ascribed the work to John Leech Porter. The real author was Josias Leslie Porter (1823–1889), who lived in Damascus from 1849 to 1859 and traveled the region; see Kuschke 1976: 161. On Porter also Aiken 2010.
sources he found most reliable – Porter and Scott – as some kind of general geodata guarantor. Only where he had measured himself, did he dare mark “not examined” regions.

Yet also in section 5, we find a general guarantor of some kind for the entire area: the travels of Edward Robinson and Eli Smith (1841, 1856). To our surprise, we found that van de Velde marked some regions “not examined” that had been mapped already based on Robinson and Smith’s travels (Kiepert 1841). This definitely needs explaining.

We saw that, when faced with a generally sketchy base of geodata and unable to make up for this lack himself, van de Velde decided not to mark the gaps on the map. Instead, he relied on third party information that he deemed sufficiently reliable, tacitly accepting that the area in question might be less accurately mapped than those he had measured himself. Yet what were his criteria for reliability? How did he decide which sources to trust? We find hints to his decision making process in the “memoir” and his travel narrative. When in Jerusalem, Robinson and Smith shortly met him on their second trip to Palestine (1857: 164), and van de Velde apparently borrowed Eli Smith's compass. After comparing it to his own and finding “a deviation of 2 to 3 degrees”, he decided that for him, their map (Kiepert 1841) was problematic: “Having well examined my compass in Paris before leaving for Syria, and knowing, that I could rely upon its accuracy, I thought that the chief cause of the discrepancy between his bearings and mine was, that the divisions of Dr Smith's Smalkander-compass were incorrect.” (1858b: 116; see also 1854b II: 192)

Not without subtle pleasure, van de Velde in his “memoir” to the map also quotes from a letter by Robinson to Potsdam at Potsdam that confirmed the compass' deficiencies (1858b: 116–117). Although Robinson was a highly respected scholar, indeed considered the father of Biblical Geography, van de Velde thought himself superior in his own field of expertise: surveying and cartography. When van de Velde cited Robinson's travel work as general reference, this apparently did not refer to the map.

Yet van de Velde did not judge lightly, but investigated the instruments and, in other instances, the entire map-making process, including calculations. Throughout the correspondence with his publisher Justus Perthes, we find more such criticisms of measurings and third party maps that van de Velde would or would not use in constructing his own map. In domains like transcribing Arabic place names or identifying biblical sites – fields that he had ventured upon as well –, he readily accepted the authority of other experts. But when surveying or map-making were concerned, he trusted only his own judgment. To draw the Damascus section of his map, he urgently waited for Porter’s Five Years in Damascus (1855; the preface is dated September 21, 1855, and van de Velde got the book only in spring 1856) and the respective map to be published, as he had been unable to measure this region adequately. The book's delayed publication deferred the “Map of the Holy Land” for a full six months. When finally the Damascus map was in his hands, he found that Porter had made a grave mistake. Yet being an able cartographer, van de Velde took to redraw the map from the original measurements that Porter had supplied:

“M. Porter, instead of correcting the angles for the deviation of 8 1/4° N.-West, has corrected them for 8 1/4° N.-East, producing a mistake of 16 1/2° for each angle. – This has of course forced me to reconstruct his map entirely, and for the completion of my map my patience and health were once more put to a test. – But after all, I am content to have seen the error of M. Porter and to finally have finished my map.”

In this quote, there are a number of elements typical for van de Velde's negotiation process with his publisher. Blowing his own trumpet was definitely part of the trade. Although by the 1850s, geography proper was only beginning to establish itself at universities, an astonishing number of expert cultures were involved in Palestine research. When van de Velde's map came out in 1858, it was reviewed by biblical
geographers, philologists, cartographers, theologians, missionaries, and popular magazines – as had his travel narrative. Amidst a cacophony of expert and lay voices, van de Velde was forced to stress his own expertise: His professional ego as a cartographer would not let him tolerate an error but “obliged” him to remake Porter’s map. Though it meant wrecking his health and patience, it gave him great satisfaction (complaining about the hardships of map-making ruining his health are a leitmotif of his correspondence). His expertise is one that verifies findings through practices: A compass must be tested in the field, a map redrawn from distances and angles. In his travel narrative, we find the same practical testing of hypotheses in the face of his own experience: Could Jesus have walked the shores of the Lake of Galilee in this place? No, there are too many boulders along the shore; it must have been over there, where the beach is sandy (1854b II: 397–398). Much as he emphasized his cartographic and surveying expertise, he was no theorist. In his work, there are frequent allusions to “the learned” – with ironic undertones. He for example described an antique monument but would not determine its origin: “This inquiry I leave to the learned. My own task – that of examining the building, determining its geographical position, and faithfully sketching it – I have accomplished.” (1854b II: 469). In the unpublished correspondence, it becomes clear that “the learned” also refers to the type of (academic) sticklers who never stop criticizing, yet whose verdict could not harm van de Velde as they were no relevant peers for him.9 His peers were, as we will see, of a different kind.

The map updated

Van de Velde updated his “Map of the Holy Land” seven years after its original publication (1865b, 1866). How much did the map change? Due to the identical distribution pattern of control points, we are actually able to determine the changes in accuracy of both sections very precisely. Based on the surviving correspondence with his publisher, we can also determine the cartographer’s priorities in the updating process.

First and second edition compared: Section 5

Section 5 had, not surprisingly, gotten much more precise. The Mean Position Error (MPE) and the standard deviation improved significantly. On average, the location accuracy of towns, villages, and natural features in section 5 improved by about 300 meters: The MPE dropped from ±2.197 m in 1858 to ±1.749 m in 1865, the standard deviation diminished from ±1.553 m (1858) to ±1.237 m (1865).10 How do the two sections compare in the updated edition? In section 5, we could only place eight new control points, mostly in areas marked “not examined” before. Apparently section 5 already had a high density of place names and settlements in the first edition. This supports our hypothesis that there was a substantial body of geographical knowledge for the biblical heartland of Judea and Samaria in 1858.

Visually, the second edition’s greater position accuracy in section 5 becomes evident when looking at MapAnalyst’s displacement circles. While the villages in the east still diverge notably, relative position

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9 On January 17, 1860 van de Velde wrote his publisher that he would continue working on the map if God granted him the health and courage for this task that only he could do, no matter what “the learned” say: “Si quelques savants ne sont pas d’accord avec moi, il reste à chercher de quel coté se trouve l’essence.” FBG SPA-MFV 009/2, fol. 241–243.

10 To give a rough comparison: Levin et al. (2010) computed and compared the accuracy of various Palestine maps published between 1799 and 1948, focusing on the Negev desert. Although they give a median error and MapAnalyst computes the mean error, and although they analyzed entire maps and focused on a different area, contrasting our findings with their numbers can give a vague idea how van de Velde’s map compares. For the Kiepert map (1841), based on Robinson and Smith, Levin et al. give a median error of 4.887 m, whereas all maps after the PEF survey range clearly under a median error of 1.000 m (2010: app. 1).
accuracy at the center of the map has improved, as visualized by smaller circles (Fig. 3). The distortion grid as well shows how and where location quality improved. The basic structure and direction of divergence remain the same, yet the horizontal and vertical lines, especially in the north and the center of the area we investigated, have straightened visibly. Thus comparing two editions of the same map allows to safely evaluate changes in accuracy. In the following, we will try to combine these results with other sources, either published alongside the map or used for constructing it. From the many examples, we will choose only those that refer to our two sample sheets (section 2 and 5), while the findings more or less hold true for the updating process of the entire map.

Figure 3: Section 5 of both map editions, details (1858a above and 1865b below), showing inaccuracy circles.

Of originally five “not examined” areas on sheet 5, only one survives in the second edition. After seven more years of research on the geography of Palestine and van de Velde’s second journey to the Holy Land in 1860/61, geographic uncertainty had apparently been minimized. We will try to elucidate this by aligning van de Velde's later surveying route with third-party sources he named in his second memoir (1865c). Following his own call to action, he had set out to eliminate the “not examined” markers. As shown above, he had not been able to measure between today’s Nablus and Qafr Qasim (Kefr Kasîm) due to extreme weather (1854b I: 410–416). His travel route in 1861 covered two “not examined” areas of the first map; they have vanished in the second edition. Juxtaposing both editions, we marked places visited on his 1861 route in purple, whereas the yellow markers assign places noted with new information in the second edition memoir (1865c). We can thus see that both route (purple) and added data (yellow) are directly related to the former “not examined” areas (Fig. 4). As an aside, the places added in the second edition show no outliers in terms of location accuracy. On the contrary: The relative position of, for example, the village Rentis improved dramatically. Van de Velde’s survey between Ramallah and Jaffa
is moreover a fine example of indigenous information being incorporated into European maps. For when he passed through Ramallah, a native guide offered his help:

“Whilst spending lately the night at Ramallah, on our way from Nabûlûs to Jerusalem, I met with an old man, Abû Yakûb, who seemed to be rather well acquainted with the country and who offered to be our guide, should I intend to make an excursion in that district.” (1865c: 15)

And really, van de Velde came back to explore the previously “not examined” areas. While his 1854 travel narrative rarely credited local guides, except when they did not know the sought-after details, he now explicitly attributed locating and naming the village Keferîyeh to Abû Yakûb. Although the second memoir does not identify other knowledge directly gained from native informants, we can safely assume that Abû Yakûb was not the only one; only the credit he was given was exceptional. The typical credited informant was European, resident or traveling, often missionary. Thus van de Velde named the German Jerusalem missionary Carl Sandreczki as a source for section 5 (on Sandreczki, see Goren 2003: 299-303):

“From the Holy City he [Sandreczki] proceeded to Beit Unieh and Janîyeh N. W., thence in a western direction by Khurbâta and Deir Kadîs to N’alin and then down to Jimzu and Ramleh. A sketch map on this occasion with the aid of a good pocket compass, formed a contribution for our map of a part, which otherwise would have remained in an imperfect state.”(van de Velde 1865b: 30).

The newly added villages west of Janîyeh are thus based on information from Sandreczki. Two more “not examined” gaps were filled thanks to information from the Royal Navy:

“The officers of the British squadron stationed on the Syrian coast on their side were induced to make an accurate survey, not only of the coast but also several of the most interesting positions in the country, which were astronomically fixed.” (1865b: 23)

We will come back to this interesting military source later.

As mentioned above, van de Velde had been unable to measure in the Jezreel valley. In 1861, he came through Jenin again, a town that overlooks both the Jordan valley to the east and the Jezreel valley to the north. Although he was slowed down by soggy ground on his way north (1865b: 7–8), location accuracy (north)east of Jenin improved significantly. As a third party source for updating sheet 5, van de Velde mentioned a map of the Galilee (Zimmermann 1861) from which he adopted details between Jenîn and Fûkû’a, as well as between Kaukab el-Hawa and Beisan (1865b: 32–33). This resulted in an overall greatly improved location accuracy – although van de Velde wondered about the Galilee map's quality:

“It is indeed surprising how the author constructed such a map from such a collection of materials.” (ibid.)

This shows how crucial third-party information – often gained only thanks to his excellent international network – was used to update the map’s geodata and advance its location accuracy. But van de Velde did not integrate third party information without further verification, as we will see.
Figure 4: Section 5 of both editions (1858a below, 1865b above), detail with displacement vectors and circles of relative inaccuracy. Places marked in purple were visited by van de Velde on his second journey, yellow markers assign places mentioned in the memoir to the second edition (1865c).
4.2.2 First and second edition compared: Section 2

Comparing first and second editions of section 2 holds another surprise: Here location accuracy in fact slightly deteriorated. The 1858 edition’s section 2 shows an MPE of ±2.445 m, which in the second edition increased by 30 meter to ±2.472 m. The pattern of control points remains roughly the same, with a sizable number of new villages added (and consequently control points). A large “not examined” area north of Tripoli was filled with ample detail and significantly extended north, leaping over the map’s border. We could thus place 247 control points on sheet 2 compared to 156 before.

When MapAnalyst compared only the new villages in the northwest (north of N 34°30’), the MPE was a lean ±1.193 m, with a standard deviation of ±844m. So while position accuracy on section 2 slightly deteriorated in total, this does not necessarily imply a lower quality of the added data. Due to the great dispersion of control points, small-scale changes are simply not reflected well by the computations. On the eastern edge of the sheet, we can verify a relative increase in position accuracy of the villages – yet absolute accuracy still deviates so much that MapAnalyst marks them as outliers. All in all, this section shows an interesting phenomenon: We can distinguish several areal clusters that show a high accuracy in relation to their neighbors (relative position accuracy), but diverge as clusters from other blocks which likewise share similar accuracy patterns. In these clusters, displacement vectors have the same length and direction, creating the visual impression of a flock of points moving in the same direction.

Although on the 1858 map, sheet 2 showed many “imperfectly known” areas (1858b: 30), van de Velde’s route in 1861/62 only led him through the south-western part of the region:

“In crossing thence [from Mu’allakah] over the great plain to Ba’albek I had occasion to make a few corrections in positions and names of the villages in this part of our Map.” (1865b: 22)

In this part of the map, showing the southern end of the Beqaa valley, location accuracy in 1865/66 actually changed for the worse. With no new control points added, the MPE increased from ±1.492 m (1858) to ±1.653 m (1865). Apart from the “few corrections” quoted above, the only new data the memoir mentioned (1865c) were recent measurings by the Royal Navy that van de Velde based his own map construction upon. Commander Arthur Lukis Mansell had already headed the Navy survey of the Bay of Suez in 1856. From 1860 to 1863 he was commander in the HMS Firefly and made several surveying trips to the “coast of Syria”, which included Palestine (for his biography, see Davis n.d.; on the survey, Goren 2002: 95). Like van de Velde, he came from a Navy family; his father had been an Admiral. In the Annual Report on Admiralty Surveys, the Hydrographer to the Navy John Washington had already in 1861 reported on a survey that he himself had taken part in (Washington 1861: cxxxviii–cxl). Under Mansell’s command, they had surveyed the coast from İçkenderun (historical Alexandretta) in Turkey to Syrian Markhab (the crusader fortress Margat) before venturing inland. Joined by civilian travelers (among them botanists Joseph Dalton Hooker and Daniel Hanbury), the party made it from Beirut as far south as the Dead Sea, measuring angles and distances with a theodolite and chronometers, and heights with six barometers. The survey under Mansell continued until 1863, working according to the highest contemporary standards and ultimately linking the longitudes measured to verified positions in Malta, thus connecting Syria to European grids (van de Velde 1865c: 24–25).

While van de Velde was busy updating his map, he received a letter by Mansell who had just traveled the region with van de Velde’s map in hand, finding it so marvelously exact that he decided to grant him access
to his survey maps and data.\(^{11}\) Van de Velde decided to postpone the second edition until Mansell would have completed his survey.

So for section 2, the most important third party sources were the maps and positions measured by Mansell. For details, van de Velde also referred to a French military map (Blondel 1862):

“We have introduced in our Map the numerous details contained in the ‘Carte du Liban’ between Jebel 'Akkar (the northern extremity of Lebanon) and the Province of Belad-Beshârah (between Tyre and the Lake el-Hûleh). Intentionally we refer to details of the French Map: for the materials which served us in the construction of our first ‘Map of the Holy Land’, seemed to us of sufficient accuracy in the geographical determination of the principal points [...]” (1865c: 24)

We will soon see why he adopted only “details”. For the time being, we can testify to the abundance of new places in this updated section, although van de Velde did not spend much time in the area in 1861/62:

“These and other villages have all been laid down in the new French map ‘Carte du Liban’ made by the officers of the Engineers during the occupation of Syria by the French army 1860/61. This leaves us nothing more to add to these geographical and topological details.” (1865c: 22)

Investigating the section with MapAnalyst, we found that relative location accuracy is comparatively high in small, coherent areas that moreover share the same direction of displacement vectors. These clusters then again diverge from other areas, which may hint to a patchworking way of putting together information from various sources and maps (here: English and French military) and combining them into one. The evidently more heterogeneous geodata of section 2 might also point to the fact that the area in question had not yet been traveled, measured, mapped, and again verified as many times as the area on sheet 5 between Jaffa and Jerusalem, the Jezreel valley and the Dead Sea (Fig. 5 and 6).

Yet how to explain that in some areas of the updated map, accuracy even deteriorated? Could linking his own measurements to those of Mansell have caused this?

There are some interesting finds preserved in the Perthes collection at Gotha that might help us solve this question. Upon being offered the results of the Mediterranean survey, van de Velde wrote to his publisher that with these, he would “never (!) have to update the map again”.\(^{12}\) Apparently the Royal Navy survey ranked so high for him that, without even having seen the results, van de Velde declared that it would raise his map to the highest scientific grade, that of timeless validity. Vice versa, Mansell had credited van de Velde’s work with the highest professional praise, a fact that joined the two men of similar background in a system of mutual recognition. Neither in the memoir (1865c) nor in the letters to Perthes, van de Velde ever mentioned checking or retracing the data provided by Mansell. He rather used them immediately to validate and correct other third-party data:

“I found the French map full of errors; these errors have been corrected based on a list of observations and trigonometric positions the English Commander Mansell sent to me.”

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\(^{11}\) Van de Velde, Haarlem, to Justus Perthes, April 29, 1863, FBG SPA-MFV 009/2, fol. 320–321: “[…] qu’il verrait de parcourir la Palestine avec quelques de ses officiers pour collationner ma carte; qu’il avait trouvé ma carte d’une exactitude merveilleuse, et qu’il en était tellement satisfait, qu’il m’offrait toutes ses propres observations astronomiques et triangulairent.” Already Washington had stated that “Van de Velde’s map of Palestine […] was found to be generally correct, and the best map of the country published.” (1861: cxxxix).

\(^{12}\) As he wrote in the same letter, Mansell’s data “me permettent d’établir ma carte corrigée d’une maniere durable, sans qu’il soit nécessaire de la retoucher plus jamais”, loc.cit.
We were ultimately unable to pinpoint Mansell’s data as causing the drop in accuracy in this part of the updated map, although they were apparently van de Velde’s only trustworthy new sources used for its construction. Yet pursuing the question which source made the map more or less “true to reality” is precisely the pitfall we should avoid. For our conclusion that van de Velde based the credibility of his sources not only on extensive own testing, but also on his internal system of reputation, it is irrelevant if a source was really as “good” as he ranked it. His astonishing comment that his map would never have to be updated again is more than enough. For more than everything else, van de Velde was greatly elated by the British officers’ praise. When finally the two large sheets depicting the Syrian coast (Mansell 1864, 1864–1865; cf. van de Velde 1865c: 24) were in his hands, well ahead of their publication, he proudly forwarded the accompanying letter by Royal Navy officer Hull to his publisher:

“I consider this letter by Mr. Hull, the man and master of his trade, as the greatest praise my map and memoir could have received. So I can congratulate you – and myself – on the conveyance of this map [...], a piece that contains the most valuable details, astronomical observations, heights, etc.”
While Latour and Woolgar portray a different field and epoch – a 20th century science lab –, they nevertheless describe a similar phenomenon in their chapter on Cycles of Credibility (1986: 202-203):

“For a working scientist, the most vital question is [...] ‘Is he reliable enough to be believed? Can I trust him/his claim? Is he going to provide me with hard facts?’ Scientists are thus interested in one another [...] because each needs the other in order to increase his own production of credible information.”

Yet when deciding on the credibility of a given source, van de Velde’s practical control mechanisms like retracing the data production process were only one aspect. Equally important was the reputation of the source, which relied not only on technical but also on symbolic capital (Bourdieu 1984). After all, he preferred the British survey over a contemporaneous French military map, without explaining why the French map was “full of errors”, except that it deviated from Mansell’s. Throughout his travelogue, he made no secret about his mistrust for French science (e.g. 1854b I: 115-117 on de Saulcy’s gullibility). “Latin” tradition and catholic science evidently had no symbolic capital with him.
Summary: Accuracy and reputation in the map-making process

Analyzing two sections of the “Map of the Holy Land” (1858a), we found that general statements on the accuracy of a single historical map are difficult to make, even with a sophisticated tool like MapAnalyst. Depending on the map sheet analyzed, on the number and diffusion pattern of control points placed, the resulting Mean Position Error (MPE) can vary greatly. Comparing the same map’s second edition to the first produced more robust results. We could clearly identify areas of the map whose planimetric accuracy had improved significantly, which in turn allowed us to relate them directly to the measurements of the surveyor-cartographer and to third party sources he used for updating the map.

Having said that, MapAnalyst proved highly useful for investigating the map and the map-making process. We were able to show that the map is a lot more heterogeneous than visible at first sight. Moreover it became apparent that external factors had a significant influence on measurements and thus data accuracy: Weather and ground conditions, chance meetings, the quality, knowledge, and openness of local guides, not least the priorities of van de Velde himself who sometimes preferred drawing a picturesque scenery over measuring angles. For the Holy Land cartographer, the biblical heartlands were both more interesting (as they held more biblical sites) and had been researched upon to a greater degree previously. The scenic Lebanon fascinated van de Velde the artist.

We could also show how the map was updated through a complex combination of the cartographer’s own measurements and third party data that he verified by a variety of practices. The underlying values, decisions and priorities in this process can be traced even in the accuracy patterns of the map. For the map-making process, it proved less relevant which sources were actually “better”, but whose authors ranked highest in van de Velde’s system of professional reputation. Local Arabic or Bedouin informants, albeit considered crucial for collecting information like place names, were credited only rarely as individuals. Unlike the Europeans who traveled the region or resided there, they were no relevant peers for van de Velde, nor were they for any other European scholars, surveyor, cartographer, or geographer.

Although we can only touch on this briefly, it is apparent in his travelogue that van de Velde maintained similar systems of reputation for collecting place names and identifying biblical sites. These were of course based on different criteria than his cartography, but equally served as guidelines for harvesting, sorting, and ultimately conveying information collected on site to his audience and scholarly peers. For instance he deemed the traditional Latin topography of holy places untrustworthy, as well as oral traditions of the native Christian population. Local Arabic traditions were his preferred sources – and that for identifying biblical sites (e.g. 1854b I: 321). Concerning local guides and native informants, he had a clear idea of how they had to be treated: no baksheesh (tips and alms), no gifts to Bedouin sheikhs, and only minimal payments to local guides in order to, as he said, prevent them from making up things the westerner wanted to hear. Only local information obtained despite meager reimbursement was considered trustworthy (1854b II: 116–117, 139).

Thus MapAnalyst not only enabled us to make statements on the planimetric accuracy of various sections of the “Map of the Holy Land”, showing the range of geodata quality within the same map, the data heterogeneity of the map, and the differences between the first and the second edition. Combined with findings from archival and published sources, it also allowed us to trace a possible discrepancy between the quality of a geodata source and its professional reputation with the cartographer. Map-making in the mid-19th century was, at least in our case study, never just a question of cartographic knowledge and abilities. Much as it was a complex socio-technical process, it was also based on an intrinsic system of reputation that determined the amount of trust and credibility that third party sources had for the cartographer.
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