Measure and map: Alphand’s contours of construction at the Parc des Buttes Chaumont, Paris 1867

Ann Komara

The urban renewal projects undertaken in Paris by Napoléon III during the Second Empire (1852-1870/71) exemplify French industrial and technological expertise as applied to the realm of landscape design. The Parc des Buttes Chaumont, christened April 1, 1867, can be singled out for examination as it demonstrates a sophisticated marriage of art and industry as well as highlights the technical skills and sophisticated expertise of the cadre of engineers and designers working under Haussmann, the Prefect of the Seine. Jean-Charles Adolphe Alphand’s (1817-1891) transformation of a notorious quarry site into a celebrated park physically demonstrates the results generated from a precise topographic survey that reconciled and used horizontal and vertical measure as codified on a sophisticated contour map depicting the landform. The noted scholar of cartography, J. B. Harley stated that it is «...a major error to conflate the history of maps with the history of measurement (Harley 107).» I suggest, in contrast, that the very convergence of measure and map is the construct underpinning the production of the Parc des Buttes Chaumont. The contour map and topographic rendering of the park site that Alphand published in *Les Promenades de Paris* (1867-73) are specific ideological tools for comprehending not only a unique spatial condition but also for envisioning the city as a technical marvel.

To understand how this condition was achieved this paper examines the relationship between the physical surveying of the site and the resulting cartographic representations of the park landscape. A history of surveying in France is lengthy and not the point of this paper, having been well covered by Buisseret (1992) and Konvitz (1987) among others. Nonetheless, a brief summary of this history helps to contextualize the work of the Second Empire and establishing the design, construction and reception of the Parc des Buttes Chaumont as a model of technical achievements.

**History of French land measures and surveys**

The history of land measure and surveying is linked to the scientific revolution and national exigencies. The knowledge was directly applied to government and military efforts and to urban and landscape design. The French government subsidized efforts undertaken at the Académie des Sciences; during «...the seventeenth and eighteenth centuries, France became the leader in topographic mapping, developing methods which became standard and later were widely adopted elsewhere (Thrower 73).» French engineers and military surveyors trained in the centralized école system. The curriculum and philosophy at the École Royale des Ponts et Chaussées in Paris, from which Haussmann drew many engineers and designers, strongly linked technical applications and design theory. This is demonstrated by a map drawn by a civil engineering
student as part of a final examination sometime in the late eighteenth century. It depicts an imaginary territory which Konvitz (1987 Plate 7) suggests is an illustration of the teachings of Abbé Marc-Antoine Laugier regarding the essential similarity between urban planning and landscape design. Alphand trained at the École from 1838 to 1843, and this philosophical link is implicit in Alphand’s work at the park. Furthermore, he would have been well aware of innovations and applied practices in land measure and surveying. To most clearly demonstrate the relevance of this in Alphand’s work, it is helpful distinguish the lineage of horizontal, triangulated measure and vertical, elevation measure.

**Horizontal surveys**

By the early nineteenth century, triangulation surveying had become standard in the production of data for horizontal distance and boundary measures. The diagram after Frisius (1553) demonstrates the principal of the triangulation method, in which, «...once the length of the base line is established, surveyors can measure angles from either end by sighting on some distant object. A triangle results, and geometry solves the lengths of the unknown sides. Then, from these sides, more triangles can be laid out and measured (Bricker 38)». Tools such as Ramsden’s great theodolites of the late eighteenth-century refined the accuracy for sighting distances and measuring the degree of the angle, and material standards for chains and rods with low coefficients of expansion assured exacting distance measures for the calculations.

France instituted the earliest national survey mapping. Jean Picard (1620–82) fixed relative horizontal positions astronomically and laid down a chain of triangles based on the Paris meridian, as shown in the Académie Royale’s map of 1670. The survey baseline established at the Observatoire that is a datum for survey work supported by the Cassini family, including the «Carte de France» of the 1680s. Jacques Cassini de Thury (1714–84) and his son, César François verified Picard’s meridian and documented their work in their 1740 publication, La Meridienne de Paris. Their work established the accurate extension of triangulation as the standard upon which French surveys proceeded, as shown in the detail of the 1744 map by Giovanni Maraldi and Jacques Cassini and the Carte de Cassini published between 1756 and 1793. (Konvitz 6–10) Through these pioneering efforts, France was the first country to be mapped on the general principles of modern survey wherein the survey proceeded «from the whole to the part . . . [by establishing] a rigid geometrical framework of triangles before filling in topographic detail by local observations of angles and distances (Singer Vol. IV, 605).»

Edme Verniquet employed triangulation to produce an important cadastral survey map of Paris based on the meridian of the Observatoire.1 Surveyed in quadrants, the 1791 «Plan de Guillot», included trigonometric tabulations and tables of distances. It highlighted street patterns, especially those superimposed on the old perimeter walls, major monuments and some residential data. Additionally, it provided some topographic clues; of particular note are the graphic indications of quarrying operations at the buttes of Montmartre, Belleville and Chaumont.

Verniquet’s extensive work served as the foundation for much of the design work in nineteenth-century Paris, including Haussmann’s. As Konvitz aptly writes, «Often engineers and architects viewed cities as they did rural landscapes, as areas to be reshaped into a new, more productive pattern of territorial organization. Maps based on thorough surveys were used to record and coordinate all public works projects and to calculate the value of property that might be expropriated (Konvitz 110).» Evidence for this practice is an 1811 plan proposing the Canal St. Martin shown drafted over Verniquet’s survey. Built between 1821 and 1825, it is clear that the canal was not discreetly set into the existing urban fabric, but rather, designed as «... an agent of change whose presence would create opportunities for commerce and industry along its banks (Konvitz 111).»

**Vertical or elevation surveys and the depiction of topography**

Parallel developments were occurring for the depiction of topography. A topographic map «presents the horizontal and vertical positions of the features [as] distinguished from a planimetric map by the addition of relief in measurable form (Thompson 254).» Drawn contours, also known as isohypses, were well established in France by the early nineteenth-century,
their origins and applications as coastline and hydrographic descriptors for channel depths having been understood by the eighteenth-century. Early debates concerning their application to landform lead Marcellin Du Carla, a Languedocien geographer, to published Expression des nouvellements, ou Méthodes nouvelle pour marquer rigoureusement sur les cartes terrestres et marines les hauteurs et les configuration des terroirs (1782). In what is today considered the «first fully developed exposition of contour lines», Du Carla wrote,

man cannot see the world as it is by looking at it; reality emerges as a synthesis of information on paper . . . With contour lines on a map . . . it becomes possible to visualize what can and cannot be seen from any one point. Contour lines are a language and from them a three-dimensional image of space can be constructed in the mind (Konvitz, 77-78).

Employing contour lines to convey the shape of a landform gained currency through Pierre-Simon Girard. His contour map of Paris (1812) recorded all data directly on Verniquet’s «massive geodetic survey of Paris . . . All measurements of the same value, corresponding to an identical elevation [above a datum] along the east-west and north-south dividing lines were connected by line, as much as possible at one-meter intervals . . . Another map was also engraved using hatch lines to express elevation instead of contour lines (Konvitz, 100).»

The use of hachures or hatch-lines to represent topography evolved into specific techniques to describe the angle and direction of slopes and landforms. In one traditional method,

lines are drawn down the slope in the direction of the steepest gradient; conventionally, they are drawn closer together where the slope is steeper. Another method employs the same number of lines per inch, but each one is proportionally thicker . . . where the thickness of the individual hachure is determined according to the angle of the slope. Another adaptation is where the hachuring is assumed to be obliquely lighted, usually from the north-west, but this is only effective in regions of strong relief, with sharply defined ridges, as in Switzerland, where the method was developed on the Dufour map (Monkhouse and Wilkinson, 96-97).

Developments in hachure representations led to proscriptive techniques such as the hachure meter shown in Enthoffer’s Manual of Topography (1869-70). While the hachure method such as that shown in Dufour’s Swiss Atlas of 1833-63 is an invaluable aid to visualizing topographic relief on a map, its chief disadvantage was the lack of absolute information or physical accuracy without inserting numerous spot elevations. Girard’s strategy of using both techniques conveyed both quantitative and descriptive information about the site and the design proposal and was typical for that period. Alphand emulated this practice for the maps of the Parc des Buttes Chaumont.

Survey work during the Second Empire

The practices of topographic surveying as a means towards envisioning the city underpin Haussmann’s building program and provide a direct link to Alphand’s work. Their attempts to refashion an entire city posed technical problems for which there were no ready solutions —no accurate [detailed topographic] map of Paris existed in 1850 and one had to be made, starting with the triangulation of the whole city (Pinckney 5).» Haussmann’s plans could not have been carried forward without accurate surveys; in 1853 he organized a Service du Plan de Paris under supervision of the Chief Surveyor, Deschamps. (Pinckney 56)

Debates at the time regarding the best method for rendering the exact disposition of three-dimensional landform as opposed to simply producing a horizontal plan generally favored the methods adopted by Deschamps. Building on Girard’s contour map and Verniquet’s survey, Deschamps’ corps of surveyors carried out an exacting survey. The basic technique of topographical land surveys were well established: « . . . into an accurate framework of triangulation the topographical detail was inserted by plane-table, detail traverse, or chain-survey methods . . . (Singer Vol. IV, 441).» To accomplish this, towers were set up around the city and vertical and horizontal data were derived from theodolite measurements with the data based on leveling, triangulation and trigonometric calculation for all areas. This well-known effort received attention in newspaper editorials and provided fodder for numerous political cartoons, such as those by the cartoonist Cham (the pseudonym of Amédée de Noé).
What emerged from this work was a large master plan of Paris, a copy on a scale of 1 to 5000 that Haussmann kept mounted in his own office, and many working copies on smaller scales (Pinckney 56). Haussmann’s survey team simultaneously prepared detailed cadastral plans and contour relief maps of the city at matched metric scales based on mutual datums of the Paris meridian and mean sea level. The concurrence between maps reflects decisions about standardization of scale and contour intervals dating from 1791 when

the Paris Académie des Sciences . . . defined the meter as 1/10,000,000 of a quadrant of the terrestrial meridian. This led to the concept of ‘natural scale’ in cartography whereby one unit of length on the map is represented by a given number of like units on the earth. This so-called representative fraction (R. F.) was first used in France in 1806 (Thrower 81).

The systematic survey of the Buttes Chaumont site provided the level of knowledge and detail Alphand required as a predicate for his design and construction of the park. Like Girard earlier in the century, Alphand presents the Parc des Buttes Chaumont in two maps registered at the same scale; a contour map and a rendered site plan. Consideration must now turn to this pair of plans to examine their relevance, to discuss how Alphand used the information in them, and what they signify.

ALPHAND’S MAPS OF THE PARC DES BUTTES CHAUMONT

The maps were published in Les Promenades de Paris, Alphand’s two-volume catalogue raisonné of works accomplished during Haussmann’s administration. Throughout Les Promenades, Alphand celebrated design solutions arrived at through engineering and design invention. He detailed the innovations employed to install and maintain the works and tabulated, enumerated, and catalogued his civic improvements. For Alphand, studying the terrain was a very interesting and delicate operation that was fundamental to all else in the design process.² (Alphand 1984, L) His projects commenced with shaping the terrain, then adding the planting and finally scripting the circulation routes. It is no surprise that his work at the Buttes Chaumont commenced with a critical step: the determination of the physical landform by way of careful mapping and geological studies.

Relevance

The contour map reconciled horizontal and vertical measure and tied the project into the overall topographic information of the city. The technical mastery evidenced in the execution and codification of the survey information is daunting. Even using sophisticated survey equipment, conducting a survey on the sixty-two acre (25 hectare) site would have been extremely difficult. The site, an old quarry and former dump, presented some inherent difficulties that included a highly irregular landform of steep quarried cliffs, declivities and cess-pools filled with offal and refuse. A careful examination of the Plan des courbes de niveau (contour plan) aids in understanding Alphand’s engineering feat. The plan, at a scale of 0m00–05 over 1m00 uses a 1-meter vertical contour increment. Black lines indicate existing or original site contours and red [darker gray] lines indicate «l’état actuel», or the «as-built» conditions of Alphand’s designed park. In the enlarged detail the overlying of these two sets of contours demonstrates the variation between the conditions. In the quarry, the lowest elevation is at 46 m, with 52 m the most consistent depth of the mine. The highest points shown are at 97–99 m. After improvements, the bottom of the lake is at 57,4 m with water level at 58,75 m, and the highest point is at 105 m. It is interesting to note that the design’s signature feature, the island with the Tempietto, stayed more or less constant at an elevation of 90 m.

Application and practice

For Alphand the raw survey data for the existing site served as the predicate for design strategies and decisions which demonstrate his dual approach as «an engineer with the talents of an artist (Pinckney 47).» In fact, he believed that to progress with a design, «il faut perfectionner les méthodes et introduire l’exactitude dans les procédés empiriques. C’est le seul moyen de relever l’art des jardins, beaucoup trop délaissé et trop méconnu de
Reshaping the features of the quarried land entailed large-scale manipulation of the earth, and the final designed landscape resulted from the careful placement of tons of imported rock and soil. Alphand’s compilation of the design drafted over the existing conditions enabled him to make detailed estimates for demolition, construction, and specifications. His published map demonstrates what I believe is the first codified techniques for using contours to proceed with design and construction, a commonplace practice today.

This was especially true for calculating "cut and fill." In this process, by comparison of the contours in section Alphand could determine what areas of the site would either need to have soil and rock removed or added and filled out with new topsoil. These calculations effectively provide a volumetric description of the earthwork providing amounts of rock and earth to be removed or placed in locations of the site to accomplish the final topographic relief desired for the overlay of plants and circulation. This process allowed him to quantify the amount of various materials needed and prepare a cost estimate for building the site that could take into account the prodigious extent of the earthwork and imported topsoil. Quantities were documented in Les Promenades, as was the cost of 2,465,769 franc for earthwork phase of the construction. (Alphand 1984, 198–204, 232)

Alphand also used the survey of the existing conditions to inform design decisions ranging from the mundane to the exhilarating. Basic applications of the contour information insured that road and promenade access points connected smoothly into existing perimeter conditions. Study of the contours and elevations also allowed Alphand to shape the land in ways that let him calculate the gradients of the slopes for walkways and roads that resulted in routes blessed with fluid, easy passage on the steep site. It also let him define areas for the requisite "rugged" paths and passages that enhance the varied experience of the park. Finally, it allowed for accurate civil engineering calculations for the retaining walls around the depressed track for the Chemin de Fer de Céinture and the retaining wall supporting the overlook along the rue de Vera-Cruz. Alphand’s deep understanding of the site conditions also supported the creation of exhilarating and sublime moments in the park, especially the development of the series of panoramic highpoints, the much cited grotto and the central island surmounted by the Tempietto. His analytical approach to design and the results thus generated suggest that, «En ce sens, les Buttes-Chaumont, le plus beau jardin de Paris, n’en demeure pas moins, avant tout, un tour de force de technique (Choay 94).»

Significance

Alphand’s influence was felt almost immediately in the realm of landscape theory and design in France. In L’Art des Jardins (1879) Edouard André clearly draws from Alphand in a number of areas. In a chapter devoted to «Travaux d’exécution. —Terassements», he described the surveying and earthworks process, calculations and estimating of costs and lines item expenses for earthwork. (André 406–436) The image of a page excerpted from his treatise depicts some of the techniques and practices of surveying a site further suggests far reaching effects of Alphand’s technical approach in the discipline of landscape architecture.

The scope and approach of Alphand’s work also extended beyond France via two key mechanisms: travel guides and visitor’s comments on the park and, more definitively, through the distribution of Les Promenades. The catalyst for both was the 1867 Exposition Universelle; the park shared opening day, a place in the program, and an audience. In fact, Les Promenades de Paris was widely distributed throughout the Exposition armature to distinguished heads of state and major cities in Europe and United States. Its influence on urban design and the design process has been recognized in cities from Stockholm and Vienna to Boston and Cleveland in the United States.

For the case of the Buttes Chaumont, the communication of French technical élan and skill was conveyed not only in the park itself and the documentation of the work, but also in the delineation and reproduction of the images in Les Promenades. Recall that the landform was mapped in two matched scale plan types—one a technical map, the other a rendered plan. They are the only such pair in Alphand’s treatise, suggesting their value. Further, the lithographic technique employed to show before and after contours on the same map is the ONLY two-
color image in *Les Promenades* aside from color botanical plates. This highlights not only the data but also the skill of the delineator, A. D. Fath and the sophisticated printing process that reproduced it. All are part of the emphasis on areas of French technological expertise.

In addition, there is the skilled work of E. Hochereau, the delineator of the rendered image of the park in plan view. Hochereau maintained the scale as well as the orientation of the contour map with north at the bottom. Thus, the shadows indicating the topographic relief are correctly cast with the sun from the southeast, rather than in the precision method established by Dufour. Additionally, this direction better highlights the dramatic highpoints and structure of the park. What has been gained is a descriptive veracity that sets this plan into the system of survey accuracy informing the partner plan of before and after contours.

**Conclusion**

Through fully documenting his technical mastery and itemizing the materials and means of production for his works in *Les Promenades*, Alphand distinguishes his work and the goals of the Second Empire. It is imperative to realize that his maps and images of the Buttes Chaumont from Les Promenades are NOT ideologically neutral — they are effectively an action, a perspective of the city and the site at that time which reflects a relationship between maps and forms of knowledge and power. (Harley 105–106) Rendered and published in a way that celebrated the technical production of the park, the contour and rendered plans are in effect projections, figured renditions of a technical vision. The emphasis on the site’s topographic attributes proclaimed an ideological mastery over the physical surface of the earth. This message was an essential tactic in Napoléon III’s agenda to proclaim the sovereignty of the convergence of art and industry in the redesign of Paris.

**NOTES**

1. The Verniquet survey appeared on the «Plan de Guillot, 1775», Centre Historiques des Archives Nationale, Paris. The cartouche in the upper right corner of the Guillot plan shows, among other things, cherubs pointing to France on a spinning world globe with charts and maps below it cherubs unfurling a chart of geometric figures and diagrams. Directly above the title, a tempie of ionic order atop a small rocky, mount from which rays of light emanate. The map just begins to include the area of the future Parc des Buttes Chaumont, and it clearly indicates the buttes as a quarried landform. See also «Plan de la Ville de Paris avec sa nouvelle enceinte, Levé Géométrique sur la Méridienne de l’Observatoire par le Citoyen Verniquet, parachevé en 1791», Centre Historiques des Archives Nationales (Paris).

2. Author’s translation: «L’étude d’un relief est une opération très-intéressante et très-difficile: car elle doit imprimer aux mouvements du sol une certaine grâce, former ou corriger la direction des vallées et des plantations et des plateaux, c’est-à-dire arrêter l’assiette du paysage. C’est l’opération fondamentale dont tout le reste dépend.»

**REFERENCE LIST**


Harley, John Brian. 2001 *The New Nature of Maps, Essays*
Measure and Map: Alphand’s contours of construction